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Asymmetric Effect of Public Debt on Inflation in Pakistan: A Time Series Analysis

Maryam Munawar
Department of Economics, University of Gujrat, Pakistan
Moniba Sana
Assistant Professor Department of Economics, University of Chakwal, Chakwal
moniba.sana@uog.edu.pk
Atif Ali Jaffri
Associate Professor Department of Economics, University of Gujrat, Pakistan

ABSTRACT
The present study has assessed the influence of public debt on yearly CPI inflation in Pakistan over the period 1983-2024, employing the NARDL approach of cointegration and error correction model. The model incorporates control factors such as money supply, real per capita growth, and trade openness. The research has also examined the asymmetric relationship between state debt and inflation in Pakistan. Both in the long term and short term, an increase in the public debt to GDP ratio has a positive and significant impact on inflation, while a drop in the public debt to GDP ratio is minimal. The results demonstrated evidence of an asymmetric influence in both the long term and the overall regression. Pakistan's debt-to-GDP ratio significantly exceeds the threshold for developing nations, resulting in almost two-thirds of tax revenue being allocated to debt servicing, so severely undermining macroeconomic stability in the country. The inflationary nature of rising debt necessitates that borrowing in Pakistan be restricted to economic purposes, hence avoiding superfluous fiscal expansion.

Keywords: *Public Debt, CPI Inflation, Asymmetric, NARDL*.
JEL Classification: E31, H63, C22, E62

1. Introduction

The percentage change in price level called inflation has important place in measuring macroeconomic performance of an economy where other goals are to create sustainable growth, employment creation and equilibrium in balance of payments. Inflation surged globally, impacting numerous countries due to heightened demand and diminished supply resulting from lockdown measures during the COVID-19 pandemic. However, Table 1.1 reveals that after three years of epidemic, the inflation started to drop down and hopes were that inflation will decline more in future. This does not mean that actual prices would decline rather the rate at which prices were increasing will reduce. Figure 1.1 illustrates that inflation in FY2025 decreased to 4.7 percent, following rates of 23.4 percent in FY2024 and 29.2 percent in FY2023.

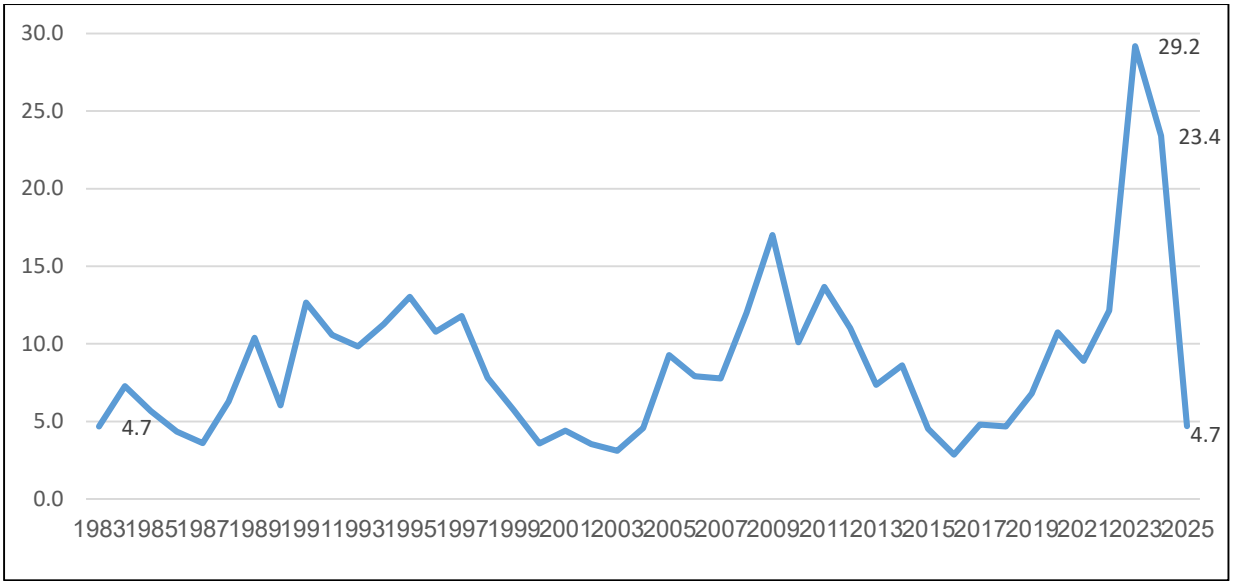


Figure 1.1: Historical View of CPI Inflation Rate in Pakistan

Numerous factors contribute to inflation, such as the accumulation of public debt and the related costs of servicing that debt in developing nations like Pakistan. On a global scale, projections indicate that the debt to GDP ratio is anticipated to exceed 100% by the year 2030, as per the IMF. This forecast has sparked considerable apprehension among economists and policymakers around the world, given the potential adverse effects on the global economy. The increase in worldwide debt can primarily be ascribed to both developed nations, such as the United States and Japan, and emerging economies, including China and India, as indicated in the OECD Global Debt Report of 2025.

