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Article

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Inflation, public debt and unemployment nexus in Ghana. An ARDL analysis

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ABSTRACT

In recent years Ghana is challenged with rising debt, surging inflation, and unfavorable unemployment rates. To mitigate their impact on economic prosperity the country requires strategic policy interventions. Using data from 1990 to 2022, this study attempts to analyze the relationship between inflation, public debt, and unemployment in Ghana. The ARDL framework was used to estimate the variables. A long-run relationship between public debt and inflation was established. Notably, inflation correlates negatively with public debt in both short and long -run. Whiles public debt demonstrated a positive correlation with unemployment in both short and long-run, remittances displayed a negative long-run correlation with unemployment. The study suggests that prioritizing domestic debts over foreign debts could be strategic to hedge against inflationary risk. Moreover, we recommend a targeted investment in infrastructure projects and the promotion of agriculture. These initiatives will spur economic growth, engender sustainable development and ultimately create more job opportunities.

IMPACT STATEMENT

This study examines the relationship between inflation, public debt, and unemployment in Ghana and provides insightful information that is important for academic discourse as well as policy formulation. Using the Autoregressive Distributed Lag (ARDL) framework and data from 1990 to 2022, the study uncovers significant findings. First of all, it proves that there is a long run negative correlation between public debt and inflation, emphasizing the need for prudent debt management measures. Notably, the preference for local debt over borrowing from external sources appears to be a possible hedge against inflationary risks. Secondly, the analysis reveals a positive long run relationship between unemployment and public debt, highlighting the significance of sustainable economic growth measures to counteract this relationship. To achieve this, it is suggested that targeted investments in infrastructure is required in key sectors like agriculture and manufacturing to stimulate economic growth and create employment opportunities.

Furthermore, the study emphasizes how crucial it is to improve the trade balance by promoting exports. The effective use of trade can reduce the burden of public debt and promote prosperity. The Ghanaian government is encouraged by these findings to prioritize domestic borrowing and take into account fixed interest rate loans, or loans denominated in local currency in managing the public debt. In the realm of academic literature, the study enriches the discourse regarding the macroeconomic dynamics of developing economies, with a focus on Sub-Saharan Africa. The research provides empirical evidence to support the current debate on debt management, inflation control employment generation. The study significantly lays the foundation for future studies and the development of public policies that promote economic stability and prosperity.

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1. Introduction

The dramatic increase in public debt levels over the past few decades is one important topic that has caught the attention of scholars and policymakers globally, and in particular among Sub-Saharan African (SSA) nations (Akram, 2016; Beqiraj et al., 2018). The overall public debt for SSA has grown, rising from

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an average of 27% of GDP in 2010 to over 59% in 2020 (IMF, 2023). Although the GDP of SSA nations increased by roughly 23% between 2010 and 2017, public debt increased by more than 90% during the same period (Manasseh et al., 2022). The declining performance of a number of macroeconomic measures, including GDP growth rates, exchange rates, unemployment, inflation, and stock market prices among others may be linked to the rising public debt (Fambeu et al., 2022). Inflation, public debt, and unemployment are three of the most important economic indicators that are closely monitored by policymakers, economists, and investors alike. They interact and can have an immense impact on a nation's stability and general state of the economy. According to Dumitrescu, Enciu, et al. (2022) countries with larger levels of public debt typically have lower rates of inflation and more unemployment, while countries with lower public debt levels tend to have lower unemployment rates and higher inflation. The COVID-19 pandemic's consequences on the global economy, including those on unemployment, public debt, and inflation, were examined by the IMF. According to the report, the pandemic has led to a notable growth in public debt, but it has caused a decrease in inflation whiles increasing unemployment (Ozili, 2021). Also, Chiu et al. (2023) asserts that while the association between inflation, public debt and unemployment has changed over time, there is still a general inverse relationship between unemployment and inflation. The overall increase in prices of goods and services over time is referred to as inflation. In developing countries, inflation can be particularly high due to factors such as supply-side constraints, monetary instability, and political uncertainty (Gopinath, 2022). In Ghana, inflation has been a persistent challenge over the past few decades, with rates fluctuating between high and low levels. According to the Ghana Statistical Service, the average inflation rate in Ghana between 2010 and 2019 was 15.8 percent (Sarpong-Kumankoma, 2023). This inflation has even increased to 38.1% in September 2023 which is obviously higher than the central bank of Ghana's target band of $8 \pm 2\%$ rate. The high inflation rate has contributed to an increase in the cost of living, resulting to the inability of citizens to pay for basic necessities and leading to a decline in purchasing power (Adil et al., 2021). The decline in purchasing power can culminate to a decline in economic growth and an increase in poverty levels. Whiles this inflation in Ghana is galloping, the country is also recording unsustainable debt to GDP levels contrary to Dumitrescu, Enciu, et al. (2022) finding of high public debt corresponding to lower inflation levels. Whiles inflation rates are on the rise in Sub-Saharan Africa, Ghana, undoubtedly records the highest inflation rate in the ECOWAS sub-region with 45.4%, Sierra-Leone - 37.8%, Nigeria- 20.1% with Togo, Mali, Cote d'Ivoire and Burkina Faso recording at most 5% inflation rates (Statista, 2023). A government's outstanding obligation to its creditors, which includes bonds and loans, is referred to as public debt. Future generations may be burdened by high levels of national debt, crowd out private investment, and lead to fiscal imbalances (Ma & Qamruzzaman, 2022). The IMF projects that Ghana's public debt would reach 98.72% by the end of 2023, having risen dramatically over the past two decades from 28.5 percent of GDP in 2010 to 88.8 percent in 2022.In Ghana the provisional gross public debt at end of the first quarter of 2023 stood at GH¢569.35 billion (US$51.67 billion), representing 71.1 percent of GDP. This comprised external debt of GH¢322.56 billion (US$29.27 billion); representing 40.3percent of GDP, and domestic debt of GH¢246.79 billion (US$22.4 billion); which is 30.8 percent of GDP (Ministry of Finance, 2023). The rising levels of public debt might be attributed to several factors, including high inflation, low tax revenue, and rising public expenditure among other factors. As a result, Ghana has requested a $3 billion bailout package from the International Monetary Fund (IMF) to help address its fiscal challenges and stabilize its economy. The program is expected to help the country reduce inflation, stabilize the local currency, and improve the fiscal position (Salman & Ali, 2022). According to Changole (2022), Ghana is restructuring its debt to complete an IMF rescue worth $3 billion. As Ghana restructures the debt, this is expected to result in losses of $427 million, with lenders registering bond losses as high as 57% during restructuring. The IMF bailout required among others, a completion of a comprehensive debt restructuring covering domestic debt and external debt in addition to fiscal consolidation efforts and other structural reforms (Gray et al., 2023). Although it is unclear if these actions would be effective in reaching the stated objectives, they nonetheless mark a significant step in resolving Ghana's debt crisis and enhancing the long-term economic prospects of the nation.

