

Robust Panel Estimation of Communicable Diseases and Economic Performance under Heteroscedasticity, Serial Correlation and Cross-Sectional Dependence: Evidence from Selected African Economies

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Abstract:

This study examines the relationship between communicable diseases, health expenditure and economic performance in eight selected African economies using panel data covering the period 2003–2022. The study focuses on current health expenditure, HIV prevalence, malaria incidence, tuberculosis incidence and inflation as determinants of Gross Domestic Product (GDP). Pooled Ordinary Least Squares, Fixed Effects and Random Effects models were initially estimated, while the F-test, Breusch–Pagan Lagrange Multiplier test and Hausman specification test were employed to determine the appropriate panel estimator. The tests favoured the Fixed Effects model. However, diagnostic tests revealed heteroscedasticity, serial correlation and cross-sectional dependence, indicating that conventional Fixed Effects standard errors may not provide reliable statistical inference. The Fixed Effects model was therefore re-estimated using Driscoll–Kraay standard errors. The results show that current health expenditure has a positive and statistically significant relationship with GDP, with a coefficient of 0.2723 ($p < 0.01$). Malaria incidence also has a positive and statistically significant coefficient of 0.0774 ($p = 0.019$). HIV prevalence, tuberculosis incidence and inflation are statistically insignificant under the Driscoll–Kraay specification. Comparison with the conventional Fixed Effects results shows that the coefficient estimates remain virtually unchanged, while the estimated standard errors and statistical significance are adjusted. In particular, malaria is significant at the 10 percent level under conventional Fixed Effects but at the 5 percent level after Driscoll–Kraay correction. As a complementary identification analysis, Fixed Effects instrumental-variable estimation shows that health expenditure remains positive and significant, while malaria and HIV prevalence become negative and significant. The findings demonstrate the importance of basing inference in panel-data studies of African economies on standard errors that account for heteroscedasticity, serial correlation and cross-sectional dependence.

Keywords: communicable diseases; economic performance; health expenditure; malaria; HIV; tuberculosis; panel data; Fixed Effects; Driscoll–Kraay

1. Introduction

Communicable diseases remain an important challenge to economic development, particularly in developing economies where health systems, productive capacity and public resources are often constrained. Diseases such as malaria, HIV/AIDS and tuberculosis can affect economic performance through several channels, including labour productivity, household expenditure, school attendance, human capital accumulation, healthcare costs and government expenditure (Bloom & Mahal, 1997; Gallup & Sachs, 2001). At the same time, investment in healthcare can improve population health and enhance the productive capacity of the labour force.

The relationship between health and economic performance has therefore attracted considerable attention in development economics. The human capital perspective considers health as an important component of productive capital, while endogenous growth theory recognises that investments that improve human capabilities can influence long-run economic performance (Bloom & Canning, 2003; Gyimah-Brempong & Wilson, 2004). However, empirical estimates of the health–growth relationship may depend not only on the variables included in the model but also on the econometric treatment of the panel-data error structure.

A major concern in panel-data estimation is that observations across countries and over time may not satisfy the assumptions underlying conventional standard errors (Baltagi, 2021; Wooldridge, 2010). Countries within the same region may experience common economic shocks, disease outbreaks, policy changes, commodity-price movements and international health interventions. In addition, shocks in one period may persist into subsequent periods, while the variability of disturbances may differ across countries. Consequently, heteroscedasticity, serial correlation and cross-sectional dependence may arise simultaneously.

These issues are particularly relevant when analysing selected African economies. The countries in the sample are economically and institutionally different, but they are also exposed to common regional and international shocks. Failure to account for these forms of dependence can make conventional standard errors unreliable and consequently affect statistical inference (Driscoll & Kraay, 1998; Hoechle, 2007).

The present study therefore focuses specifically on the robustness of panel-data inference in examining communicable diseases and economic performance. Rather than assuming that the conventional Fixed Effects standard errors are adequate, the study first estimates the standard panel models, conducts diagnostic tests and subsequently applies Driscoll–Kraay standard errors to the Fixed Effects specification.

The study covers eight African economies over 2003–2022. The sample comprises seven West African countries—Benin, The Gambia, Ghana, Nigeria, Senegal, Sierra Leone and Togo—and Cameroon, which is located in Central Africa. The variables considered are current health expenditure, HIV prevalence, malaria incidence, tuberculosis incidence and inflation, with GDP serving as the measure of economic performance.

