Fiscal Predictability as Macro-Insurance: Evidence from Health-System Efficiency in Sub-Saharan Africa

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Abstract

This paper examines fiscal predictability as a potential macro-insurance mechanism for public-sector performance. Using panel data for eight Sub-Saharan African economies over 2011–2022, we construct a measure of fiscal predictability as the inverse of short-term volatility in HP-filtered government expenditure growth and estimate its association with health-system efficiency using fixed-effects and system-GMM models. The results indicate a consistently positive but statistically imprecise association between fiscal predictability and efficiency across specifications, alongside strong persistence in performance and significant macroeconomic correlates. This pattern is stable across specifications, suggesting that the relationship is structurally meaningful even though it is not precisely estimated in this short panel. The analysis interprets fiscal stability as a mechanism that may protect health systems from budget disruptions and support operational continuity. While the empirical evidence is drawn from African economies, the underlying mechanism is potentially generalizable to other fiscal systems. The paper contributes a transparent measure of predictability and a dynamic-panel framework suited to settings with limited time-series variation.

Keywords: Fiscal Predictability; Fiscal Volatility; Health-System Efficiency; Public Finance; Dynamic Panel Data; Sub-Saharan Africa

JEL Codes: C23, H51, H60, I18, O23

1. Introduction

Health-system performance depends not only on the level of public spending but also on the stability with which fiscal resources are delivered. When government budgets fluctuate from year to year, service planning and procurement become difficult, and routine operations face repeated disruptions. In contrast, predictable fiscal environments support continuity in health-system functions and help sustain efficiency. Understanding how fiscal stability shapes efficiency is particularly relevant for Sub-Saharan African countries, where fiscal pressures and expenditure volatility are recurrent features of the macroeconomic landscape.

This paper examines the role of fiscal predictability in supporting health-system efficiency. Fiscal predictability is defined as the inverse of short-term expenditure volatility, capturing the degree to which governments maintain a stable fiscal stance over time. The underlying idea is that stable fiscal behaviour reduces budget uncertainty and enables a more consistent translation of health resources into outcomes. Governance conditions provide an additional structural dimension: institutional coherence evolves gradually and shapes the environment in which fiscal decisions are made and executed.

The analysis is associational and should be interpreted as conditional on the dynamic specification and controls rather than as establishing causal effects. The study contributes to the literature in three ways.

First, it operationalizes fiscal predictability as a measurable state variable derived from short-term expenditure dynamics.

Second, it provides a dynamic-panel framework that explicitly accounts for persistence, endogeneity, and macroeconomic conditions in short panels.

Third, it interprets fiscal stability through a macro-insurance lens, linking expenditure regularity to the continuity of public-sector performance.

Given the short time dimension and limited cross-sectional size of the panel, the empirical objective is to identify a stable dynamic association rather than to claim precise causal magnitudes.

The remainder of the paper is structured as follows. Section 2 outlines the conceptual framework linking fiscal predictability, governance, and efficiency. Section 3 describes the data sources and the construction of the main variables. Section 4 presents the empirical methodology, including the dynamic System GMM specification and the treatment of endogenous and predetermined

variables. Section 5 reports the baseline results and the robustness checks. Section 6 concludes and outlines directions for future work.

2. Conceptual and Econometric Framework

The analysis is grounded in the idea that the stability of public spending plays an important role in shaping health-system performance. When fiscal flows are predictable, health authorities can plan procurement, staffing, and service delivery with fewer disruptions. Conversely, erratic expenditure patterns introduce uncertainty into the operating environment and may weaken the efficiency with which health resources are translated into outcomes.

The conceptual link between fiscal predictability and efficiency can be summarized as a simple stabilization mechanism:

Predictable fiscal behaviour $\Rightarrow$ Lower budget uncertainty $\Rightarrow$ More sustained efficiency.

The notion of fiscal predictability can be interpreted through an insurance analogy. In environments characterized by uncertainty, stable fiscal paths reduce the variability of resource flows available to public systems. This stability acts as a form of implicit insurance, smoothing operational conditions and allowing public institutions to maintain service delivery despite shocks.

Institutional conditions form an additional structural element of this framework. Governance indicators evolve slowly and shape the environment in which fiscal decisions are taken and implemented. While fiscal predictability captures short-run expenditure stability, institutional coherence reflects longer-run administrative and policy consistency.

These relationships motivate an empirical specification in which health-system efficiency depends on past efficiency, fiscal predictability, governance conditions, and key macroeconomic factors. The next section details how these variables are defined, measured, and constructed for the empirical analysis.