The number of people who are willing and able to work but are unable to obtain employment is referred to as unemployment .Unemployment can have significant social and economic costs, particularly in developing countries where it can lead to poverty and inequality (Barber, 2023).

The trends reveals that the unemployment rate in Sub-Saharan Africa was as low as 5.45% in 2008, which subsequently fluctuated but rose to 6.798% in 2021. The records show that for the past few years in Sub-Saharan Africa, the unemployment rate peaked in 2021.There is an undesirable fact from the trend that the unemployment rate has been increasing since 2008 which remains unhealthy for the economy of the sub-region (Obasun, 2023). Unemployment in Ghana, has been a challenge, with the average unemployment rate between 2010 and 2019 being 4.3 percent (Mensah, 2023). By the end of 2023, it is anticipated that Ghana's unemployment rate would be 5.00 percent. Increased poverty, a slowdown in economic growth, and social instability can be caused by high unemployment rate. Additionally, the unemployment rate in Ghana remains high, particularly among youth and women. The unemployment rate of Ghana in 2022 was 3.5%. This increased to 3.60 percent in 2023 from 3.50 percent in 2022 (Ubah et al., 2023). The COVID-19 pandemic has made the situation even worse, as many workers have lost their jobs and seen a decrease in incomes as a result of businesses being compelled to shut down or scale back operations (Shafi et al., 2020, p. 19).

In light of this, the goal of this study is to analyze the contemporaneous relationship between inflation, public debt and unemployment in the Ghanaian context. This research is significant and original since it seeks to make an exclusive contribution to the lingering debate. The absence of studies of the correlation between inflation, public debt, and unemployment is one main research gap in the extant literature. While earlier research has looked at few of these indicators (Ahuru et al., 2023; Alnaa & Matey, 2023; Beqiraj et al., 2018; Montati, 2023; Prabheesh et al., 2023; Shuaibu et al., 2021), no attempt has been made to investigate inflation, public debt and unemployment nexus simultaneously. More so, in Ghana few studies have been done which failed to address this lacuna (Aimola & Odhiambo, 2021; Asravor et al., 2023; Evans, 2022). There is also no agreement on which variable leads and which lags in the correlation chain in earlier studies conducted in the literature. This study will also offer policy recommendations geared toward the achievement of sustainable development goal eight (SDG 8), that require us to ensure and promote decent work and economic growth in Ghana. Furthermore, to leverage the benefits of African Continental Free Trade Area (AfCFTA) without increasing public debt, creating more employment opportunities, and reducing inflationary pressures, Ghana would need to ensure prudent macroeconomic management. By analyzing the inflation, public debt and unemployment nexus within Ghana's specific context, policymakers can develop strategies that mitigate economic volatility, foster job creation, and support sustainable economic growth. Hence, determining intricacies among these variables is critical for Ghana especially at a time when the country is debt distressed and has sought IMF support.

2. Literature review

Ghana, a West African nation, is among the region's economies with the quickest rate of growth and has implemented a number of structural reforms to lower unemployment, inflation, and public debt. Inflation, public debt, and unemployment continue to be major obstacles to the nation's economic growth and development despite these efforts. Therefore, it becomes imperative for policymakers to comprehend the interplay between, inflation, public debt, and unemployment in order to develop useful economic policies. In affluent nations, the interaction between inflation, public debt, and unemployment has been thoroughly examined, but little research has been done on the subject, notably in Ghana. Previous studies have demonstrated a relationship between unemployment, public debt, and inflation; any alteration in one of these variables can have a significant impact on the other two. For instance, Olaoye (2023) found that inflation and public debt are positively related, suggesting that a rise in public debt can lead to an increase in inflation in Sub Saharan Africa .Similarly, Shuaibu et al. (2021) posit that in Nigeria, a long run correlation exists between public debt and unemployment. Unemployment rises with public debt, although external debt increases unemployment more than domestic debt. However, cointegration study results indicate that there is no correlation between inflation and public debt. Meanwhile studies by Montanti (2023) have proven that inflation and public debt are positively correlated in many countries. In the same vein, Saungweme and Odhiambo (2021) revealed that their research reveals evidence that public debt has a positive and noteworthy influence on Zimbabwe's inflation dynamics, especially over the long-run.

Igberi et al. (2016) discovered in their research that there is a long-run positive correlation between public debt and unemployment in Nigeria. Specifically, a 1% increase in unemployment led to a 1.6% increase in unemployment rate all things being equal. However, the long-run correlation between unemployment and inflation was found to be negative. Specifically, a 1% increase in inflation led to a 0.2% decrease in unemployment. An investigation conducted by Singh et al. (2018) evaluated how India's GDP and unemployment rate were impacted by inflation. This analysis suggests that although insignificant, inflation has a negative correlation with GDP and unemployment. This confirms the study by Ahuru et al. (2023) who concludes that inflation and unemployment are negatively related in many countries. For other studies on public debt. Heimberger (2023) analyzes 816 estimates from 47 primary studies using meta-regression techniques and discovered a lack of proof that a high public debt-to-GDP consistently creates a negative growth effect. Conversely, Abate (2023) discovered that a significant positive shock in debt promotes economic growth, whereas a minor negative shock has the opposite effect. The findings also show that debt has a threshold effect, which implies that; it contributes positively to Ethiopia's economic growth at levels much below 66.75% of GDP or 36.27% of GNI. Debt incurred above these threshold levels worsens the nation's economic growth.