The main research question is:

Does the relationship between communicable diseases, health expenditure and economic performance remain statistically reliable after accounting for heteroscedasticity, serial correlation and cross-sectional dependence in the panel?

The contribution of the study is methodological as well as empirical. The study does not claim that the Driscoll–Kraay estimator produces fundamentally different economic coefficients. Rather, it demonstrates that conclusions about the health–growth relationship should be based on inference that reflects the actual dependence structure of the panel. This distinction is important because robust standard errors address inference, whereas endogeneity requires a separate identification strategy.

The remainder of the paper is organised as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 presents the data and methodology. Section 4 reports the empirical results. Section 5 discusses the findings. Section 6 presents the robustness and methodological implications. Section 7 discusses policy implications, while Section 8 considers limitations and directions for future research. Section 9 concludes the study.

2. Literature Review

2.1 Communicable Diseases and Economic Performance

Communicable diseases can influence economic performance through their effects on labour supply and productivity. Poor health reduces the effective amount of labour available to production and may increase absenteeism and worker turnover. At the household level, illness can also redirect income from productive investment towards medical expenditure.

The effect may be particularly important in economies where disease burdens are high and health systems have limited capacity. Malaria, HIV/AIDS and tuberculosis can impose direct costs on households, firms and governments while also generating indirect costs through lost productivity.

From a macroeconomic perspective, persistent disease burdens can affect human capital accumulation and investment. Illness among working-age populations can reduce current production, while illness among children may affect educational attainment and future productivity.

However, the empirical relationship is not necessarily uniform across countries. Differences in health systems, labour-market structures, disease prevalence, public expenditure and institutional quality may produce different outcomes.

2.2 Health Expenditure and Economic Growth

Health expenditure may contribute to economic performance by improving health status and labour productivity. Grossman's health-capital framework views health as a form of capital that generates productive and consumption benefits (Grossman, 1972). Similarly, endogenous growth theory suggests that investments in human capabilities can influence productivity and long-run economic growth.

Empirical studies have generally provided evidence of a positive relationship between health investment and economic performance, although the magnitude and direction may depend on the composition and efficiency of health expenditure (Chewe & Hangoma, 2020; Gyimah-Brempong & Wilson, 2004; Odhiambo, 2021).

The expected relationship in the present study is therefore positive. Higher current health expenditure is expected to improve access to healthcare, disease prevention and treatment, thereby enhancing labour productivity and economic performance.

2.3 Panel-Data Methodological Issues

Panel data provide important advantages because they combine cross-sectional and time-series information. Fixed Effects estimation is particularly useful when unobserved country-specific characteristics may be correlated with the explanatory variables (Baltagi, 2021; Wooldridge, 2010).

Nevertheless, conventional panel estimators may require adjustments when the disturbances exhibit heteroscedasticity, serial correlation or cross-sectional dependence. Cross-sectional dependence is especially important in regional panels because countries can be affected by common shocks.

Driscoll and Kraay (1998) developed a covariance estimator capable of providing standard errors robust to a broad range of cross-sectional and temporal dependence. Hoechle (2007) subsequently demonstrated its usefulness for panel regressions where cross-sectional dependence is present.

The implication is that a researcher should not simply select Fixed Effects and stop the analysis. The adequacy of the resulting inference must also be assessed through appropriate diagnostic testing.

2.4 Research Gap

Much of the existing health–growth literature focuses on the substantive relationship between health variables and economic performance. Comparatively less attention is devoted to how the statistical inference surrounding those relationships changes when heteroscedasticity, serial correlation and cross-sectional dependence are simultaneously present.

This study addresses this methodological gap by explicitly testing for these problems and comparing conventional Fixed Effects inference with Driscoll–Kraay-corrected inference.

The contribution is therefore not merely the application of another estimator. Rather, the study shows how accounting for the actual error structure of the panel affects the statistical conclusions concerning health expenditure and communicable diseases.

2.5 Hypotheses

The study evaluates the following hypotheses:

H1: Current health expenditure has a significant positive association with economic performance.

H2: HIV prevalence has a significant association with economic performance.

H3: Malaria incidence has a significant association with economic performance.

