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AN INVESTIGATION ON IMPACT OF TRADE OPENNESS & BUDGET DEFICIT ON PAKISTAN'S PUBLIC DEBT: ARDL APPROACH TO COINTEGRATION

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KEYWORDS	ABSTRACT
Public Debt, Trade Openness, Budget Deficit, Inflation, ARDL, ECM, Granger Causality, Pakistan	In this empirical research, the purpose was to investigate the impact of trade openness and budget deficits on public debt in Pakistan. In this regard, data was examined spanning from 1975 to 2020. To map both long-run and short-run interactions, we used the autoregressive distributed lag (ARDL) method of co-integration along with ECM approaches. The results show that variables such as public debt, budget deficit, trade openness, and inflation have long- and short-term co-integration. Also, trade openness's coefficient's negative sign with value of -0.759 confirms negative relationship between public debt, trade openness and shows that a 1% upsurge in trade openness will bring a 75.9% decrease in public debt's growth in Pakistan. While budget deficit and inflation both possess a positive sign of coefficients and a positive link with public debt, the coefficient of budget deficit is 0.498, which depicts that a 1% escalation in budget deficit will lead to a rise in public debt of 49.8 percent. In conclusion, Pakistan's national debt is rising due to budget deficit & inflation, but it is falling due to trade openness. To reduce budget deficit, government should balance domestic & external debt so as to sustain desired position. So, it is suggested the government actively trade internationally to minimize the public debt.
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INTRODUCTION

After independence in 1947, Pakistan faced major social, economic, political, and institutional issues. Unfortunately, these major obstacles have hindered the country's progress, and daily crises and discontent have distorted our economy despite hidden reforms in many areas. Our major issues are catastrophic inflation and payment inequities. We feel obligated to seek refuge in the every household and close the income gap with foreign loans due to these serious issues.

Still, our currency's global decline and high main currency borrowing interest costs burden our budgets. Irrationally tightening to escape debt pushes us to take on extra debt to pay it off. That vicious cycle will continue. We borrow heavily from abroad due to these shortages, like many developing nations. Pakistan domestic capital market is young as it borrows from authorized lenders and international organizations. We use external resources to make up the budget gap, stressing our economic stability & self-sufficiency issues. After independence in 1947, Pakistan faced social, economic, political, and institutional issues. They slowed economic growth, while inflation and balance of the payments issues exacerbated it. Pakistan finances its budget deficit, interest payments, and debt by international borrowing, massive foreign debt and the currency depreciation.

Pakistan borrowed internationally due to the weak banking institutions. The dependence show Pakistan's economic instability and lack of self-reliance. In 1980s, economic problems caused inflation, loans, investments and inequality in Pakistan and other growing nations. The budget measures had diverse effects, showing fiscal policy's economic impact. The governments must balance capital growth with money printing, taxation & borrowing. Poor decisions undermine macroeconomic aims. Pakistan use expansionary monetary policy and borrow from domestic and foreign sources to cover budget shortfalls. This borrowing worsens future deficits since the government must issue more debt to repay it. Pakistan's finances are weak. To grow, invest in people, infrastructure & green projects. Still, immature countries like Pakistan have investment finance choices. Political, financial instability increase economic snags causing budget deficits. Development needs deriving, even too much debt could damage economic growth. Absurdly, neoclassic economists think government outlay inhibits private investment. Keynesians argue inflation promotes demand and investment. Pakistani currency deflation has hiked borrowing rates, detrimental credit markets and GDP (Lad, 1984; Okunroumu, 1993; Chimobi & Igwe, 2010).

Still, the nation's macroeconomic environment and its chosen financing strategy significantly influence how budget deficits impact debt (Ogunmuyiwa, 2008, 2011). Therefore, the purpose of financing government deficit is to raise capital while considering factors like expenditure, risks, and broader economic implications of different financing sources. The issuance of new money can raise prices, while increase in taxes can raise interest rates, hindering the formation of new capital and economic expansion (Anyanwu, 1998). Furthermore, if they choose to use public debt to finance deficits, it may worsen the problem by requiring funds to finance debt in the next fiscal period, perpetuating cycle of deficits (Adedotun, 1997). This suggests that public debt may be responsible for the imbalance in the national budget. Moreover, research shows that amount of debt in developing countries exacerbates financial crises. On contrary, using domestic debt promotes steady economic expansions. In asymmetric model, trade openness had no discernible influence on the economic expansion. (Klein, 1994; Ariyo, 1993), while some researchers did not find a clear relationship between these factors, they do change over time (Ogunmuyiwa, 2011). It constrains resources & economic efficiency as defined by Onvioduokit (1999).

