

Promoting Per Capita Income Through Sustainable External Debt Management And Inflation Dynamics: Evidence From Selected African Countries

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Abstract

Per capita income is a key indicator of economic welfare because it reflects the average income available to individuals and serves as a measure of living standards and economic development. This study investigates the effects of external debt dynamics and inflation shocks on per capita income in Africa from 2010 to 2025 using a panel dataset. External debt, external debt stock, external debt servicing, external debt shocks, inflation rate, inflation shocks, and exchange rate were included as explanatory variables. The panel ARDL model was employed to estimate both short run and long run relationships, while FMOLS and DOLS were used to verify the robustness of the results. The ARDL findings indicate that external debt related variables and inflation shocks significantly reduce per capita income, suggesting that excessive indebtedness and macroeconomic instability undermine economic welfare. The FMOLS and DOLS estimates reveal mixed effects across specifications, highlighting the importance of debt management and macroeconomic conditions in shaping income outcomes. The study concludes that sustainable debt management, effective inflation control, productive use of borrowed funds, enhanced revenue mobilisation, and prudent monetary policies are essential for improving per capita income and promoting long run economic development across African economies....

Keywords Per Capita Income, Sustainable External Debt, Inflation Dynamics...

INTRODUCTION

Per-capita income is a vital economic metric in African countries, indicating the average income individuals earn. Simon Kuznets (1966) states that Economic development is influenced by factors such as Gross Domestic Product (GDP), income distribution, education, skill development, access to modern infrastructure, technology, and employment opportunities. However, income inequality, political instability, infrastructure gaps, unemployment, and educational disparities can slow per capita income growth. External debt, a common source of financing for development projects and economic growth, can significantly impact per capita income. Foreign loans can support infrastructure projects, such as energy facilities, transportation networks, and communication systems, which improve GDP and per capita income. Additionally, external debt can support the development of human capital and education, as demonstrated by countries like Ghana. However, excessive external borrowing can have unintended consequences, as it may take funds away from important public services that promote economic growth. External debt and inflation shocks significantly impact per capita income in African nations. These issues can lead to a vicious circle of domestic economic problems, including inflation, insufficient internal savings for investment in productive facilities, and the oblivion of these facilities. Capital-exporting creditor countries can impose financial demands on chronic debtors, creating a modern tool for domination and dependency. High levels of external debt can lead to economic vulnerabilities and impede long-term growth. Inflation shocks, characterised

by unpredictable and rapid increases in prices and sudden increases in inflation rates, can erode the purchasing power of individuals, impacting their real income. Poor governance challenges, economic mismanagement, and external shocks can lead to the misallocation of borrowed funds and ineffective policy responses to inflation shocks. These issues have a wide-ranging impact on the economy, including investment, productivity, and trade. High levels of external debt can divert resources away from critical public services and investments, while inflationary shocks can lower consumer purchasing power and disrupt economic planning. Despite their efforts, African countries continue to struggle with unsustainable debt burdens and inflationary pressures.

Understanding these parameters and resolving issues is essential for advancing economic development in African countries. Inflation can have severe consequences on the economic well-being of African nations, particularly when it spirals out of control. Understanding how inflation shocks impact per-capita income is essential for devising effective economic policies. Inflation can be beneficial when steady and moderate, stimulating investment and expenditure, and raising GDP. However, high and erratic inflation can lower real income and reduce people's motivation to save and invest. Demand-pull and cost-push inflation are the main components of inflation shocks. This study aims to analyse the relationship between external debt, inflation, and income levels in different African economies, considering their unique economic structures and vulnerabilities. It will provide empirical evidence and quantitative analysis to support policy recommendations and contribute significantly to the knowledge base on debt and inflation dynamics in Africa. The study focuses on the specific difficulties and chances faced by African countries, addressing the knowledge gap caused by contextual specificity. Examining the complexities of inflation shocks and external debt in the African context clarifies the difficulties and interactions impacting per capita income, offering a more comprehensive understanding of these complex relationships.

Considering the fact that Per-capita Income is rarely investigated with deep analysis in Africa, this study therefore examined the impact of external debt and inflation shocks on Per-capita Income in twenty-eight selected African countries. Furthermore, we extended the inquiry to investigate the effect of external debt shocks, external debt stocks, external debt service, and inflation on Per-capita Income, and also ascertain the interactive effect of governance and external debt on the economic growth of the selected countries. This study differs from previous studies in several ways. First, Beyene and Kotosz (2022) provide a comprehensive examination of how external debt impacts total factor productivity (TFP), GDP growth, and the mechanisms through which debt affects the economies of heavily indebted poor countries (HIPC). Their findings indicate that external debt significantly reduces both TFP and GDP growth, emphasising a non-linear relationship between debt, productivity, and growth. However, these studies do not control for the influence of government spending or inflation on external debt because it's a major problem in Africa. This is important because evidence has shown that countries with a government that engages in calculated and controlled spending tend to accurately service their debt, and such countries benefit more from utilising external debt compared to countries with wasteful governance. Second, other studies such as Shahzad and Javid (2015) investigated the relationship between debt, investment, and productivity in rising Asian economies, finding that debt negatively impacts aggregate, private, and per capita investment, as well as total factor and labour productivity.

However, these studies do not take into consideration factors that may likely curb negative debt servicing, such as inflationary shocks, government effectiveness, etc. Third, the study by Makun (2021) explored the relationship between economic progress and external debt in Fiji, finding that external debt has a detrimental effect on GDP growth, with the increase in debt stock having a more significant negative impact than reducing external debt shocks. However, Makun did not examine the effect of external debt servicing and external debt stocks. This study aims to address the knowledge gap left by previous research by conducting a deep analysis of the impact of external debt and inflation shocks on Per-capita Income in twenty-eight selected African countries. Unlike earlier studies that often overlook the role of debt management, this research will incorporate the influence of external debt management and inflation on Per-capita Income. The study will investigate not only the direct effects of external debt and external debt volatility but also the influence of inflation on per capita income. While prior research has established a significant relationship between external debt and economic growth, many of these studies fail to control for the influence of inflationary shocks, which is a vital factor in Africa where exchange rate fluctuations are prevalent. It is well-documented that countries with transparent governments and robust institutions manage external debt more effectively and derive greater economic benefits compared to those with weaker institutional frameworks.

Distinct from previous studies such as (Hassan and Meyer 2021, and Shahzad and Javid 2015) among others, we employed a novel dynamic panel autoregressive distributed lag (ARDL) model as proposed by Pesaran et al. (1999, 2001) to investigate the impact of external debt and inflation shocks on per capita income in selected African countries and carried out the interactive effects of external debt shocks, external debt stock, external debt service, and inflationary shocks to see how they affect individual income and robust-checked the ARDL results by employing the panel fully modified ordinary least squares (FM-OLS) and panel dynamic ordinary least squares (DOLS) to take care of the cross-sectional dependence and country-specific effects that the ARDL model could

not account for. The remaining sections of this study were structured as follows: literature review in chapter two, data description and methodology in chapter three, empirical results and discussion of findings in chapter four, and summary, conclusion, and policy recommendations in chapter five.

2. REVIEW OF RELATED LITERATURE

The review of related literature provides the theoretical and empirical foundation for examining the relationship between external debt and economic growth. It is organised into two sections. The study reviewed the Endogenous Growth Theory and the Debt Overhang Theory as the conceptual framework underpinning the study. The second examines previous empirical studies on external debt and economic growth, highlighting their methodologies, major findings, areas of agreement and disagreement, and existing research gaps. This review establishes the basis for the present study and demonstrates its contribution to the existing literature.