Table 1.1: Top 20 Countries with Highest Rate of Inflation (2020-2024)

Rank	Country	2020	2021	2022	2023	2024
1	Zimbabwe	557.21	98.546	193.399	667.361	560.981
2	Argentina	42.015	48.409	72.431	133.489	249.793
3	Sudan	163.258	359.092	138.808	171.471	145.535
4	Venezuela	2355.15	1588.51	186.542	337.458	99.981
5	Turkey	12.279	19.596	72.309	53.859	59.52
6	South Sudan	23.984	30.229	-3.21	40.195	54.754
7	Sierra Leone	13.447	11.874	27.209	47.716	39.118
8	Iran	36.43	40.214	45.752	41.5	37.5
9	Egypt	5.7	4.5	8.5	24.392	32.547
10	Malawi	8.639	9.343	20.839	30.295	27.892
11	Nigeria	13.247	16.953	18.847	24.66	26.311
12	Ethiopia	20.354	26.794	33.938	30.219	25.572
13	Pakistan	10.741	8.901	12.148	29.181	24.757
14	Haiti	22.945	15.941	27.576	44.1	23.013
15	Ghana	9.885	9.976	31.713	37.531	22.271
16	Angola	22.277	25.765	21.36	13.639	22.004
17	Burundi	7.305	8.313	18.888	26.955	21.964
18	Lao P.D.R	5.104	3.754	22.959	31.23	21.5
19	Suriname	34.89	59.12	52.448	51.582	20.741
20	Congo	11.358	8.989	9.266	19.894	17.247

Source: International Monetary Fund, World Economic Outlook Database, April 2024

Pakistan has amassed an extraordinary level of public debt and liabilities amounting to Rs.84.9 trillion, coupled with substantial debt servicing that consumes 77 percent of tax revenue in FY2024. This situation is exerting inflationary pressures and restricting growth to a mere 2.7 percent in FY2025. The debt to GDP ratio of 67.4 percent in FY2024 significantly exceeds the recommended threshold of 25-30 percent as suggested by the World Bank and IMF for emerging economies such as Pakistan (SBP, AR FY2024). This persistent trend is increasingly alarming to policymakers, as it undermines macroeconomic stability, especially in developing nations where monetary authorities tend to be less robust and more reliant when it comes to the formulation and execution of monetary policies. Consequently, the relationship between public debt and inflation plays a pivotal role in the inflationary dynamics of an economy (Aimola & Odhiambo, 2020).

The primary aim of the proposed study is to assess the influence of public debt on inflation in Pakistan. Additionally, the specific objectives are to:

1. Assess the influence of aggregate debt on inflationary trends in Pakistan from 1983 to 2024.
2. Examine the asymmetric effects of public debt on inflation in the context of Pakistan for the period spanning 1983 to 2024.
3. Formulate policy recommendations grounded in the empirical findings of the study.

In this context, a substantial body of literature has examined the implications of increasing public debt on inflation, as evidenced by the works of Bhat and Sharma (2020), Aimola and Odhiambo (2021b), Saungweme and M Odhiambo (2021), Aimola and Odhiambo (2021a), Ahmad (2022), Helmy (2022), and Siddiqui, Iftikhar, and Naqvi (2022). Moreover, several studies have demonstrated the asymmetric nature of the relationship between public debt and inflation, as evidenced by the works of U Aimola and M Odhiambo (2022), Sharaf and Shahen (2023), Saungweme, Maluleke, and Odhiambo (2023), and Sharaf, Shahen, and Binzaid (2024). Nevertheless, regarding Pakistan, there have been only a limited number of studies conducted historically, highlighting a significant gap in the literature. There exists an urgent necessity to generate contemporary evidence that encompasses the past four years, a period during which the nation's debt has effectively doubled. Furthermore, Pakistan is currently navigating challenges associated with newly established agreements with the IMF, which complicate efforts to attain robust economic growth and job creation.

This study aims to enhance the existing literature concerning Pakistan by providing contemporary evidence on the inflationary effects of public debt and examining the asymmetric relationship that exists between public debt and inflation. This research addresses a significant gap in the literature by examining the asymmetric relationship between total public debt and inflation over the period from 1983 to 2024. The analysis employs the contemporary estimation technique known as NARDL, as introduced by Shin et al. (2014), a methodological approach that has not been utilized in prior studies.

2. Review of Literature

The theoretical literature posits that an escalation in public debt leads to an increase in interest rates, which subsequently triggers a wealth effect that stimulates demand, ultimately resulting in heightened inflation. This indicates that public debt exerts a considerable influence on inflation (Woo & Kumar, 2015). From the perspective of monetarism, inflation is fundamentally regarded as a monetary phenomenon, indicating that it is primarily influenced and regulated by monetary policy measures. The supply of money constitutes a critical determinant of inflationary pressures, and it is noteworthy that an increase in the money supply often correlates with a rise in debt levels. Estimating the impact of total public debt on future

inflation rates is crucial for policymakers, as it enables them to formulate appropriate fiscal and monetary policies in response to economic conditions. Research indicates that a low rate of inflation can contribute to economic stability. Furthermore, a significant number of economists contend that accurately forecasting inflation serves as an effective strategy for mitigating future uncertainties. (Oner, 2010). The existing body of literature provides a pertinent case study of the United States and various other nations during the period from 1970 to 1980, when high inflation emerged as a significant economic challenge in these regions. The elevated inflation rates have resulted in numerous challenges for consumers and producers alike, ultimately leading to economic instability and the potential for recession, even within developed nations. It can be concluded that maintaining a low rate of inflation is essential for the stabilization of the economy. However, it is imperative that the rate does not fall below zero, as this could lead to deflation, a phenomenon that poses greater risks than inflation. (Billi & Kahn, 2008)