H4: Tuberculosis incidence has a significant association with economic performance.

H5: Inflation has a significant association with economic performance.

3. Data and Methodology

3.1 Study Area, Countries and Period

The study uses annual panel data for eight selected African economies covering 2003–2022. The sample consists of Benin, Cameroon, The Gambia, Ghana, Nigeria, Senegal, Sierra Leone and Togo.

The sample includes seven West African economies and Cameroon, which is geographically located in Central Africa. This distinction is maintained to avoid incorrectly describing all eight countries as West African.

The final balanced panel contains 160 country-year observations.

3.2 Variables and Measurement

The dependent variable is Gross Domestic Product (GDP), used as the measure of economic performance.

The explanatory variables are:

1. **CHEXP**: current health expenditure;
2. **PREHIV**: HIV prevalence;
3. **MAL**: malaria incidence;
4. **TBRIN**: tuberculosis incidence; and
5. **INFLATION**: inflation rate.

The GDP, current health expenditure, malaria incidence, tuberculosis incidence and inflation data were obtained primarily from the World Development Indicators (World Bank, 2024), while HIV prevalence data were obtained from UNAIDS (2024).

The logarithmic transformation was applied to the relevant variables to reduce scale differences and facilitate elasticity interpretation.

3.3 Econometric Model

The general panel-data model is specified as:

$$\ln GDP_{it} = \beta_0 + \beta_1 \ln CHEXP_{it} + \beta_2 \ln PREHIV_{it} + \beta_3 \ln MAL_{it} + \beta_4 \ln TBRIN_{it} + \beta_5 \ln INFLATION_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where i represents country and t represents year.

μ_i captures unobserved country-specific effects, λ_t captures common year effects and ε_{it} represents the idiosyncratic disturbance.

3.4 Panel Estimators

Three conventional panel specifications were initially considered:

Pooled OLS

Pooled OLS assumes that the country-specific effects can be ignored and that the observations can be pooled into one regression. (Baltagi, 2021).

Fixed Effects

The Fixed Effects model controls for unobserved time-invariant country-specific characteristics that may be correlated with the explanatory variables. (Baltagi, 2021; Wooldridge, 2010).

Random Effects

The Random Effects model treats the country-specific effect as random and assumes that it is uncorrelated with the explanatory variables. (Baltagi, 2021; Wooldridge, 2010).

3.5 Model Selection

Table 4. Panel Model-Selection Tests

Test	Statistic	p-value	Decision
F-ratio test	2157.02	0.0000	Reject pooled OLS; FE preferred to pooled OLS
Breusch–Pagan LM	413.56	0.0000	Reject pooled OLS; panel effects present
Hausman test	19.92	0.0013	Reject RE; Fixed Effects preferred

The F-test, Breusch–Pagan Lagrange Multiplier test and Hausman test were used to select the appropriate estimator (Breusch & Pagan, 1980; Hausman, 1978).

The F-test strongly rejected the pooled model, with an F-statistic of 2157.02 and p-value of 0.0000. The Breusch–Pagan LM test also rejected the pooled specification, with a chi-square statistic of 413.56 and p-value of 0.0000. (Breusch & Pagan, 1980).

The Hausman test produced a chi-square statistic of 19.92 with a p-value of 0.0013 (Hausman, 1978). The null hypothesis of no systematic difference between the Fixed Effects and Random Effects estimators was therefore rejected. Fixed Effects was selected as the preferred conventional estimator.

3.6 Diagnostic Tests

Table 5. Diagnostic Test Results

Diagnostic test	Null hypothesis	Result	Conclusion
Modified Wald	Groupwise homoscedasticity	Rejected	Heteroscedasticity present
Wooldridge test	No first-order serial correlation	Rejected	Serial correlation present
Pesaran CD	Cross-sectional independence	Rejected	Cross-sectional dependence present

After selecting Fixed Effects, diagnostic tests were conducted for:

1. groupwise heteroscedasticity;
2. serial correlation; and
3. cross-sectional dependence.

The Modified Wald test indicated groupwise heteroscedasticity. The Wooldridge test indicated serial correlation, while the Pesaran CD test produced a p-value of 0.0000, indicating cross-sectional dependence (Pesaran, 2004; Wooldridge, 2010).

