Inflation Determinants and its Effect on Public Debt: The Case of Egypt

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ABSTRACT

Purpose: This study examines the factors determining inflation and how it affects Egypt's public debt using annual data from 1976 to 2022 under the ARDL approach.

Design/ Methodology/Approach: This study applies the bounds testing approach and the ADF test along with diagnostic tests for heteroscedasticity and serial correlation. CUSUM, CUSUM squared and Ramsey tests assess the impact of inflation on Egypt's public debt.

Findings: Results reveal that both in the long and short term, public debt adversely influences inflation. Conversely, public debt is unaffected by inflation over the long run. In the short term, this relation becomes negative.

Conclusion: The study offers several critical advantages. It highlights the complexity of analyzing inflation and public debt, emphasizing their importance for economic stability, policy success, intergenerational justice, and investor confidence, recommending focusing on factors most influencing inflation and public debt.

Research Limitations/implications: During the study period, the Egyptian economy experienced political shifts, external shocks and global events, complicating the assessment of inflation's impact on public debt. However, the study provides insights for stable economic growth strategies.

Practical implications: The findings help policy makers balance debt and inflation for long term stability, guiding central banks to control inflation without increasing public debt.

Contribution to Literature: The research enriches economic literature by considering a wide range of factors, providing a deeper understanding of debt-inflation dynamics for better policy making. Household consumption drives demand-pull inflation and PCE is used instead of CPI to provide a more comprehensive view of inflation's impact on public debt.

Keywords: *ARDL, Egypt, Household consumption, Inflation, PCE, Public debt.*

1. INTRODUCTION

Economists worldwide are giving attention to the problem of persistent inflation. Inflation is generally understood to be a continuous and steady rise in the overall level of prices causing a decline in the purchasing power (Lim & Sek, 2015).

Debates on inflation stem from the differences that take place between industrialized and developing nations. Jung and Marshall (1986) as cited in Dastgerdi (2020) argue that cost push and demand-pull inflation theories mostly explain inflation in industrialized nations but they fall short in explaining the causes of inflation in emerging nations. In fact, the structural inflation theory has provided a fundamental understanding of the causes of inflation in these countries by focusing on their economic structures.

Several studies address that the two main structural reasons of inflation in emerging nations are the government's fiscal constraints and foreign exchange restrictions. The problems they face include inadequate and constrained capital markets as well as unsuitable tax and subsidy structures. Because of such restrictions governments are forced to find alternative means of financing deficit especially through the creation of new money which limits the

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monetary authority's ability to manage inflation (Tanzi, 1978, Kirkpatrick & Nixson, 1987; Ghatak & Sanchez-Fung, 1995 cited in Dastgerdi (2020)).

In the same issue, debt- financed deficits are the primary source of public debt. In order to raise extra funds to cover government spending requirements that cannot be satisfied by traditional tax means, emerging nations are turning to greater public debt where government spending is expanding more quickly than revenues and the majority of the surplus is financed by borrowing from both domestic and foreign sources (Aimola & Odhiambo, 2020).

Researchers when looking into the association between public debt and inflation have carried out a number of studies in advanced and emerging nations using variety of approaches, datasets, and estimating techniques. Results have been mixed, as certain research indicates an adverse link between the two, while other findings indicate a positive one (Abdukadir & Abdulle, 2024).

Previous investigations have frequently produced conflicting results. This indicates the complexity of the relationship underlying public debt and inflation. The study adds a number of worthwhile aspects to the existing literature. First, it employs the personal consumption expenditure index (PCE) to measure inflation instead of the consumer price index (CPI). PCE offers a more accurate illustration of consumer behavior (McCully, Moyer, & Stewart, 2007). Second, it provides a wide range of factors influencing inflation rather than being limited. Third, the study focusses on household consumption, a major driver of demand-pull inflation to provide a thorough view on inflation and how it impacts public debt.

The paper's reminder is as follows: Section 2 offers an overview of relevant research that is more pertinent to the topic with the hypotheses. The econometric model is described in section 3 along with the discussion of the methodology. Section 4 provides the results' analysis and key findings. Section 5 concludes the study.

2. LITERATURE REVIEW

The public debt-inflation relationship has received significant attention in economic research because of its important ramifications for macroeconomic stability and policy making. Researchers have long sought to understand how rising public debt levels influence inflationary trends, particularly when it comes to advanced and emerging countries. The dynamics of this relationship are intricate and influenced by a variety of factors. Despite the extensive body of research, results remain inconsistent due to using diverse data sets, time periods and methodological approaches (Abdukadir & Abdulle, 2024).

Karakaplan (2009) analyzed a sample of 121 countries, encompassing advanced as well as developing nations, from 1960 to 2004. Using an unbalanced panel data set and the generalized method of moments (GMM) approach, the study reveals an inverse relationship between public debt an inflation among nations with developed financial markets.

Reinhart and Rogoff (2010) evaluated the interaction among inflation, high public debt levels, and growth in 24 emerging market countries and 20 advanced economies. Their research indicates that in advanced economies, an adverse relationship between public debt and inflation is present. In emerging markets, the association is positive.

Bilan and Roman (2014) examined the public debt-inflation relationship in 22 advanced and emerging nations across the period 1990 to 2012. According to their analysis, the two variables showed a positive correlation in developing nations.

Nastansky, Mehnert, and Strohe (2014) used quarterly data from 1991 to 2010 for Germany and employed the vector error correction model. Their findings revealed that consumer prices were positively influenced by public debt levels.

Van Bon (2015) used GMM Arellano-Bond regression in examining the public debt-inflation relationship for 15 developing Asian economies from 1990 to 2012.The study stated that inflation was positively impacted by public debt in these countries.

Essien, Agboegbulem, Mba, and Onumonu (2016) focused on Nigeria, using data from 1970 to 2014 and applying the VAR framework. Their findings showed that neither external nor domestic public debt significantly affected the country's total pricing levels.

Afonso and Ibraimo (2020) employed quarterly data across the time span 2000 to 2016 to find out the overall impact of public debt on the Mozambican economy. The study applied a structural VAR estimation approach and

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found no evidence of an inflationary effect from either external or total debt. However, it did suggest that domestic debt positively influenced short-term price levels.

Aimola and Odhiambo (2021) used yearly data across the period 1983 to 2018 to look into the relation between inflation and Ghana's public debt. Their results, following the ARDL approach and accounting for structural breaks, reveled a positive influence of public debt on inflation in the country.