2.1 Theoretical Review

Endogenous Growth Theory is a framework for studying output growth in production systems, similar to the neoclassical growth model. It assumes growing returns to scale and handles technology spillovers and positive externalities. The model does not predict that impoverished countries will outperform affluent ones in terms of growth, suggesting convergence is unlikely. It emphasises the importance of human capital investments and the benefits of knowledge transfer from technologically advanced countries. Learning-by-doing, a process where firms and personnel with more production experience can produce more effectively, is a key component of this theory. Studies by Romer (1994), Lucas (1993), Grossman-Helpman (1991), and Aghion-Howitt (1992) have expanded this model, contributing to understanding economic growth dynamics and the role of factors like human capital, research, education, government policies, and institutional factors.

The Debt Overhang Theory, proposed by Krugman in 1988, suggests that a country's ability to repay debt decreases as the outstanding debt exceeds a threshold level. This theory acknowledges the negative effects of government limitations and reduced investment due to external debt on the economy, such as inflation, taxes, uncertainty, and capital flight. However, it fails to explain how foreign debt affects inflation and currency rates. Keynes' Keynesian theory, proposed in 1936, suggests underutilization of resources due to a lack of credit and budget deficits. Ricardo's Ricardian Equivalence Theory, created in 1979, examines the impact of debt management on monetary policy and suggests that households prioritise saving. However, it fails to establish a clear link between a country's internal prices and external debt due to different social, economic, and political systems. Monetarism is an economic theory that suggests the money supply is the main factor influencing short-term GDP and long-term price levels. It gained popularity in the 1970s and helped reduce inflation in the US and UK. The quantity theory of money states that the money supply multiplied by velocity equals the economy's nominal expenditures. Monetarism is based on long-term monetary neutrality, short-run monetary non-neutrality, and interest rate flexibility. Monetarists argue that the Fed should target the growth rate of money to match real GDP growth and that government intervention can destabilise the economy.

2.2 Empirical Literature

Empirically, Beyene and Kotosz (2022) investigated how external debt affects total factor productivity (TFP), GDP growth, and the TFP as a channel via which it affects the economies of heavily indebted poor countries (HIPC). The study found that debt significantly reduces TFP and GDP growth. It also emphasizes the non-linear link between external debt, total factor productivity, and GDP growth. Hassan and Meyer (2021) used the GMM estimate approach to study the 30 Sub-Saharan African nations from 1985 to 2019. The study found that external debt in SSA countries has a non-linear impact on economic growth via three channels: total factor productivity, government investment, and private sector investment. Makun (2021) examined the relationship between economic progress and external debt in Fiji, a Pacific Island republic, from 1980 to 2018. The study examined long-term linear and non-linear correlations between variables, including exports and total factor productivity. The results suggest that external debt hurts GDP growth. The study found that increasing debt stock had a higher negative impact on growth than lowering external debt shocks. Munir and Mehmood (2018) found an inverse U-shaped relationship between debt and economic progress in South Asian countries. Debt primarily impacts economic development through private, public, and TFP investment channels. From 1990 to 2013, annual data for South Asian nations (Bangladesh, India, Pakistan, and Sri Lanka) were used. The study also suggests that debt boosts economic growth to a certain point, after which it has a negative impact.

Shahzad and Javid (2015) studied the relationship between debt, investment, and productivity in rising Asian economies between 1984 and 2007. To address the endogeneity issue, two models with different specifications were estimated for data with a yearly frequency. GMM was employed as an estimating method. Lag explanatory variables were used as instruments. Debt negatively impacts aggregate, private, and per capita investment, as well as total factor and labour productivity. Afonso and Jalles (2013) analysed cross-sectional and time-series data from 155 developed and developing countries from 1970 to 2008 to explore the potential link between fiscal

policy advancements and GDP growth. The researchers found that the government debt ratio negatively impacts the entire sample in their study. Debt maturity varies based on the proportion of short- or long-term debt to GDP or total debt. Research indicates that short-term debt has a positive impact on growth, with a longer average duration of government debt leading to better growth rates. Higher debt ratios promote TFP growth and the expansion of capital stock per worker from a growth accounting perspective.

Hameed et al. (2008) investigated the dynamic link between external debt and economic development in Pakistan between 1970 and 2003 while adjusting for other sources of growth. The researchers used a multiple cointegration approach to investigate the association between external debt and economic development. The study found that debt service has a negative long-term impact on GDP, particularly on capital and labour productivity. The findings also revealed a short- and long-run causal relationship between debt service and GDP. Several research studies (Elibadawi et al. 1997, Iyoha 1999, Calvo 1998, Amoating & Amoaku-Adu 1996) challenged the notion that external debt boosts economic growth. Tefera (2019) investigated the impact of external debt on economic growth as well as its sustainability in Sub-Saharan Africa. The panel threshold approach revealed a substantial negative correlation between external debt and economic growth, based on annual data from 41 countries from 2000 to 2017. The bootstrapping method was used to examine the long-term viability of external debt. The findings showed that external debt was unsustainable in SSA nations.

Lee et al. (2017) found inconclusive evidence about the relationship between external debt and economic development. Further investigation revealed a negative association between external debt and economic growth at the lower threshold of 30%. An investigation of the current relationship between corruption and external debt growth has shown that corruption has a positive and significant impact on external debt growth. Lee et al. (2017), Kim et al. (2017), and Cooray et al. (2017) investigated the relationship between corruption, the shadow economy, and government debt from 1996 to 2012. The research reveals that the shadow economy is positively associated with corruption in public debt, reducing tax income while increasing the debt load. With the use of GMM estimation methods. Agyapong and Bedjabeng (2020) investigated the impact of external debt and foreign direct investment on African financial development. Using annual time series data from 2002 to 2015, they found a significant positive association between foreign debt, FDI, and African financial development. They did, however, urge that the governments of the selected countries use the borrowed funds for more constructive purposes. A study by Tarek B. A & Ahmed Z (2017), in selected MENA nations, found that institutional measures have a significant impact on public debt accretion. The study found a negative correlation between weak institutions and lower GDP growth rates Sania et al. (2019). They used GMM to study the impact of institutional quality on public debt in 46 Sub-Saharan African nations from 2000 to 2014. The analysis identified both direct and indirect links between public debt and institutional quality. Further investigation revealed a significant debt-growth link.

Other research, such as (Senadza et al. 2018, Ndieupa 2018, Akinkunmi 2017), used a variety of techniques to assess the influence of external debt on African economic growth. While Senadza et al. (2018) found an insignificant negative relationship between external debt and economic growth from a panel of 39 SSA countries from 1990 to 2013 using SGMM, Ndieupa's (2018), study on six Central African Economic and Monetary Community countries from 2000 to 2016 showed that public debt had a significant and indirect impact on economic growth. Using a linear and non-linear panel ARDL approach, Akinkunmi (2017), a significant long-run relationship between external debt and economic growth using the non-linear ARDL approach, whereas the linear model revealed a significant long-run relationship between investment and economic growth. Musibau et al. (2018) investigated the relationship between external debt and economic growth in selected ECOWAS member countries. The study found causal relationships between external debt and economic growth, both in the short and long run. Furthermore, in a study of the impact of foreign debt on investment and economic growth in 23 low-income countries from 2000 to 2017, Hakimi et al. (2019) discovered a substantial adverse link between external debt, investment, and economic growth using the SUR model.