Nevertheless, attention has also been directed towards the significance of fiscal policy in managing inflationary pressures. (Romero & Marín, 2017). The fiscal theory of price level presents a perspective that stands in contrast to monetarist views, positing that it is not money supply that influences inflation, but rather the role of debt in this dynamic. (Niepelt, 2004; Gordon & Leeper, 2006). The escalation of foreign loans denominated in foreign currency serves as a significant factor contributing to the depreciation of the domestic currency. The devaluation of domestic currency leads to a situation where trade openness adversely impacts the price level, thereby exacerbating the depreciation of the currency. This phenomenon is particularly pronounced in developing countries, where imports typically exceed exports. The elevation in the price level can be attributed to the rising costs associated with imported raw materials. The effects of trade openness exhibit significant variation across developed nations. (Kurihara, 2013). Furthermore, a modest level of debt can exert a beneficial influence on private investment; however, as the debt escalates, it begins to manifest adverse effects on investment, which ultimately impacts production in the long term. Following an escalation in total debt, when the public sector is compelled to finance its expenditures through augmented government borrowing, there is a resultant increase in interest rates. This elevation in rates tends to dissuade investors, as they find themselves unable to acquire capital at the now higher interest rates, ultimately resulting in a contraction of private investment. In the context of a declining trend in investment, one observes a concomitant shortage of supply within the market, which subsequently results in an increase in prices. (Penzin, Salisu, & Akanegbu, 2022).

A multitude of economists and researchers have provided empirical evidence utilizing various methodologies regarding the relationship between debt and inflation, grounded in the intricate interconnections of monetary and fiscal implications. The initial scholars to explore the impact of government debt on price levels include Musgrave in 1949, followed by Phelps in 1973, and later contributions from Nastansky and Strohe in 2015, as well as Kwon, McFarlane, and Robinson in 2009. Subsequently, numerous researchers expanded upon this inquiry, examining the effects in various regions globally, thereby illustrating the dynamic interplay between debt and inflation. This study engages with certain aspects of empirical research. A considerable body of contemporary research has established a notable correlation between public debt and inflation; however, there exists a paucity of studies that have explored the causal directionality between these two variables. Consequently, this study examines the dynamic Granger-causality relationship between external and domestic debt and inflation in Nigeria, covering the period from 1986 to 2019. The relationship between interest rates and economic growth has been treated as a set of intermittent variables to address the issue of omitted variable bias. The

study finds a one-way causal relationship from inflation to external debt. Additionally, while there exists a short-term relationship between domestic debt and inflation, a long-term causal relationship is identified from domestic debt to inflation (Aimola & Odhiambo, 2022). An analysis was conducted for a developed nation such as the United States, revealing a negative correlation between inflation and nominal public debt. A significant level of indebtedness had been amassed, necessitating a strategic approach to alleviate the debt burden. In 1946, when the public debt had escalated to 108.6%, it subsequently experienced a reduction of over one-third, primarily attributable to an increase in the price level. The model was developed to examine the phenomenon of public debt reduction in the context of increasing price levels. The analysis indicates that a 6% rise in inflation is projected to result in a 20% reduction in the debt-to-GDP ratio over a four-year period. Nonetheless, this uptick was marginally above the typical inflationary rate observed. Inflation serves as a crucial mechanism that can substantially reduce the debt-to-GDP ratio. In a scenario where the debt to GDP ratio exceeds 100%, one can anticipate that the price level will significantly surpass prior predictions (Aizenman & Marion, 2011).

A research study was conducted in the United States to examine the effects of alterations in public debt on inflation, interest rates, and output. This analysis utilized data spanning from 1980 to 1995 and employed VAR methodology to assess the validity of Ricardian equivalence theory. The variance decompositions indicate a positive relationship between debt and prices, as well as interest rates and output, whereas the impulse response functions reveal a negative impact. The findings suggest that an increase in debt leads to a decrease in prices, interest rates, and output, thereby supporting the Ricardian perspective as articulated by Wheeler in 1999. A further examination was conducted to scrutinize the interplay between public debt and inflation, taking into account the implications of the Fiscal Theory of the Price Level (FTPL). Furthermore, it incorporates both monetary and fiscal variables. The findings indicate that alterations in public debt exert inflationary pressures in general; however, the outcomes related to both monetary and fiscal variables present a mixed picture. This suggests that both monetary and fiscal policies significantly influence price determination within an economy. This study highlights the significance of both the Quantity Theory of Money (QTM) and the Fiscal Theory of the Price Level (FTPL) in the context of Paraguay during the period from 1993 to 2019 (Urquhart, 2022).

The dynamics of monetary policies are significantly influenced by fluctuations in public debt, which can yield detrimental consequences for an economy already grappling with elevated inflation levels, particularly when considering the impact of inflation expectations. Consequently, a study has been undertaken to examine the impacts of monetary factors in both emerging and developed economies. The findings indicate that fluctuations in public debt exert considerable influence on inflation within emerging economies, primarily due to the elevated levels of both public debt and prices, coupled with less rigorous monetary policies. In contrast, developed economies demonstrate a capacity to manage such public debt shocks effectively, attributable to their robust fiscal and monetary frameworks, which prevent inflation from escalating (Brandao-Marques, Casiraghi, Gelos, Harrison, & Kamber, 2024).