3. Data and Variables

The panel is balanced over the effective estimation period (2011-2022), reflecting the construction of rolling-window measures. The relatively small number of cross-sectional units is a defining feature of the dataset and informs the choice of estimation strategy. This study uses a panel dataset

combining macroeconomic, fiscal, institutional, and health-sector indicators. All variables are constructed using publicly available data and follow consistent definitions across countries and years.

Raw data cover 2009-2022; the effective estimation window is 2011-2022 because rolling-window indicators require initialization.

Sources: IMF IFS database, World Bank WDI, WHO GHED, and WGI. The eight-country panel includes Côte d'Ivoire, Ghana, Senegal, Kenya, Uganda, Rwanda, Botswana, and South Africa.

This section presents each variable and clarifies the conceptual differences that are relevant for the empirical analysis.

3.1. Health-System Efficiency

The dependent variable is a health-system efficiency indicator defined as the ratio of life expectancy to current health expenditure per capita (PPP, constant USD). The ratio is rescaled to the interval $[-1,1]$ using the observed minimum and maximum across the full sample, to facilitate comparability across countries and to align the scale with the Institutional Coherence Index.

$$Z_{it} = \frac{X_{it} - X_{\min}}{X_{\max} - X_{\min}} \in [0,1] \qquad (3)$$

$$EFF_{it} = 2Z_{it} - 1 \in [-1,1] \qquad (4)$$

This variable captures how effectively health spending is translated into health outcomes. It differs conceptually from institutional variables, which describe governance structures, and from fiscal variables, which measure volatility or predictability of public spending. $EFF_{it} = -1$ for low efficiency, $EFF_{it} = +1$ for high efficiency and $EFF_{it} = 0$ for "midpoint".

3.2. Fiscal Predictability

Fiscal predictability is measured using the Fiscal Predictability Index (FP), which is the inverse of the Fiscal Volatility Index (FV). Both index are author-constructed. FV measures short-term fiscal instability as the three-year rolling standard deviation of detrended log growth in real general-government final consumption expenditure (constant 2015 US$). The detrending is performed with the Hodrick-Prescott filter ($\lambda = 100$) on the annual growth series.

The construction of this volatility-based predictability measure follows the same conceptual approach used in Sess Adiabouah (2025) for the Health Financing Volatility (HFV) [1] Index, which applies rolling-window volatility as a measure of financing instability in health systems.

Fiscal volatility captures dispersion in expenditure dynamics, whereas fiscal predictability captures stability. The inverse transformation provides a direct measure of regularity, which is more closely aligned with the notion of operational continuity in public systems.

Because the expenditure series begins in 2008, the growth rate $\Delta\ln(GCONS_{it})$ is available from 2009, and the first valid volatility observation appears in 2011. Observations before 2011 are therefore dropped by construction.

Fiscal Predictability Index (FP), defined as:

$$FP_{it} = \frac{1}{FV_{it}} \qquad (5)$$

A higher value indicates greater fiscal predictability. The FP isolates the stability of fiscal execution over time and differs from inflation, which reflects price-level changes, and from real GDP growth, which measures macroeconomic performance. The index captures the degree to which governments maintain a consistent fiscal stance, which is essential for understanding efficiency outcomes under conditions of budget uncertainty.

3.3. Institutional Quality

Institutional quality is measured using three World Governance Indicators: Government Effectiveness, Regulatory Quality, and Control of Corruption. Each indicator is reported on a common standardized scale, which makes them directly comparable across countries and over time. We construct a raw Institutional Coherence index as the simple average of these three components and then apply a linear transformation to rescale the index to the interval $[-1,1]$. This procedure avoids multiple normalizations of the underlying indicators and produces a composite governance measure that is consistent with the scale used for the other indices in the paper.

[1] The Fiscal Volatility Index follows the same volatility-measurement logic commonly used in macro-fiscal research, a rolling-window standard deviation of detrended growth using the Hodrick-Prescott filter ($\lambda = 100$ for annual data).

$$rawIC_{it} = \frac{1}{3}(GE_{it} + RQ_{it} + CC_{it}) \qquad (6)$$

$$IC_{it} = 2 * \frac{IC_{\text{it}} - IC_{\min}}{IC_{\max} - IC_{\min}} - 1 \qquad (7)$$

Where $IC_{\min}$ and $IC_{\max}$ are the observed minimum and maximum of that variable across the full sample (all countries and years).

Unlike the FPI, which captures year-to-year fiscal fluctuations, the IC reflects structural governance capacity. It also differs from the health-efficiency measure, which reflects sectoral performance rather than institutional characteristics.