Obviously, existing research has provided valuable insight into the interaction between inflation, public debt, and unemployment. In Ghana however, some few studies have notably studied the relationship between public debt and unemployment, public debt and inflation, or public debt and unemployment. In light of this, limited attention has been paid to investigate the simultaneous interactions and the intricate dynamics of these variables altogether. For instance, a study by Evans (2022) indicates that GDP growth and external debt are positively correlated in Ghana whiles inflation and unemployment poses a negative effect on GDP growth. The findings further demonstrate that GDP decreased inflation while external debt increased it, and that unemployment had no impact on inflation. According to research by Owusu-Nantwi and Erickson (2016), although there is a bidirectional Granger causality link between public debt and GDP in the short -run, there is a positive and statistically significant long-run association between public debt and economic growth in Ghana.

This paper is unique for several reasons. First of all, because Ghana has a unique economic structure any results, if any, from research on the relationship between inflation, public debt and unemployment cannot be specifically applied to Ghana. Secondly, this study attempts to fill the gap in literature by investigating the inflation, public debt and unemployment nexus simultaneously. Thirdly, the government has implemented various policies over the years to address several socio-economic challenges by the establishment of the Monetary Policy Committee to ensure price stability, the issuance of bonds to manage public debt, and the implementation of job creation programs such as the Youth Employment Agency targeted at reducing the unemployment in the country. Therefore, an investigation into the nexus between inflation, public debt, and unemployment in Ghana would provide valuable insight into the effectiveness of these policies and their impact on the economy.

3. Methodology of the study

This section presents the theoretical framework on the interplay between the variables under consideration, the various statistical tools and packages used for analysis of this study. Annual data spanning from 1990 to 2023 was obtained from World Development Indicators (WDI) website. First and foremost, a statistically descriptive assessment of the variables was carried out. Secondly, a test for stationarity was conducted by employing the Augmented-Dicky-Fuller (ADF) (Dickey & Fuller, 1979) test for all the series. The ARDL method was then applied after the bound test for cointegration was completed. The lags of all variables were selected using the Akaike Information Criterion (AIC).

3.1. Theoretical framework

The theoretical basis for the inflation, public debt, and unemployment nexus in Ghana is based on the idea that inflation, public debt, and unemployment are interrelated and have a causal relationship with each other. According to the classical macroeconomic theory, public debt is predicted to rise as a result of high inflation as the government tries to finance its expenditures (Guénette et al., 2022). Furthermore,

high inflation can also result in higher unemployment as firms are unable to adjust their prices quickly, leading to lower output and employment (Tesfaselassie & Wolters, 2018). Conversely, excessive public debt can put upward pressure on inflation as the government finances its debt through monetary expansion (Kose et al., 2022). High levels of public debt can also result in lower growth and higher unemployment as resources are diverted away from productive uses to service the debt (Nupehewa et al., 2022).

3.2. Empirical model specification

Upon verifying the existence of long-run relationships between all the variables, we plausibly proceeded to estimate the ARDL model. Our first model was to estimate the effect of inflation on public debt which is specified as follows:

$$PD = f(INF, BD, EXR, GDP, TR) \quad (1)$$

where $PD = Public\ Debt$ (Total of domestic and foreign debt as % of GDP)

$INF = Inflation$ rate, with each variable described in Table A1 at the Appendix.

The second model which estimated the impact of public debt on unemployment, is specified as follows:

$$Unemp = f(PD, INF, GDP, FDI\ \ REM, GCF,) \quad (2)$$

Where $Unempt = Unemployment\ rat$ e, PD is public debt PD (Total public debt as a percentage of GDP), with all other the variables defined in Table A1 at the Appendix. Econometrically, Equations (1) and (2) can be presented in Equations (3) and (4) below:

$$PD_t = \alpha_0 + \alpha_1 INF_t + \alpha_2 BD_t + \alpha_3 EXR_t + \alpha_4 GDP_t + \alpha_5 TR_t + \varepsilon_t \quad (3)$$

$$UNEMP_t = \beta_0 + \beta_1 PD_t + \beta_2 INF_t + \beta_3 GDP_t + \beta_4 FDI_t + \beta_5 REM_t + \beta_6 GCF_t + \mu_t \quad (4)$$

The ARDL was employed due to its effectiveness in managing varying degrees of integration and its perceived superiority over the conventional or well-known cointegration models, such as the Engle-Granger (Engle & Granger, 1987), Johansen test (Johansen & Juselius, 1990), and Phillip-Ouliaris test, which can simultaneously estimate short and long-run estimates (Işık et al., 2013). The ARDL model has the benefit of simultaneous estimation of short and long-run parameters. When the series are I (0), I (1), or a mix of the two, ARDL can be used. Pesaran (1997) and Ouattara et al. (2004) state that ARDL cannot be applied in cases where any variable is stationary at I (2) since the results will be erroneous. The ARDL models estimated are specified as follows:

$$\Delta PD_t = \beta_0 + \beta_1 PD_{t-1} + \beta_2 INF_{t-1} + \beta_3 BD_{t-1} + \beta_4 EXR_{t-1} + \beta_5 GDP_{t-1} + \beta_6 TR_{t-1} + \sum_{i=1}^{n} \gamma_1 \Delta PD_{t-i} + \sum_{i=1}^{q} \gamma_2 \Delta INF_{t-i} + \sum_{i=1}^{q} \gamma_3 \Delta BD_{t-i} + \sum_{i=1}^{q} \gamma_4 \Delta EXR_{t-i} + \sum_{i=1}^{q} \gamma_5 \Delta GDP_{t-i} + \sum_{i=1}^{q} \gamma_6 \Delta TR_{t-i} + \varepsilon_t \quad (5)$$

In Equation (5), Δ represents the difference operator, β_0 denotes the intercept term β_1 to β_6 estimates the long-run parameters whiles γ_1 to γ_6 are the short run coefficients. n reports the lags for public debt and q reports the lags for the regressors. To determine the short run coefficients, the error correction model (ECM) is then established. The ECM function can be stated as follows:

$$\Delta PD_t = \sum_{j=1}^{n} \alpha_1 PD_{t-j} + \sum_{j=1}^{n} \alpha_2 INF_{t-j} + \sum_{j=1}^{n} \alpha_3 BD_{t-j} + \sum_{j=1}^{n} \alpha_4 EXR_{t-j} + \sum_{j=1}^{n} \alpha_5 GDP_{t-j} + \sum_{j=1}^{n} \alpha_6 TR_{t-j} + \theta ECM_{t-j} + \mu_t \quad (6)$$

where θ is the ECM coefficient, which is essentially expected to be strongly negative and controls the rate of adjustment to long-run equilibrium. The error correction term known as ECM takes into account the model's long-run representation (Darko, 2016).