While these studies among others have provided valuable insights about public debt-inflation relationship, certain critiques have been made regarding their methodologies. For instance, Reinhart and Rogoff's study has been criticized for not fully capturing the disparities in inflation experiences over time and across countries. Their approach has been deemed overly simplistic. Other critiques include biases in data selection and the failure to account for dynamic economic factors and country specific conditions (Herndon, Ash, & Pollin, 2014).

The above discussion ensures the complexity of the inflation-public debt relationship and hence the need of more complex models that incorporate a broader range of economic parameters in order to provide a more accurate understanding of this relationship.

To broaden the scope of research a broad array of factors has been used over the short and long run term to clarify inflation through its determinants and then examine its impact on public debt.

The literature has looked at a number of variables to explain inflation such as lending interest rate, deposit interest rate, money supply, real effective exchange rate, government spending, government revenues, and public debt (Al-Mutairi, Al-Abduljader, & Naser, 2020; George-Anokwuru & Ekpenyong, 2020; Kwon, McFarlane, & Robinson, 2009; Mirza & Rashidi, 2018; Munir, 2022; Rachman, 2019).

Ramady (2009) identified money supply as a vital aspect contributing to inflation. According to Armesh, Salarzehi, Yaghoobi, and Heydari (2010) and Iya and Aminu (2014) a boost in money supply positively impacts inflation. Conversely, other research suggests an adverse effect between the two (Inam, 2014; Olubusoye & Oyaromade, 2008; Tang & Lean, 2007).

The directionality of the causal relationship between inflation and the money supply has been studied in more detail by further studies. Sasongko and Huruta (2018); Su, Fan, Chang, and Li (2016); Zhang (2013) and Kesavarajah and Amirthalingam (2012) found that money supply and inflation are causally related in a one-way direction. In contrast, Denbel, Ayen, and Regasa (2016) found that there is a bidirectional relation between the two variables.

The dynamics of inflation are further affected by exchange rates. Al-Ezzee (2016) indicated that over the long - term, inflation is influenced by the nominal effective exchange rate, while Loukil (2017) found no substantial effect of exchange rate on inflation. In turn, Sharaf and Shahen (2023) claimed that inflation is adversely affected by the nominal effective exchange rate. While Munir (2022) argued that over the long-term inflation is adversely impacted by real effective exchange rate, Asad, Ahmad, and Hussain (2012) found that real effective exchange rates and inflation are positively correlated.

The government spending-inflation relationship has produced mixed results in literature. Mehrara, Soufiani, and Rezaei (2016) found that government expenditure does not affect inflation in situations characterized by tight monetary policy or low liquidity growth. The long-term government spending-inflation relationship on the other hand, was found to be negative and statistically significant, according to George-Anokwuru and Ekpenyong (2020). The same study identified a positive but statistically insignificant short-term relationship between the two variables. In turn, Imoisi, Ajudua, and Odishka (2023) concluded that across the short and long run term, government expenditure did not affect inflation.

Research on the government revenues and inflation relationship is more limited. Maskie and Hoetoro (2021) found that the boost in inflation is accompanied by the increase in government revenues.

In the context of aggregate demand, household consumption is often considered an important factor. Bonsu and Muzindutsi (2017) noted that inflation is one of the factors influencing household consumption. This study discusses the other way round examining how household expenditure impacts the rate of inflation.

Critiques of studies examining the determinants of inflation often point to several key issues including methodological challenges, the complexity of inflation's underlying causes and the need for a more comprehensive approach to understanding inflation. A common concern is the tendency to place excessive emphasis on monetary factors, which may result in policy recommendations that focus too narrowly on adjusting monetary policy-either through tightening or expansion. This focus can overlook important non-monetary factors that also contribute to inflation, thereby limiting the effectiveness of policy responses. A more balanced approach that incorporates both

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monetary and non-monetary influences is essential for a clearer understanding of inflation dynamics (Choudhri & Hakura, 2006; Mishkin, 2007).

As previously mentioned, the precise nature of inflation-public debt relationship remains unclear. However, majority of research suggests that while inflation adversely affects public debt, public debt tends to have a positive impact on inflation (Van Bon, 2015).

Public debt has an adverse long-term impact on inflation, according to Taghavi (2001) while the short- term relationship is still unclear. Other research showed that public debt has a positive impact on inflation. Yien, Abdullah, and Azam (2017) and Lopes da Veiga, Ferreira-Lopes, and Sequeira (2016) for instance came to the conclusion that rising public debt tends to drive up inflation over time.

In contrast, some research has focused on the reverse relationship i.e., how inflation influences public debt. Akitoby, Binder, and Komatsuzaki (2017) looked at how different inflation rates affected public debt and found that if inflation were to remain at zero, the average net debt would rise by approximately 5% over the next five years. Conversely, high inflation helps in reducing public debt to some extent. This finding coincides with the work of Hilscher, Raviv, and Reis (2014) who contend that the real value of outstanding government debt may decline as inflation rises.

Further supporting this perspective, Aizenman and Marion (2011) suggest that governments may have an incentive to promote inflation to a certain level, which could, in turn, reduce the debt to GDP ratio. However, this view is not universally accepted. Sargent and Hall (2010) contend that inflation has only a negligible effect on public debt reduction, suggesting that the influence of inflation on public debt may be less significant than some studies indicate.

In light of the previously given literature three hypotheses are formulated:

H_1*: Public debt has an inverse relation with inflation.*

H_2*: Household consumption positively impacts inflation.*

H_3*: inflation negatively influences public debt.*

Under these hypotheses personal consumption expenditure (PCE) is used instead of the consumer price index (CPI) to provide a more comprehensive view of inflation and its subsequent impact on public debt.

3. METHOD

Time series data from 1976 to 2022 is used in this study in order to achieve its primary goal, which is to investigate how inflation affects Egypt's public debt. The selected time frame is based on data availability. Time series analysis develops mathematical models that provide credible explanations for the sample data (Shumway, Stoffer, & Stoffer, 2000). Therefore, it is appropriate here. Data is extracted from the IMF and the World bank annually from 1976 to 2022.

