



# An Empirical Analysis of Public Debt Sustainability in Kenya

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## Authors' contributions

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## Article Information

DOI: <https://doi.org/10.9734/ajebe/2024/v24i91497>

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/123269>

**Original Research Article**

**Received: 06/07/2024**

**Accepted: 11/09/2024**

**Published: 13/09/2024**

## ABSTRACT

The study provides a focused analysis of Kenya's determinants of debt sustainability owing to its consistent budget deficits and higher debt servicing costs. Unlike broader studies, this research focuses on Kenya's unique economic conditions and talks about the consequences of unchecked debt servicing payment failures in Kenya that could undo macroeconomic progress if unchecked. The study deploys a single equation regression analysis followed by a series of robustness checks and a generalized method of moments (GMM) technique to analyze the link for Kenya, 1990-2023. The regression results show that debt in Kenya is not sustainable, with factors such as an increase in debt stock, high-interest rate costs, increase in budget deficits, inflation rate increase and high depreciation of the local currencies ultimately wiping out the repayment potential of Kenya. However, the results show that increased export revenue earnings and faster economic growth can

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**Cite as:** Mose, Naftaly, Daniel Ewusi Arthur, Michael Provide Fumey, and John Thomi. 2024. "An Empirical Analysis of Public Debt Sustainability in Kenya". *Asian Journal of Economics, Business and Accounting* 24 (9):350-66. <https://doi.org/10.9734/ajebe/2024/v24i91497>.

improve budget resources for debt servicing. Our findings suggest that policymakers in Kenya should focus on fiscal consolidation by reducing non-interest expenditures and enhancing revenue collections.

*Keywords: Debt service; sustainability; budget deficit; public debt.*

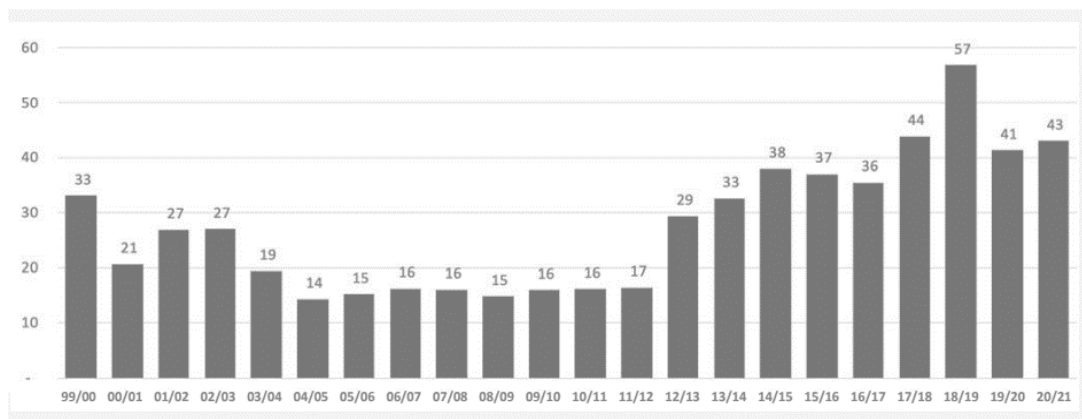
## 1. INTRODUCTION

### 1.1 Background

Debt sustainability is a multifaceted and intricate challenge shaped by various economic, institutional, and policy-related factors. These factors are essential for creating strategies that promote macroeconomic stability and sustainable economic growth. Yussuff & Omobolanle [1]. This analysis combines findings from multiple studies to highlight the critical determinants of public debt sustainability, focusing on macroeconomic indicators, institutional quality, and fiscal policies (Chien et al., [2], Cahyadin, [3]). A fundamental determinant of government debt sustainability is the relationship between economic growth and debt growth. For debt to be sustainable, the growth rate of (Gros Domestic Product) GDP should exceed the growth rate of government debt, ensuring that the debt-to-GDP ratio remains stable or declines over time. This principle is supported by studies on ASEAN countries, highlighting the importance of maintaining GDP growth above the real interest rate to achieve sustainability [3]. Kenya like many developing countries faces a high risk of debt distress and thus questioning Africa's debt sustainability ability. Many countries in sub-Saharan Africa, including Kenya, are now trying to restructure their debt to avoid a complete loan default [4]. Equally, concerns remain high on Kenya's

sustainability agenda as a result of the continued rise in the country's debt levels with institutions such as the World Bank and International Monetary Fund (IMF) stressing the need for Kenya to focus on fiscal consolidation [5]. Kenya's debt sustainability has become a pressing issue, exacerbated by various economic and institutional factors. The country's reliance on external borrowing, particularly from China, and the impact of the COVID-19 pandemic have significantly influenced its debt dynamics.

Kenya's fiscal policy space has changed significantly in the last 10 years on account of an expansionary fiscal policy driven by large spending on infrastructure development. This has pushed total public debt as a percentage of GDP from 44 % in 2010 to an estimated 60 % in 2023, 10 % above IMF's recommended threshold of 50 % for developing states (Cytton, [5], Ariemba, [6], Central Bank, [7]). The total debt service to revenues increased exponentially to 64 per cent in 2023 from 17 per cent in 2012, higher than the IMF's recommended threshold of 30 %, and as such elevating the risks of repayment following shocks arising from the Covid-19 pandemic, stressing how much public debt servicing weighs on the country's expenditure Ariemba, [6], Cytton, [5]. Central Bank of Kenya [7] data shows the trend of debt service to revenue performance over the years as shown in the following Fig. 1.



**Fig. 1. Trends of Debt service to revenue ratio**

*Source: Ariemba (2022); Central Bank (2022)*

The fiscal deficits resulting from the revenue-expenditure mismatch have also presented an ever-present challenge in fiscal consolidation as revenue continues to lag behind expenditure. Despite debt servicing consuming a large proportion of the country's resources, it is argued that Kenya's debt is sustainable. This is one of the reasons why the country does not qualify for the Heavily Indebted Poor Countries (HIPC) relief. This study is therefore an effort to explore the determinants of debt-servicing in Kenya.