$$\Delta UNEMP_t = \beta_0 + \beta_1 UNEMP_{t-1} + \beta_2 PD_{t-1} + \beta_3 INF_{t-1} + \beta_4 GDP_{t-1} + \beta_5 FDI_{t-1} + \beta_6 REM_{t-1} + \beta_7 GCF_{t-1} + \sum_{i=1}^{n} \theta_1 \Delta UNEMP_{t-i} + \sum_{i=1}^{n} \theta_2 \Delta PD_{t-i} + \sum_{i=1}^{n} \theta_3 \Delta INF_{t-i} + \sum_{i=1}^{n} \theta_4 \Delta GDP_{t-i} + \sum_{i=1}^{n} \theta_5 \Delta FD_{t-i} + \sum_{i=1}^{n} \theta_6 \Delta REM_{t-i} + \sum_{i=1}^{n} \theta_7 \Delta GCF_{t-i} + \varepsilon_t \quad (7)$$

Similarly, in Equation (7), Δ refers to the difference operator, β_0 represents the intercept term, β_1 to β_8 determines the long run parameters whiles θ_1 to θ_6 also denotes the short run coefficients. Thus, the ECM function to determine the short run coefficients can be expressed as below:

$$\Delta UNEMP_t = \sum_{j=1}^{n} \alpha_1 UNEMP_{t-j} + \sum_{j=1}^{n} \alpha_2 PD_{t-j} + \sum_{j=1}^{n} \alpha_3 INF_{t-j} + \sum_{j=1}^{n} \alpha_4 GDP_{t-j} + \sum_{j=1}^{n} \alpha_5 FDI_{t-j} + \sum_{j=1}^{n} \alpha_6 REM_{t-j} + \sum_{j=1}^{n} \alpha_7 GCF_{t-j} + \gamma ECM_{t-1} + \mu_t. \quad (8)$$

where γ is the coefficient of the error correction term, which ought to be negative and significant. The ECM provides a metric for the speed of adjustment to the long-run. Following the estimation of the long and short-run coefficients, the model is subjected to pertinent diagnostic and stability tests to make sure it is stable, devoid of serial correlation, and heteroskedasticity.

3.3. Data analysis and discussion of findings

Annual time-series data from 1990 to 2022 were used in the analysis. The variables were subjected to a descriptive analysis in order to demonstrate their distribution and trends. Public debt had the second-highest mean value in Table 1 below, at 58.97, behind trade with 72.897. This points to Ghana's extremely high and erratic levels of national debt over the period of the study. Such amounts of public debt may result from borrowing to fund fiscal shortfalls or the financing of infrastructure projects. The nation's average budget deficit was 5.908%, indicating a fiscal imbalance and a potential inclination to borrow money to cover the shortfall. The exchange rate turned out to be the least volatile variable, whereas public debt was the most volatile. In terms of standard deviation, which measures how dispersed the observed variables are from their mean. The cost-of-living index, or inflation, recorded a mean of 18.762% for the period, with significant price fluctuations between 6.698% and 59.317%. A number of variables, including excessive growth of money supply, supply chain disruptions, or external shocks, may be responsible for the high inflation and rising cost of living. Ghana's unemployment rate fluctuated between 2.170% to 10.460%, with a mean of 5.53%, reflecting a relatively stable rate. The country's average GDP was 5.247%, signifying good economic growth and promising future prospects for the nation. Furthermore, the average amount of remittances received by Ghana (2.342) was less than FDI (3.895), which was also less than gross capital formation (20.179). This suggests that while gross capital formation has contributed moderately to Ghana's economic growth throughout this time, FDI and remittances have contributed very little. Finally, with a mean of 1.917 and a standard deviation of 1.796,

Table 1. Descriptive statistics of variables.

Variable	Observation	Mean	Maximum	Minimum	Std. dev
PD	33	58.970	111.945	26.216	19.743
INF	33	18.762	59.317	6.698	11.794
UNEMPT	33	5.536	10.460	2.170	2.142
TR	33	72.897	116.048	38.517	19.466
REM	33	2.342	10.085	0.094	2.721
GDP	33	5.247	14.047	0.514	2.483
GCF	33	20.179	29.002	11.764	4.854
FDI	33	3.895	9.466	0.251	2.692
EXR	33	1.917	5.712	0.680	1.796
BD	33	−5.908	−1.590	−17.440	3.272

Source: Author's construct, 2023.

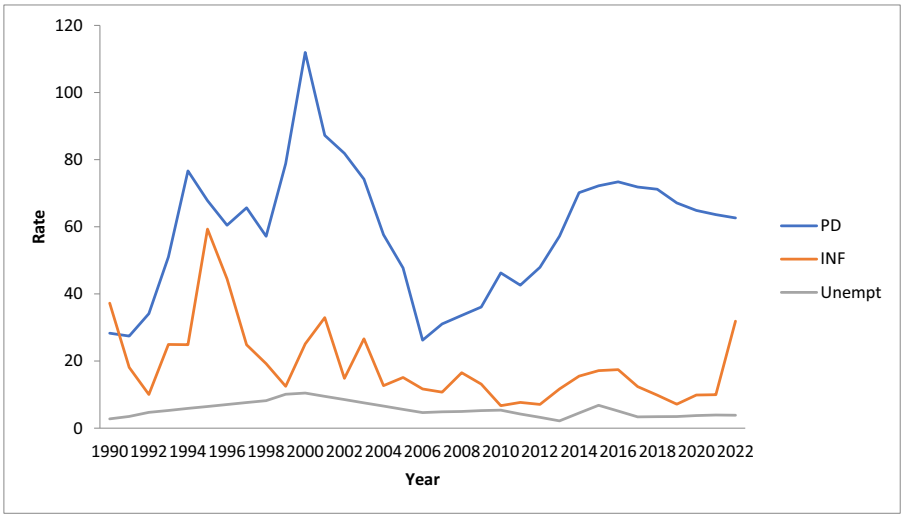

Figure 1. Trend graphs of variables.
Source: Authors' construct, 2023.

Table 2. Results of Unit Root Test (ADF).