Using the autoregressive distributed lag (ARDL) testing approach, this study will examine the factors influencing inflation and how it affects Egypt's public debt under two distinct models. The fundamental concept of the ARDL is that all variables should be integrated at first difference or at level. They may never be integrated at I(2) but may be mutually integrated. This is the primary advantage that fortifies the ARDL model and qualifies it for the current investigation. Also, ARDL can cope with a variety of lag structures. It is also suitable for small sample sizes unlike other cointegrating approaches (Pesaran & Shin, 1995; Pesaran, Shin, & Smith, 2001; Shin, Yu, & Greenwood-Nimmo, 2014).

Based on Munir (2022); Dilanchiev and Taktakishvili (2021); Kia and Sotomayor (2020); Mirza and Rashidi (2018) and Bashir (2011) who examined a number of variables that could influence inflation, the model employed is:

$$\mathrm{INF_t} = \beta_0 + \beta_1 \mathrm{LEND_t} + \beta_2 \mathrm{DEP_t} + \beta_3 \mathrm{M_t} + \beta_4 \mathrm{EXCH_t} + \beta_5 \mathrm{EX_t} + \beta_6 \mathrm{REV_t} + \beta_7 \mathrm{DEBT_t} + \beta_8 \mathrm{CONS_t} + \varepsilon_t \quad (1)$$

To measure inflation Personal consumption expenditure rather than the consumer price index is used (McCully et al., 2007). Based on Engen and Hubbard (2004); Kariuki (2013); Andreas Nastansky and Strohe (2015); Couharde, Rey, and Sallenave (2016); Del Monte and Pennacchio (2020); Reis (2022); Gogas, Plakandaras, and Papadimitriou (2014) and Lai, Trang, and Kuo (2015) model (2) is specified as follows:

$$\mathrm{DEBT_t} = \beta_0 + \beta_1 \mathrm{LEND} + \beta_2 \mathrm{DEP_t} + \beta_3 \mathrm{M_t} + \beta_4 \mathrm{EXCH_t} + \beta_5 \mathrm{EX_t} + \beta_6 \mathrm{REV_t} + \beta_7 \mathrm{CONS_t} + \beta_8 \mathrm{INF} + \varepsilon_t \quad (2)$$

The dependent variable in Equation 1 is INF (inflation) as determined by personal consumption expenditure *(PCE). In Equation 2 INF is an independent variable.* Personal consumption expenditure computed as nominal consumption over real consumption in constant 2015 USD ×100*. The dependent variable of Equation 2 is DEBT. It*

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represents the total public debt in constant 2015 USD. In both models the intercept is β_0. The models' coefficients are β_0……β_8. The independent variables are the following: real lending interest rate in % is denoted by (LEND), the real deposit interest rate in % by (DEP), broad money in constant 2015 USD by (M), the real effective exchange rate index by (EXCH), the total government expenditure in constant 2015 USD by (EX), the government revenues in constant 2015USD by (REV), the total debt in constant 2015 USD (DEBT) and the household consumption expenditure in constant 2015 USD (CONS). Logarithmic form is used to express all variables with the exception of interest rates.

The study employs the ARDL approach as developed by Pesaran et al. (2001). First is an analysis of the Augmented Dickey Fuller (ADF) unit root test (Dickey & Fuller, 1981 mentioned in Chang and Park (2002)). Second, to investigate long-term correlation among the models' variables, the bounds testing method is employed. The null hypothesis, which denotes that there is no long run cointegration, is rejected only when the computed F-statistics value surpasses the lower and upper critical values. The conclusion can't be drawn If the F-statistics lies between the two critical values. If F-statistics value is below the critical values, the null hypothesis fails to be rejected. (Pesaran & Shin, 1995; Pesaran et al., 2001).

Third, the variables' long-term cointegration must be confirmed (Pesaran et al., 2001). Fourth, diagnostic and stability tests to evaluate the ARDL models' goodness of fit are applied. The residuals' serial correlation, heteroscedasticity and normality distributions are all examined in the diagnostic analysis. To check for stability, the CUSUM along with CUSUM square tests are employed as recommended by Brown et al. (1975) mentioned in Dritsaki and Stamatiou (2019).

4. RESULTS

Testing the stationarity of the ARDL model is the first phase in the analytical process. Yule (1926) asserted that if a series has a unit root, it is non-stationary. Augmented Dickey Fuller is prevalent and effective here taking into account the variables' integration order in the model (Dickey & Fuller, 1981 mentioned in Chang and Park (2002)).

Table 1. Unit root test (ADF) on the individual series.

Variable	Series		P-value	Series in first difference		P-value
	Test statistic	Dickey-Fuller critical value (5%)		Test statistic	Dickey-Fuller critical value (5%)	
INF	-1.304	-2.928	0.6199	-5.036	-2.928	0.000
LEND	-5.374	-2.927	0.0000	-	-	-
DEP	-3.766	-2.927	0.0061	-	-	-
M	-2.995	-2.927	0.0428	-	-	-
EXCH	-3.897	-2.931	0.0044	-	-	-
EX	0.148	-2.928	0.9660	-6.188	-2.928	0.000
REV	-2.182	-2.928	0.2153	-6.548	-2.928	0.000
DEBT	-1.858	-2.928	0.3486	-4.159	-2.928	0.002
CONS	0.567	-2.929	0.9872	-4.984	-2.929	0.000

At 5% level Table 1 indicates that with the exception of LEND, DEP, M and EXCH which are integrated at level, all other variables are integrated at first difference.

ARDL model responses to the number of lag orders. The model which has the lowest Schwartz information criterion (SBIC) and lowest Akaike Information Criterion (AIC) is determined as identified by Stock and Watson (1993).

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Table 2. Maximum number of lags: Inflation model.

Lag	AIC	SBIC	HQ
0	4.049	4.415	4.185
1	-10.892	-7.243*	-9.539
2	-12.768	-5.834	-10.197
3	-15.338*	-5.119	-11.549*

Note: *denotes the optimal lag.

Table 3. Maximum number of lags: Public debt model.

Lag	AIC	SBIC	HQ
0	4.049	4.415	4.185
1	-10.892	-7.243*	-9.539
2	-12.768	-5.834	-10.197
3	-15.338*	-5.119	-11.549*

Note: *denotes the optimal lag.