Similarly, Çiftçiöğlu & Sokhanvar (2018) investigated twelve chosen Central and Eastern European rising economies from 1995 to 2014 and discovered that external debt has a negative long-term impact on economic growth. Further analysis revealed a significant causal relationship between external debt and economic development. Mensah et al. (2018) used SGMM techniques to investigate the relationship between institutional quality and foreign debt growth in 36 Sub-Saharan African nations from 1996 to 2013. The study demonstrated a long-term association between external debt and economic growth. Further analysis revealed that institutional quality influenced economic growth. Similarly, Carmody et al. (2021) and Zajontz (2021) investigated the motivations for the Chinese government's post-reform evolution. This study examines China's Belt and Road Initiative (BRI), which focuses on regional infrastructure projects in Eurasia and Africa (e.g., Kenya, Djibouti, and Ethiopia). The study's findings contradict BRI's purpose of regional infrastructure development in the sampled countries. The report suggests that the looming debt crisis and the COVID-19 pandemic may hinder the initiative's success. According to the analysis, the BRI projects may not be sustainable, undermining Kenya, Djibouti, and Ethiopia's ambitions for economic development. However, the analysis indicates that the looming debt crisis may jeopardise the purpose of such debt.

The literature presents mixed evidence on the relationship between external debt and economic growth. Tarro'sy (2020) argues that rising dependence on Chinese loans may increase debt vulnerability and constrain repayment capacity, with creditor countries potentially deriving greater benefits than debtor nations. Similarly, Carmody et al. (2021) contend that Africa's recurring debt challenges reflect broader structural weaknesses in its integration into the global economy, warranting closer examination of the economic, social, and political implications of the current debt cycle. In contrast, Checherita Westphal and Rother (2012) report a nonlinear relationship between public debt and economic growth, showing that debt supports growth only up to a threshold of about 90 to 100 percent of GDP, beyond which it adversely affects long run growth through lower total factor productivity. These findings underscore the importance of prudent debt management in sustaining economic growth.

Pattillo et al. (2011) investigated the mechanisms by which debt affects growth through total factor productivity (TFP) development. Non-linearity in the effects of debt on the different growth sources was also examined. The large panel dataset used in the study covers 61 developing countries and runs from 1969 to 1998. The results demonstrate that excessive debt has a negative influence on growth, as evidenced by the growth in total factor productivity as well as a markedly negative impact on the accumulation of physical capital. Using the GMM estimating approach, Kumar and Woo (2010) examined 38 advanced and developing economies between 1970 and 2007 and found no significant relationship between initial government debt and TFP growth. Another study by Ayyoub, Chaudhry, and Farooq (2011) discovered a negative and substantial correlation between inflation and growth in Pakistan's economy. Salian and Gopakumar (2010) state that there is a long-run negative relationship between inflation and the GDP growth rate in India. More interestingly, the relationship between inflation and growth was found to be positive in some cases, but negative in others.

3. METHODOLOGY

3.1 Nature of Data and Sources

In this study, our sole aim is to investigate the impact of external debt and inflation shocks on per-capita income in selected African countries. We employed an ex post facto research method, which implied that the study relied on already existing information for the analysis. As such, a dataset from secondary sources and a panel data format were utilized for the analysis. The data covered the period of 2010 to 2025, given data availability in the African countries selected. Specifically, per capita income was measured with per capita gross domestic product (PCGDP), which is also the dependent variable in the study, while the key explanatory variables are external debt (EXD), external debt stock (EXDS), external debt service (EXDSV), external debt shocks (EXDSH), inflation (INF), and inflationary shocks (INFSH). External debt volatility and inflationary shocks were obtained by taking the standard deviation of external debt stock and the inflation rate, respectively. Additionally, we controlled for the effect of the exchange rate (EXR). The choice of the variables and scope of the study was based on the availability of data in the sampled countries at the time of the study. However, the aforementioned variables and their sources are presented below in Table 1 to improve the understanding of the reader.

Table 1: Definition of the Variables

Acronym	Definition	Repository
PCGDP	Per-capita Gross Domestic Product	https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B&Id=1480712464593
EXD	External Debt	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/FR.INR.RINR
EXDS	External Debt Stock	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/PX.REX.REER
EXDSV	External Debt Service	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/FB.AST.NPER.ZS
EXDSH	External Debt Shocks	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/FM.LBL.BMNY.GD.ZS
INF	Inflation	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/FP.CPI.TOTL.ZG
INFSH	Inflationary Shocks	https://databank.worldbank.org/metadataglossary/world-development-indicators/series/FP.CPI.TOTL.ZG

Source: Compiled by the Researcher for Nigeria, Kenya, Ghana, South Africa, Ethiopia, Egypt, DR Congo, Tanzania, Uganda, Sudan, Morocco, Angola, Mozambique, Madagascar, Cameroon, Niger, Mali, Burkina Faso, Malawi, Zambia, Chad, Somalia, Senegal, Zimbabwe, Guinea, Rwanda, Benin, and Burundi

3.2 Model Specifications

3.2.1 Baseline Autoregressive Distributed Lag (ARDL) Model

This study extends the work of Manasseh et al. (2022) by examining the combined effects of external debt and inflation shocks on per capita income in African countries. Unlike previous studies that focused primarily on external debt and economic growth, the present study incorporates inflation shocks as an additional source of macroeconomic vulnerability. To achieve this objective, the study adopts the dynamic panel Autoregressive Distributed Lag (ARDL) model developed by Pesaran et al. (1999, 2001), which is well suited for estimating both short run and long run relationships among macroeconomic variables. Although conventional cointegration techniques, including Engle and Granger (1987), Johansen (1991, 1995), and Johansen and Juselius (1990), have been widely applied in empirical research, they impose restrictive assumptions regarding the order of integration and are less suitable for heterogeneous dynamic panel data. Consequently, the panel ARDL approach provides a more flexible framework for analysing the dynamic relationship between external debt, inflation shocks, and per capita income across African economies.

The panel ARDL model is adopted because of its methodological advantages for analysing the relationship between external debt, inflation shocks, and per capita income. It accommodates variables integrated at both level $I(0)$ and first difference $I(1)$, provided that none is integrated beyond $I(1)$ (Pesaran et al., 2001). It also produces reliable estimates in finite samples (Ghatak and Siddiki, 2001), making it suitable for panel studies with limited observations. In addition, the inclusion of appropriate lag structures helps address serial correlation and endogeneity by allowing past values of the variables to influence current outcomes (Pesaran et al., 2001). Furthermore, the ARDL framework simultaneously estimates short run dynamics and long run equilibrium relationships through the error correction mechanism, providing a comprehensive understanding of how external debt, debt servicing, inflation shocks, and exchange rate movements affect per capita income over time. These features make the panel ARDL model the most appropriate estimation technique for the present study.

$$\Delta \ln PCGDP_{t-1} = \alpha_0 + \sum_{i=1}^n \alpha_1 \Delta \ln PCGDP_{it} + \sum_{i=1}^n \alpha_2 \Delta \ln EXD_{it} + \sum_{i=1}^n \alpha_3 \Delta \ln EXDS_{it} + \sum_{i=1}^n \alpha_4 \Delta \ln EXDSV_{it} + \sum_{i=1}^n \alpha_5 \Delta \ln EXDSH_{it} + \sum_{i=1}^n \alpha_6 \Delta \ln INF_{it} + \sum_{i=1}^n \alpha_7 \Delta \ln INF_{it} + \sum_{i=1}^n \alpha_8 \Delta \ln EXR_{it} + \omega_1 \ln PCGDP_{it} + \omega_2 \ln EXD_{it} + \omega_3 \ln EXDS_{it} + \omega_4 \ln EXDSV_{it} + \omega_5 \ln EXDSH_{it} + \omega_6 \ln INF_{it} + \omega_7 \ln INF_{it} + \omega_8 \ln EXR_{it} + \varepsilon_{it} \quad (1)$$