A recent study concerning Gambia explored a pertinent question regarding the nature of the relationship between public debt and inflation, specifically whether this relationship is symmetric or asymmetric, utilizing time series data spanning from 1978 to 2019. The research employed the NARDL technique to examine the relationship in question. The research demonstrated an asymmetric effect of public debt on inflation, revealing that positive shocks to

debt have a significant influence on inflation, whereas negative shocks to debt exhibit an insignificant impact on inflation in Gambia (U Aimola & M Odhiambo, 2022).

The escalating external debt in Cameroon presents a significant challenge that necessitates effective debt management strategies to address the issue appropriately. The current debt stands at 12 billion, representing 45% of the nation's GDP, which exceeds the established threshold level. A study was undertaken to examine the asymmetrical effects of debt on inflation, particularly in the context of developing nations that are already burdened by significant levels of debt. This situation poses a potential threat to the stability of their economic frameworks. The NARDL model was employed to examine asymmetry. The analysis revealed that debt exerts a considerable asymmetric influence on inflation over the long term. While the long-term effects of debt on inflation were predominantly positive, the short-term analysis revealed significant impacts stemming from both increases and decreases in debt levels. Consequently, attention was directed towards the government to mitigate the debt stock, as this could potentially lead to inflationary pressures in the long term (Ewane & Mejame, 2023).

In the context of Pakistan, both external and domestic debt represent significant mechanisms employed to address the fiscal deficit. The government's borrowing activities are linked to inflationary pressures, which can adversely affect the economy. Consequently, it is imperative to evaluate financing sources for fiscal deficits that exert the least inflationary pressure. In this context, a recent study was undertaken that empirically examined the inflationary impact of these resources by analyzing data spanning from 1972 to 2014 for Pakistan. The study employed the Johnson cointegration method and the ARDL model to explore the long-run relationship. The research findings indicate that, when evaluating various sources of both international and domestic borrowing, domestic loans—especially those obtained from central banks—are associated with higher costs and contribute more significantly to inflation compared to foreign loans and non-banking sources of finance (Ali & Khalid, 2019). The results of this investigation align with those of a previous study, which similarly underscores the inflationary effects of domestic borrowings from banks within the context of Pakistan. This study (Agha & Khan, 2006) presents empirical evidence that substantiates this argument.

An examination has been conducted regarding the impact of monetary policies on inflation across various timeframes in Pakistan. The factors contributing to the rate of inflation in various periods in Pakistan include the influence of monetary policies, supply shocks, and the escalation of international prices (Malik & Khawaja, 2006). This finding is corroborated by an additional analysis examining the determinants of inflation in Pakistan. The analysis indicated that monetary policies, alongside various factors such as inflation in trading nations, growth within the private sector leading to heightened demand and subsequent inflation, as well as expectations concerning price levels, exerted a positive and significant influence on inflation. In contrast, fiscal policies appeared to have minimal or negligible impact on inflation in Pakistan during the period of 2005-2006 (Khan, Ahmed, & Hyder, 2007). Within this area of inquiry, there exists additional empirical evidence that demonstrates a lack of association between inflation and budget deficits over the long term. The current inflationary trends can be attributed primarily to the dynamics of money supply, rather than an increase in fiscal deficits. Nevertheless, one cannot overlook the significance of fiscal deficits in influencing fluctuations in inflation. The process of monetary expansion is initiated to address both external and internal debt obligations, which subsequently leads to inflationary pressures (Mukhtar & Zakaria, 2010).

In contrast to the aforementioned findings that suggest inflation is predominantly a monetary phenomenon, it has been observed that fiscal deficits exert positive effects on inflation in Pakistan. It has been posited that deficits can exert a positive influence on inflation, as they contribute to an increase in the money supply or are subject to monetization. In this study, aside from the effects of money supply, a direct correlation between budget deficits and inflation has been identified, and this relationship is both statistically robust and significant. This observation has been corroborated by numerous studies, especially in the context of developing nations (Shabbir, Ahmed, & Ali, 1994). Inflation has long been correlated with fiscal deficits in Pakistan, with government debt serving as a significant factor positively associated with inflationary pressures. Consequently, it is imperative to recognize that fiscal policies play a vital role in achieving price stability in conjunction with monetary policies (Mughal et al., 2011).

A recent study has examined the asymmetric impact of government debt originating from within the country on inflation, revealing that domestic debt exhibits an asymmetric relationship with price levels in Pakistan. The rise in debt indicates a corresponding increase in prices; conversely, a reduction in debt similarly reflects an uptick in prices. The non-linear relationship in question has been examined utilizing the NARDL model, as demonstrated by the work of Hassan, Hassan, Kalim, Saeed, and Mahmood in 2023. The asymmetric effects of government debt on inflation in Pakistan have been examined for the period from 1992 to 2022 utilizing the NARDL methodology. In the same study, the asymmetric effects of money supply, currency appreciation or depreciation, and government expenditure on inflation have been assessed using the NARDL approach. The findings indicate a positive and asymmetric relationship in both the long run and the short run. The research additionally identified the causal link between the money supply and inflation (Zeb, Shuhai, & Ullah, 2024).