Table 2 and Table 3 show that maximum lag when applying Hannan-Quinn Information Criterion (HQ), Schwarz information criterion (SBIC), and Akaike Information Criterion (AIC). Upon applying Schwarz information criterion (SBIC), the optimal lag is 1. The optimal lag is 3 when applying AIC and HQ. Among other lags these are the lowest values (- 15.338 for AIC, -7.243 for SBIC, -11.549 for HQIC). ARDL regression at optimal distributed lags according to Akaike and Schwarz criterion is the first phase in model estimating (Stock & Watson, 1993). Examining the variables' short- and long -term correlation is the second phase.

Table 4. ARDL regression Inflation model.

ARDL (1, 1, 2, 2, 2, 3, 3, 3, 3) regression						
Sample: 1976-2022	Observations					47
	R-squared					0.998
	Adjusted R-squared					0.995
	Root mean squared error (RMSE)					0.020
	F-statistic					284.567
Log likelihood = 108.16	Prob > F					0.000
inf	**Coefficient**	**Standard error**	**T**	**P > |t|**	**[confidence interval 95%]**	
INF						
L1	0.386	0.124	3.108	0.007	0.121	0.651
LEND						
L0	-0.001	0.004	-0.379	0.710	-0.009	0.007
L1	0.014	0.005	2.560	0.022	0.002	0.026
DEP						
L0	-0.007	0.004	-2.071	0.056	-0.015	0.000
L1	0.000	0.002	0.131	0.897	-0.005	0.006
L2	0.006	0.002	2.404	0.030	0.000	0.011
M						
L0	0.240	0.160	1.504	0.153	-0.100	0.580
L1	-1.595	0.341	-4.676	0.000	-2.322	-0.868
L2	1.124	0.302	3.716	0.002	0.479	1.769
EXCH						
L0	0.164	0.076	2.156	0.048	0.002	0.327
L1	-0.244	0.110	-2.214	0.043	-0.479	-0.009
L2	-0.305	0.072	-4.228	0.000	-0.459	-0.151
EX						

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L0	0.217	0.583	0.371	0.715	-1.026	1.460
L1	-0.055	0.614	-0.090	0.929	-1.365	1.254
L2	-0.507	0.569	-0.890	0.387	-1.720	0.706
L3	-0.749	0.430	-1.742	0.102	-1.665	0.167
REV						
L0	-0.595	0.178	-3.334	0.005	-0.975	-0.215
L1	-0.209	0.176	-1.188	0.253	-0.585	0.166
L2	0.288	0.138	2.086	0.054	-0.006	0.582
L3	-0.122	0.101	-1.202	0.248	-0.337	0.094
DEBT						
L0	-0.143	0.125	-1.147	0.269	-0.409	0.123
L1	0.082	0.155	0.532	0.603	-0.248	0.412
L2	-0.357	0.133	-2.682	0.017	-0.642	-0.073
L3	0.269	0.092	2.909	0.011	0.072	0.465
CONS						
L0	1.452	0.479	3.033	0.008	0.432	2.472
L1	1.965	0.580	3.386	0.004	0.728	3.201
L2	0.024	0.687	0.034	0.973	-1.440	1.487
L3	-1.130	0.532	-2.126	0.051	-2.264	0.003

Table 4 demonstrates how public debt and inflation relationship varies depending on the lags. At lag zero and lag one public debt does not influence inflation at 10% level. The result is consistent with that of Osei and Ogunkola (2022). At lag two public debt adversely influences inflation at 5% level while at lag three the correlation is positive at 5% level.

At 10% level, the lag two coefficient of household consumption is not significant. At 1% level, the lag zero and lag one coefficients of household consumption are positive. At 10% level, the lag three coefficient is negative. The basis of the p-value test of significance is provided by Rao (1992).

Table 5. ARDL regression: Public debt model.

ARDL (1, 0, 1, 0, 0, 1, 0, 1, 1) regression						
Sample: 1976-2022	Observations					47
	R-squared					0.989
	Adjusted R-squared					0.984
	Root mean squared error (RMSE)					0.058
	F-statistic					220.7183
Log likelihood = 68.03	Prob > F					0.000
DEBT	**Coefficient**	**Standard error**	**T**	**P > |t|**	**[confidence interval 95%]**	
DEBT						
L1	0.744	0.073	10.237	0.000	0.601	0.886
LEND						
L0	-0.001	0.003	-0.430	0.670	-0.008	0.005
DEP						
L0	0.008	0.003	2.318	0.027	0.001	0.015
L1	0.008	0.003	2.903	0.007	0.003	0.013
M						
L0	0.362	0.109	3.322	0.002	0.149	0.576
EXCH						
L0	-0.228	0.046	-4.991	0.000	-0.318	-0.138
EX						
L0	1.203	0.577	2.084	0.045	0.072	2.334
L1	0.739	0.611	1.210	0.235	-0.458	1.936
REV						

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L0	-0.211	0.118	-1.780	0.085	-0.443	0.021
CONS						
L0	0.176	0.534	0.330	0.743	-0.871	1.224
L1	1.637	0.517	3.165	0.003	0.623	2.651
INF						
L0	-0.386	0.132	-2.933	0.006	-0.645	-0.128
L1	0.360	0.127	2.841	0.007	0.111	0.6080

In Table 5, at 1% level; while inflation has an adverse impact on public at lag zero, the lag one coefficient is positive.

Table 6 provides the value of ADJ (-0.614) to represent the speed of adjustment. This shows how quickly the equilibrium distortion occurs. Long term coefficients in the first part of Table 6 show that public debt adversely influences inflation at the 10% level. The contribution from public debt is about 0.24%. Household consumption positively influences inflation at 1% level. The contribution from household consumption is about 3.8%. Hence, H_1 and H_2 are both accepted.

Table 6. ARDL short-run and long-run results: Inflation model.