	Level Form		First Difference	
	ADF		ADF	
Variable	Intercept	Prob	Intercept	Prob
PD	−2.1873	0.2145	−4.5964***	0.0009
REM	−1.6708	0.4359	−6.7007***	0.0000
INF	−3.2405**	0.0267	−6.1696***	0.0000
FDI	−1.8962	0.3298	−5.1294***	0.0002
EXR	−2.2722	0.4326	−4.7583***	0.0033
GCF	−2.6787	0.0887	−5.4363***	0.0001
GDP	−3.7145***	0.0086	−7.8050***	0.0000
UNEMPT	−1.2552	0.6368	−4.6641***	0.0008
TR	−2.4225	0.1438	−6.7538***	0.0000
BD	−2.1856	0.2151	−3.8477***	0.0070

***Significance at 1% level.
Source: Author's construct, 2023.

the exchange rate was the most stable variable, while trade was found to be the most volatile, with a mean of 72.897 and variance between 38.517 and 116.048.

The trend of these variables was also observed and assessed over the period, which is depicted in Figure 1 below. Before 1992 we observed a decline in inflation. Subsequently, there was a dip in inflation in 1992. Both inflation and public debt were positive, increased steadily from 1992 to 1996 and turned negative with a decline until the year 1999 when there was a dip in both economic variables. These two variables became positive, and made a steady increase until 2001 when they peaked and thereafter declined until 2002. After 2002, inflation turned stochastic, and modestly positive until 2021 to 2022 when it became explosively positive. This rise in inflation could be attributed to high government spending in election 2020, and the obvious disruption of supply chains with the associated shortages and price hikes for imports resulting from the COVID-19 pandemic. However, public debt tends to decrease sharply from 2000 till 2006, increased steadily thereafter until 2016 and began to decline moderately till 2021. This sharp decline in the public debt from 2000 could be explained perhaps by the change in government and the declaration of Ghana as a highly indebted country (HIPIC), granting Ghana the opportunity to have most of her debt canceled. Unemployment over the period remained positive and only increased modestly.

3.4. Stationarity test

To avoid producing spurious regression results which could be used for analysis and consequently for making economic decisions, it is desirable to conduct stationarity test of the series. Therefore, the unit root test was conducted.

Table 3. Results of bounds test for cointegration.

Effect of inflation on public debt - Model 1			
	Critical values		F- statistics
Significance Level	Lower bound I(0)	Upper bound I(1)	
10%	2.26	3.35	
5%	2.62	3.79	12.07
2.50%	2.96	4.18	
1%	3.41	4.68	
Effect of Debt on Unemployment - Model 2			
	Critical values		F- statistics
Significance Level	Lower bound I(0)	Upper bound I(1)	
10%	2.72	3.77	
5%	3.23	4.35	6.95
2.50%	3.6	4.89	
1%	4.29	5.61	

Source: Author's estimation, 2023.

Table 4. Estimated long-run results.

Public debt as dependent variable - Model 1			
Variable	Coefficient	Std. error	Prob
INF	−4.6912	1.0046	0.0185
BD	−5.9239	0.6882	0.0033
EXR	18.5901	4.3438	0.0234
GDP	−11.1941	1.3897	0.0040
TR	1.1224	0.2400	0.0185
Unemployment rate as a dependent variable - Model 2			
PD	0.074325	0.014372	0.0000
REM	−0.6168	0.0851	0.0000
GCF	0.0439	0.0521	0.4083

Source: Author's estimation, 2023.

The outcomes of the unit root tests for each variable are shown in Table 2 above. All the variables were non-stationary at level, with the exception of GDP and inflation; nevertheless, the variables became stationary following the initial differencing. Thus, applying the ARDL model makes sense because all the variables were of orders I (0) and I (1), and it reliably confirms that there are no I (2) series.

3.5. Bound test for cointegration

We first performed the unit root test and then followed by the bound test for cointegration. When determining whether a set of time series variables are cointegrated, which implies that they have a long-run relationship, the bound test is a statistical test for cointegration that is frequently used. Cointegration demonstrates that the variables move together over the long run, despite likely short-run oscillations. Cointegration demonstrates that over the long run the variables move together regardless of any short-term fluctuations. Table 3 below shows the results of the bound tests. Since the F-statistic is bigger than the upper bound value I (1) at the 5% significance level, the alternative hypothesis that there is evidence of cointegration can be accepted in light of the data. We estimated the long run coefficients of the model using the ARDL technique once the cointegration of the variables was established. Table 4 below displays empirical data that shows a long-run correlation between public debt, inflation rate, budget deficit, exchange rate, GDP, and trade variables. Conversely, Table 4 indicates that all other variables do not predict unemployment in Ghana, with the exception of public debt and remittances, which influence unemployment in the long-run. Thus, whiles public debt positively and significantly correlates with unemployment, remittances was found to affect unemployment negatively and significantly in the long run. Inflation records a negative coefficient which implies that inflation negatively correlates with public debt in the long run in Ghana. Thus, there is a negative correlation between inflation and public debt with a coefficient of 4.69. This finding is inconsistent with our a priori expectations considering that government of Ghana recorded budget over runs, with high inflationary pressures in the midst of high and very volatile public debt conditions over the period. This result is congruent with that of

Dumitrescu, Kagitci et al. (2022). It is however at variance with the results of Montanti (2023), Olaoye (2023), Saungweme and Odhiambo (2021), and Shuaibu et al. (2021) who found no relationship between inflation and public debt.