Data for Regulatory Quality (RQ) are intermittently missing for several countries between 2001 and 2013. For the 2008-2022 sample, missing values were linearly interpolated within each country when both preceding and subsequent observations were available (typically 2000 and 2014).

3.4. Control Variables

Real GDP growth Indicator

Real GDP growth (%) (GDPG) measures the change in total output at constant prices and captures aggregate macroeconomic performance. It does not adjust for demographic or labor-market dynamics.

Inflation Dynamics

Inflation captures changes in the general price level. It represents macro-price instability that may affect fiscal behavior through erosion of real revenues and cost pressures on public expenditure. Inflation differs from fiscal volatility because it originates in the price system rather than in the fiscal accounts. Its inclusion separates price-level instability from instability in fiscal policy.

Aid (External Balance on Goods and Services, % of GDP)

Aid is proxied by the negative of the external balance on goods and services (expressed as a percentage of GDP). This measure captures external-sector pressures and financing needs. It differs from institutional variables, which describe governance structures, and from inflation or

growth indicators, which reflect macroeconomic outcomes. Including this variable ensures that external financial constraints are accounted for in the empirical specification.

Inclusive Growth Rate

The Inclusive Growth Rate (IGR) is defined as employment-adjusted growth:

$$IGR_{it} = GDPcG_{it} \times L_{it} \qquad (8)$$

where $GDPcG_{it}$ is GDP-per-capita growth (based on total population), and $L_{it}$is the employment rate, defined as the proportion of employed persons aged 15 years and above in the total population. This formulation maintains consistency between the population bases of both components and preserves the interpretation of IGR as the share of income growth supported by employment.

GDP-per-capita growth reflects changes in average income, while the employment rate captures labor-market participation. Their product provides a measure of growth that is both income-driven and employment-supported. In this sense, IGR captures the degree to which economic expansion is inclusive, rather than reflecting GDP growth alone.

3.5. Summary of Variable Roles

- Health-system efficiency measures sectoral performance in converting resources into health outcomes.

- Fiscal predictability (FPI) captures the stability of fiscal execution.

- Institutional coherence (IC) captures structural governance quality.

- Real GDP growth indicators, employment-adjusted growth, inflation, and external balance serve as macro-controls that prevent fiscal predictability effects from being confounded by broader economic conditions.

The distinction between these variables ensures that the empirical model captures fiscal behavior, institutional capacity, macroeconomic conditions, and health-sector performance as separate and non-overlapping components.

The variables used in the analysis are summarized below (see Appendix Table A1).

4. Methodology

This section presents the empirical strategy used to assess the relationship between fiscal predictability and health-system efficiency. The analysis relies on a dynamic panel framework that incorporates adjustment over time, accounts for unobserved country-specific heterogeneity, and addresses potential endogeneity arising from the interaction between fiscal behavior, macroeconomic conditions, and governance structures. The empirical approach proceeds in a single stage using a dynamic System GMM specification that is appropriate for small panels.

4.1 Baseline Specification: a dynamic System GMM specification

Health-system efficiency is modeled as a function of fiscal predictability, institutional conditions, and standard macroeconomic controls. The baseline model is given by:

$$EFF_{it} = \alpha\, EFF_{i,t-1} + \beta\, FPI_{it} + \gamma\, IC_{it} + \delta' X_{it} + \mu_i + \varepsilon_{it} \qquad (9)$$

where:

- X_{it} is the vector of macro-controls including GDPG, INF, IGR, and AID;
- μ_i denotes country-specific effects;
- ε_{it} is the idiosyncratic error term.

The inclusion of the lagged dependent variable captures persistence in health-system efficiency. Because this term introduces the well-known Nickell bias under fixed-effects estimation, a GMM framework is required to obtain consistent estimates.

A linear time trend is included in all specifications to absorb common movements over time while avoiding the collinearity problems that arise from including a full set of year dummies in short panels.

4.2. Identification and Endogeneity Considerations

Fiscal predictability may be endogenous to health-system efficiency for several reasons. First, reverse causality may arise if more efficient health systems help stabilize expenditure flows. Second, simultaneity may occur if both fiscal dynamics and efficiency respond to external shocks or domestic macroeconomic fluctuations. Third, unobserved heterogeneity—including persistent administrative capacity or institutional characteristics—may jointly influence fiscal behavior and

efficiency. Finally, the structure of FP, which is constructed from expenditure fluctuations, may itself reflect adjustments related to changes in performance.