ARDL (1, 1, 2, 2, 2, 3, 3, 3, 3) regression						
Sample: 1976-2022	Observations					47
	R-squared					0.9629
	Adjusted R-squared					0.9306
Log likelihood = 108.16	Root mean squared error (RMSE)					0.0203
INF	**Coefficient**	**Standard error**	**T**	**P > |t|**	**[Confidence interval 95%]**	
ADJ						
INF						
L1	-0.614	0.046	-13.241	0.000	-0.704	-0.523
LR						
LEND	0.020	0.013	1.603	0.130	-0.005	0.046
DEP	-0.002	0.009	-0.257	0.800	-0.019	0.015
M	-0.377	0.251	-1.499	0.154	-0.8670	0.116
EXCH	-0.626	0.228	-2.743	0.015	-1.074	-0.179
EX	-1.783	1.028	-1.733	0.104	-3.799	0.233
REV	-1.039	0.474	-2.189	0.044	-1.970	-0.109
DEBT	-0.244	0.123	-1.973	0.067	-0.487	-0.002
CONS	3.764	1.005	3.744	0.002	1.794	5.735
SR						
LEND						
D1.	-0.001	0.002	-0.833	0.418	-0.005	0.002
DEP						
D1.	-0.008	0.002	-4.843	0.000	-0.011	-0.004
M						
D1.	0.240	0.107	2.232	0.041	0.029	0.451
EXCH						
D1.	0.164	0.039	4.214	0.000	0.087	0.241
EX						
D1.	0.749	0.278	2.694	0.017	0.204	1.293
REV						
D1.	-0.595	0.094	-6.298	0.000	-0.780	-0.410
DEBT						
D1.	-0.143	0.074	-1.919	0.074	-0.289	0.003
CONS						

Nurture**: Volume 19, Issue 1, 114-132, **2025
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D1.	1.452	0.292	4.981	0.000	0.881	2.023

Similarly, the ADJ value of Table 7 is -0.256. This illustrates the speed at which the equilibrium distortion occurs. Long term coefficients in the first section of Table 7 show that household consumption positively influences public debt at 1% level. The contribution from household consumption is about 7.08%. Furthermore, inflation has no impact on public debt at 10% level. H_3 is rejected. Significance test relies on Rao (1992).

Table 7. ARDL short-run and long -run results: Public debt model.

ARDL (1, 0, 1, 0, 0, 1, 0, 1, 1) regression						
Sample: 1976-2022	Observations					47
	R-squared					0.730
	Adjusted R-squared					0.696
Log likelihood = 68.03	Root mean squared error (RMSE)					0.058
DEBT	**Coefficient**	**Standard error**	**T**	**P > |t|**	**[Confidence interval 95%]**	
ADJ						
DEBT						
L1	-0.256	0.030	-8.507	0.000	-0.315	-0.19726
LR						
LEND	-0.006	0.013	-0.435	0.666	-0.031	0.020
DEP	0.062	0.024	2.584	0.015	0.015	0.109
M	1.414	0.379	3.731	0.000	0.671	2.156
EXCH	-0.890	0.285	-3.126	0.003	-1.448	-0.332
EX	7.578	2.349	3.227	0.003	2.975	12.181
REV	-0.822	0.553	-1.487	0.147	-1.906	0.262
CONS	7.076	2.263	3.126	0.004	2.639	11.512
INF	-0.104	0.336	-0.310	0.759	-0.763	0.555
SR						
LEND						
D1.	-0.001	0.003	-0.430	0.670	-0.008	0.005
DEP						
D1.	0.008	0.003	2.318	0.027	0.001	0.015
M						
D1.	0.362	0.109	3.322	0.002	0.149	0.576
EXCH						
D1.	-0.228	0.046	-4.991	0.000	-0.318	-0.139
EX						
D1.	1.203	0.578	2.084	0.045	0.072	2.334
REV						
D1.	-0.211	0.118	-1.780	0.085	-0.443	0.021
CONS						
D1.	0.176	0.534	0.330	0.743	-0.871	1.224
INF						
D1.	-0.386	0.132	-2.934	0.006	-0.644	-0.128

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Table 8. Bound test: Inflation model.

H0: No long-run relationships exist					F	12.706
Third case					t	-13.242
F test	**10%**		**5%**		**1%**	
	I (0)	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**
F	1.95	3.06	2.22	3.39	2.79	4.1
T	-2.57	-4.4	-2.86	-4.72	-3.43	-5.37

Table 9. Bound Test: public debt model.

H0: No long-run relationships exist					F	12.706
Third case					t	-13.242
F test	**10%**		**5%**		**1%**	
	I (0)	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**
F	1.95	3.06	2.22	3.39	2.79	4.1
T	-2.57	-4.4	-2.86	-4.72	-3.43	-5.37

According to the results of Table 8 and 9, the F -statistic is 12.706. At 10%, 5%, and 1% level, this value is higher than the critical thresholds. H0 is therefore rejected (Kripfganz & Schneider, 2020). Consequently, the variables have a long -term correlation.

Some econometrics tests such as normality, heteroscedasticity, and serial correlation are crucial for diagnosing the inflation model and the public debt model. The Ramsey RESET often known as the misspecification test will be used. Furthermore, the CUSUM square and CUSUM tests will assess the models' stability.