These findings are important because they affect the reliability of conventional standard errors and hypothesis tests. They do not necessarily imply that the Fixed Effects coefficients themselves are biased. Rather, they indicate that conventional inference should be corrected.

3.7 Driscoll–Kraay Estimation

Because all three problems were detected, the Fixed Effects model was re-estimated using Driscoll–Kraay standard errors.

The Driscoll–Kraay approach is appropriate because it provides standard errors robust to heteroscedasticity, serial correlation and general forms of cross-sectional dependence (Driscoll & Kraay, 1998; Hoechle, 2007).

The coefficients remain those of the Fixed Effects model; the principal adjustment concerns the covariance matrix and therefore statistical inference.

4. Empirical Results

4.1 Descriptive Statistics

Table 1. Descriptive Statistics

Variable	Mean	Observations
GDP	1.02e+11	160
Current health expenditure (CHEXP)	50.1423	160
HIV prevalence (PREHIV)	2,006,863	160
Tuberculosis incidence (TBRIN)	140.675	160
Malaria incidence (MAL)	286.219	160
Inflation	8.0303	160

The descriptive statistics indicate substantial variation across the selected economies. GDP has a mean of approximately 1.02e+11, while current health expenditure has a mean of 50.14. The mean values for HIV prevalence, tuberculosis incidence and malaria incidence are approximately 2,006,863, 140.68 and 286.22 respectively, while the average inflation rate is 8.03 percent.

The variables also display different degrees of skewness and kurtosis. Inflation is particularly highly skewed, reflecting periods of unusually high inflation in some country-year observations.

The descriptive statistics therefore suggest considerable heterogeneity across the sampled countries.

4.2 Panel Unit-Root Tests

Table 2. Summary of Panel Unit-Root Results

Variable	Order of Integration	Conclusion
ln(GDP)	I(1)	Non-stationary at level; stationary after first difference
ln(CHEXP)	I(1)	Non-stationary at level; stationary after first difference
ln(PREHIV)	I(1)	Non-stationary at level; stationary after first difference

ln(TBRIN)	I(1)	Non-stationary at level; stationary after first difference
ln(MAL)	I(0)	Stationary at level
INFLATION	I(0)	Stationary at level

The panel unit-root tests indicate that GDP, current health expenditure, HIV prevalence and tuberculosis incidence are integrated of order one, I(1), while inflation and malaria are stationary at level, I(0). The procedures draw on established panel unit-root approaches including Levin–Lin–Chu, Im–Pesaran–Shin and Fisher-type tests (Im et al., 2003; Levin et al., 2002; Maddala & Wu, 1999).

Importantly, none of the variables is integrated of order two. This supports the subsequent panel estimation strategy.

4.3 Correlation Analysis

The correlation analysis shows a relatively strong positive relationship between GDP and current health expenditure, with a correlation coefficient of 0.720.

GDP has a weak positive correlation with malaria incidence (0.073), a weak negative correlation with HIV prevalence (-0.088), a moderate positive correlation with tuberculosis incidence (0.444), and a weak positive correlation with inflation (0.061).

Correlation results, however, do not establish causality and should not be interpreted as substitutes for the panel regression analysis.

4.4 Multicollinearity

The Variance Inflation Factor results indicate no serious multicollinearity problem. The individual VIF values range from 1.04 to 1.83, while the mean VIF is 1.38.

These values are well below conventional thresholds commonly used to indicate problematic multicollinearity. Thus, the estimated coefficients are unlikely to be distorted by severe linear dependence among the explanatory variables.

4.5 Conventional Panel Regression Results

Table 3. Pooled OLS, Fixed Effects and Random Effects Estimates

Variable	Pooled OLS	Fixed Effects	Random Effects
ln(CHEXP)	2.577***	0.2720***	0.280***
ln(PREHIV)	-1.029***	0.1020	0.102
ln(MAL)	1.338***	0.0774*	0.0766*
ln(TBRIN)	1.382***	-0.0271	-0.0182
INFLATION	0.00684	-0.00136	-0.00130
Constant	14.67***	20.1100***	20.03***
R ²	0.7122	0.9307	0.9307
Observations	160	160	160

The initial panel regressions were estimated using Pooled OLS, Fixed Effects and Random Effects.

The Pooled OLS estimates differ considerably from the Fixed Effects estimates, indicating that unobserved country-specific characteristics are important.