The persistent rise in public debt beyond a certain threshold, coupled with elevated inflation rates in Pakistan, poses significant risks to the economy. Consequently, it is essential to conduct a thorough empirical analysis of these variables using appropriate estimation techniques. Understanding their interrelationship is vital for the formulation of sound monetary and fiscal policies, ensuring that public debt is managed effectively and allocated efficiently towards economic and structural development initiatives. A study was undertaken to empirically examine the impact of public debt and inflation on the economic growth of Pakistan (Iqbal, Arif, Jadoon, & Rana, 2023). In addition to the influence of public debt on a nation's price level, one must also consider various other determinants that correlate with the rate of inflation, including economic growth, terms of trade, among others. In this context, a research study has demonstrated the correlation between these variables and inflation, concluding that a high rate of inflation is significantly negatively correlated with GDP growth and trade in Pakistan. Consequently, the examination of growth and terms of trade in conjunction with inflation is of paramount importance (Ahmad, 2022).

Based on the preceding discourse in the literature, it can be concluded that public debt predominantly exerts a positive and significant impact on inflation, both in the short term and the long term. Nonetheless, it is imperative to recognize that inflation is influenced by a multitude of variables beyond the realm of public debt. These include interest rates, exchange rates, economic growth, the money supply, fluctuations in international primary commodities, among various other determinants. Several studies have demonstrated the asymmetric nature of the relationship between public debt and inflation. In the context of Pakistan, there exists a limited number of studies examining the impact of public debt on inflation. Notably, there has been a lack of research focused on estimating the asymmetric characteristics of this relationship.

3. Methodology

This section delineates the model employed to assess the impact of public debt on inflation, considering both the short-term and long-term perspectives.

3.1 Model Specification

The empirical model developed in the present study draws upon the framework established by U Aimola and M Odhiambo in 2022. In this model, the dependent variable, inflation, is influenced by public debt, while control variables such as broad money supply, per capita GDP, and trade openness are also incorporated into the analysis. The analysis will employ time series data spanning from 1983 to 2024.

INF = f (PD, M2, PCG, OPEN,) ---------- (3.1)

Where

INF = Annual CPI inflation rate in Pakistan
PD = Total Public debt to GDP (in percentage)
M2 = Broad money supply to GDP ratio (in percentage)
PCG = Per capita real GDP growth (in percentage)
OPEN = Trade openness measured as merchandise trade to GDP ratio

The empirical model articulated in the semi-logarithmic format is presented below, wherein the coefficients of the explanatory variables yield elasticities directly, with the exception of the per capita growth variable.

$linft = \beta_0 + \beta_1 lpdt + \beta_2 lm2_t + \beta_3 pcg_t + \beta_4 lopen_t + \mu_t$ ---------- (3.2)

3.2 Estimation Technique

In order to elucidate the asymmetric effects of debt on inflation, this research utilizes the nonlinear autoregressive distributed lag (NARDL) methodology, as established by Shin et al. (2014), thereby extending the conventional ARDL framework in the following manner:

$linf_t = \delta_0 + \delta_1 lpd\mathbf{p}_t + \delta_2 lpd\mathbf{n}_t + \delta_3 lm2_t + \delta_4 pcg_t + \delta_5 lopen_t + \mu_t$ ----------(3.3)

4.3 Data Sources

The table 4.1 presented below delineates the data source for each variable under consideration. The anticipated effects of each independent variable on the dependent variable in Pakistan, as derived from the literature examining various countries, are also presented in the table below.

Table 4.1: Data Sources

Variables	Abbreviated as	Expected Impact	Data Source
Inflation Rate	INF	-	WDI, World Bank
Public debt to GDP Ratio	PD	Positive	WDI, World Bank
Money supply to GDP Ratio	MS	Positive	WDI, World Bank
Real GDP per capita Growth	PCG	Positive/Negative	WDI, World Bank
Trade openness	OPEN	Positive	WDI, World Bank

4. Estimation Results

4.1 Descriptive Statistics

This section presents the results of the analysis of the time series data for each variable, including measures of data dispersion and central tendency. Presented below in Table 4.1 are the descriptive statistics.

Table-4.1: Descriptive statistics

Variables	LINF	LPD	LMS	PCG	LOPEN
Mean	2.043	4.195	3.771	1.848	3.297
Median	2.062	4.179	3.814	1.759	3.317
Maximum	3.373	4.608	3.999	5.448	3.531
Minimum	1.051	3.761	3.357	-2.970	2.995
Std. Dev.	0.535	0.204	0.142	2.025	0.149
Skewness	0.162	-0.177	-1.084	-0.191	-0.423
Kurtosis	2.662	2.157	4.032	2.636	2.099
Jarque-Bera	0.384	1.462	10.096	0.489	2.676
Probability	0.825	0.481	0.006	0.783	0.262
Sum	85.804	176.177	158.380	77.596	138.473
Sum Sq. Dev.	11.756	1.709	0.827	168.230	0.908
Observations	42	42	42	42	42

4.2 Stationarity Tests:

Table-4.2: Augmented Dickey Fuller Test

Series	In levels		In first difference	
	With intercept	With trend and intercept	With intercept	With trend and intercept
LINF	-3.95(6)***	-		
LPD	-1.58(0)	-1.74(0)	-6.47(0)***	-6.38(0)***
LMS	-2.14(0)	-2.16(0)	-6.93(0)***	-5.18(0)***
PCG	-4.88(0)***	-4.82(0)***	-7.88(1)***	-7.76(1)***
LOPEN	-2.27(0)	-2.76(0)	-6.91(0)***	-6.84(0)***

In Table 5.2, the stationarity of the series has been evaluated through the application of the ADF unit root test. The findings suggest that all variables exhibit integration of order I(1), with the exception of LINF and PCG, which are integrated of order I(0). Notably, there are no variables that demonstrate integration of order I(2). The stationarity of the variables is reassessed through the application of the PP unit root test.