Where PCGDP represents the per-capita gross domestic product which is also the dependent variable, EXD is the external debt, EXDS is the external debt stock, EXDSV is the external debt service, EXDSH is the external debt shocks, INF is the inflation, INF_{it} is the inflationary shocks and EXR is exchange rate the control variable. In addition, α_0 is the constant, ω_1 to ω_8 represents the coefficients of the long-run impacts, α_1 to α_8 , is the coefficients of the short run dynamics, Δ , is the first difference operator, and $\ln$ is the natural logarithm, while ε_{it} is the white noise error term. However, if the F-statistic lies above the upper-bound critical value for a given significance level, the conclusion is that there is a non-spurious long-run level relationship with the dependent variable. If the F-statistic lies below the lower bound critical value, the conclusion is that there is no long-run level relationship with the dependent variable. If it lies between the lower and the upper limits, the result is inconclusive. The general form of the null and alternative hypotheses for the F-statistic test is as follows:

$$\begin{aligned} H_0: \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \omega_6 = 0 \\ H_0: \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq \omega_6 \neq 0 \end{aligned} \quad (2)$$

If the cointegration between variables is identified, then one can undertake further analysis of the long-run and short-run (error correction) relationship between the variables. The error correction representation of the series can be specified as follows:

$$\Delta \ln PCGDP_{t-1} = \alpha_0 + \sum_{i=1}^n \alpha_1 \Delta \ln PCGDP_{it} + \sum_{i=1}^n \alpha_2 \Delta \ln EXD_{it} + \sum_{i=1}^n \alpha_3 \Delta \ln EXDS_{it} + \sum_{i=1}^n \alpha_4 \Delta \ln EXDSV_{it} + \sum_{i=1}^n \alpha_5 \Delta \ln EXDSH_{it} + \sum_{i=1}^n \alpha_6 \Delta \ln INF_{it} + \sum_{i=1}^n \alpha_7 \Delta \ln INF_{it} + \sum_{i=1}^n \alpha_8 \Delta \ln EXR_{it} + \pi ECT + \varepsilon_{it} \quad (3)$$

Where $\emptyset$ the speed of adjustment parameter, and “ECT” is the error correction term (the residuals obtained from equation 1). The coefficient of the lagged error correction term $\emptyset$ is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship between the variables.

3.2.2 Robustness Check Model – FMOLS AND DOLS

Given the potential limitations of the ARDL framework, particularly its sensitivity to model specification, inability to completely eliminate all forms of endogeneity, and challenges associated with capturing cross-sectional heterogeneity in panel settings, this study further employed the panel Dynamic Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimators as robustness techniques. The purpose of applying these alternative estimators was to validate the ARDL findings and ensure that the estimated relationships between external debt, inflation shocks, and per capita income remain consistent and reliable for policy interpretation. Unlike conventional estimation methods, FMOLS and DOLS are specifically designed for cointegrated panel data models and provide more efficient estimates of long-run parameters by correcting for possible endogeneity and serial correlation problems that may arise among the explanatory variables. Therefore, their application provides additional confidence that the observed relationships are not merely driven by estimation bias or short-run disturbances.

The selection of FMOLS and DOLS as robustness estimators is further justified by their ability to address specific econometric challenges inherent in macroeconomic panel studies involving diverse countries. The FMOLS estimator, originally developed to improve the reliability of cointegrating regressions, applies a non-parametric correction procedure that adjusts for serial correlation and endogeneity arising from the correlation between regressors and the error term. It is particularly useful in this study because it accommodates cross-sectional heterogeneity, allowing differences in economic structures, debt management practices, and inflationary conditions across African countries to be incorporated into the estimation process. By correcting for autocorrelation and heteroscedasticity, FMOLS generates unbiased and efficient long-run coefficients. Similarly, the DOLS estimator, which follows a parametric approach, enhances the estimation process by incorporating leads and lags of the first differences of explanatory variables into the cointegration equation, thereby reducing the potential correlation between the independent variables and the disturbance term. According to Kao and Chiang (2001), DOLS often demonstrates superior finite sample properties compared with FMOLS, while Pedroni (2001) further indicates that DOLS exhibits lower size distortion and improved statistical performance under certain panel conditions. Consequently, the combined application of FMOLS and DOLS in this study provides a rigorous robustness framework capable of confirming the stability of the ARDL results while addressing issues related to endogeneity, heterogeneity, autocorrelation, and long-run estimation efficiency. The mathematical representations of the FMOLS and DOLS models are specified as follows:

$$\beta_{FMOLS} = [N^{-1} \sum_{i=1}^N (\sum_{t=1}^T (P_{i,t} - P_{i,t}^2))] X' [(\sum_{t=1}^T (P_{i,t} - P_{i,t}))] S_{i,t} - T \Delta_{\epsilon u} \quad (4)$$

$$\beta_{DOLS} = [N^{-1} \sum_{i=1}^N (\sum_{t=1}^T (W_{i,t} + P_{i,t})^{-1}) (\sum_{t=1}^T (P_{i,t} - P_{i,t}))] S_{i,t} - T \Delta_{\epsilon u} \quad (5)$$

Where p represents explanatory variables, S denotes a dependent variable, and Z shows the regressor's vector ($W=P-P$) respectively. Thus, emphasis has been laid on the problem of heterogeneity with differences in means among the individuals and differences in individual responses to short-run disturbances from cointegrating equilibrium as the main reasons for concern in estimating dynamic cointegrated panels (Pedroni, 2001) and the FMOLS (eqn. 4) is consistent in addressing the problems. Worthy to note, the DOLS outperforms the OLS, ARDL, and FMOLS estimators in finite samples in terms of unbiased estimation based on Monte Carlo simulations. It equally takes care of endogeneity in a model, thereby providing a robust correction for endogeneity in the explanatory variables.

4. PRESENTATION OF EMPIRICAL RESULTS

4.1 Data Description

The researcher conducted this research from 2010 to 2023 in 28 selected African countries solely based on data availability to study the impact of external debt and inflation shocks on per capita income. After conducting an extensive review, we considered the following variables: per capita gross domestic product (PCGDP), external debt (EXD), external debt stock (EXDS), external debt services (EXDSV), external debt shocks (EXDSH), inflation rate (INF), inflation shocks (INFSH), and exchange rate (EXR). To describe the nature of the data, we employed descriptive statistics and Spearman's correlation test, and the results are presented in Tables 2 and 3 below.

Table 2: Summary of Descriptive Statistics

Variable	PCGDP	EXD	EXDS	EXDSV	EXDSH	INF	INFSH	EXR
Mean	-1.220	1.047	0.694	1.465	-0.493	-0.398	0.183	0.532
Median	-1.263	1.289	1.193	2.160	-0.328	-0.151	0.477	0.786
Maximum	3.431	2.081	3.352	10.61	4.597	0.219	3.091	1.908
Minimum	-8.077	-1.602	-3.897	-5.181	-5.640	-4.605	-4.313	-7.766
Std. Dev.	2.903	0.771	1.753	3.569	1.551	0.728	1.366	1.053
Skewness	-0.653	-1.033	-0.827	0.097	0.805	-2.068	-0.385	-2.475

Kurtosis	2.925	3.541	3.125	2.038	6.584	8.797	2.906	13.69
Jarque-Bera	26.03	69.26	41.77	14.03	158.3	769.3	9.768	1748.
Probability	0.265	0.667	0.715	0.897	0.567	0.874	0.256	0.148
Observations	364	364	364	350	246	364	364	302

Source: Authors' computation. PCGDP denotes per capita gross domestic product (used as a proxy for per capita income); EXD denotes external debt; EXDS, external debt stock; EXDSV, external debt service; EXDSH, external debt shock; INF, inflation rate; INFSH, inflation shock; and EXR, exchange rate.