In Ghana, budget deficit also correlates negatively with public debt with a coefficient of 5.92, ceteris paribus. This evidence is unexpected since budget deficits are sometimes undesirable because to finance the fiscal deficit may imply borrowing by governments of developing countries which consequently lead to soaring up of their debt burden. The results suggest that the exchange rate correlates positively with public debt with a coefficient of 18.59. Increasing exchange rates implies that a country's local currency is losing value in relation to the foreign currency that is used to pay for the debt, if it has borrowed money in that currency. Consequently, more local currency would be needed to pay back the debt. We further found GDP to negatively correlate with public debt with a coefficient of 11.19, all things being equal. This result is anticipated since growth in GDP implies a boost to economic activities which promote revenue generation in the domestic economy; and that could ultimately contribute to reduction of public debt. In contrast, this negative effect of GDP on public debt is at variance to the finding of Fincke and Greiner (2015). Trade in the equation positively correlate significantly with public debt in the long run with a coefficient of 1.12. This positive effect of trade on public debt is unexpected because high trade volumes rather improve balance of payment conditions of economies. This result supports the conclusion that trade surpluses in the northern countries of the euro area caused an increase in public debt in the periphery nations (Zestos et al., 2016). Moreover, this suggestion is in stark contrast to the claim that a favorable sign for trade means that nations participating in international trade can achieve economic expansion through imports and exports. For instance, it is said that exports of goods and services represent a substantial source of foreign exchange that helps to create jobs whiles also relieving pressure on the balance of payments (Potdar & Shihab, 2014). With the results of the effect of public debt on unemployment, the study recorded a positive influence of public debt on unemployment in the long-run. Precisely, public debt is positively associated with unemployment with a coefficient of 0.07. This result supports prior studies by Shuaibu et al. (2021), Igberi et al. (2016), Olaoye (2023), and Pemberton et al. (2013) but at variance with Iwuoha (2020). As expected, remittances have a negative effect on unemployment in Ghana. Thus, remittances correlate negatively with unemployment with a coefficient of 0.62. Since remittances are meant to spur investment and thus support economic growth, and lower unemployment, this outcome is beneficial. Therefore, this finding may be attributed to

Table 5. Estimated short-run results.

	Model 1		Model 2	
Variable	Coeff	Prob	Coeff	Prob
C	62.8033	0.0008	0.9573	0.0002
	(4.5435)		(0.2124)	
D(INF)	−0.8724	0.0017		
	(0.0806)			
D(BD)	0.7663	0.0841		
	(0.3008)			
D(EXR)	−5.8179	0.0090		
	(0.9594)			
D(GDP)	−4.9251	0.0010		
	(0.3840)			
D(TR)	0.9398	0.0009		
	(0.0701)			
D(PD)			0.0371	0.0005
			(0.0092)	
D(REM)			0.0122	0.8655
			(0.0709)	
CointEq (-1)*	−1.0621	0.0008	−0.5623	0.0000
	(0.0764)		(0.1001)	
Observation	29		31	
R-squared	0.9898		0.7365	
Log likelihood	−47.7106		−24.4248	
DW stat	2.5628		1.9826	
F-statistic	38.6347		13.9731	
Prob (F-stat)	0.0000		0.0000	

Source: Author's estimation, 2023.
Note. Numbers in brackets represent standard error.

Ghana's productive utilization of remittances. The result corroborates with prior studies by Mazher et al. (2020; Asad et al., 2016) but is incongruent with findings from studies by Saani et al. (2023), Orji et al. (2019), and Kim (2007) who posit that remittances positively corelate with unemployment in Ghana, Nigeria and Jamaica, respectively.

3.6. Short run dynamics

From Tables 5 below, as expected, the ETC"CointEq (-1)" has a negative coefficient and is statistically significant for both models 1 and 2. This refers to the error correction term of the models which indicates that the variables in the models have a long-run relationship. The error correction term measures the rate of adjustment from the short run to the long run. Therefore, the ETC recommends that fluctuations in unemployment and public debt need to be adjusted at a rate of 0.562 and 1.062, respectively, to preserve long-run convergence to equilibrium. Empirical evidence from the results indicates that in Ghana inflation rate (D INF) correlate negatively and significantly with public debt. Therefore, inflation is negatively associated with public debt in the short run with a coefficient of 0.87. Notably, public debt and unemployment had a positive correlation in the short-run. In other words, an increase in public debt is associated with a corresponding increase in the unemployment of Ghana and vice versa. Remittances records a 0.012152 coefficient which suggest that, remittances correlate positively with unemployment in Ghana. In the short -run, public debt and budget deficit was found to be positively related but insignificant. Public debt is influenced by the exchange rate and GDP negatively and significantly in the short -run, all other factors remaining constant. Specifically, we found that public debt associates negatively with the exchange rate of Ghana with a coefficient of 5.82. Moreover, public debt was found to correlate negatively with the GDP of Ghana in the short run. This result is expected because growth in GDP is supposed to yield some wealth for a possible reduction of the debt burden. A favorable exchange rate will boost trade especially exports which would create revenue that could facilitate a reduction of the public debt. A decrease in public debt in Ghana may be possible through a devaluation of the cedi to promote export, enhance tourism, resulting in higher foreign exchange earnings for a possible reduction of the public debt. Finally, trade in our equation affect public debt positively which is statistically significant in the short run. Specifically, in Ghana trade was found to correlate positively with public debt with a coefficient of 0.94. This could be attributed to trade imbalance emanating from the import led economy status of the country. Ghana is grappling with trade deficits resulting from balance of payment short falls. Ins other to finance the deficit government may have to borrow. Secondly, if Ghana relies on short-term or high-interest rate loans to finance its trade activities, it can lead to a debt crisis. This is occasioned where the country struggles to meet its debt obligations. Consequently, this may lead to further borrowing and hence may result in an increase in the public debt.

Table 6. Residual and stability tests results.

Effect of inflation on public debt - Model 1		
Method	F-Statistic	Prob
Serial correlation	34.85601	F (2, 1) = 0.1189
Heteroscedasticity	2.909614	F (25, 3) = 0.2060
Normality (Jarque-Bera)	2.235262	0.327054, Normal
CUSUM	Within 5% critical region	Stable
CUSUMSQ	Within 5% critical region	Stable
Effect of public debt on unemployment- Model 2		
Serial Correlation	0.046930	F(2,20) = 0.9543
Heteroscedasticity	1.033135	F (8,22) = 0.4417
Normality (Jacque -Bera)	1.355566	0.507442, Normal
CUSUM	Within 5% critical region	Stable
CUSUMSQ	Within 5% critical region	Stable
CUSUMSQ	Within 5% critical region	Stable

Source: Author's construct, 2023.

3.7. Residual and stability diagnosis

The Breusch-Pagan residual test for heteroskedasticity, the Jarque-Bera test for normality, and the LM test for serial correlation are used in this investigation. Table 6 below revealed that the probability values of the F statistic were higher than the usual significance level of 5%, implying that the data is normally distributed and that the model is free from serial correlation and heteroskedasticity issues. The CUSUM and CUSUMSQ, which are shown in figures A and B at the Appendix, are typically used to confirm the stability of the parameters. Models estimated at the 5% level of significance are shown to be stable since all of the blue lines fall inside the boundaries.