Many factors have been recognized as potential determinants of debt sustainability in Kenya; the current study captures this complex interplay. The relationship between external debt, domestic debt, inflation, economic growth, interest rates, budget deficits, and exports with debt sustainability, as measured by debt servicing, is multifaceted and complex. Debt sustainability is crucial for economic stability, and understanding these relationships helps formulate effective fiscal and monetary policies. External debt sustainability is often challenged by the need to service debt, which can negatively impact economic growth if not managed properly. A study by Miszta [8] for the European Union countries empirically confirmed that high debt reduces economic growth. In Nigeria, for instance, external debt services have been found to have a negative relationship with economic growth, suggesting that high debt servicing costs can hinder economic development [9]. Domestic debt can positively impact economic services provision more than external debt. In Nigeria, internal debt has been shown to positively correlate with economic services delivery, suggesting that domestic borrowing might be more beneficial for economic growth than external borrowing. Inflation can affect debt sustainability by influencing the actual value of debt and the cost of debt servicing. A stable inflationary environment is essential for maintaining manageable debt levels. In the context of fiscal sustainability, a benign inflationary outlook can support debt management by reducing the real burden of debt Fumey et al., [10], Boateng et al., [11].

Interest rates directly impact the cost of debt servicing. High interest rates can increase the debt servicing burden, making it more challenging to maintain debt sustainability. Conversely, a decline in interest rates, as observed in some economies, can ease the debt servicing burden and support fiscal sustainability [12]. A large budget deficit can lead to increased

domestic and external borrowing, which raises debt servicing requirements. Fiscal consolidation, through reducing non-interest expenditures and enhancing revenue, is essential for improving debt sustainability [13]. The relationship between exports and debt sustainability is significant, as exports generate foreign exchange needed for debt servicing. In Nigeria, the external debt-to-export ratio is a critical indicator of debt sustainability, with a higher ratio indicating potential challenges in meeting debt obligations [9]. Enhancing exports can thus improve a country's ability to service its external debt. Additionally, the switch from foreign to domestic borrowing, as seen in some heavily indebted countries, can have mixed effects on debt sustainability, depending on the domestic interest rate environment and fiscal policies. Therefore, a comprehensive approach that includes public debt considerations and macroeconomic stability is essential for achieving sustainable debt levels.

## 1.2 Research Goals and Methodology

The rising foreign debt of Kenya has raised questions over the nation's capacity to achieve long-term debt sustainability without sacrificing economic development. Given growing budget deficits and a changing global economic climate, understanding the mechanics of foreign debt sustainability has become even more critical for legislators. The research is driven by the requirement of a solid empirical study capable of guiding policy choices to control Kenya's debt load and guarantee sustainable economic development. The study answers the following questions: (RQ1) How does public debt impact and debt sustainability in Kenya? (RQ2) How do economic growth, inflation, interest rates, interest rate and budget deficits influence Kenya's debt sustainability? (RQ3) How do export levels affect the country's ability to service its external debt? This study makes several critical contributions to the literature on debt sustainability:

- I. By employing the Generalized Method of Moments (GMM), the study addresses endogeneity issues and captures the dynamic relationships between external debt and other macroeconomic variables. This approach provides more accurate and reliable estimates, offering a methodological advancement over traditional estimation techniques.
- II. The study provides a focused analysis of Kenya's public debt sustainability, offering insights directly relevant to policymakers in

the country. Unlike broader studies, this research focuses on Kenya's unique economic conditions and challenges.

- III. The findings of this study will inform policy decisions on managing government debt, ensuring that Kenya can achieve sustainable debt levels while fostering economic growth. The study's results will be valuable for designing strategies to balance debt servicing with investments in development.
- IV. By filling the existing research gap, this study enriches the literature on debt sustainability, particularly in the context of developing countries like Kenya. It adds to the understanding of how debt interacts with other macroeconomic factors to influence overall economic health

The remainder of the paper is structured as follows: Section two covers the literature review, encompassing the theoretical and empirical background; section three presents the data and methodology; Section four presents the results and discussions; and section five contains the study's conclusions and practical recommendations.

## 2. LITERATURE REVIEW

According to Krugman [14], in developing the debt overhang theory, the prospect of future debt repayments inhibits investment when a nation's foreign debt is too large, slowing down its economic growth. The basic assumption is that rather than financing profitable developments at high debt levels, fresh borrowing would most likely be utilized to pay current debt, generating a cycle of stagnation and rising debt loads. This idea holds for Kenya's present economic predicament, where growing foreign debt, budget deficits, and changing interest rates might impede investment and development. Saungweme and Odhiambo [15] claim that debt sustainability is more difficult when debt exceeds a certain level as its negative effect on development becomes apparent. Using the Debt Overhang Theory, this study investigates how Kenya's rising foreign debt can cause economic progress obstacles, endangering long-term debt sustainability.

The relationship between debt and debt sustainability is a complex interplay that involves assessing a country's ability to manage its debt without compromising economic stability and growth. External debt sustainability is crucial for

maintaining macroeconomic stability, as unsustainable debt levels can lead to financial crises. This answer explores the factors influencing external debt sustainability, the impact of external debt on economic growth, and strategies for achieving sustainable debt levels. The borrowing and lending countries' economic and financial conditions significantly impact external debt sustainability. For instance, the financial development index and the current account ratio to GDP are critical inflow factors for developing countries. At the same time, global interest rates and commodity prices are influential outflow factors [16]. In Egypt, the unsustainability of external debt was linked to the imbalance between domestic adjustments and foreign borrowing [17]. High levels of external debt can lead to a debt overhang, where debt servicing burdens discourage investment and economic growth. This was observed in Sri Lanka, where debt overhang and the crowding-out effect were linked to low economic well-being [18]. Countries like Nigeria are advised to improve debt management practices, increase internally generated revenue, and prioritize investments for sustainable development (Rukayat Omobolanle, 2024). In Vietnam, efficient use of external debt is crucial for achieving sustainable development goals, such as social equity and poverty alleviation Minh & Phuong, [19]. Reducing reliance on external borrowing by exploring alternative financing sources, such as taxation and domestic savings, can help sustain debt. This approach is recommended for countries like Kenya to minimize dependency on external assistance Chindengwike, 2022; David, [20]. Establishing autonomous institutions, such as an External Debt Council, can provide oversight and ensure that debt sustainability is maintained through informed policy decisions [21]. While external debt can be a vital tool for economic development, its sustainability is contingent upon effective management and policy frameworks. Countries must balance borrowing with economic growth objectives and be resilient to economic and non-economic shocks. By implementing sound debt management practices and exploring alternative financing sources, nations can achieve sustainable debt levels and foster long-term economic stability.