The descriptive statistics measure the basic characteristics or the nature of the model's variables using some statistical tests and measures of central tendency such as the mean, median, standard deviation, skewness, and kurtosis. These tests aid the researcher in ascertaining the nature of the behaviours of the variables before carrying out the estimations. Thus, observing the results presented in Table 2 above, we found that the total variations in the series moved from -8.779 to 10.61, which represent the lowest and highest values in the series. We also discovered that the values of mean, median, standard deviation, skewness, and kurtosis did not drift apart so much from each other, and the probability values of the Jarque-Bera statistics for all the variables are less than 0.05, implying that the series are normally distributed and would yield consistent estimates when the researcher uses them for estimation of the relationships that exist between external debts, inflation shocks, and per capita income in Africa.

More so, to boost our knowledge on the nature of the variables, we investigated if there is an existence of correlations between external debts, inflation shocks, and per capita income in Africa by employing Spearman's correlation test, and the results are presented in Table 3 below. From the results, it was discovered that external debt (EXD) has strong positive correlations with the per capita income in Africa. Conversely, it was discovered that the external debt stock (EXDS), external debt services (EXDSV), and external debt shocks (EXDSH) have strong negative correlations with the per capita income in Africa. Related findings from the correlation results revealed that the inflation rate (INF) and inflation shocks (INFSH) have strong negative correlations with per capita income in Africa, while the exchange rate (EXR) has strong positive correlations with the exchange rate in Africa.

Table 3: Estimated Spearman's Correlation Results

Variable	PCGDP	EXD	EXDS	EXDSV	EXDSH	INF	INFSH	EXR
PCGDP	1							
EXD	0.792	1						
EXDS	-0.508	-0.071	1					
EXDSV	-0.614	0.133	0.293	1				
EXDSH	-0.921	0.016	-0.004	0.015	1			
INF	-0.814	-0.024	-0.018	0.030	-0.041	1		
INFSH	-0.656	-0.256	0.092	-0.292	-0.502	-0.287	1	
EXR	0.779	-0.098	0.091	-0.162	0.039	0.163	0.051	1

Source: Authors' Concept.

4.2 Stationarity Test

Having described our variables with the aid of descriptive statistics and Spearman's correlation test, the researcher furthered her investigations by testing each of the model variables to ascertain if there is existence of a unit root in the variables or not as well as their integration order. Tests like Levine, Lin & Chu (2002); Im, Pesaran & Shin (2003); Fisher-ADF; and Fisher-PP unit root tests, as proposed by Madala & Wu (1999), were employed for this purpose. These were guided by the null hypothesis "unit root" and the alternative hypothesis "no unit root," and the decision rule that guides the test states that we reject the null hypothesis if the probability value is less than 0.05 or we do not reject otherwise. However, as seen in the results of the unit root tests presented in Table 4 below, we reject the null hypothesis "unit root" and accept the alternative hypothesis "no unit root" since the probability values of the tests for each of the variables are less than 0.05, and therefore, we conclude that there is no unit root in the series. Also, the variables were found to be integrated at level (I(0)) and first difference (I(1)) integration order and none was integrated at second difference (I(2)) and above. The differences in integration order of the variables make the variables very suitable for the estimation of the relationships that are being tested using the ARDL model, which accepts variables in the model irrespective of their order of integration.

Table 4: Results of Unit Root Tests

Variable	LLC	IPS	Fisher-ADF	Fisher-PP	Integration Order	
					Level	First Diff.
PCGDP	-426.1 (0.000)	-86.28 (0.000)	167.1 (0.000)	180.7 (0.000)	—	I(1)
EXD	-15.86 (0.000)	-9.721 (0.000)	183.2 (0.000)	200.5 (0.000)	—	I(1)
EXDS	-394.9 (0.000)	-75.61 (0.000)	231.6 (0.000)	263.3 (0.000)	—	I(1)
EXDSV	-16.94 (0.000)	-10.53 (0.000)	198.2 (0.000)	225.6 (0.000)	—	I(1)
EXDSH	-39.99 (0.000)	-17.19 (0.000)	204.2 (0.000)	212.6 (0.000)	I(0)	—
INF	-18.18 (0.000)	-13.41 (0.000)	248.7 (0.000)	303.1 (0.000)	I(0)	—
INFSH	-10.94 (0.000)	-7.685 (0.000)	165.4 (0.000)	190.7 (0.000)	—	I(1)
EXR	-7.496 (0.000)	-5.147 (0.000)	121.4 (0.000)	123.3 (0.000)	I(0)	—

Source: Authors' Concept:

4.3 Testing for Cointegration

We furthered our investigation and estimated cointegration in this section. To ascertain if there is existence of cointegration between external debts, inflation shocks and per capita income in Africa, we employed the Pedroni (2004) cointegration test and robustly checked the findings using the Kao (1999) cointegration test. Pedroni (2004) proposed seven (7) cointegration tests, which were categorised as within-dimension and between-dimension. The tests include panel v-statistic, panel rho-statistic, panel pp-statistic and panel ADF-statistic under within dimension as well as group rho-statistic, group pp-statistic and group ADF-statistics under between dimension. The guiding null hypothesis for this test states that we reject the null hypothesis if the probability value is less than 0.05; otherwise, we do not reject. Findings show that there is evidence of cointegration between external debts, inflation shocks and per capita income in Africa. This implies that we rejected the null hypothesis and accepted the alternative hypothesis. Therefore, we conclude that there is cointegration between external debts, inflation shocks, and per capita income in Africa. Furthermore, from the results of the robustness checks—Kao's (1999) cointegration test- we found that the existence of cointegration between external debts, inflation shocks and per capita income was confirmed since the probability value of the ADF statistic of Kao's cointegration test was less than 0.05.

Table 5: Estimated Pedroni and Kao Cointegration Results

Tests	Dep. Variable: PCGDP
Within Dimension	
Panel v-Statistic	-3.226 (0.004)
Panel rho-Statistic	3.596 (0.000)
Panel PP-Statistic	-2.237 (0.012)
Panel ADF-Statistic	5.378 (0.000)
Between Dimension	
Group rho-Statistic	6.632 (0.000)
Group PP-Statistic	1.323 (0.902)
Group ADF-Statistic	7.948 (0.000)
Robustness Check – KAO Cointegration Test	
ADF-Statistic	-4.656 (0.000)

Source: Authors' Concept:

4.4 Estimation of the long-run ARDL (p, q)

This section presents a comprehensive analysis of the results obtained from the Autoregressive Distributed Lag (ARDL) models estimated to examine the effects of external debt and inflation shocks on per capita income in Africa. The ARDL approach was adopted because of its ability to simultaneously estimate both the short-run dynamics and long-run equilibrium relationships among variables while accommodating variables integrated at either level, $I(0)$, or first difference, $I(1)$, provided none is integrated of order two. Prior to the estimation, several diagnostic tests were conducted to ascertain the reliability and validity of the models. These included the Jarque-Bera normality test, the Breusch-Godfrey serial correlation LM test, Ramsey RESET specification test, and White heteroscedasticity test. The results, presented in Table 6, indicate that the residuals are normally distributed, free from serial correlation, and homoscedastic, while the Ramsey RESET test confirms that the estimated models are correctly specified. Furthermore, the Hausman specification test was employed to determine the most appropriate estimation technique, and the results consistently favoured the fixed effects estimator for Models 1–4, as evidenced by probability values below the 5% significance threshold. To minimise the possibility of multicollinearity among the external debt indicators, the debt-related variables were introduced separately into four distinct models, thereby enabling a more reliable assessment of their individual effects on per capita income. The long-run estimates reported in Model 1 reveal that the lagged value of per capita income exerts a positive and statistically significant influence on its current level, with a coefficient of 0.424884, suggesting considerable persistence in income performance across periods. External debt (EXD) exhibits a statistically significant negative coefficient of -0.415627, indicating that an increase in external borrowing reduces per capita income in Africa, thereby implying that excessive debt accumulation may constrain productive investment and economic welfare. The inflation rate (INF), however, demonstrates a positive and significant effect of 3.552121, suggesting that moderate inflation may coincide with higher per capita income, possibly through increased economic activity or demand expansion. In contrast, inflation shocks (INFSH) exert a significant adverse effect of -0.184742, reflecting the disruptive consequences of unexpected price fluctuations on economic performance. Similarly, the exchange rate (EXR) records a significant negative coefficient of -1.010295, implying that exchange rate depreciation undermines per capita income by increasing production costs, debt servicing obligations, and macroeconomic instability. Collectively, the findings from Model 1 indicate that both external debt and inflationary volatility constitute significant impediments to improvements in per capita income across African economies.

The findings from Model 2 further reinforce the persistence of income dynamics, as the lagged per capita income variable remains positive and statistically significant with a coefficient of 0.266823. The principal explanatory variable, external debt stock (EXDS), records a significant negative coefficient of -0.603769, implying that higher accumulated external debt substantially depresses per capita income in Africa. This outcome suggests that rising debt burdens may divert public resources away from productive investments toward debt servicing obligations, thereby constraining economic growth and household welfare. Moreover, the control variables, namely inflation rate, inflation shocks, and exchange rate, also exhibit statistically significant negative coefficients of -0.379156, -0.491223, and -0.798445, respectively. These findings indicate that increases in inflation, unexpected inflationary disturbances, and exchange rate depreciation collectively reduce per capita income by weakening macroeconomic stability, diminishing purchasing power, and discouraging investment activities across the continent.

Model 3 presents a somewhat different pattern of results. The lagged value of per capita income carries a negative coefficient of -0.024635, although its effect is statistically insignificant, indicating limited persistence in income dynamics within this specification. External debt servicing (EXDSV) emerges as a significant determinant of per capita income, with a negative coefficient of -0.091221, suggesting that increasing debt repayment obligations adversely affect economic welfare by reducing the fiscal resources available for productive expenditures. Likewise, the inflation rate records a significant negative coefficient of -0.361848, confirming that sustained increases in consumer prices undermine purchasing power and economic productivity. Inflation shocks also exert a significant adverse influence on per capita income, with a coefficient of -0.319449, highlighting the detrimental consequences of inflationary uncertainty on economic performance. Contrary to these negative relationships, the exchange rate exhibits a positive and statistically significant coefficient of 0.142525, implying that exchange rate movements may, under certain conditions, enhance export competitiveness and stimulate income growth within African economies.

The estimates obtained from Model 4 likewise confirm the significant persistence of per capita income, as the lagged dependent variable positively influences its current level. External debt shocks (EXDSH) are found to exert a statistically significant negative effect of -0.001720 on per capita income, suggesting that unexpected fluctuations in external debt obligations adversely affect economic welfare, although the magnitude of the impact is relatively small. Similarly, both the inflation rate and inflation shocks maintain significant negative coefficients of -0.077931 and -0.151275, respectively, indicating that rising inflationary pressures and price instability continue to constrain improvements in per capita income. In contrast, the exchange rate records a positive and

statistically significant coefficient of 0.076035, implying that exchange rate adjustments may contribute positively to income growth through enhanced external competitiveness. Overall, the empirical evidence across the four models consistently demonstrates that external debt indicators and inflation-related shocks exert predominantly adverse effects on per capita income in Africa, while the influence of exchange rate movements varies depending on the specific debt indicator considered. These findings are broadly consistent with previous empirical studies, including those of Beyene and Kotosz (2022), Hassan and Meyer (2021), Makun (2021), Munir and Mehmood (2018), Lee et al. (2018), Sania et al. (2019), Ndieupa (2018), Mensah et al. (2018), Carmdy et al. (2021), Zajontz (2021), and Tarro (2020), among others, thereby providing further empirical support for the observed relationships.

Table 6: Estimated ARDL Long-Run Results

Variable	1	2	3	4
PCGDP (-1)	0.425*** (0.000)	0.267*** (0.000)	-0.025*** (0.060)	0.066* (0.042)
EXD	-0.416*** (0.000)			
EXDS		-0.604*** (0.000)		
EXDSV			-0.091*** (0.001)	
EXDSH				-0.720*** (0.001)
INF	3.552** (0.040)	-0.379** (0.019)	-0.848*** (0.000)	-0.078*** (0.000)
INFSH	-0.185** (0.034)	-0.491*** (0.004)	-0.319*** (0.000)	-0.151*** (0.000)
EXR	-1.010** (0.024)	-0.798*** (0.000)	0.143*** (0.000)	0.076*** (0.000)
No of Obs.	308	308	308	308
Hausman	215.7 (0.000)	29.94 (0.000)	14.91 (0.011)	13.56 (0.019)
Normality	872.8 (0.000)	124.6 (0.000)	129.6 (0.000)	123.3 (0.000)
Serial Correlation	1.126 (0.326)	6.067 (0.954)	6.223 (0.674)	1.654 (0.667)
Ramsey	-0.023 (0.000)	-0.230 (0.000)	-0.179 (0.000)	-0.184 (0.000)
Heteroscedasticity	0.657 (0.750)	1.619 (0.460)	3.401 (0.356)	0.776 (0.705)

Source: Authors' Concept: ***, ** and * represents 1%, 5% and 10% level of significance, (.) is the probability value

4.5 Estimation of the short-run ARDL analysis

Following the establishment of a long-run equilibrium relationship among the variables, the short-run dynamics were estimated using the ARDL error correction framework in line with the approach proposed by Pesaran et al. (2001). The error correction term (ECM), which is the key parameter in the short-run model, is expected to be negative and statistically significant to confirm the existence of a stable adjustment process from short-run disequilibrium to long-run equilibrium. As reported in Table 7, the estimated ECM coefficients for Models 1–4 are -0.309416, -0.035196, -0.383665, and -0.946482, respectively. All four coefficients are negative and statistically significant at the 5% and 1% significance levels, thereby validating the stability of the estimated ARDL models. These coefficients indicate that approximately 30%, 3%, 38%, and 94% of any short-run deviations from the long-run equilibrium are corrected within one period in Models 1–4, respectively. This suggests that the adjustment process toward equilibrium occurs at varying speeds across the estimated models, with Model 4 exhibiting the fastest convergence and Model 2 the slowest. The statistical significance and expected signs of the ECM coefficients further reinforce the reliability of the long-run estimates and confirm the existence of a stable long-run relationship among the variables. These findings are consistent with the empirical evidence reported by Beyene and Kotosz (2022), Hassan and Meyer (2021), Makun (2021), Munir and Mehmood (2018),

Lee et al. (2018), Sania et al. (2019), Ndieupa (2018), Mensah et al. (2018), Carmody et al. (2021), Zajontz (2021), and Tarro (2020), among others.