At the same time, [Easterly and Hebbel's \(1993, 2003\)](#) warnings about foreign debt could lead to a chain of bad events, such as a growing current account deficit, a rise in the real exchange rate, and a dangerous imbalance in balance of payments. This concatenation of factors perpetuates the cycle of external indebtedness, thus exacerbating labyrinth of fiscal challenges ([Folorunso & Falade, 2013:346-347](#)). It is imperative to emphasize importance of significant investments in human capital, physical infrastructure, and adaptive capabilities to address the environmental exigencies, among other critical factors, in realizing the aspirations encapsulated within the SDG. To surmount both immediate and lasting resource constraints, spur economic progress, governments may find it necessary to secure funds domestically and internationally if revenue generation falls short of expenditures. Hence, national debt serves as a pivotal instrument for sustaining government spending, promoting economic growth & easing capital accumulation, particularly when applying tax increases and expenditure reductions proves challenging. Also, public debt can serve as a buffer against the unforeseen and temporary crises, thus alleviating immediate need for tax hikes to cover delicate expenses ([Yusuf & Mohd, 2023; Makhoba et al., 2022](#)).

Research Objectives

1. The goal is to evaluate impact of trade openness on Pakistan's public debt and determine the extent to which trade openness can lower public debt levels.
2. To investigate relationship between Pakistan budget deficits & public debt, highlighting how fiscal imbalances fuel the country's debt spiral.
3. To offer policy suggestions that address how Pakistan's government might lower budget deficit to pay off its debt, based on empirical data.

LITERATURE REVIEW

The association between trade openness, inflation, budget deficits, and public debts are poorly studied, as is effect of trade openness, inflation, and budget deficits on public debt, especially in Pakistan. As a consequence, we think it's imperative to carry out empirical study to ascertain the connection between the relevant factors. We also want to stress that the research that has already been done on the variables we chose for our model is included in the literature review that follows. [Seidu and Vasilev \(2024\)](#) examined years prior to and following military rule in their comprehensive research of the Ghana's fiscal dynamics and inflation trends from 1960 to 2022. They draw attention to the fact that budget deficits have frequently resulted in rising the public debt, starting the vicious cycle of financial instability. One major problem is the poor mobilization of the domestic revenue, which is lower than in wealthy countries and leads to ongoing deficits. The Central Bank of the Ghana frequently increases the money supply to fund these deficits, that ties fiscal imbalances to inflation. The researchers point out that, in line with fiscal theory of inflation, this approach temporarily reduces budgetary burdens while rising inflation.

Their research offers important insights for policymakers seeking to stabilize Ghana's economy by highlighting the necessity of increased domestic income mobilization to counteract the negative consequences of borrowing, inflation & budget deficits. [Suryandaru \(2023\)](#) undertook

a comprehensive examination to understand the intricate dynamics between trade openness, public indebtedness, and trajectory of economic advancement within the Indonesian economic landscape. Employing a methodological duality, navigated over two distinct models alongside a meticulously curated quarterly dataset spanning from the initial quarter of 2010 to conclusive quarter of 2019 (2010: Q1 - 2019: Q4). Using symmetric model within autoregressive distributed lag (ARDL) framework and comparing it to the nonlinear ARDL-based asymmetric model, he tried to figure out how the variables under study were connected right away and in long term. The culmination of his efforts revealed a discernible pattern: the encumbrance of foreign debt exacts toxic toll on trajectory of economic advancement, as discerned across both symmetric & asymmetric model framework. On the contrary, using the domestic debt helps steady economic expansion.