Domestic debt can be a tool for economic growth if managed prudently, but it also poses risks to fiscal sustainability if not aligned with economic fundamentals. This answer explores domestic debt dynamics and its implications for debt

sustainability, drawing insights from various studies. Domestic debt can stimulate economic growth by providing necessary funds for public investment, which in turn can enhance infrastructure and public services. However, the sustainability of this growth depends on the effective management of debt levels and interest rates. For instance, in Nigeria, domestic debt has been found to impact economic growth positively, but only when managed within sustainable limits [22]. In Sub-Saharan Africa, a non-linear relationship exists between domestic debt and economic growth, with a turning point at 11.4% of GDP. Beyond this threshold, domestic debt crowds out private-sector credit, hindering capital accumulation and growth [23]. Fiscal sustainability is crucial for maintaining manageable levels of domestic debt. Domestic debt sustainability also depends on the government's ability to manage interest rates and economic growth. In Korea, changes in U.S. interest rates affect domestic debt sustainability, highlighting the interconnectedness of global and domestic financial systems [24]. Governance and institutional quality play a significant role in domestic debt sustainability. Countries with robust governance structures and social cohesion tend to have more stable domestic credit markets, which supports debt sustainability [25]. Effective debt management requires a comprehensive approach considering economic forces such as interest and exchange rates and institutional frameworks promoting fiscal discipline [26]. While domestic debt can catalyze economic growth, its sustainability depends on prudent fiscal management and balancing public and private sector needs. The interplay between domestic debt and economic growth is complex, with potential benefits and risks that policymakers must carefully consider. Effective governance and institutional frameworks are essential to ensure domestic debt contributes positively to economic development without compromising fiscal sustainability.

Inflation can serve as both a tool and a consequence in managing sovereign debt, influencing the sustainability of fiscal policies. Various factors shape this relationship, including government debt levels, fiscal deficits, and the coordination of monetary and fiscal policies. Inflation can act as a form of partial default, allowing governments to erode the actual value of debt, thereby reducing the incentive to default outright. This mechanism can expand the repayment region and provide welfare gains during periods of debt stress. However, these

gains are more modest in the long run due to the inflationary bias it introduces [27]. Inflation can be a significant tool for achieving fiscal solvency in high-debt environments, especially when monetary and fiscal policies are not well-coordinated. In such cases, inflation tends to be higher, more volatile, and persistent, playing a significant role in fiscal adjustments [28]. The relationship between inflation and fiscal deficits is not straightforward. In Turkey, for instance, the consolidated budget deficit did not impact inflation in the long run. In contrast, the Public Sector Borrowing Requirement (PSBR) was cointegrated with inflation, indicating that PSBR is a more reliable indicator of fiscal deficits (Cevdet Akgay et al., 2018). In many developing countries, high inflation is often linked to financing budget deficits through seignior age, which can lead to hyperinflation or debt crises if not appropriately managed. High government debt levels will likely induce higher inflation, particularly when debt management and monetary policy are not coordinated. The maturity structure of debt also affects inflation persistence, with longer maturity debt leading to more persistent inflation adjustments [28]. However, empirical evidence suggests that fiscal imbalances are primarily addressed through adjustments in the primary deficit, with inflation playing a relatively minor role (0-10%) in fiscal sustainability [29]. Effective coordination between fiscal and monetary policies is crucial for maintaining debt sustainability and controlling inflation. An increase in sovereign risk can lead to higher inflation and consumption, necessitating a fiscal and monetary stances shift to stabilize the economy [30]. While inflation can be a strategic tool for managing debt, its role is limited and context-dependent. The effectiveness of inflation in achieving debt sustainability largely hinges on the coordination of fiscal and monetary policies, the structure of government debt, and the broader economic environment. In some cases, reliance on inflation to manage debt can lead to adverse outcomes, such as persistent inflation or loss of policy credibility, underscoring the importance of comprehensive and coordinated policy frameworks.

The relationship between interest rates and debt sustainability is a complex interplay that involves various economic factors and policy decisions. Interest rates influence the cost of servicing debt, and their interaction with economic growth rates and fiscal policies determines the sustainability of public debt. Risk premiums, financial instruments

like swaps, and macroeconomic conditions further complicate this relationship. Below, we explore these dynamics in detail. The risk premium plays a crucial role in determining the sustainability of public debt. When interest rates increase exponentially with public debt due to a default risk premium, the conditions for debt sustainability become more stringent. In such scenarios, even high GDP growth rates or primary budget surpluses have a limited impact on maintaining sustainable debt levels [31]. A General Equilibrium Asset Pricing model suggests that the safe rate is not always appropriate for assessing debt sustainability. Including risk premiums often results in interest rates exceeding growth rates, necessitating fiscal adjustments to close the sustainability gap [32]. Interest rate swaps have been used by EU countries to hedge public debt, improving primary surpluses and thus enhancing debt sustainability. However, these financial instruments introduce additional risks not fully captured by standard Debt Sustainability Analysis (DSA) [33]. Swaps can ameliorate short-term fiscal pressures but may pose medium-term risks, primarily if not managed correctly in the context of broader fiscal policies. The interest rate-growth differential ( $r-g$ ) is critical to debt dynamics. In many advanced economies,  $r$  has been less than  $g$ , which theoretically supports debt sustainability. However, this differential is variable and can reverse during economic crises, particularly for countries with high debt burdens [34]. A negative  $r-g$  differential can paradoxically improve debt sustainability by reducing the cost of debt servicing relative to economic growth. However, it should not be seen as a justification for increasing debt levels without considering fiscal constraints. Son and Park [24] further state that the transmission of U.S. interest rates to domestic rates, as seen in Korea, can affect household debt sustainability. Rising interest rates can increase the proportion of vulnerable households, especially under adverse economic conditions. While low interest rates relative to growth rates can support debt sustainability, they are not a panacea. Risk premiums, financial instruments like swaps, and the variability of the interest rate-growth differential all introduce complexities that require careful management. Policymakers must consider these factors with fiscal policies to ensure long-term debt sustainability. Additionally, the potential for speculative attacks and the nonlinear behaviour of interest rates in crises underscore the need for credible fiscal and monetary frameworks [35].