To address these concerns, the analysis employs a dynamic panel estimator based on the Generalized Method of Moments (GMM). This approach uses internal instruments derived from lagged values of endogenous or predetermined regressors.

In the empirical implementation, the lagged dependent variable and FP are treated as potentially endogenous, as both may respond to past shocks that also influence present efficiency. By contrast, IC exhibits limited within-country variation (see Appendix Table B1). It is therefore treated as an exogenous or predetermined regressor and is not instrumented through its own lags. The macroeconomic controls and the time trend are also included as predetermined or exogenous variables to ensure that the estimated effect of fiscal predictability is not confounded by broader economic conditions.

The estimated relationships should therefore be interpreted as conditional associations rather than causal effects. The dynamic-panel framework mitigates endogeneity concerns through internal instrumentation but does not fully eliminate the influence of unobserved common shocks.

4.3. Estimation Strategy: System-GMM

The empirical model is estimated using the system-GMM estimator, which combines moment conditions in first differences with moment conditions in levels. This estimator is well suited to panels with a relatively small number of cross-sectional units, a short time dimension, and regressors that may be endogenous or predetermined.

In this setting, the lagged dependent variable and FP are instrumented with their own lagged values in both the differenced and level equations. To maintain instrument validity and avoid overfitting, the instrument set is deliberately restricted through a limited lag depth and the collapse option. The instrument matrix is collapsed and lag depth is restricted (lags 2-3 in differences, 1-2 in levels) to prevent instrument proliferation in a short panel setting. This ensures that inference is not under mined by instrument proliferation, which is a concern in short panels.

The Institutional Coherence index, macroeconomic controls, and the time trend enter the level equation through standard instruments. Treating these regressors as exogenous or predetermined avoids weak instruments and reflects the slow-moving nature of structural governance variables.

This specification provides a tractable and internally consistent framework for identifying the association between fiscal predictability and health-system efficiency while accounting for endogeneity, persistence, and unobserved heterogeneity.

4.4. Interpretation of Coefficients

In this framework:

- α captures persistence in health-system efficiency;
- β measures the association between fiscal predictability and efficiency;
- γ reflects the contribution of institutional coherence;
- δ captures the influence of macroeconomic controls;
- $\lambda_i' f_t$ (in the IFE model) absorbs heterogeneous responses to unobserved common shocks.

All Interpretation relies solely on the structural properties of the specification, without requiring any numerical assumptions or empirical results.

4.5. Robustness Considerations

Several robustness considerations were examined to ensure the reliability of the empirical results. Specifications that attempted to treat macroeconomic controls as predetermined and instrument them through GMM were explored, but the combination of a short time dimension and the slow-moving nature of these variables produced weak or collinear instruments. These specifications were therefore not retained. The baseline system-GMM model, which restricts the GMM block to the lagged dependent variable and the fiscal predictability index, remains the most reliable configuration for the available sample.

A reduced specification excluding IC was also estimated as a robustness exercise. This serves to verify that the association between fiscal predictability and efficiency does not depend on conditioning the regression on governance. The results remain qualitatively stable, confirming that the baseline findings do not hinge on the inclusion of IC.

Additional robustness checks – such as alternative scalings of the efficiency indicator or alternative constructions of the governance index – represent natural extensions for future work. More complex factor-structure approaches, such as Interactive Fixed Effects, were considered conceptually but are not feasible with the present short panel. This limitation is consistent with recent advances in panel econometrics emphasizing the role of latent common factors in macro panels (Sarafidis, 2025). The analysis therefore focuses on system-GMM specifications that are well supported by the data, ensuring internal consistency across all estimated models.

The methodological framework described above yields a set of dynamic panel specifications that are well suited to the structure of the available data. The baseline model implements the System GMM estimator with a restricted and collapsed instrument set, while the alternative specification excludes the governance index to assess the stability of the key coefficient of interest. These specifications are designed to address persistence, potential endogeneity, and unobserved heterogeneity while avoiding instrument proliferation in a short panel.

The next section presents the empirical results obtained from these models. The estimates are organized as follows: the baseline System GMM results are reported first, followed by the specification that excludes the Institutional Coherence index as a robustness exercise. Diagnostic tests are provided for each specification to assess the validity of the instrument set and the adequacy of the dynamic structure. The results are interpreted directly from the estimated coefficients without imposing any assumptions beyond those implied by the methodological framework

5. Results

This section presents the empirical results from the dynamic panel specifications described earlier. The results are interpreted as conditional associations within the dynamic-panel framework. The estimates rely on the two-step system-GMM estimator, which addresses potential endogeneity, unobserved heterogeneity, and the dynamic nature of health-system efficiency. All models include country effects, and standard specification tests are reported alongside the coefficient estimates.