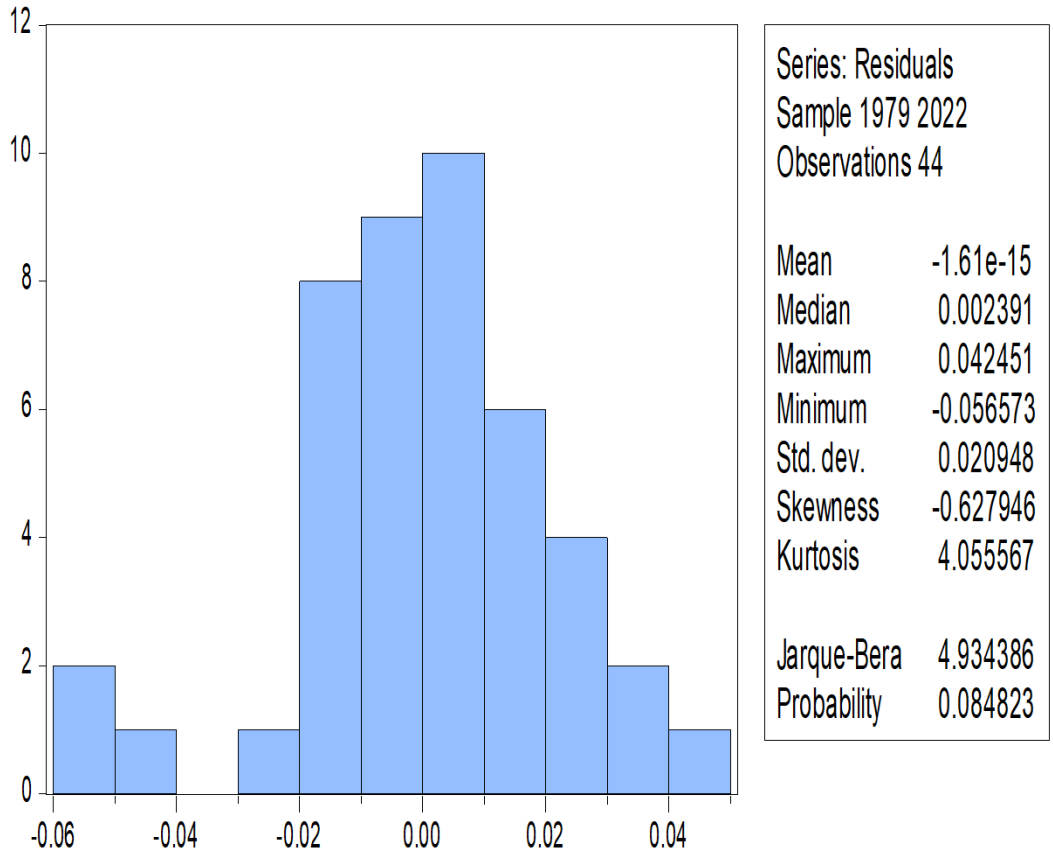

Figure 1. Normality test inflation model.

Nurture**: Volume 19, Issue 1, 114-132, **2025
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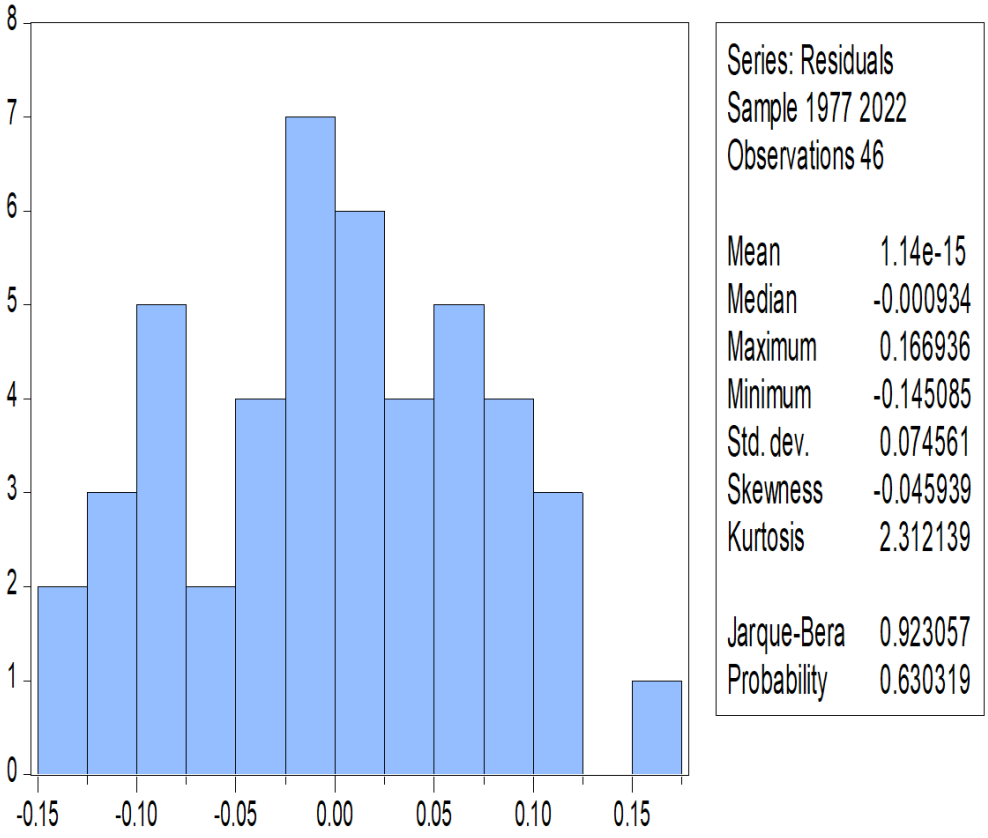

Figure 2. Normality test public debt model.

The p-values of Figure 1 and Figure 2 illustrate that H_0(The distribution is normal) is not rejected at 5% and 10% level of significance respectively confirming that the Jarque-Bera normality test was passed by the models for inflation and public debt (Jarque-Bera,1980 mentioned in Thadewald and Büning (2007)).

Table 10. Serial correlation test inflation model.

Breusch-Godfrey serial correlation test			
F-statistic	1.447	Prob. F (2,13)	0.271
Obs*R-squared	8.010	Prob. Chi-square (2)	0.018

Table 11. Serial correlation public debt model.

Breusch-Godfrey serial correlation test			
F-statistic	0.074	Prob. F (2,34)	0.929
Obs*R-squared	0.199	Prob. Chi-square (2)	0.905

The *10% level of significance H0 (the residuals are not correlated) is not rejected (Breusch, 1978; Godfrey, 1978* mentioned in Uyanto (2020).

The lack of autocorrelation is demonstrated in Tables 10 and 11 where the p-value shows that at 10% level of significance H0 (The residuals are not correlated) is not rejected (Breusch, 1978; Godfrey, 1978 mentioned in Uyanto (2020)).

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Table 12. Heteroscedasticity test inflation model.

Heteroscedasticity test: Breusch-Pagan-Godfrey			
F-statistic	0.919	Prob. F (28,15)	0.591
Obs*R-squared	7.796	Prob. Chi-square (28)	0.475
Scaled explained SS	4.935	Prob. Chi-square (28)	1.000

Table 13. Heteroscedasticity test public debt model.

Heteroscedasticity test: Breusch-Pagan-Godfrey			
F-statistic	1.094	Prob. F (9,36)	0.392
Obs*R-squared	9.876	Prob. Chi-square (9)	0.361
Scaled explained SS	3.969	Prob. Chi-square (9)	0.914

Table 12 and Table 13 demonstrate that the residuals for the inflation and public debt models are homoscedastic. At the significance level of 10%, the null hypothesis that the residuals are homoscedastic fail to be rejected (Breusch and Pagan, 1979 mentioned in Uyanto (2020)).

Table 14. Ramsey test inflation model.