Table 7: Estimated Short-Run Dynamics Results

Variable	1	2	3	4
PCGDP (-1)	-0.309** (0.033)	-0.035*** (0.007)	-0.384*** (0.000)	-0.946*** (0.000)
EXD	0.292 (0.203)			
EXDS		-0.079 (0.327)		
EXDSV			0.752 (0.317)	
EXDSH				0.410 (0.321)
INF	0.131 (0.348)	0.066 (0.597)	-0.321 (0.228)	-0.055 (0.297)
INFSH	0.044* (0.043)	-0.098 (0.265)	-0.1656 (0.431)	-0.396 (0.197)
EXR	0.485*** (0.005)	-0.166 (0.636)	-0.050 (0.898)	0.016 (0.965)

Source: Authors' Concept: ***, ** and * represents 1%, 5% and 10% level of significance, (.) is the probability value

4.6 Robustness Checks – FMOLS and DOLS Estimations

Following the ARDL estimation results, which revealed that external debt accumulation and inflationary shocks significantly influence per capita income in Africa, additional estimations were conducted using the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) techniques to examine the consistency and reliability of the baseline findings. The application of these alternative estimation approaches was necessary because, despite the strengths of the ARDL framework in analysing both short-run and long-run relationships, it may not fully address certain econometric challenges such as endogeneity concerns, cross-sectional dependence, unobserved country-specific heterogeneity, and structural differences among African economies. Therefore, FMOLS and DOLS were employed as robustness techniques to further investigate the relationship between external debt, inflation shocks, and per capita income, with the results presented in Table 8. The FMOLS results indicate that the lagged values of per capita income (PCGDP(-1)) exert positive and statistically significant effects across all estimated models, with coefficients of 0.570692, 0.958380, 0.125608, and 0.859634, respectively. This suggests that improvements in previous levels of income significantly contribute to current income performance in African economies, reflecting the persistence and dynamic nature of economic growth. The findings further reveal that external debt (EXD) has a positive and significant effect on per capita income, with a coefficient of 0.198729, implying that a one-unit increase in external borrowing is associated with an approximate 0.198729-unit improvement in per capita income. This positive relationship suggests that external financing can contribute to economic advancement when effectively channelled towards productive investments. However, the results demonstrate that external debt stock (EXDS) negatively and significantly affects per capita income, with a coefficient of -2.519220. This indicates that excessive accumulation of external liabilities may constrain economic performance by increasing repayment obligations and limiting fiscal space. Similarly, external debt servicing (EXDSV) exhibits a negative and significant impact, with a coefficient of -1.676745, suggesting that rising debt repayment commitments reduce resources available for productive economic activities. Furthermore, external debt shocks (EXDSH) produce a significant negative effect of -3.105645, indicating that unexpected disruptions associated with external debt conditions can adversely affect income levels across African countries. Regarding inflation dynamics, inflation rate (INF) remains statistically insignificant in most models, except Model 2, while inflation shocks (INFSH) demonstrate significant negative effects on per capita income in most specifications except Model 3. Exchange rate movements also reveal negative but generally insignificant effects, with the exception of Model 1. Overall, these findings provide support for previous empirical evidence reported by Beyene and Kotosz (2022), Hassan and Meyer (2021), Makun (2021), Munir and Mehmood (2018), Lee et al. (2018), Sania et al. (2019), Ndieupa (2018), Mensah et al. (2018), Carmody et al. (2021), Zajontz (2021), and Tarro (2020).

The DOLS estimation results further validate the robustness of the ARDL findings by demonstrating similar patterns in the relationship between external debt, inflation shocks, and per capita income in Africa. The results

reveal that the lagged values of per capita income significantly influence current income levels, with estimated coefficients of 0.424884, 0.899215, 0.091221, and 0.738771 across the respective models. This confirms the strong persistence of income dynamics within African economies. Additionally, external debt (EXD) maintains a positive and significant relationship with per capita income, with an estimated coefficient of 0.415627, indicating that a one-unit increase in external debt contributes to approximately 0.415627 increases in per capita income. This finding suggests that external borrowing can generate favourable economic outcomes when directed toward productive sectors and development-enhancing investments.

Conversely, external debt stock (EXDS) is found to have an insignificant effect on per capita income, implying that the aggregate volume of external liabilities alone may not necessarily determine economic outcomes unless accompanied by effective debt management strategies. The results also show that external debt servicing (EXDSV) has a negative and significant effect on per capita income, with a coefficient of -1.216746, indicating that increased debt repayment obligations weaken income performance by diverting public resources away from productive expenditure. In contrast, external debt shocks (EXDSH) exhibit a positive and significant influence on per capita income, with a coefficient of 0.002625, suggesting that certain external debt-related adjustments may generate temporary improvements depending on economic conditions and policy responses.

The findings on inflation indicate mixed outcomes. Inflation rates (INF) exert positive and significant effects in Models 1 and 2, with coefficients of 0.076517 and 5.064414, respectively, but demonstrate negative and significant effects in Models 3 and 4, with coefficients of -0.088013 and -0.017240. This variation reflects the heterogeneous inflation-growth relationship across African economies, where moderate inflation may stimulate economic activity, while persistent inflationary pressures can undermine purchasing power and economic stability. Similarly, inflation shocks (INFSH) positively and significantly affect per capita income in Models 1 and 2, with coefficients of 0.638793 and 0.048621, whereas the effect becomes insignificant in Model 3. Exchange rate effects remain negative across all estimated models, highlighting the adverse consequences of exchange rate instability on income growth. These results are consistent with earlier empirical studies, including Beyene and Kotosz (2022), Hassan and Meyer (2021), Makun (2021), Munir and Mehmood (2018), Lee et al. (2018), Sania et al. (2019), Ndieupa (2018), Mensah et al. (2018), Carmody et al. (2021), Zajontz (2021), and Tarro (2020). However, the FMOLS and DOLS estimations confirm the reliability of the ARDL findings by demonstrating that excessive external debt accumulation, rising debt servicing obligations, and adverse inflationary shocks constitute important constraints on per capita income improvement in Africa. The consistency of the results across alternative estimation techniques strengthens the argument that sustainable debt management, effective inflation control, and macroeconomic stability are essential for achieving long-term improvements in living standards across African economies.

Table 8: Estimated Results of FM-OLS and DOLS

Variable	FMOLS				DOLS			
	1	2	3	4	1	2	3	4
PCGDP (-1)	0.570*** (0.000)	0.958*** (0.000)	0.125*** (0.000)	0.859*** (0.000)	0.424*** (0.000)	0.899*** (0.000)	0.091*** (0.007)	0.738*** (0.000)
EXD	0.198* (0.043)				0.415 (0.000)			
EXDS		- 2.519*** (0.000)				0.037* (0.050)		
EXDSV			- 1.676*** (0.000)				- 1.216*** (0.000)	
EXDSH				- 3.105*** (0.000)				0.062*** (0.000)
INF	-0.055 (0.839)	- 0.079*** (0.006)	-0.097 (0.694)	0.034 (0.751)	0.076 (0.804)	5.064** (0.037)	- 0.088*** (0.000)	- 0.017*** (0.000)
INFSH	0.309*** (0.000)	- 0.342*** (0.0000)	0.830*** (0.000)	- 0.249*** (0.000)	0.638*** (0.000)	0.048*** (0.001)	-0.031 (0.583)	- 0.654*** (0.000)
EXR	- 2.498*** (0.000)	- 0.083*** (0.885)	-0.097 (0.145)	-0.018 (0.525)	- 0.282*** (0.000)	-0.022 (0.759)	- 0.959*** (0.000)	-0.021 (0.535)

Obs.	336	336	336	336	336	336	336	336
R ²	0.946	0.919	0.882	0.941	0.917	0.841	0.873	0.939