4. Conclusions and policy recommendations

This paper seeks to analyze the inflation, public debt and unemployment nexus in Ghana. To conduct the study, annual data was sourced from WDI spanning from 1990 to 2022. The ARDL technique was employed to investigate the intricacies and to understand the long run and short run dynamics among the variables. The empirical results point to a long-run correlation between Ghana's public debt and the country's inflation rate, budget deficit, exchange rate, GDP, and trade. Interestingly, we discovered that with exception to public debt and remittances, which have a long-run effect on unemployment no other variable could explain unemployment in Ghana. Consequently, whiles public debt has a positive and strong short and long run correlation with unemployment, remittances exhibit a negative and significant long-run correlation with unemployment. This could be due to excessive government borrowing by government of Ghana with the associated crowding out effect of business, the downgrades in credit ratings resulting in government's inability to access foreign investment. This militates against the implementation of expansionary policies to create jobs in both the short and long run. Contrary to our expectation inflation negatively and significantly correlates with public debt in Ghana in both short run and long run. This may be the case if the government incur debt with fixed interest rates or debt denominated in local currency, which turns to bear a lower real burden as inflation rises. However, this is true only when the estimation of the public debt is made in real terms since the actual outstanding debt burden remains fixed over time. After controlling for all other variables, GDP produced a statistically significant and negative effect on Ghana's public debt burden over the short and long-run. This is expected, since a growing economy usually means the government will generate more revenue from domestic tax revenue and other sources like foreign direct investment to spend on debt repayment. Accordingly, government can allocate a larger portion of its budget to paying off debts. Trade (economic openness) of Ghana affect public debt positively and its significant at 5% in the short and long run. This is possible in Ghana more especially where our imports exceed exports resulting in trade imbalances and currency depreciation. Such trade deficits and expensive imports, can strain foreign exchange reserves and consequently cause government to borrow to finance trade. Finally, whiles in the short run exchange rate correlates negatively with public debt, in the long run the exchange rate positively affects public debt in Ghana. This could be attributed to exchange rate fluctuations especially in the short run where the depreciation of the local currency turns out to boost exports and economic growth. This can potentially lead to higher government revenues through taxation. Higher revenues can be used to reduce budget deficits and, in turn, reduce the need for additional borrowing, thereby reducing the growth rate of public debt. In the long run the positive effect of exchange rate on public debt may be attributable to the continuous depreciation of the local currency with the associated increasing cost of foreign currency denominated debts, inflationary pressures, budget deficits, higher interest rates on bonds and due to low investor confidence etc. The study recommends that government of Ghana should consider contracting foreign debts with fixed interest rates or opt for local currency denominated loans, and prioritize domestic over external borrowing. This will serve as a hedge against increasing debt burden resulting from the volatile inflationary pressures. Moreover, it is desirable to reduce public debt through GDP (sustainable economic growth) strategies in other to mitigate the positive effect of public debt on unemployment. By investing in vital infrastructure and promoting agriculture and manufacturing to stimulate economic activities, the public debt burden could be alleviated in both short and long runs. Furthermore, government should improve the trade balance by promoting exports of a broader range

of manufactured products, whiles embarking on import substitution drive. Thus, the government can reduce the debt burden by leveraging trade effectively.

Data source

Data source was WDI (World Development Indicators) maintained by the World Bank. The data we used for this study covered the period 1990–2022.The WDI database covers a wide range of data on macroeconomic variables which includes inflation, unemployment etc. Interms of data size, the WDI database covers a vast amount of data on hundreds of countries over several decades. This data source by the World Bank is publicly and freely accessible through the World Bank's website (data.worlbank.org). WDI data base is free and can be accessed and used by any one especially for non-commercial purposes. Therefore, WDI is an open access data base and users do not necessarily require any rights and permission to use it.

Disclosure statement

We, the authors of the manuscript titled "Inflation, Public Debt, and Unemployment Nexus in Ghana: An ARDL Analysis," hereby declare that we have no relevant financial or non-financial competing interests that could be perceived as influencing the objectivity, integrity, or publication of this paper. We confirm that this research was conducted with utmost objectivity, and the findings and conclusions presented in the manuscript are based on our unbiased interpretation of the data.

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Data availability statement

The data is available upon request.

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Appendix

Table A1. Variables and their measurement.

Variable	Definition	Measurement
PD	Public debt	Total domestic and foreign debt as a percentage of GDP
INF	Inflation rate	Inflation as measured by the consumer price index
UNEMPT	Unemployment rate	Labour force as a percentage of total working age population
TR	Trade (Openness of the economy)	Imports plus exports (% of GDP)
REM	Foreign Remittances received	Total remittances received (% of GDP)
GDP	Gross Domestic Product	Annual percentage growth rate of GDP at market prices
GCF	Gross Capital Formation	Gross Capital Formation as a percentage of GDP
FDI	Foreign Direct Investment	Foreign Direct Investment as a percentage of GDP
EXR	Exchange rate	Exchange rate in US dollars as percentage of GDP
BD	Budget deficit	Budget deficit as a percentage of GDP

Source: Author's construct, 2023.