Ramsey RESET test			
Specification: INF INF (-1) LEND LEND (-1) DEP DEP (-1) DEP (-2) M M (-1) M (-2) EXCH EXCH (-1)			
REV (-2) REV (-3) DEBT DEBT (-1) DEBT (-2) DEBT (-3) CONS CONS (-1) CONS (-2) CONS (-3) C Omitted variables: Squares of fitted values			
RESET test	**Value**	**df**	**Probability**
t-statistic	0.125127	14	0.9022
F-statistic	0.015657	(1, 14)	0.9022
F-test summary	Sum of sq.	df	Mean squares
Test SSR	2.11E-05	1	2.11E-05
Restricted SSR	0.018870	15	0.001258
Unrestricted SSR	0.018849	14	0.001346

Table 15. Ramsey test public debt model.

Ramsey RESET test			
Specification: DEBT DEBT (-1) LEND DEP M EXCH EX REV CONS INF C			
Omitted variables: Squares of fitted values			
RESET test	**Value**	**df**	**Probability**
t-statistic	0.514842	35	0.6099
F-statistic	0.265063	(1, 35)	0.6099
F-test summary	Sum of sq.	df	Mean squares
Test SSR	0.001880	1	0.001880
Restricted SSR	0.250172	36	0.006949
Unrestricted SSR	0.248292	35	0.007094

Using the misspecification test also called the Ramsey RESET test, Table 14 shows that the null hypothesis is true. p value of 0.9022 is higher than the significance level of 10%. This confirms that the model of inflation is well-defined and has no omitted variables. Likewise, the p-value of 0.6099 obtained in Table 15, is over the 10% level of significance. This supports the validity of the null hypothesis. The model is well specified and no omitted variables available (Hendry, 1995 mentioned in Fuinhas and Marques (2012)).

The CUSUM and CUSUM square tests show that the parameters of the ARDL models are stable over the course of the sample period (Brown et al., 1975 cited in Dritsaki and Stamatiou (2019)). This is clearly shown in Figures 3,4,5 and 6. Red lines indicate critical boundaries at the 5 % level of significance.

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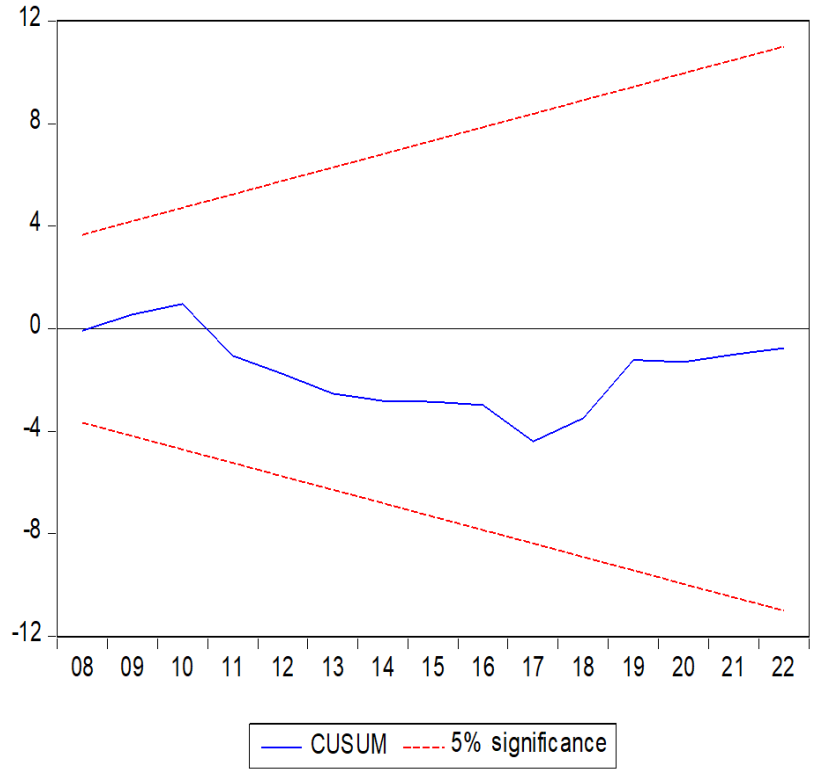

Figure 3. CUSUM test inflation model.

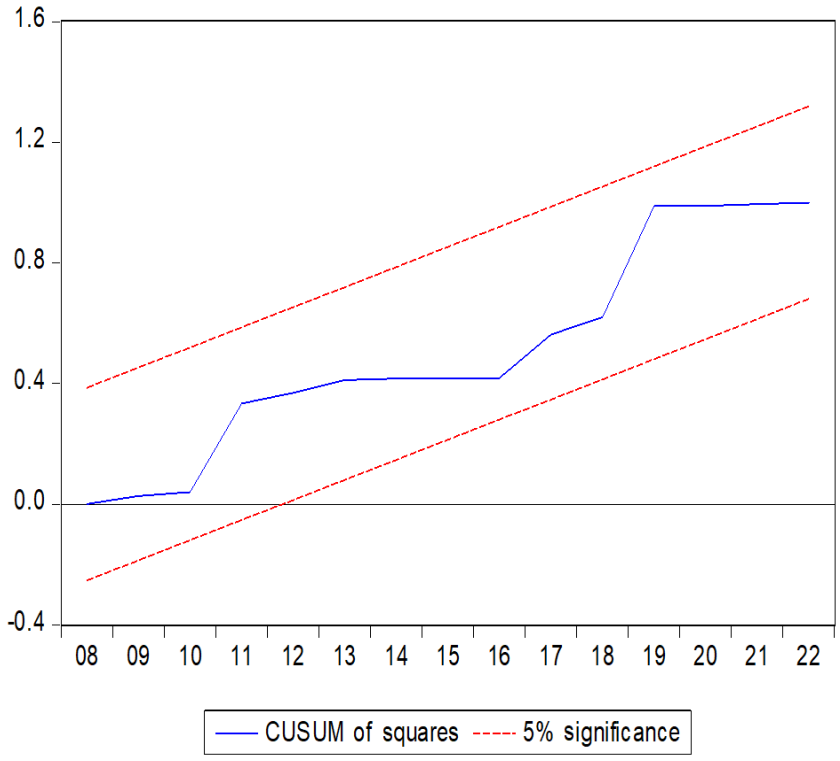

Figure 4. CUSUM square test inflation model.