The relationship between budget deficit, export, and debt sustainability is a complex interplay that significantly impacts a country's economic stability and growth. Various factors, including government fiscal policies, external economic conditions, and structural economic characteristics, influence this relationship. The synthesis of the provided research papers reveals several key insights into how these elements interact and affect debt sustainability. Research indicates a stable long-term relationship between budget deficits and debt sustainability. For instance, in the Iranian context, reducing budget deficits is crucial for improving government debt sustainability, especially given the country's reliance on oil revenues [36]. In developing countries, budget deficits negatively affect sustainable economic development. However, controlling corruption can mitigate these adverse effects, suggesting that governance quality is critical in managing budget deficits and ensuring debt sustainability [37]. In Nigeria, fiscal synchronization, where government revenues and expenditures are aligned, is essential for managing budget deficits and ensuring debt sustainability. The study highlights the challenges of financing debt in the long run due to over-reliance on resource exports [38]. The relationship between trade deficits and external debt is significant. In Romania, a persistent trade deficit correlates with increasing external debt, exacerbated by low domestic productivity and insufficient foreign direct investment (FDI) [38] further research found that Countries heavily reliant on exports, particularly of natural resources, face challenges in maintaining debt sustainability. For example, Nigeria's overconfidence in resource exports can undermine its ability to finance debt sustainably. While the relationship between budget deficits, exports, and debt sustainability is generally seen as unfavourable, with deficits and trade imbalances often leading to unsustainable debt levels, there are nuances. Effective governance, such as corruption control and strategic fiscal policies, can mitigate these adverse effects and promote sustainable economic development. Additionally, the context of global economic conditions and structural economic characteristics, such as reliance on specific exports, play a crucial role in shaping this relationship.

## 2.1 Research Gap

There is a wealth of literature on debt sustainability (Beqiraj et al., [39]; Mehrotra & Sergejev, 2021), but little of it specifically

discusses Kenya's government debt sustainability, especially in light of the country's recent notable increases in external borrowing. Most current research looks at macroeconomic effects generally or focuses on overall debt sustainability without separating debt from service cost. Moreover, while many studies use traditional econometric approaches (Ibrahim & Khan, [22], Mehrotra & Sergeyev, [12], dynamic methodologies, such as the Generalized Method of Moments (GMM), which handles endogeneity, heteroscedasticity, or serial correlation.

### 3. RESEARCH METHODOLOGY

The causal research design was used in an attempt to build a cause-and-effect link between debt sustainability and explanatory variables in Kenya, 1990-2023. The study covers the period from 1990 to 2023 for, Kenya, we are working with 34 observations in a time series which ensures the statistical validity of our results and enables us to draw conclusions and policy recommendations. Kenya's debt servicing cost has increased over the years mainly due to the continuous accumulation of external debt and the depreciation of the currency posing a risk to economic growth and financial stability. The Heavily Indebted Poor Countries (HIPC) program was launched in 1996 by Breton Wood institutions to provide debt relief that is "broader, deeper, and faster. " However, according to the criteria Kenya does not face an unsustainable debt burden yet there is still a problem in meeting

debt service payments evidenced by the recent rescheduling of government debts [40]. Secondary data for estimation was taken from the World Bank database, CEIC database, International Monetary Finance (IMF) statistics and statistical abstracts published by the Kenya National Bureau of Statistics (KNBS). The dependent variable is debt sustainability measured as debt-service ratio as a percentage of revenue as provided by Kamau [40], IMF has recommended 30 per cent as an expected ratio, highlighting how much of the government's revenue is used to service debt. The debt-service-to-revenue ratio is a possible indicator of debt sustainability because it indicates how much of a country's revenue will be used up. The study followed the empirical works of Kamau [40] to identify study-independent variables. The explanatory variables included stock of public debt measured as Debt -to-GDP ratio, budget deficit proxied by fiscal balance ratio of GDP, economic growth measured as GDP per capita growth, interest rate measured by lending interest rate, exports of goods and services proxied by aggregate exports ratio of GDP, exchange rate measured by official exchange rate and inflation rate measured by consumer prices index. The literature review shows that there is a positive relationship between exports, economic growth and debt sustainability and a negative relationship between debt stock, budget deficit, exchange rate, inflation rate, interest rate and debt sustainability. Table 1 shows the sources of data and definition of study variables.

**Table 1. Information about variables**

Variable	Proxy	Data Source	Expected Sign
Debt sustainability (DS)	Debt service ratio (% Revenue)	IMF	Not applicable Kim & Lee, [16]
Public debt stock (PD)	Debt -to-GDP ratio (%)	World Bank	Positive Misztal , [8]
Exchange rate (EXR)	Official exchange rate (LCU per US\$, period average)	World Bank	Positive Reed et al., [36]
Budget deficit (BD)	Fiscal balance (% of GDP)	CEIC	Positive Thuy Van et al., [37]
Lending interest rate (INR)	Lending interest rate (%)	World Bank	Positive (S�everine Menguy, 2023)
Inflation rate (INF)	Consumer prices index (%)	World Bank	Positive SenGupta & Atal, [41]
Exports (EXP)	Exports of goods and services (% of GDP)	World Bank	Negative Reed et al., [36]
Economic growth (GDP)	GDP per capita growth (%)	KNBS	Negative Jude et al., [9].

Source: Own conceptualization (2024)

This study adopts a system equations model used by Metwally and Tamaschke (1994), Kamau [40], Misztal [8] and Kim & Lee [16] in their analysis of the foreign debt problem of North Africa, Kenya and developing countries, respectively. The study first tests the hypothesis that high debt stock hurts debt servicing by testing the following single-equation model:

$$DS = \delta_1 + \delta_2 PD_t + \delta_3 X_t + \varepsilon_t \quad (1)$$

where,

DS=Debt-service ratio as a percentage of revenue in period t to represent debt sustainability.