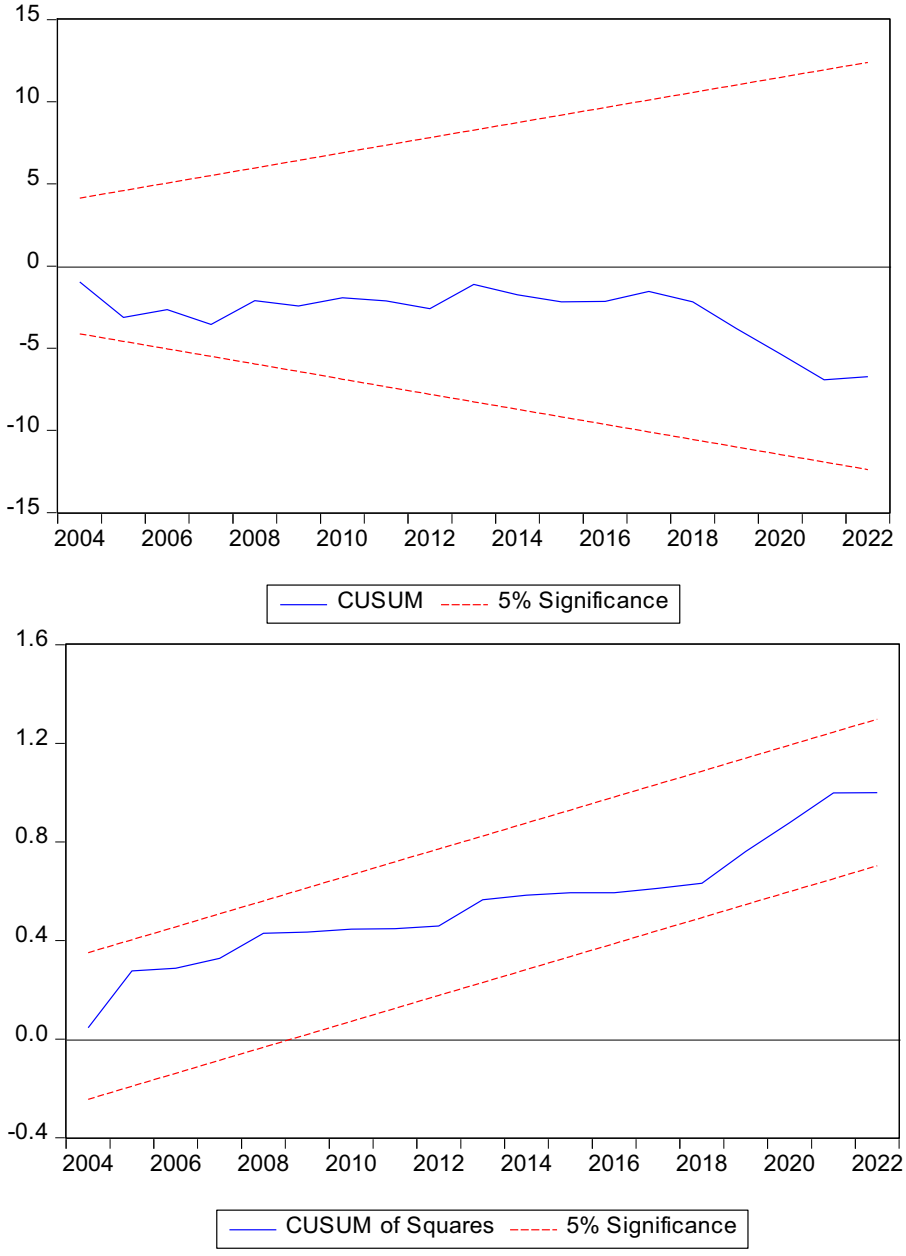

Figure A1. Stability test for Model 1.

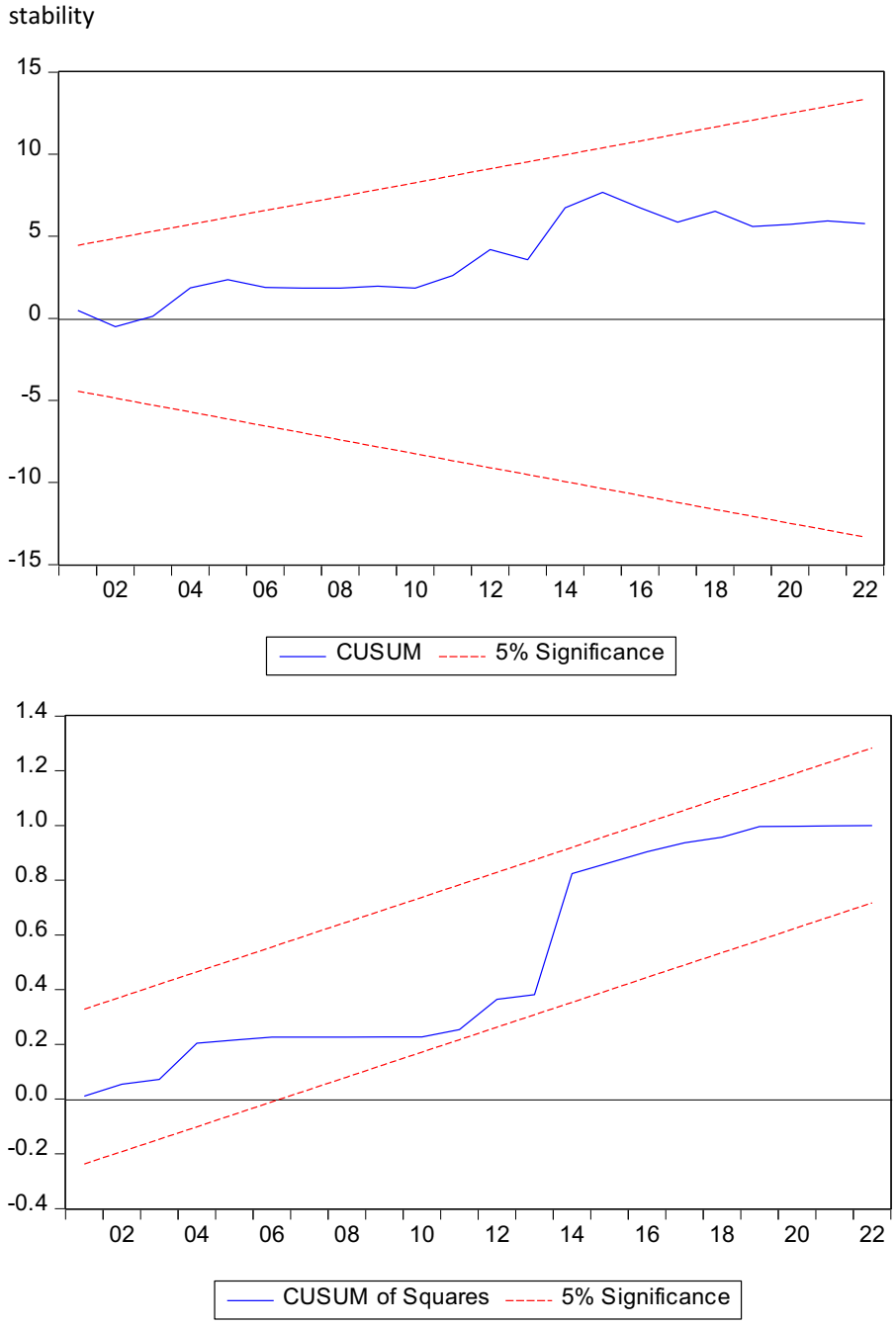

Figure B1. Stability test for Model 2.