In the asymmetric model, trade openness had no discernible influence on economic expansion. He argues that there is empirical evidence linking lower trade openness to higher rates of long-term economic growth. Furthermore, both models' diagnostic tests yield positive results. In their study, [Van et al. \(2020\)](#) examined the impacts of budget deficits and public debt upon emerging economies' ability to grow steadily, taking anti-corruption measures into account. Using skewed panel data from 59 developing countries, researchers analyzed the data, which covers the years 2004 to 2015, using the two-step GMM technique. Research has shown that public debt and inflation have an adverse and negative impact on maintainable improvement, while positive anti-corruption measures have produced positive results. The study's results highlight the detrimental effects of sustainability. Still, these negative effects can be mitigated by reducing corruption through the interaction between public debt and inflation, and over actual corruption control strategies. According to their article, developing countries should not see maintaining fiscal deficits or increasing public debt as way to attain sustainable economic development.

We felt that study, using empirical evidence from developing countries, reinforces the concepts of complementary costs, crowdsourcing, and institutional theory. [Akram \(2011\)](#) The researcher analysed the impression and effect of Pakistan's public debt on investment and economic progress by studying data spanning from 1972 to 2009. He noted that Pakistan has struggled to raise enough money to fund its budget throughout the years. Due to the resulting twin deficit issue, the government requires both public external and internal debt to fund constructive and progressive operations. The benefits of the public debt stem from the reality that, when done effectively, debt financing boosts growth in resource-constrained economies, increasing their capability to service and pay back public debt. The detrimental impacts operate primarily over two channels: "debt overhang" and "crowding out." He created a combination of models for his investigation that clearly account for the significance of public debt in development equations. Because some of the variables in his analysis have integration order of I (1) while others have I (0), thus, he chose to compute the desired model using autoregressive distributed lag (ARDL) methodology.

A comprehensive study has substantiated the notion of a "debt overhang effect," revealing a detrimental connection between public foreign debt and both per capita GDP and investment

levels. The researcher noted that weak correlations among debt service, investment, and per capita GDP hindered the validation of the crowding-out hypothesis. Furthermore, the study highlighted adverse connection between investment, per capita GDP, and national debt. Also, it appears that legislative actions have impeded private-sector investment behaviour. As per to [Muhammad, Saidu, and Nwokobia \(2013\)](#), unemployment and inflation have impact on wages in Nigeria. Initially, Ordinary Least Squares Method relied on t-statistics, that show how much unemployment impacts wage rates, and Durbin-Watson statistics, show the model's validity. The unit root test findings show that at 1%, 5%, & 10%, all variables are stationary. As per to Granger causality results, wage rate is distinct to either unemployment/inflation. This finding suggests one-way fundamental overtone amid redundancy and pay rates, rather than inflation -wage rate links. Unemployment certainly impact pay rate and inflation has no effect on wage rate.

[Umar and Razaullah \(2013\)](#) discovered effects of Pakistan GDP & inflation on unemployment rate. They are using SPSS to do regression on time series data from 2000 to 2010. According to the results, the F-test score is quite low, below value of 4.00. The R square varies only slightly, between 0.70 and 22.8%, depending on the factors such as unemployment, GDP, and inflation. [Mallik and Chowdhury \(2001\)](#) found two things: first, there is a statistically significant positive association between inflation and expansion in the economy in Bangladesh, Pakistan, India, and Sri Lanka. Second, modifications to inflation rates had a greater impact on growth than variations in growth rates had on inflation. Moderate inflation encourages economic growth. Moreover, they arrived at a robust threshold inflation level of 11 percent with close coefficients after eliminating the development rates of the entire labour force and the money supply, both of which the OLS models showed to be unimportant. They also showed that inflation continues even at very low threshold levels. However, to offer fresh support for the threshold impact, their analysis did not assess the degree of the sensitivity of projected coefficients throughout the smaller samples of the entire sample period. In order to find such evidence, the study's conclusion emphasised need to broaden the analysis's context to encompass lower threshold values.