PD= Public debt stock (domestic and external debt) as a percentage of GDP in period t.

X= Set of independent variables that explain debt sustainability in period t.

$\varepsilon_t$  = Error term

For estimation purposes, the set of independent variables is the rate of exports of goods and services, GDP per capita growth, budget deficits, exchange rate, inflation rate and lending interest rate, so equation (2) is specified as follows.

$$DS = \delta_0 + \delta_1 PD_t + \delta_2 BD_t + \delta_3 GDP_t + \delta_4 EXP_t + \delta_5 INR_t + \delta_6 EXR_t + \delta_7 INF_t + \varepsilon_t \quad (2)$$

where,

DS=Debt-service ratio as a percentage of revenue in period t to represent debt sustainability.

PD= Public debt stock (public domestic and external debt) as a percentage of GDP in period t.

BD=Budget deficits

GDP=Economic growth

EXP=Exports of goods and services

INR= Lending interest rate

EXR= Exchange rate

INF= Inflation rate

$\varepsilon_t$  = Error term and subscript t is the time dimension.

For panel data, basic estimation methods such as OLS are prone to inefficiency because they do not discriminate between various cross-sectional units and, thus, ignore heterogeneity. Fixed and random effect estimators control both observed and unobserved heterogeneity. ARDL models can accommodate a variety of lag structures and include well-known models such as static regressions as special cases and simultaneously estimate short-run and long-run dynamics while GMM is used for data without lagged dependent variables [41]. The study used the Generalized Method of Moments (GMM) technique articulated by Arellano and Bond (1991) to analyze the determinants of public debt sustainability in Kenya. Moreover, while many studies use traditional econometric approaches (Ibrahim & Khan, [22], Mehrotra & Sergeyev, [12], Mose, [42], dynamic methodologies, such as the Generalized Method of Moments (GMM), which handles endogeneity, heteroscedasticity, serial correlation issues. The critical feature of GMM is that it relies on using instrumental variables to estimate parameters by exploiting moment conditions derived from the data. The instrumental variable should ameliorate any concerns about the correlation this assumption imposes. It has been significantly understudied how external debt sustainability in Kenya is evaluated. With an emphasis on external debt sustainability in Kenya, this study aims to close this gap by including possible endogeneity and dynamic interactions among the variables of interest using GMM estimates. To test the validity of GMM regression results, the study will conduct J-tests or Hansen tests aimed at checking for the validity of the exclusion restrictions. The null hypothesis states that instruments are correctly excluded from the GMM model (Hansen & West, 2002; Roodman, 2009). Jarque-Bera test will be applied to make sure whether the data fits the normal distribution or not. The study computed Variance Inflation Factors (VIF) to check if variables are correlated. Finally, the Granger causality test was conducted to define the causal link between dependent and explanatory factors (Granger, 1988).

A stationarity test was carried out to meet the assumptions of performing a causality test and GMM regression model. The study used Augmented Dickey-Fuller (ADF) and Philips-Peron (PP) tests to test for stationarity of the time series data. The expected integration order is I(0)



or I(1). This study adopted the Phillips-Perron (PP) technique to check for stationarity, the alternative to the ADF test. The main strength of PP over other tests is that it is a non-parametric test. Thus, it is not necessary to specify the model and lagged parameter in the test regression (Phillips & Perron, 1988). The PP unit root test is specified as shown in Equation 3:

$$\Delta X_t = \alpha_t + \beta_i X_{t-1} + \sum_{j=1}^k \gamma_{i,j} \Delta X_{t-j} + \varepsilon_t \quad (3)$$

Where  $\Delta$  is the first difference operator,  $X_t$  is the dependent variable,  $\varepsilon_t$  is the stochastic term.

## 4. RESULTS AND DISCUSSION

### 4.1 Descriptive Analysis

Correlation analysis was done to determine if the variables used in the analysis are related while

descriptive statistics was used to simply describe the characteristics.

The descriptive statistics presented in the study offer a detailed overview of key economic indicators in Kenya from 1990 to 2023. The debt-to-revenue ratio (DS) averaged around 33.87%, with a standard deviation of 14.02%, indicating significant variability over the years. Public Debt (PD) had a mean value of 44.86%, with a maximum of 70.20%, reflecting fluctuations in the country's debt levels. Inflation (INF) showed high variability, with a mean of 11.21% and a maximum of 45.98%, indicating periods of extreme price instability. Interest rates (INR) also varied widely, averaging 18.61%, with a peak of 36.24%. The budget deficit (BD) averaged -3.73%, indicating a generally negative fiscal balance, while the exchange rate (EXR) averaged 77.99. The descriptive statistics reveal a diverse range of economic conditions over the study period, highlighting Kenya's economic volatility.

**Table 2. Descriptive statistics**

	DS	PD	INF	INR	BD	EXR	YG	EXP
<b>Mean</b>	33.87493	44.85559	11.20505	18.61087	-3.733824	77.98715	1.001616	21.08103
<b>Median</b>	36.85932	41.28000	8.434869	16.53678	-3.655000	77.95760	1.439908	21.56852
<b>Maximum</b>	57.20000	70.20000	45.97888	36.24000	0.840000	139.8464	5.520436	38.90363
<b>Minimum</b>	14.00000	26.46875	1.554328	11.99578	-8.570000	22.91477	-3.766723	9.640400
<b>Std. Dev.</b>	14.01590	11.43497	9.117695	6.783188	3.144208	25.20336	2.400420	7.182394
<b>Skewness</b>	-0.011251	0.849791	2.119210	1.184590	-0.055919	-0.059486	-0.266101	0.450958
<b>Kurtosis</b>	1.749610	2.932233	7.742957	3.301840	1.488242	3.234030	2.179521	3.011692
<b>Jarque-Bera</b>	2.215642	4.098656	57.31812	8.080840	3.255386	0.097643	1.354936	1.152585
<b>Probability</b>	0.330278	0.128821	0.000000	0.017590	0.196382	0.952351	0.507901	0.561978
<b>Sum</b>	1151.747	1525.090	380.9718	632.7697	-126.9500	2651.563	34.05494	716.7551
<b>Sum Sq. Dev.</b>	6482.700	4315.031	2743.368	1518.384	326.2394	20961.90	190.1465	1702.364
<b>Observations</b>	34	34	34	34	34	34	34	34