Under the conventional Fixed Effects model, current health expenditure has a coefficient of 0.2720 and is statistically significant at the 1 percent level. Malaria incidence has a coefficient of 0.0774 and is significant at the 10 percent level.

HIV prevalence has a coefficient of 0.1020 but is statistically insignificant. Tuberculosis incidence has a coefficient of -0.0271 and is insignificant, while inflation has a coefficient of -0.00136 and is also insignificant.

The within R^2 is 0.9307, indicating that the model explains a substantial proportion of within-country variation in GDP.

4.6 Conventional Fixed Effects versus Driscoll–Kraay Fixed Effects

To make the effect of robust inference transparent, the conventional Fixed Effects estimates and Driscoll–Kraay estimates are presented side by side.

Table 6. Conventional Fixed Effects and Driscoll–Kraay Fixed Effects Estimates

Variable	Conventional FE Coefficient	Conventional FE SE	DK-FE Coefficient	DK-FE SE
ln(CHEXP)	0.2720***	0.0403	0.2723***	0.0619
ln(PREHIV)	0.1020	0.0983	0.1017	0.1846
ln(MAL)	0.0774*	0.0423	0.0774**	0.0301
ln(TBRIN)	-0.0271	0.0443	-0.0271	0.0473
INFLATION	-0.00136	0.000877	-0.0014	0.0011
Constant	20.1100***	1.5940	20.1067***	3.1067
Observations	160		160	
Countries	8		8	
Within R^2	0.9307		0.9307	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Year effects are included. Conventional Fixed Effects standard errors are reported for comparison, while Driscoll–Kraay standard errors are used for the preferred inference.

The comparison reveals an important result. The coefficient estimates are virtually identical across the two specifications. The main difference lies in the estimated standard errors and consequently in statistical inference.

For current health expenditure, the coefficient changes only from 0.2720 to 0.2723, while the standard error increases from 0.0403 to 0.0619. Despite this increase, the variable remains significant at the 1 percent level.

For HIV prevalence, the coefficient remains approximately 0.102, but its standard error increases from 0.0983 to 0.1846. The variable remains statistically insignificant.

For malaria incidence, the coefficient remains 0.0774, while the standard error decreases from 0.0423 to 0.0301. Consequently, malaria moves from significance at the 10 percent level under conventional Fixed Effects to significance at the 5 percent level under Driscoll–Kraay.

Tuberculosis incidence and inflation remain statistically insignificant under both approaches.

This comparison demonstrates that Driscoll–Kraay estimation does not substantially alter the estimated coefficients. Its principal contribution is to provide inference that accounts for the detected dependence structure.

4.7 Diagnostic Evidence and Need for Robust Inference

The diagnostic tests provide the justification for preferring the Driscoll–Kraay standard errors for final inference.

The Modified Wald test indicates groupwise heteroscedasticity. The Wooldridge test indicates serial correlation, while the Pesaran CD test rejects the null hypothesis of cross-sectional independence.

These findings imply that the conventional Fixed Effects standard errors may not adequately reflect the actual covariance structure of the disturbances. Consequently, the statistical significance obtained from conventional standard errors should not be treated as the final inference.

The results support the use of Driscoll–Kraay standard errors, which are robust to heteroscedasticity, serial correlation and cross-sectional dependence.

4.8 Driscoll–Kraay Fixed Effects Results

Table 7. Fixed Effects Regression with Driscoll–Kraay Standard Errors

Variable	Coefficient	DK Standard Error	t-statistic	p-value
ln(CHEXP)	0.2723***	0.0619	4.40	0.000
ln(MAL)	0.0774**	0.0301	2.57	0.019
ln(PREHIV)	0.1017	0.1846	0.55	0.588
ln(TBRIN)	-0.0271	0.0473	-0.57	0.573
INFLATION	-0.0014	0.0011	-1.19	0.247
Constant	20.1067***	3.1067	6.47	0.000

Observations: 160

Countries: 8

Within R²: 0.9307

F-statistic: 498.02

Prob > F: 0.0000

Year effects: Included

Maximum lag: 2

The Driscoll–Kraay results constitute the preferred basis for statistical inference because the diagnostic tests identified heteroscedasticity, serial correlation and cross-sectional dependence. (Driscoll & Kraay, 1998; Hoechle, 2007).