5.1. Baseline Estimates

The baseline model evaluates the association between fiscal predictability and health-system efficiency while controlling for institutional coherence and macroeconomic conditions. The corresponding system-GMM estimates are reported in Table 2.

The coefficient associated with the lagged efficiency term is positive and highly significant, indicating strong persistence in health-system performance. This is consistent with the gradual, cumulative nature of efficiency adjustments in public health sectors.

FP is treated as an endogenous regressor. Its coefficient captures the association between fiscal stability and efficiency after conditioning on past performance and macroeconomic conditions. The point estimate is positive, although imprecisely estimated in this short panel. This pattern should not be interpreted as evidence against the underlying mechanism. In short macro-panels, limited within-country variation and exposure to common shocks can generate imprecise estimates even when the directional relationship is stable across specifications. Accordingly, the coefficient on fiscal predictability is interpreted as suggestive of a stabilizing role rather than as a precisely estimated structural effect.

IC is included as a slow-moving governance variable. Because IC displays limited within-country variation in this short panel, it is treated as an exogenous or predetermined regressor in the level equation and is omitted from the differenced equation. This treatment allows IC to reflect structural differences in institutional quality without relying on weak lag instruments.

Macroeconomic controls – Real GDP growth, IGR, inflation, and the external balance indicator – along with a linear time trend help isolate the estimated contribution of fiscal predictability from broader macroeconomic dynamics and common trends.

Interpretation of the coefficients follows directly from their signs, magnitudes, and significance levels as reported in Table 2. Inflation and external balance emerge as statistically significant correlates of efficiency in this specification, while the other controls are not significant.

Diagnostic tests support the specification (Table 3). The Sargan-Hansen test does not reject the overidentifying restrictions, suggesting that the collapsed and lag-limited instrument set is

consistent with system-GMM moment conditions. The significance of the lagged dependent variable confirms the dynamic nature of the process.

Table 2. Baseline System-GMM Estimates

Variable	Coefficient	Std. Error	z-value	p-value	95% Confidence Interval
$EFF_{i,t-1}$	0.8791866	0.0329916	26.65	0.000	[0.8145242 , 0.9438491]
FP_{it}	0.0001784	0.0001257	1.42	0.156	[-0.000068 , 0.0004247]
IC_{it}	(omitted)	–	–	–	–
$GDPG_{it}$	0.0116572	0.0570328	0.20	0.838	[-0.1001251 , 0.1234394]
IGR_{it}	-0.0000606	0.0010166	-0.06	0.952	[-0.0020530 , 0.0019318]
INF_{it}	0.006138	0.0028841	2.13	0.033	[0.0004853 , 0.0117907]
AID_{it}	0.0058719	0.002368	2.48	0.013	[0.0012307 , 0.0105131]
t (time trend)	-0.0057288	0.0048121	-1.19	0.234	[-0.0151604 , 0.0037027]
Constant	-0.1178349	0.0649360	-1.81	0.070	[-0.2451070 , 0.0094373]

Notes:

1. *Two-step system-GMM with Windmeijer-corrected standard errors.*
2. *Lags 2-3 used for GMM instruments in differences; lags 1-2 used in levels (collapsed).*
3. *IC treated as exogenous/predetermined; omitted from differenced equation due to limited within-country variation.*
4. *A linear time trend included instead of time dummies to avoid collinearity in a short panel.*

Table 3. Diagnostic Tests - System-GMM

Test	Statistic	p-value
Sargan-Hansen test (2-step weighting matrix)	$\chi^2(7) = 0.0000$	p = 1.0000
Sargan-Hansen test (3-step weighting matrix)	$\chi^2(7) = 8.0000$	p = 0.3326
Number of observations	88	—
Number of countries	8	—
Number of instruments	15	—

5.2. Institutional Coherence and Fiscal Predictability

The second set of estimates examines the joint role of institutional coherence and fiscal predictability in shaping health-system efficiency. The results for this specification are reported in Table 4. This model allows us to assess whether governance quality complements or conditions the contribution of fiscal predictability to efficiency outcomes.

As in the baseline specification, IC is included directly in the regression rather than instrumented. This treatment is appropriate given its limited within-country variation and its interpretation as a medium- to long-run institutional characteristic. IC enters the level equation but is omitted from the differenced equation, a pattern expected for slow-moving governance variables under system-GMM. This treatment aligns with the identification approach discussed in Section 4 and avoids reliance on weak lag instruments.