Source: Own calculation (2024)

**Table 3. Correlation matrix**

DS	PD	BD	GDP	EXR	INF	INR	EXP	
1.0000	0.6834	-0.4182	-0.0075	0.1840	-0.0563	0.2357	-0.2358	DS
	1.0000	-0.3889	0.2957	0.7443	-0.3443	-0.1615	-0.5671	PD
		1.0000	-0.0773	-0.3308	-0.2162	0.2588	0.3955	BD
			1.0000	0.5115	-0.4937	-0.4422	-0.4308	GDP
				1.0000	-0.4871	-0.5634	-0.7619	EXR
					1.0000	0.3587	0.6334	INF
						1.0000	0.6439	INR
							1.0000	EXP

Correlation coefficients, using the observations 1990 - 2023

5% critical value (two-tailed) = 0.3388 for n = 34

Source: Own calculation (2024)

The correlation matrix provides insights into the relationships between the various economic indicators. Public Debt (PD) is strongly positively correlated with the exchange rate (EXR) at 0.7443, suggesting that the exchange rate tends to depreciate as public debt increases. Conversely, PD is negatively correlated with the budget deficit (BD) and inflation (INF) at -0.3889 and -0.3443, respectively, indicating that higher public debt might be associated with lower budget deficits and inflation. The debt-to-revenue ratio (DS) is positively correlated with PD (0.6834) and the exchange rate (0.1840) but negatively correlated with the budget deficit (-0.4182) and inflation (-0.0563). These correlations propose complex interdependencies between debt levels, fiscal health, and macroeconomic stability in Kenya.

#### 4.2 Testing for the Order of Integration

The analysed time series were tested for unit root test to establish the order of integration using Phillips-Perron (PP) unit root test. Table 4 reports the result of testing for unit roots in the level variables as well as in their differences.

The stationarity test results using the Phillips-Perron (PP) unit root test provide critical insights into the time series properties of the data and a requirement of the GMM estimation. Table 4 shows that most variables are non-stationary at their levels, meaning they exhibit a unit root. A non-stationary series is one whose statistical properties, such as mean and variance, change over time. This non-stationarity implies that

shocks to the variable can have a permanent effect, making long-term forecasts unreliable if used in their original form. However, when these non-stationary variables are differenced once, they become stationary, meaning their statistical properties become stable over time. This transformation indicates that the variables are integrated into order one, denoted as I(1). Stationarity is essential because it ensures that the relationships identified in the regression models are genuine and not due to spurious correlations driven by trends or other non-stationary behaviour in the data. Inflation (INF), on the other hand, is stationary at its level, which means it is integrated of order zero, denoted as I(0). This suggests that inflation does not exhibit a unit root and its statistical properties remain consistent over time without needing differencing. This inflation characteristic is vital for its role in the model, as it directly impacts the stability and reliability of the regression estimates.

#### 4.3 GMM Estimation Regression Results

In studying the relationship between debt sustainability and independent factors, the study used the generalized method of moments (GMM) estimation method. The Generalized Method of Moments (GMM) estimation in Table 5 provides critical insights into the relationships between various economic variables and Kenya's debt servicing costs. The results underscore the complexity of the factors influencing debt sustainability. The results of modelling the debt sustainability equation are reported in Table 5.

**Table 4. Stationarity test results**

Variables	Level		First difference		Decision
	Adjusted t	Prob.	Adjusted t	Prob.	
DS	-1.038924	0.7275	-6.445064***	0.0000	I(1)
PD	-1.449616	0.5461	-6.969486***	0.0000	I(1)
BD	-1.452640	0.5446	-4.095158***	0.0033	I(1)
INR	-1.251103	0.6401	-5.670022***	0.0000	I(1)
EXR	-0.419195	0.8944	-4.263915***	0.0021	I(1)
INF	-3.022235**	0.0431			I(0)
GDP	2.787948	1.0000	-3.884398***	0.0056	I(1)
EXP	-1.149862	0.6838	-5.071263***	0.0002	I(1)

Note: \*\*\* and \*\* denote significance at a 1% and 5% level of significance

Null Hypothesis: The variable has a unit root

Source: Own calculation (2024)

**Table 5. Results of GMM regression**

Variable	Coefficient	Standard error	t-Statistics	p-Value
<i>PD</i>	1.802959	0.350616	5.142255	0.0000
<i>INF</i>	1.528401	0.510692	2.992806	0.0058
<i>INR</i>	0.803369	0.339634	2.365399	0.0255
<i>BD</i>	0.032453	0.014748	2.200454	0.0365
<i>EXR</i>	0.515936	0.136946	3.767436	0.0008
<i>GDP</i>	-0.042337	0.012916	-3.277740	0.0029
<i>EXP</i>	-2.700718	0.530511	-5.090785	0.0000
Durbin Watson test		= 2.046563	Adjusted R <sup>2</sup> = 0.580647	
Multicollinearity			Mean VIF=3.37	
Hansen test		= 3.858102	P-value = 0.145286	
Normality test of residuals		= 3.793590	P-value = 0.150049	

Note: \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01 are significance levels, in which the null hypothesis is rejected. Dependent variable: DS

Source: Own estimation (2024).

From Table 5, it can be seen that the coefficient of public debt stock is positive and significant at a 5 per cent level of significance. The equation shows that public debt increase has a positive effect on the debt service-revenue ratio. A one per cent increase in public debt leads to a 1.8 increase in the debt service ratio. The positive and highly significant coefficient (1.8) indicates that debt servicing costs rise accordingly as public debt increases. This is consistent with economic theory, where higher debt levels typically lead to increased interest payments, reflecting the more significant financial burden of debt servicing. In the context of Kenya Kim & Lee, [16], this finding highlights the challenge of managing rising debt levels, which could strain the country's fiscal resources over time. Similarly, Onjala [43] discusses the debt sustainability problem in Kenya due to increased external borrowing, particularly from China, for infrastructure development projects. The findings support the similar result by Onjala [23] and Kim and Lee [16] that an increase in public debt increases debt service costs [44,45].