Current health expenditure has a coefficient of 0.2723 and is statistically significant at the 1 percent level. This indicates a positive association between health expenditure and GDP.

Malaria incidence has a coefficient of 0.0774 and is statistically significant at the 5 percent level. The positive sign should not be interpreted as evidence that malaria promotes economic growth. Rather, it represents the estimated conditional association in the robust Fixed Effects specification and is contrary to the conventional theoretical expectation.

HIV prevalence has a positive coefficient of 0.1017 but is statistically insignificant. Therefore, the study does not find sufficient evidence of a statistically significant aggregate relationship between HIV prevalence and GDP under the Driscoll–Kraay specification.

Tuberculosis incidence has a negative coefficient of -0.0271 but is statistically insignificant. Similarly, inflation has a negative coefficient of -0.0014 but is statistically insignificant.

The overall model is statistically significant, with an F-statistic of 498.02 and a probability value of 0.0000.

5. Discussion of Results

5.1 Current Health Expenditure and Economic Performance

The finding that current health expenditure has a positive and statistically significant coefficient of 0.2723 is consistent with the theoretical expectation that investment in health improves productive capacity (Grossman, 1972; Bloom & Canning, 2003).

The coefficient indicates that, holding the other explanatory variables constant, a 1 percent increase in current health expenditure is associated with approximately a 0.272 percent increase in GDP.

This finding is consistent with the human capital perspective, Grossman's health-capital framework and endogenous growth theory, all of which provide mechanisms through which better health can improve labour productivity and economic performance.

The result is also consistent with empirical evidence showing that health investment can contribute to economic growth in developing economies and Sub-Saharan Africa (Gyimah-Brempong & Wilson, 2004; Odhiambo, 2021).

The implication is that healthcare expenditure should not be viewed only as consumption expenditure. Properly targeted health spending can also function as productive investment through improved health status, labour productivity and human capital.

5.2 Malaria Incidence and Economic Performance

Malaria incidence has a coefficient of 0.0774 and is statistically significant at the 5 percent level under the Driscoll–Kraay specification.

The positive coefficient is unexpected because malaria is generally associated with illness, reduced labour productivity, absenteeism, healthcare costs and human-capital losses (Gallup & Sachs, 2001).

Therefore, the result should be interpreted cautiously. The coefficient represents a conditional empirical association and should not be interpreted as showing that malaria is beneficial to economic growth.

One possible explanation is that malaria incidence may be correlated with factors that are not fully captured in the model. Another possibility is reverse causality, whereby economic expansion changes reporting, healthcare access, diagnosis and recorded disease incidence. Measurement issues and differences in disease surveillance across countries may also influence the estimated relationship.

5.3 HIV Prevalence and Economic Performance

The Driscoll–Kraay estimate for HIV prevalence is 0.1017, but the coefficient is statistically insignificant with a p-value of 0.588.

The absence of statistical significance means that the study does not establish a statistically significant aggregate relationship between HIV prevalence and GDP under the robust Fixed Effects specification. This should not be read as evidence that HIV has no economic consequences; prior research has identified potential channels through which HIV/AIDS can affect economic performance (Bloom & Mahal, 1997).

The finding does not necessarily imply that HIV has no economic consequences. Rather, the aggregate country-level relationship may be affected by differences in treatment availability, antiretroviral therapy, labour-market structures, demographic characteristics and public-health interventions.

5.4 Tuberculosis Incidence and Economic Performance

Tuberculosis incidence has a negative coefficient of -0.0271 but is statistically insignificant under the Driscoll–Kraay specification.

The negative sign is consistent with the theoretical expectation that disease burden can reduce productive capacity (Bloom & Mahal, 1997). However, the absence of statistical significance means that the study cannot reject the null hypothesis of no statistically significant relationship between tuberculosis incidence and GDP in the robust FE model.

The result may reflect differences in tuberculosis treatment, disease detection, public-health programmes and the economic structures of the selected countries.

5.5 Inflation and Economic Performance

Inflation has a coefficient of -0.0014 and is statistically insignificant.

The negative sign is consistent with the expectation that persistent inflation can reduce purchasing power, increase uncertainty and weaken investment. However, the statistical insignificance indicates that the study does not find sufficient evidence that inflation has a statistically significant effect on GDP within the estimated model.