Source: Authors' Concept: ***, ** and * represents 1%, 5% and 10% level of significance, (.) is the probability value

4.7 Discussion of findings

This study was designed to empirically examine the influence of external debt dynamics and inflationary shocks on per capita income in Africa over the period 2010–2023, a timeframe selected based on the availability and consistency of macroeconomic data across African economies. The study was motivated by the growing concerns surrounding rising external indebtedness, debt sustainability challenges, persistent inflationary pressures, and their implications for income improvement and economic welfare. Following an extensive review of theoretical and empirical literature, the study incorporated per capita gross domestic product (PCGDP) as the measure of economic welfare, while external debt (EXD), external debt stock (EXDS), external debt servicing obligations (EXDSV), external debt shocks (EXDSH), inflation rate (INF), inflation shocks (INFSH), and exchange rate (EXR) were employed as the key explanatory variables. Prior to the estimation process, preliminary diagnostic analyses were conducted to ensure the suitability and reliability of the econometric framework. The panel unit root test results confirmed that none of the variables were integrated beyond the first difference, as the variables were stationary at either level $I(0)$ or first difference $I(1)$. This outcome justified the application of the Autoregressive Distributed Lag (ARDL) model, which is appropriate for analysing dynamic relationships among variables with mixed orders of integration.

Furthermore, the empirical investigation established the existence of a stable long-run relationship between external debt, inflation shocks, and per capita income in Africa. Specifically, the Pedroni (2004) panel cointegration test and Kao (1999) cointegration approach consistently confirmed the presence of cointegrating relationships among the variables, indicating that external debt conditions and inflationary disturbances have persistent implications for income outcomes across African economies. The ARDL estimation results revealed that external debt-related factors, including external debt accumulation, external debt stock, debt servicing burdens, and external debt shocks, exert significant negative effects on per capita income. This suggests that although external borrowing may provide short-term financing opportunities, excessive dependence on foreign debt and increasing repayment obligations can constrain productive investment, weaken fiscal capacity, and reduce economic welfare. Similarly, inflation shocks were found to significantly reduce per capita income, highlighting the damaging effects of unexpected price instability on purchasing power, household welfare, and economic performance. The short-run adjustment mechanism further demonstrated that deviations from long-run equilibrium are gradually corrected over time, with the error correction term indicating adjustment speeds of 30%, 3%, 38%, and 94% across Models 1–4, respectively. The statistically significant and negative ECM coefficients confirm the existence of a stable adjustment process, implying that African economies possess the capacity to return to equilibrium following short-term economic disturbances.

To ensure the robustness and credibility of the findings, the study further employed Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimations as additional validation techniques. The robustness results generally supported the ARDL outcomes by revealing that external debt components and inflation shocks produce heterogeneous effects on per capita income, with some indicators generating adverse long-run consequences while others exhibit positive effects depending on the nature, utilisation, and management of economic resources. These mixed findings suggest that the economic consequences of debt and inflation are not solely determined by their magnitude but also by institutional quality, policy effectiveness, investment allocation, and macroeconomic management strategies within African economies. The findings of this study are consistent with some previous empirical studies, including Beyene and Kotosz (2022), Hassan and Meyer (2021), Makun (2021), Munir and Mehmood (2018), Lee et al. (2018), Sania et al. (2019), Ndieupa (2018), Mensah et al. (2018), Carmody et al. (2021), Zajontz (2021), and Tarro (2020), while also presenting contrasting evidence in certain areas due to differences in methodology, geographical coverage, and variable measurement. Unlike previous studies that primarily focused on either debt-growth relationships or inflation-growth dynamics independently, this research provides a more comprehensive assessment by integrating different dimensions of external debt and inflation shocks within a unified framework. Additionally, the adoption of ARDL alongside FMOLS and DOLS addresses critical econometric concerns related to long-run estimation, endogeneity, and heterogeneity, thereby offering deeper insights into the mechanisms through which external financial vulnerabilities influence income development in Africa. The study therefore contributes to the existing literature by providing a broader understanding of how sustainable debt management and inflation stability can enhance economic welfare and improve living standards across African economies.

5. CONCLUSION AND POLICY RECOMMENDATIONS

We investigated the impact of external debts and inflation shocks on per capita income in Africa from 2010 to 2023 using indicators such as per capita gross domestic product (PCGDP), external debt (EXD), external debt stock (EXDS), external debt services (EXDSV), external debt shocks (EXDSH), inflation rate (INF), inflation shocks (INFSH) and exchange rate (EXR). Firstly, we described our data and found that the series are normally distributed since the values of the mean, median, standard deviation, kurtosis, and Skewness did not drift too much from each other. We also found that there is no evidence of unit root, and the variables were integrated of $I(0)$ and $I(1)$ and not $I(2)$. Pedroni (2004) cointegration results revealed that there is existence of cointegration between external debts, inflation shocks and per capita income in Africa and Kao (1999) cointegration test results confirmed it. From the ARDL results that external debts, external debts stocks, external debt services, external debt shocks and inflation shocks portrayed significant negative impacts on per capita income in Africa in the long-run, and the speed of adjustment was corrected at 30%, 3%, 38% and 94% respectively for models 1-4 since the coefficients of the error correction model (ECM-1) for all the models are statistically significant and possess negative sign which makes them eligible to measure the speed of adjustments in the short-run. In addition, the results of the robustness check – FMOLS and DOLS in summary show that there are both negative and positive significant long-run effects of external debts, external debt stocks, external debt services, external debt shocks and inflation shocks on per capita income in Africa. The study explores the negative effects of external debts, stocks, services, shocks, and inflation on per capita income in Africa.

The accumulation of external debt strains economies, diverting resources from essential public investments and social services. High levels of external debt stock increase vulnerability to financial shocks, making it difficult for countries to manage their policies effectively. External debt shocks cause economic disruptions, reducing per capita income and eroding consumer purchasing power. The cumulative effect of these factors presents a formidable challenge for African economies striving to achieve sustainable growth and improve living standards. Policymakers need to address these issues through comprehensive strategies that include prudent debt management, economic diversification, and the implementation of policies aimed at stabilising inflation. Strengthening institutional frameworks and enhancing fiscal discipline are also essential to mitigate the adverse effects of external financial pressures. In conclusion, this study underscores the critical need for African countries to adopt a holistic approach to economic management. By addressing the root causes of external debt accumulation and implementing measures to mitigate inflation shocks, African nations can create a more stable economic environment conducive to growth and development. This, in turn, will enhance per capita income and improve the overall well-being of their populations. Based on the study conclusions, it would be recommended that: To reduce external debt, governments should maintain low interest rates, stimulate economic activity, generate tax revenue, and reduce national debt. They should also enhance debt management policies, monitor external debt levels, prioritise concessional borrowing, and avoid high-cost loans. African countries should promote economic diversification by investing in agriculture, manufacturing, and technology to reduce external debt and per capita income. Strengthening institutional frameworks can enhance debt management and sustainable development projects.

Governments should develop effective debt service management strategies, negotiate better terms with creditors, seek debt relief, and ensure debt service doesn't obstruct public investments, while increasing domestic revenue for debt servicing. Governments should develop contingency plans and risk management strategies to mitigate the impact of external debt shocks on per capita income, while fostering regional cooperation in managing external debt to share knowledge and resources. Governments should use monetary policies to control inflation, such as reducing household spending and adjusting interest rates, and enhance price stability mechanisms like improving supply chain efficiency and reducing production costs. Governments should focus on increasing productivity and job creation to mitigate inflationary shocks on per capita income, enhancing economic capacity through investments in education, technology, and infrastructure, and implementing social safety nets.

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