The budget deficit is expected sign and significant at 5 percent. A one per cent increase in fiscal deficit rate leads to a 0.03 increase in debt service cost. Further, debt levels have continued to grow due to the government continuously running budget deficits [46]. With increased budget deficits (expenditure-revenue) they borrow to fill the financing gap which makes the governments accumulate debt to be serviced by future generations and therefore redistributing income (Thuy Van et al., [37]; Alhaji, [38]. This theory explains the fact that a budget deficit increases domestic debt. Further, in Kenya, the

fiscal deficit has averaged 8.1% over the last ten years due to the focus on both development and recurrent expenditure [47].

There is a significant statistical relationship between inflation and the debt service ratio. The increase in the inflation rate is significantly positively related to the debt service ratio [48]. The coefficient of the inflation rate is 1.52, indicating that for every 1% increase in the inflation rate, the debt service ratio will increase by 1.52%. High inflation rates can increase the debt servicing burden, making it more challenging to maintain debt sustainability [12]. The positive and significant coefficient (1.5) for inflation suggests that higher inflation rates exacerbate the debt service burden. Inflation can devalue the local currency, making it more expensive to service foreign-denominated debt (Hurtado et al., 2022). This result is particularly relevant for countries like Kenya, where inflationary pressures can undermine fiscal stability, leading to higher costs in managing public debt. In contrast, other studies argue the relationship is positive, in the short term, inflation generally lowers the debt ratio, as when prices rise, nominal GDP (the denominator) surges, thus automatically reducing debt [49].

The increase in lending interest rate is significantly positively related to the debt service ratio. A one per cent increase in lending interest rate debt leads to a 0.8 increase in the debt service ratio. interest rates increase, and therefore the cost of servicing debt increases. The positive coefficient (0.80) indicates that increases in lending interest rates directly

contribute to higher debt servicing costs. This finding is intuitive, as higher interest rates elevate the cost of borrowing, thereby increasing the overall debt burden (Séverine, 2023). Persistently higher interest rates raise the cost of servicing debt, adding to fiscal pressures and posing risks to financial stability. For Kenya, managing interest rates is crucial to maintaining affordable debt service levels, especially in an environment of rising global interest rates [50].

Exchange rate depreciation is positive to debt service cost. The coefficient of exchange rate depreciation is 0.51, indicating that for every 1% increase in exchange rate, the debt service ratio changes by 0.51. The negative and significant coefficient (-0.51) is somewhat unexpected, as exchange rate depreciation typically increases the cost of servicing foreign debt. However, this result may indicate that other factors, such as foreign reserves or exchange rate interventions, could have mitigated the adverse impact of currency depreciation on debt servicing during the study period [36]. This highlights the need for a deeper investigation into Kenya's exchange rate policies and their effectiveness in managing debt costs. Most of the external debt is denominated in USD at 68.1% and the high depreciation of the shilling has continued to put more pressure on the debt serving, the Kenya shilling has depreciated by 8.9% year following a 9.0% depreciation recorded in 2022.

The equation shows that economic growth improves the debt sustainability in Kenya. A one per cent increase in economic growth leads to a 0.04 decline in the debt service ratio. The debt service ratio is reduced by 0.04 for every 1% increase in economic growth. The positive and significant coefficient (0.04) is important, as higher GDP growth is usually expected to reduce debt service costs by boosting economic output and revenue. The negative relationship found here may suggest that the growth experienced during the period under review was sufficient to offset the rising debt levels or that other economic challenges, such as income inequality or structural inefficiencies, improving the potential benefits of GDP growth on debt sustainability. Accelerated growth results in increasing incomes, and hence domestic savings [9]. This will in turn reduce the need for foreign borrowing to finance investment projects. The slow-down in growth of the stock of debt will result in a reduction in the debt-service ratio [40]. Reduced borrowing would cause the government to exploit their tax revenue efficiently in

investment and not repayment of debts thus encouraging an improvement in economic growth. This is because as the economy grows, debt servicing is equally growing. The finding agrees with a similar study by Kamau [40] in Kenya and Jude et al. [9] in Nigeria.

The regression coefficient of export revenue is significantly negative at a 5 per cent significance level. The coefficient of exports is 2.70, indicating that for every 1% increase in the export earnings, the debt service ratio will decline by 2.70%. Enhancing exports can thus improve a country's ability to service its external debt. The positive and significant coefficient (2.70) is also normal, given that higher exports typically generate foreign exchange earnings that can ease the burden of servicing debt, particularly foreign-denominated debt. This expected finding could indicate structural issues within Kenya's export sector, such as diversification or promotion of export activities, which might have accelerated their effectiveness in supporting debt sustainability [36].

The coefficient of determination R-squared indicates that 58 per cent of the variation in the dependent variable has been explained by independent variables, thus showing that data fits the model well. The study computed Variance Inflation Factors (VIF) the result indicates mean VIF is 3.37. The values are all below 10, with the means less than 3.37. Hence, we can safely conclude there are no multicollinearity issues. Furthermore, the instrumental variable should ameliorate any concerns about the correlation this assumption imposes. Furthermore, Durbin Watson value of 2.046 has confirmed that the error term is free of serial correlation. Implying autocorrelation is not an issue. J-tests or Hansen tests were conducted to check for instrument validity. From Hansen J statistics, with a p-value of J-Hansen greater than 0.05, suggesting that the study cannot reject the null hypothesis that the instruments are correctly excluded or jointly valid, indicating that instrument variables are jointly valid and thus the GMM approach can be employed.

#### 4.4 Causality Test Results

The Granger causality test was conducted to define the directions of the relationship between study variables. Table 6 presents the Granger causality result between growth and explanatory variables, with a lag of 1.