4.3 Brock, Dechert and Scheinkman (BDS) Test

Given the aim of examining the asymmetric relationship between inflation and public debt, it is essential to ascertain whether the time series data exhibits linear or non-linear characteristics.

Table- 4.3: BDS results

Dimensions	LINF	LPD	LMS	PCG	LOPEN
2	0.05(0)	0.14(0)	0.10(0)	0.01(0.5)	0.08(0)
3	0.04(0)	0.23(0)	0.17(0)	-0.01(0.4)	0.12(0)
4	0.05(0)	0.28(0)	0.21(0)	0.00(0.8)	0.16(0)
5	0.08(0)	0.30(0)	0.22(0)	0.00(0.9)	0.17(0)
6	0.10(0)	0.31(0)	0.20(0)	-0.02(0.2)	0.16(0)

The results of the BDS test, as presented in Table 4.3, indicate a rejection of the null hypothesis concerning identically and independently distributed (IID) data across all variables, with the exception of PCG. This outcome substantiates the existence of non-linearity and provides a rationale for the application of the NARDL model.

4.4 Bounds, Wald test and NARDL Model Results

4.4.1 Bounds Test and Walt Test

The bounds testing approach serves as a method for verifying the presence of cointegration among the dependent and independent variables within the model framework. The F-Statistic is calculated to be 5.022, indicating a significance level at 1%. Consequently, we reject the null hypothesis, leading us to conclude that there exists a cointegration relationship among the variables in question.

Table-4.4: NARDL-Bounds test for cointegration results

F-Statistic **5.022**

Critical values from Pesaran et al. (2001)	**10%**		**5%**		**1%**	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	2.080	3.000	2.390	3.380	3.060	4.150

Based on these findings, the long-run relationship between public debt and inflation can be empirically analyzed in NARDL model.

Table 4.5: Impact of public debt on inflation (Wald test)

	F-statistics	**Probability**	**Relationship status**
Long-run	24.45454	0.0000	Asymmetric effect exist in long-run
Short-run	0.196295	0.6611	Asymmetric effect does not exist in short-run
Long-run and Short-run Jointly	13.89182	0.0001	Asymmetric effect exist both in long-run and short-run jointly

The findings from the Wald test indicate that the relationship between debt and inflation exhibits asymmetry in both the long run and short run within the context of Pakistan.

4.4.2 Long run results (cointegrating equation)

Table 4.6: NARDL Model - Long Run Results

Variables	**Coefficients**	**Std. Error**	**t-stats**	**Probability**
LPD-POS	1.969957	0.605787	3.251896	0.0026
LPD-NEG	0.148486	0.372884	0.398211	0.6930
LMS	-2.739235	0.855228	-3.202929	0.0030
PCG	0.062481	0.067748	0.922252	0.3629
LOPEN	4.631505	0.774880	5.977060	0.0000

Following the analysis of the primary variable, we will now turn our attention to the examination of the coefficients associated with the control variables. The coefficient of money supply, denoted as LMS, indicates a negative and statistically significant effect of money supply on inflation over the long term. The Ricardian and Non-Ricardian approaches present a fundamental contradiction regarding the fiscal and monetary influences that determine inflation. The study's findings are substantiated by a non-Ricardian perspective, which posits that it is debt that instigates inflation rather than the money supply itself. The accumulation of debt to finance fiscal deficits leads to a wealth effect, suggesting that inflation should be viewed as a fiscal phenomenon rather than a purely monetary one (Woodford, 1998; Erdogdu, 2002). The findings indicate that a 1% augmentation in the money supply corresponds to a -

2.7% reduction in inflation over the long term. While this outcome does not align with the initial expectations of the study, it is nonetheless corroborated by research (Amassoma, 2018, p, 113) and the perspectives of the non-Ricardian and FTPL schools of thought, which indicate the existence of fiscal dominance, with monetary policy playing a more passive role. The metric for assessing the money supply is designated as M2, which does not encompass government debt. It encompasses solely the currency in circulation along with liquid assets. The per capita growth coefficient exhibits a positive value; however, it lacks statistical significance in the long run. This suggests that, in the long run, economic growth does not exert a significant influence on inflation in Pakistan. Therefore, it is imperative to consider additional variables when analyzing the determinants of inflation, rather than solely focusing on economic growth. In conclusion, we observe that the coefficient associated with trade openness is not only positive but also exhibits a high level of statistical significance. An increase of 1% in trade openness in Pakistan correlates with a 4.6% rise in inflation, indicating a substantial rate of inflation increase that is statistically significant. In the context of Pakistan, it can be observed that trade openness exerts an inflationary effect in the long run, demonstrating a positive and statistically significant relationship with inflationary trends. Both Sahu (2018) and Zakarıa (2010) arrived at identical conclusions. A considerable body of literature has demonstrated that trade openness tends to exert a favorable influence on inflation in emerging economies, in contrast to developed economies, where the relationship appears to be inversely correlated.