RESEARCH METHODOLOGY

Before proceeding to research methodology, it would prefer to present theoretical framework, which provide some information about association and connection among budget deficit, trade openness, and public debt. The relationship between the budget deficit (BD) and public debt (PD) is straightforward. When a government runs a budget deficit, its expenditures (G) exceed its revenues (T), necessitating borrowing to finance shortfall and deficit. This borrowing adds to public debt.

$$\text{Debt Accumulation Equation: } \Delta PD = BD + rPD \dots\dots\dots (1)$$

Where: ΔPD is the change in public debt; $BD = G - T$ is budget deficit; r is the real interest rate on existing debt. Equation (1) shows that budget deficit (BD) directly increases public debt (PD). Over time, repeated deficits compound debt due to interest payments, further increasing total public debt.

Relationship Between Trade Openness & Public Debt

Trade Openness Reduces Public Debt: Trade openness, measured by degree of engagement in international trade (exports+imports), impacts public debt over impact on economic progress and development and fiscal health.

$$\text{National Income Identity: } Y = C + I + G + (X - M) \dots\dots\dots (2)$$

Where: Y is national income or GDP; C is consumption; I is investment; G is government spending. (X-M) is net exports (exports-imports). Impact of Trade Openness: Higher Economic Growth: Increased net exports ((X - M)) boost GDP (Y). Increased Tax Revenues: Higher GDP leads to higher tax revenues ((T = tY), improving fiscal balance. Reduced Borrowing Needs: With more tax revenue, government can cover costs without borrowing, reducing the budget deficit and public debt.

Modified Debt Accumulation Equation Incorporating Trade Openness

$$\Delta PD = G = t(C + I + G + (X - M) + rPD) \dots\dots\dots (3)$$

Simplifying the equation:

$$\Delta PD = G = t(C + I + G) + rPD - t(X - M) \dots\dots\dots (4)$$

Where: t is effective tax rate on national income, in lieu of proportion of GDP that is collected as tax revenue. As trade openness increases, net exports (X - M) rise, making -t(X - M) negative, which reduces ΔPD.

We Employ Autoregressive Distributed Lag (ARDL) Method for Co-integration.

We will use autoregressive distributed lag approach to co-integration (ARDL) in conjunction with ECM methodologies. Equation (1), which alone depicts long-run equilibrium connection, may constitute a cointegration set as long as all the variables integrate into orders 0 and 1, that is, I (0) and I (1).

The model's data and specifications

In conducting our research, we will rely on facts, figures, and data that pertain to Pakistan and span the years 1975 through 2020. To gather the necessary data, we rely on Economic Survey of Pakistan from various years, as well as the annual reports that State Bank of Pakistan publishes at various intervals and times of the year. In addition, we also used data from the State Bank of Pakistan's 2020 Handbook of Statistics. We aim to construct following econometric model to investigate impact of trade openness, budget deficit and inflation on growth and improvement of Pakistan's public debt, and to identify the variables that have potential to reduce this debt and its dependence.

$$\ln PD_t = \beta_0 + \beta_1 \ln TO_t + \beta_2 \ln BD_t + \beta_3 \ln INF_t + \varepsilon_t \dots\dots\dots (1)$$

Dependent Variable = lnPD_t = Public Debt; Explanatory Variables = lnTO_t = Trade Openness. lnBD_t = Budget Deficit. lnINF_t = Inflation. ln = Natural log; β₀ = the constant or the intercept. β₁ – β₃ = are parameters of explanatory variables; While, anticipated signs of the parameters are: β₁<0, β₂>0, β₃>0; The error term (ε) is thought to have independent distribution. (t) is a time index subscript.

Unit Root Test

When time series data displays a unit root characteristic, it is considered non-stationary and leads to spurious regression, as articulated by Mukhtar (2010) and Nelson and Plooser (1982). Therefore, we will verify the presence of a unit root and apply the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979). In this regard, by running a subsequent regression on the series Y_t , ADF test tries to find a t-statistic for $\delta = 0$. This checks the null hypothesis that series is not stationary.

$$\Delta Y_t = \alpha + \gamma T + \delta Y_{t-1} + \sum_{i=1}^p \beta_i \Delta Y_{t-i} + u_t \quad (2)$$

Where, α and γT are the deterministic elements, Y_t is a variable at time t , and u_t is disturbance term.