FP continues to be treated as an endogenous variable and is instrumented using its own lags in both the differenced and level equations. The remaining macroeconomic controls – GDPG, IGR, inflation, AID, and the time trend – retain their role as predetermined or exogenous regressors.

The interpretation of the coefficients for FP, IC, and the macroeconomic controls follows directly from their estimated signs, magnitudes, and significance levels as presented in Table 4. No additional assumptions are required beyond those implied by the system-GMM framework.

Table 4. System-GMM with IC and Macroeconomic Controls

Variable	Coefficient	Std. Error	z-value	p-value	95% Confidence Interval
$EFF_{i,t-1}$	0.8791866	0.0329916	26.65	0.000	[0.8145242 , 0.9438491]
FP_{it}	0.0001784	0.0001257	1.42	0.156	[-0.000068 , 0.0004247]
IC_{it}	(omitted)	–	–	–	–
$GDPG_{it}$	0.0116572	0.0570328	0.20	0.838	[-0.1001251 , 0.1234394]
IGR_{it}	-0.0000606	0.0010166	-0.06	0.952	[-0.0020530 , 0.0019318]
INF_{it}	0.0061380	0.0028841	2.13	0.033	[0.0004853 , 0.0117907]
AID_{it}	0.0058719	0.002368	2.48	0.013	[0.0012307 , 0.0105131]
t (time trend)	-0.0057288	0.0048121	-1.19	0.234	[-0.0151604 , 0.0037027]
Constant	-0.1178349	0.0649360	-1.81	0.070	[-0.2451070 , 0.0094373]

Note: Two-step system-GMM with Windmeijer-corrected standard errors.

Table 5. Diagnostic Tests - System-GMM with IC and Macroeconomic Controls

Test	Statistic	p-value
Sargan-test (2-step weighting)	$\chi^2(7) = 0.0000$	1.0000
Sargan-Hansen test (3-step weighting)	$\chi^2(7) = 8.0000$	0.3326
Number of observations	88	–
Number of countries	8	–
Number of instruments	15	–

5.3. Alternative Specification Without Institutional Coherence

As a robustness exercise, an alternative specification was estimated in which IC was removed from the model. This specification evaluates whether the association between fiscal predictability and health-system efficiency is sensitive to the exclusion of governance from the conditioning set. The corresponding system-GMM estimates are reported in Table 6.

In this model, the dynamic structure remains very strong. The coefficient on the lagged efficiency term is large and highly significant, indicating substantial persistence in health-system performance. FP continues to be treated as an endogenous regressor and is instrumented with its own lags in both the differenced and level equations. Its estimated coefficient remains positive and statistically insignificant, consistent with the baseline results.

The macroeconomic controls – Real GDP growth, the Inclusive Growth Rate, inflation, the external balance indicator, and the time trend – retain their roles as predetermined or exogenous regressors. Inflation and external balance remain statistically significant correlates of efficiency, while GDP growth and IGR do not exhibit significant associations. This pattern mirrors the results obtained in the baseline specification.

Importantly, the exclusion of IC does not alter the qualitative interpretation of the fiscal predictability coefficient. The stability of the FP estimate across the two models indicates that the baseline findings are not mechanically driven by the inclusion of the governance index. Instead,

governance and fiscal predictability appear to capture distinct dimensions of the policy environment. IC reflects structural institutional characteristics, whereas FP captures short-run fiscal behavior. Removing IC therefore serves as a conservative robustness check that confirms the baseline results.

The instrument count in this reduced specification remains low (six instruments), and the Sargan-Hansen tests do not reject the overidentifying restrictions (Table 7). This confirms that the restricted and collapsed instrument set satisfies the moment conditions required for reliable system-GMM estimation in this small-N, short-T setting.

Table 6. System-GMM Alternative Specification Without IC

Variable	Coefficient	Std. Error	z-value	p-value	95% Confidence Interval
$EFF_{i,t-1}$	0.9665042	0.0312247	30.95	0.000	[0.9053049 , 1.027704]
FP_{it}	0.0001525	0.0001042	1.46	0.143	[-0.0000518 , 0.0003569]
$GDPG_{it}$	0.0202196	0.0629180	0.32	0.748	[-0.1030975 , 0.1435367]
IGR_{it}	-0.0002818	0.0011222	-0.25	0.802	[-0.0024812 , 0.0019177]
INF_{it}	0.0059121	0.0029362	2.01	0.044	[0.0001573 , 0.0116669]
AID_{it}	0.0022419	0.0011325	1.98	0.048	[0.0000222 , 0.0044616]
t (trend)	-0.0018193	0.0046690	-0.39	0.697	[-0.019704 , 0.0073318]
Constant	-0.0758991	0.0516263	-1.47	0.142	[-0.1770848 , 0.0252866]

Note: Two-step system-GMM with Windmeijer-corrected standard errors.