4.4.3 Short-Run Results

The Error Correction Model (ECM) serves as a valuable tool for examining the dynamics of both short-run and long-run relationships among variables, particularly in the context of their movement towards equilibrium following a disturbance or alteration in the independent variables. The ECM model examines the fluctuations of past data by analyzing the lagged values alongside the changes observed in the current period. The initial focus is on examining the impact of public debt on inflation within the framework of the ECM model. The variation in positive changes in debt appears to be negligible, while the negative changes in debt exert a notable influence on inflation in the short term. Specifically, a 1% reduction in debt is associated with a 1.6% increase in inflation, and the p-value indicates significance at the 1% level. The debt does not exhibit inflationary characteristics in the short run, assuming that it will manifest inflationary effects in the long run due to a cointegrating relationship. While the rate of change in inflation and the rate of change in the partial sum of squares of debt exhibit distinct behaviors, the application of a symmetry test on the short-run NARDL model revealed no evidence of an asymmetric relationship among the variables when analyzed independently. Nonetheless, the analysis revealed an asymmetric relationship that was observed across both the long run and short run periods collectively.

Table 4.7: NARDL model – short run results

Variables	Coefficient	Std. Error	t-Statistic	Probability
D(LPD-POS)	0.887104	0.804330	1.102911	0.2778
D(LPD-NEG)	1.608618	0.613665	2.621329	0.0130
D(PCG)	-0.033167	0.019458	-1.704488	0.0974
D(PCG(-1))	-0.064465	0.020128	-3.202770	0.0030
D(LOPEN)	1.970690	0.482879	4.081126	0.0003
ECM(-1)	-0.745256	0.114063	-6.533726	0.0000
Diagnostic Tests				
Jarque Bera Normality test (Prob.)			2.5031 (0.2860)	

Breusch-Godfrey serial correlation LM Test (Prob.)	1.4086 (0.2625)
CUSUM	Stable
CUSUMSQ	Stable

The differentiation of the variable PCG reveals a negative impact on inflation in the short run, with significance at the 10% level. A 1% increase in PCG exerts a negative influence on inflation, resulting in a decrease of 0.03%. This observation aligns with existing literature, which has examined the impact of per capita growth on inflation, revealing both positive and negative influences. Moreover, it is evident that the effects on inflation vary across different nations. Munyeka (2014) and Ahmad (2022) present evidence of a negative relationship between economic growth and inflation, whereas Datta (2011) demonstrates a positive relationship. This indicates that an increase in the per capita growth rate is associated with a decrease in the inflation rate. The variation in the lagged value of PCG indicates a detrimental effect on inflation, whereby a 1% increase in the differenced lagged value of PCG corresponds to a decrease in inflation of -0.06%. Furthermore, the p-value associated with this coefficient is notably significant at the 1% level. Consequently, PCG exhibits inflationary characteristics in both the preceding and current periods. Consequently, the implementation of PCG exhibits disinflationary effects in the short term within the context of Pakistan's economy. Upon examining the coefficient of trade openness, we observe that the differenced variable of LOPEN demonstrates a positive and statistically significant effect on inflation in the short term. Specifically, a 1% increase in trade openness correlates with a 1.97% rise in inflation, with this relationship being highly significant at the 1% level. Consequently, the findings indicate that trade openness exerts an inflationary effect in the present period, particularly in the short run, within the context of Pakistan. The ECM value is negative and statistically significant at -0.74, indicating that the long-run relationship between the variables adjusts towards equilibrium at a rate of 74% in response to a shock experienced in the previous period. In order to ascertain the robustness of the findings, a comprehensive suite of diagnostic tests has been conducted and the results are presented in table 4.7. Furthermore, the analysis of the CUSUM and CUSUMSQ plots indicates that the model has been appropriately specified, as illustrated in Figure 02. The multiplier graph (Figure 4.3) provides a visual representation that substantiates the asymmetric reaction of inflation to both positive and negative shocks in public debt.