The result may reflect differences in inflationary episodes and macroeconomic policy across the countries.

6. Robustness and Methodological Implications

6.1 Why the Driscoll–Kraay Results Are Preferred for Inference

The conventional Fixed Effects model provides the baseline estimates, but the diagnostic tests indicate that the panel contains heteroscedasticity, serial correlation and cross-sectional dependence.

The appropriate response is not to discard the Fixed Effects estimator. Rather, the standard errors should be corrected so that statistical inference reflects the error structure.

The Driscoll–Kraay results therefore constitute the preferred basis for inference in this paper.

The comparison between conventional FE and DK-FE demonstrates that the coefficient estimates are essentially unchanged. What changes is the estimated uncertainty around the coefficients.

This distinction is central to the methodological contribution of the paper.

6. Policy Implications

The findings provide several policy implications.

First, the positive and statistically significant relationship between current health expenditure and GDP supports continued investment in healthcare. Governments should improve both the level and efficiency of health expenditure.

Second, the significant malaria result under the robust FE model reinforces the need for stronger malaria prevention and control. Governments should prioritise vector control, early diagnosis, effective treatment and public-health education.

Third, although HIV prevalence is statistically insignificant under the DK-FE model, the broader evidence on HIV burden indicates that HIV should remain an important policy concern. Treatment, prevention and access to antiretroviral services should therefore remain priorities.

Fourth, tuberculosis incidence has a negative but statistically insignificant relationship with GDP. Nevertheless, continued tuberculosis surveillance, diagnosis and treatment remain important because disease-control policy should not depend exclusively on statistical significance in a single macroeconomic model.

Fifth, the evidence of cross-sectional dependence suggests that African countries should strengthen regional cooperation in disease surveillance, health information systems and communicable-disease control.

Finally, the methodological findings themselves have policy relevance. Economic policy recommendations based on panel regressions should rely on inference that appropriately accounts for the dependence structure of the data.

7. Limitations and Future Research

The study has several limitations.

First, the analysis uses country-level data and therefore cannot fully capture household-level or individual-level effects of communicable diseases.

Second, the availability and quality of disease indicators may differ across countries. Differences in surveillance and reporting systems may affect the measurement of disease incidence.

Third, the study covers eight selected African economies and therefore the findings should not automatically be generalised to all African countries.

Fourth, although the IV analysis provides additional evidence regarding endogeneity, the validity of the instrument remains an important consideration. Future studies could employ alternative instruments or identification strategies.

Future research could also examine dynamic panel models, nonlinear relationships, threshold effects and country-specific mechanisms. Greater attention could be given to how institutional quality, health-system capacity and public-health governance mediate the health–growth relationship.

8. Conclusion

This study examined the relationship between communicable diseases, health expenditure and economic performance in eight selected African economies over the period 2003–2022. The analysis initially considered Pooled OLS, Fixed Effects and Random Effects models. The model-selection tests favoured Fixed Effects.

However, diagnostic tests revealed heteroscedasticity, serial correlation and cross-sectional dependence. Consequently, conventional Fixed Effects standard errors were not considered sufficient for final statistical inference, and the Fixed Effects model was re-estimated using Driscoll–Kraay standard errors.

The robust results show that current health expenditure has a positive and statistically significant relationship with GDP, while malaria incidence is also statistically significant. HIV prevalence, tuberculosis incidence and inflation are statistically insignificant under the Driscoll–Kraay specification.

An important methodological finding is that the coefficients from the conventional FE and Driscoll–Kraay FE models are virtually identical. The major difference concerns the standard errors and, consequently, statistical inference. Current health expenditure remains significant at the 1 percent level under both approaches, while malaria moves from significance at the 10 percent level under conventional FE to significance at the 5 percent level under Driscoll–Kraay. The other variables remain statistically insignificant.

The study therefore demonstrates that the principal value of Driscoll–Kraay estimation in this context is not to generate different economic coefficients, but to provide more appropriate statistical inference when the panel exhibits heteroscedasticity, serial correlation and cross-sectional dependence.

Overall, the findings support continued investment in healthcare and stronger communicable-disease prevention and control. More broadly, the study demonstrates that empirical conclusions concerning health and economic performance in African panel data should be based on econometric inference that reflects both country-specific heterogeneity and the dependence structure of the panel.

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