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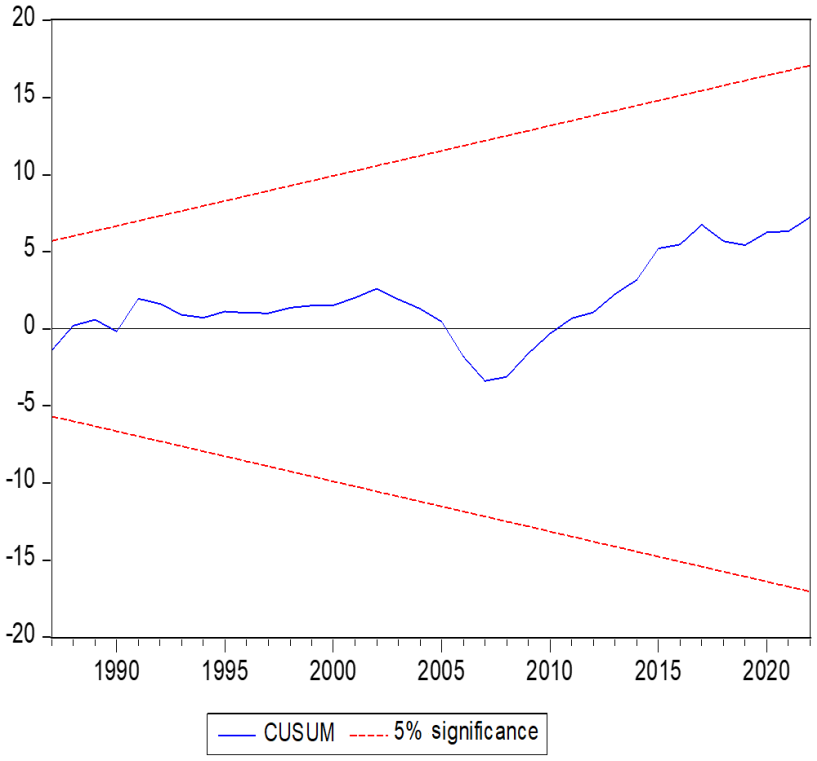

Figure 5. CUSUM test public debt model.

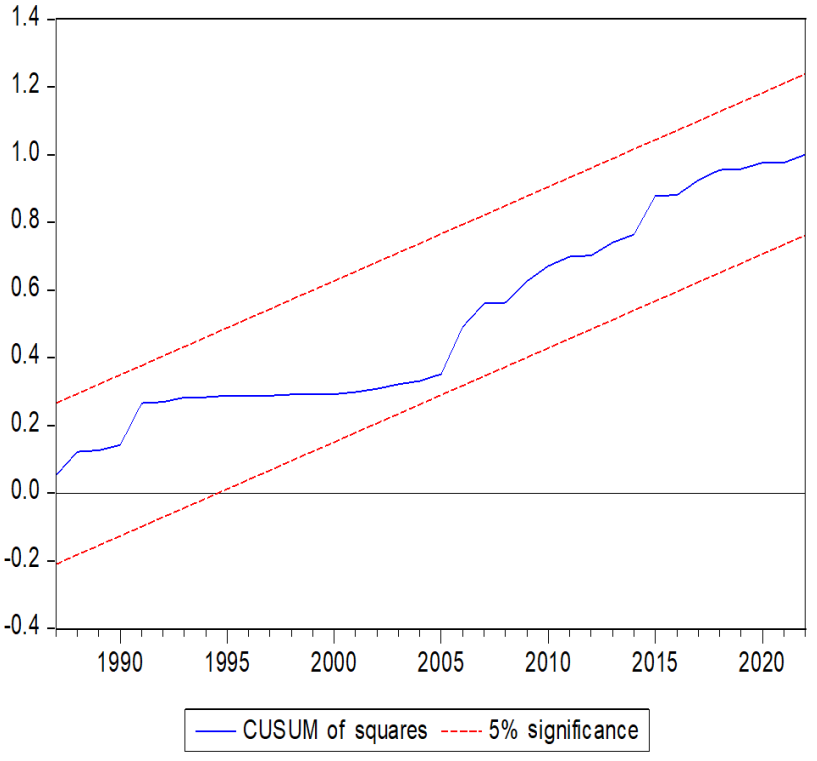

Figure 6. CUSUM square test public debt model.

Variations are found in empirical research towards the findings related to public debt and inflation.

Nurture**: Volume 19, Issue 1, 114-132, **2025
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According to some studies public debt has a positive influence on the rate of inflation (Ahmad, Sheikh, & Tariq, 2012; Kwon, McFarlane, & Robinson, 2006; Lopes da Veiga et al., 2016; Martin, 2015; Nastansky et al., 2014; Sargent & Wallace, 1981; Van Bon, 2015). Other studies reveal that the two variables are adversely correlated (Essien et al., 2016; Ezirim, Mojekwu, Amuzie, & Muoghalu, 2016; Karakaplan, 2009). In fact, results are influenced, by the estimation method, sample period, and the country indicated. This study supports previous studies showing an adverse long-term cointegrated correlation between public debt and the rate of inflation. On another stream, inflation has an adverse impact on public debt. This aligns of the findings of Akitoby et al. (2017). Moreover, Keynes (1936) mentioned in Meltzer (1981) *states that one of the three elements of effective demand is household consumption where inflation results from an excess of effective demand over the level necessary for full employment. According to this study household consumption positively influences inflation. In contrast with previous research that focused on just a couple of variables, the findings of the current research offer a more thorough and nuanced understanding of the mechanisms influencing the dynamics of inflation and debt taking into account variety of variables including household consumption.*

5. CONCLUSION

The autoregressive distributed lagged order (ARDL) is used in this study to identify the factors influencing inflation and how they affect public debt in Egypt within the time span 1976 to 2022. Confirming stationarity was the first phase in the econometric test. The variables were integrated at first difference, with the exception of money supply, lending interest rate, real effective exchange rate and deposit interest rate which were all stationary at level.

Under the ARDL approach, analysis indicates that public debt adversely impacts inflation over the long and short-terms. In contrast, public debt is unaffected by inflation. Furthermore, throughout the long and short run terms, inflation is positively influenced by household consumption. The study has an array of benefits. To promote long-erm prosperity and sustainable economic growth while maintaining economic stability, developing effective policies, ensuring intergenerational justice, and preserving investor confidence, the study recommends prioritizing the factors that have the most significant impact on inflation and public debt.

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INSTITUTIONAL REVIEW BOARD STATEMENT

Not Applicable

TRANSPARENCY

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study is available upon request. Data is available at the World Bank [http://data.worldbank.org] and the IMF [http://www.imf.org/en/data]

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript

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