Figure 02. Plot of CUSUM and CUSUMSQ of the Recursive Residulas

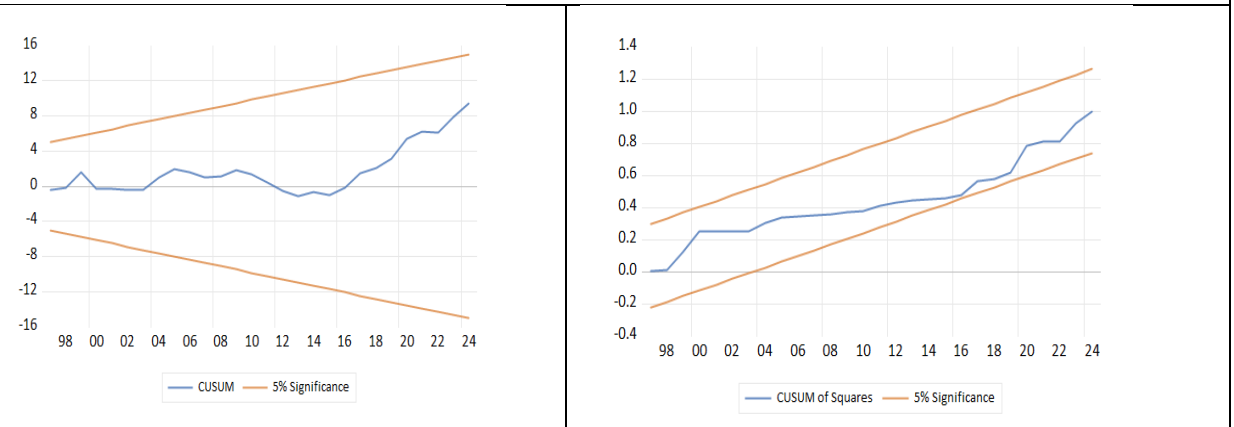
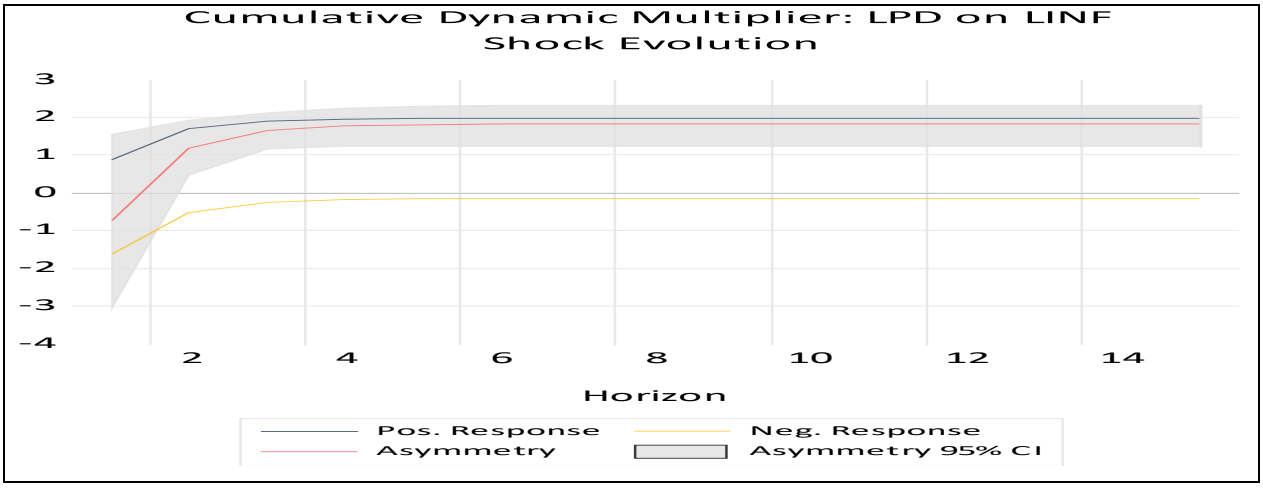


Figure 03. Cumulative Dynamic Multiplier Graph



5. Conclusion and Policy Recommendations:

Using the NARDL technique, the current study empirically examined the asymmetric influence of public debt on inflation in the example of Pakistan between 1983 and 2024. Drawing upon empirical findings, one may arrive at several conclusions that warrant significant policy recommendations. The total public debt to GDP ratio exhibits a positive correlation with inflation, demonstrating a more pronounced inflationary effect over the long term. The relationship between public debt and inflation in Pakistan exhibits an asymmetric nature, indicating that any further increase in public debt warrants careful consideration due to its potential adverse effects on inflationary pressures. Public debt plays a more significant role in controlling inflation, as the money supply has a negative impact on inflationary pressures. In this context, it is imperative to regulate superfluous government expenditures in order to mitigate fiscal deficits. The findings indicate that, within the timeframe of the current analysis, economic growth does not exert a significant influence on inflation in Pakistan. This outcome may be associated with the diminishing relevance of the traditional Phillips curve and the prevailing influence of global factors on inflationary trends. The findings of this research further substantiate that trade openness has a positive and significant impact on inflation in Pakistan. In the context of Pakistan, it is evident that exports are predominantly reliant on imports, constituting less than fifty percent of the total imports. Consequently, any increase in global prices exerts inflationary pressure on the domestic economy.

5.1 Policy Recommendations and Future Prospects

The findings suggest that an increase in public debt has a substantial impact on the rate of inflation. The asymmetric nature of the relationship indicates that an increase in inflation poses significant challenges for future reductions, even in the presence of a decrease in debt levels. Consequently, it is imperative for policymakers to exercise considerable caution and vigilance when considering the accumulation of additional public debt to finance deficits. The persistent increase in the public debt stock can be attributed to the escalating costs associated with debt servicing, which in turn fosters the emergence of Ponzi schemes in nations burdened by significant indebtedness. This scenario presents the issue of debt overhang, with nations such as Pakistan ensnared in a debt trap, thereby exacerbating the economic conditions within the country. In such a scenario, it is imperative that efficient and prudent fiscal policies be implemented to curtail excessive and unnecessary government spending. The revenues generated through taxation and other means ought to be allocated towards productive investments aimed at enhancing the economic landscape of Pakistan, particularly in sectors such as infrastructure development, agriculture, and industry to bolster production.

Furthermore, fiscal discipline must be established, imposing limits on government expenditures; expenditures exceeding these thresholds should be curtailed. Debt must be managed judiciously in accordance with established fiscal rules and regulations. Additionally, the government of Pakistan should ensure transparency regarding the utilization of accumulated debt, fostering a system of accountability concerning fiscal deficits, the decision-making process surrounding foreign loans, and the patterns of expenditure associated with such debt. The primary objective of fiscal policies should be to achieve a primary surplus, thereby facilitating a reduction in the debt-to-GDP ratio, which is essential for managing further inflationary pressures. The debt to GDP ratio is projected to be 67.4% for the year 2024, exceeding the threshold level of 60% established for Pakistan. Empirical studies indicate that a debt to GDP ratio above this threshold tends to exert a positive influence on inflation, whereas a ratio below the threshold is associated with a negative impact on inflation. Consequently, the mitigation of debt levels is essential for the management of inflationary pressures in Pakistan.

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