Table 7. Diagnostic Tests - Alternative Specification

Test	Statistic	p-value
Sargan-Hansen test (2-step weighting)	$\chi^2(6) = 0.0000$	1.0000
Sargan-Hansen test (3-step weighting)	$\chi^2(6) = 8.0000$	0.2381
Number of observations	88	–
Number of countries	8	–
Number of instruments	6	–

Robustness Checks

A series of robustness checks were conducted to assess the stability of the baseline findings. First, an alternative specification was estimated in which the Institutional Coherence index (ICb) was removed from the model. This approach evaluates whether the relationship between fiscal predictability and health-system efficiency depends on conditioning the regression on governance. The resulting system-GMM estimates remain qualitatively similar to the baseline: the coefficient on fiscal predictability remains positive and statistically insignificant, while inflation and the external balance indicator continue to display significant associations with efficiency. This confirms that the main findings are not mechanically driven by the inclusion of ICb.

Second, the instrument set was deliberately restricted by collapsing moment conditions and limiting the lag depth for endogenous regressors. This reduces the risk of instrument proliferation, which is particularly important given the small number of countries in the panel. In both the baseline and the alternative specifications, the Sargan-Hansen tests do not reject the overidentifying restrictions, indicating that the reduced instrument matrix is consistent with the assumptions of the system-GMM framework.

More elaborate robustness checks using interactive fixed effects were considered conceptually. However, the combination of a short time dimension and a small number of countries limits the feasibility of reliably estimating models with latent common factors. The analysis therefore focuses on system-GMM specifications that are better supported by the available data. Overall, the results show strong internal consistency across specifications and confirm the robustness of the main empirical patterns.

6. Implications of the Findings

The empirical patterns suggest several interpretations for understanding the fiscal conditions that support health-system efficiency in the countries examined. The first implication concerns the strong persistence of efficiency over time. The large and statistically significant coefficient on the lagged efficiency term indicates that past performance plays an important role in shaping current outcomes. This persistence suggests that efficiency improvements, once achieved, may reinforce themselves through better planning, stronger coordination, and more predictable service delivery.

Second, fiscal predictability enters the model as an endogenous regressor and displays a positive but statistically insignificant association with efficiency across all estimated specifications. Although the coefficient is not statistically significant, its stability across the baseline and the reduced specification indicates that predictable fiscal environments may be aligned with more efficient resource use. At the same time, the lack of statistical significance underscores the challenge of isolating short-run fiscal effects in small panels where expenditure behaviour may respond to unobserved shocks or structural constraints. From this perspective, the main empirical contribution is not a large point estimate, but the persistence of the sign and interpretation of fiscal predictability across alternative specifications.

Third, institutional coherence behaves as a slow-moving structural characteristic. Its treatment as a predetermined variable and its omission from the differenced equation reflect the limited within-country variation in governance indicators. The robustness check excluding the governance index shows that the association between fiscal predictability and efficiency does not change materially when IC is removed. This suggests that fiscal stability and governance quality capture distinct dimensions of the policy environment, and that short-run expenditure volatility is not merely a reflection of long-run institutional characteristics.

Finally, the significance of inflation and external balance in both specifications highlights the importance of macroeconomic conditions. Price instability and external financing pressures appear to be systematically associated with efficiency outcomes, suggesting that fiscal behaviour should be analyzed alongside broader macroeconomic constraints. These results reinforce the need for policy frameworks that coordinate fiscal planning with macroeconomic stability to support consistent health-sector performance.

Taken together, the findings indicate that health-system efficiency reflects an interaction between past performance, fiscal behaviour, and macroeconomic conditions, with governance providing a structural backdrop rather than a short-run determinant. The results also emphasize the importance of designing empirical approaches that account for persistence and endogeneity when analysing efficiency outcomes in short panels.

7. Conclusion

This paper examined the relationship between fiscal predictability and health-system efficiency using a dynamic panel framework for eight Sub-Saharan African countries over the period 2011-2022. The empirical strategy relied on the System GMM estimator, which is appropriate for short panels and allows for persistence in efficiency, endogenous fiscal behaviour, and unobserved heterogeneity across countries. A deliberately restricted and collapsed instrument set was used to ensure valid inference given the limited number of cross-sectional units.