**Table 6. Pairwise granger causality tests**

Null hypothesis	Observations	F-statistics	Probability	Decision
PD does not Granger Cause DS	33	0.00718	0.9330	unidirectional
DS does not Granger Cause PD		2.88849	0.0996	
INF does not Granger Cause DS	33	0.64239	0.4291	No causality
DS does not Granger Cause INF		0.06021	0.8078	
INR does not Granger Cause DS	33	0.04271	0.8377	No causality
DS does not Granger Cause INR		0.01164	0.9148	
BD does not Granger Cause DS	33	12.4961	0.0013	unidirectional
DS does not Granger Cause BD		0.68847	0.4132	
EXR does not Granger Cause DS	33	2.12400	0.1554	unidirectional
DS does not Granger Cause EXR		3.69491	0.0641	
GDP does not Granger Cause DS	33	5.44981	0.0265	unidirectional
DS does not Granger Cause GDP		1.60208	0.2154	
EXP does not Granger Cause DS	33	0.53775	0.4691	No causality
DS does not Granger Cause EXP		0.16936	0.6836	

Source: Own estimation (2024).

Table 6 reveals several important causal relationships. First, there is unidirectional causality from debt servicing to public debt, suggesting that rising debt service costs can lead to increased public debt, possibly due to the need for additional borrowing to cover these costs. In contrast, no causality was found between inflation and debt servicing, indicating that inflation does not directly predict changes in debt servicing costs, nor does debt servicing influence inflation, possibly due to other factors like external economic conditions or monetary policy interventions playing a more significant role. Similarly, no causality was observed between the lending interest rate and debt servicing, which could imply that both interest rates and debt service costs in Kenya are influenced by broader global financial conditions or other domestic policies not captured in this analysis. Moreover, there is unidirectional causality from the budget deficit to debt servicing, indicating that a rising budget deficit can lead to higher debt service costs, likely through increased borrowing. The test also shows unidirectional causality from debt servicing to the exchange rate, suggesting that fluctuations in debt service costs can affect exchange rate movements, with higher costs potentially leading to greater demand for foreign currency and subsequent local currency depreciation. Additionally, GDP growth was found to cause changes in debt servicing, implying that economic growth can impact debt sustainability by affecting government revenue and the country's ability to meet its debt obligations. However, no causality was found between exports and debt servicing, suggesting that the level of exports does not directly influence debt

service costs, nor do changes in debt servicing predict future export performance. This finding could point to the need for a more diversified export base or the possibility that export earnings are not sufficiently leveraged to improve debt sustainability. Overall, the Granger causality test results provide valuable insights into the directional relationships between Kenya's debt servicing costs and various economic variables. The unidirectional causality from the budget deficit and GDP growth to debt servicing underscores the importance of fiscal discipline and economic growth in managing Kenya's debt. Conversely, the lack of causality between inflation, interest rates, and exports with debt servicing suggests that broader economic conditions may influence these factors or that their impact on debt sustainability is more complex and indirect. These findings highlight the multifaceted nature of debt management and the need for a comprehensive approach to understanding and mitigating the factors driving Kenya's debt dynamics [51].

## 5. CONCLUSION AND POLICY RECOMMENDATIONS

### 5.1 Conclusion

The study on Kenya's external debt sustainability offers critical insights into the factors significantly influencing debt servicing costs. The analysis reveals that public debt, inflation, and lending interest rates all positively and substantially impact the country's debt service obligations. These findings underscore Kenya's challenges in managing its debt levels, particularly given the unexpected positive relationships between

several macroeconomic variables under study on debt servicing costs. These results suggest that Kenya's economic growth and export performance is robust enough to ease the debt burden effectively. Additionally, the study highlights the critical role of fiscal discipline and exchange rate stability in maintaining debt sustainability. The findings suggest that Kenya's debt sustainability is under pressure due to the high levels of public debt and the economic variables that drive debt servicing costs. The significant positive impacts of the budget deficit, public debt, inflation, and interest rates on debt servicing emphasize the need to manage fiscal and monetary policies carefully. The relationship between the budget deficit and debt servicing costs also highlights the importance of maintaining fiscal discipline to effectively manage the country's debt. Furthermore, the unexpected results concerning GDP growth and exports indicate that structural economic reforms are needed to ensure that economic growth and export earnings contribute more effectively to reducing debt service costs. Our empirical results show that there is a distinct unidirectional causal flow from the debt service ratio to both public debt and exchange rate in Kenya. We also find that both economic growth and budget deficit Granger cause debt sustainability.

## 5.2 Recommendations

First, the government should prioritize strengthening fiscal discipline and enhance fiscal consolidation by reducing the budget deficit. This can be achieved through enhanced revenue collection, cutting down on unnecessary expenditures, and improving the efficiency of public spending. A lower budget deficit will help curb public debt growth and reduce associated debt service costs. Second, adjustments in monetary policy are crucial. The Central Bank of Kenya should closely monitor inflation and interest rates, implementing policies that maintain low and stable inflation and favourable interest rates. By stabilizing these variables, the Central Bank can help mitigate the debt servicing burden, particularly by ensuring that inflation does not erode the currency's value, making debt repayment more manageable. Third, economic diversification and structural reforms are essential. The unexpected positive relationship between GDP growth and debt servicing costs indicates the need for structural changes within the economy. The government should focus on diversifying the economy by expanding the industrial and service sectors to ensure

economic growth directly reduces the debt burden. Additionally, diversifying export products and markets will help stabilize export earnings and strengthen their impact on debt sustainability. Fourth, effective exchange rate management is vital. Given the significant impact of exchange rate fluctuations on debt servicing, the government should implement policies to stabilize the local currency. This could include building up foreign exchange reserves, encouraging foreign direct investment, and maintaining a competitive export sector, which would contribute to reducing the cost of servicing foreign-denominated debt. Lastly, a comprehensive debt management strategy is necessary. This strategy should prioritize borrowing for productive investments that generate sufficient returns to cover the debt servicing cost. Regular assessments of public debt sustainability and adjustments to borrowing plans based on current economic conditions and debt service capacity should be integral to this strategy. By implementing these recommendations, Kenya can enhance its debt sustainability, alleviate the debt servicing burden, and foster a more stable economic environment conducive to growth and development. The study was carried out in Kenya, however, given the small sample size, there is a need to increase the sample size to other African countries to increase the robustness of the regression finding. Further, a comprehensive study should be conducted by the ARDL model, the ARDL bounds test approach to cointegration is robust and performs better even in smaller samples and generates both long-run and short-run estimates.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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