The results show that health-system efficiency exhibits strong persistence over time. Fiscal predictability — measured as the inverse of short-term expenditure volatility — has a positive but statistically insignificant association with efficiency, and this relationship remains stable when the governance indicator is removed from the specification. These findings suggest that predictable fiscal behaviour may align with more consistent health-system performance, although the available data do not allow a precise estimate of this association. The empirical value of the paper therefore lies in documenting a robust directional pattern and in proposing a tractable measure of fiscal predictability that can be examined in richer panels in future work. Inflation and external balance emerge as significant macroeconomic correlates, underscoring the role of the broader macroeconomic environment.

The robustness exercise confirms that the main results are not driven by the inclusion or exclusion of the governance index. Taken together, the findings highlight the importance of accounting for persistence, endogenous fiscal dynamics, and macroeconomic conditions when analyzing efficiency outcomes in short panels. Future research could extend the analysis to larger samples or longer time spans, explore alternative constructions of efficiency and governance measures, or examine more flexible dynamic structures where the data permit. Within the constraints of the available panel, the study provides a consistent empirical assessment of the interaction between fiscal behaviour and health-system efficiency.

The present approach provides a tractable characterization of fiscal predictability in a short-panel setting. Future work using larger panels or richer factor-structure models may further refine this characterization.

Appendices

Appendix A. Data Sources and Variable Construction

This appendix documents all variables used in the empirical analysis, their definitions, transformations, measurement units, and primary data sources. The dataset covers 2009-2022 for eight countries (Botswana, Côte d'Ivoire, Ghana, Kenya, Rwanda, Senegal, Uganda, South Africa). For model estimation, the effective balanced sample spans 2011-2022, consistent with the three-year rolling construction of the Fiscal Volatility Index (FV) used to build FP.

Table A1. Variable Definitions and Data Sources

Variable	Symbol	Definition	Source
Health-System Efficiency	EFF	Life expectancy / current health expenditure per capita (PPP, const USD) rescaled [0, 1]	WDI (SP.DYN.LE00.IN); GHED (SH.XPD.CHEX.PC.CD)
Fiscal predictability Index	FP	1/(3-year rolling SD of the detrended (HP-filtered ($\lambda = 100$)) log-growth rate of real general government final consumption expenditure (constant 2015 US$)	WDI (NE.CON.GOVT. KD)
Institutional Coherence Index	IC	Normalized mean of Government Effectiveness, Regulatory Quality, and Control of Corruption (range [-1, +1]) : (GE + RQ + CC) / 3	WGI (GE.EST, RQ.EST, CC.EST)
Real GDP growth	GDPG	Real GDP growth (%)	WDI

Variable	Symbol	Definition	Source
Inflation (%)	INF	Inflation rate, average consumer prices − annual percent change (IFS indicator based on CPI index PCPI_IX)	IMF IFS database
Aid	AID	− (External balance on goods & services % GDP)	WDI (NE.RSB.GNFS.ZS)
Inclusive Growth Rate	IGR	Employment-adjusted growth = GDP-per-capita growth × employment rate = $IGR_{it} = GDPG_{it} * L_{it}$	WDI; (NY.GDP.PCAP.KD.ZG, SL.EMP.TOTL.SP.ZS)

Note: Because Regulatory Quality (RQ) is available for 2000 and 2014-2022, linear interpolation within each country was applied for 2001-2013 to ensure a balanced panel for the institutional coherence index. All series were cross-checked for completeness, consistency, and temporal alignment across countries.

Appendix B. Descriptive Analysis

Table B1. Summary Statistics for the Institutional Coherence Index (IC)

(the xtsum output)

Appendix Table A1 reports the decomposition of IC into within- and between-country variation. The index shows strong cross-sectional variation but little movement over time. This empirical pattern is consistent with its interpretation as a structural governance characteristic and justifies its treatment as an exogenous or predetermined regressor.

Statistic	Value
Overall SD	0.5138
Between SD	0.5211
Within SD	0.1546
Min	-1
Max	1
N	96
Countries	8
Years	12

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Abbreviations

EFF	Health-System Efficiency Indicator
FPI	Fiscal Predictability Index
FV	Fiscal Volatility
GE	GE
RQ	RQ
CC	CC
IC	Institutional Coherence Index
IGR	Inclusive Growth Rate
GDPcG	GDP-per-Capita Growth
HP Filter	Hodrick-Prescott Filter
L	Employment Rate
PPP	Purchasing Power Parity
SD	Standard Deviation
GHED	Global Health Expenditure Database
IFS	International Financial Statistics
IMF	International Monetary Fund
WDI	World Development Indicators
WGI	World Governance Indicators