Autoregressive Distributed Lag (ARDL) Model

As described in Pesaran et al. (2001) and Mohammad et al. (2012) and Choong et al. (2005), we use the bounds test method to estimate long-run equation (1) as a general vector autoregressive (VAR) model of order p in Z_t .

$$Z_t = Co + \beta t + \sum_{i=1}^p \Omega_i Z_{t-i} + \mu t, \quad t = 1, 2, 3, \dots, T \quad (3)$$

With β signifying a $(k+1)$ - vector of trend coefficients and Co indicating a $(k+1)$ - vector of the intercepts (drift). In this linking, the conditional VECM of interest can be specified in equation:

$$\Delta \ln PD_t = Co + \delta_1 \ln PD_{t-1} + \delta_2 \ln TO_{t-1} + \delta_3 \ln BD_{t-1} + \delta_4 \ln INF_{t-1} + \sum_{i=1}^p \omega_i \Delta \ln PD_{t-i} + \sum_{j=1}^q \lambda_j \Delta \ln TO_{t-j} + \sum_{k=1}^q \phi_k \Delta \ln BD_{t-k} + \sum_{l=1}^q \psi_l \Delta \ln INF_{t-l} + \mu t \quad (4)$$

Where δ_i are the long run multipliers, Co is the Drift, and μt are white noise errors in the study.

Bounds Testing Procedure

Following Fosu and Magnus's (2006) methodology; formally, the null hypothesis $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ is juxtaposed against the alternative $H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$. This normalised PD test is represented as $F_{PD} (PD \setminus TO, BD, INF)$.

$$\ln PDT = Co + \sum_{i=1}^p \delta_1 \ln PDT_{t-i} + \sum_{i=1}^{q1} \delta_2 \ln TO_{t-i} + \sum_{i=1}^{q2} \delta_3 \ln BD_{t-i} + \sum_{i=1}^{q3} \delta_4 \ln INF_{t-i} + \mu t \quad (5)$$

Where every variable has the same definition as before. Using the Akaike information criterion (AIC), the ordering of the ARDL ($P1, q1, q2, q3$) model in four variables is chosen. The third and last phase involves calculating an error correction model linked to the long-run estimate in order to get the short-run dynamic parameters. The details of this are as follows from equation:

$$\Delta \ln PD_t = v + \sum_{i=1}^p \omega_i \Delta \ln PD_{t-i} + \sum_{j=1}^q \lambda_j \Delta \ln TO_{t-j} + \sum_{k=1}^q \phi_k \Delta \ln BD_{t-k} + \sum_{l=1}^q \psi_l \Delta \ln INF_{t-l} + \theta ECM_{t-1} + \mu t \quad (6)$$

Here, ω, λ, ϕ , and ψ , are short-run dynamic coefficients model convergence to equilibrium and θ is speed of adjustment.

Estimation and Interpretation of Empirical Results.

Table 1 displays the results of the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) in terms of both the level and first difference of the variables under examination. Upon careful

examination of the ADF test results, it becomes evident that prior to differencing, all variables exhibited non-stationarity at their respective levels in study. However, upon first differencing, a transformational shift occurred, rendering variables stationary. As a result, it is appropriate to assert that all of the variables in the question exhibit integration of the order one, succinctly denoted as I (1).

RESULTS OF STUDY

Table 1

Result of ADF Tests (Augmented Dickey-Fuller (ADF) Test for unit Roots)

Variables	Level					
	Constant			Constant & Trend		
	C.V	T.Stat:	Prob:	C.V	T.Stat:	Prob:
DlnPD						
1% Level	-3.588509	-0.714548	0.8324	-4.180911	-1.862549	0.6567
5% Level	-2.929734			-3.515523		
10% Level	-2.603064			-3.188259		
DlnTO						
1% Level	-3.592462	-0.154868	0.9364	-4.186481	-2.858126	0.1857
5% Level	-2.931404			-3.518090		
10% Level	-2.603944			-3.189732		
DlnBD						
1% Level	-3.574446	-0.428005	0.8958	-4.161144	-3.042515	0.1318
5% Level	-2.923780			-3.506374		
10% Level	-2.599925			-3.183002		
DlnINF						
1% Level	-3.600987	-4.325967	0.0014	-4.198503	-4.237301	0.0091
5% Level	-2.935001			-3.523623		
10% Level	-2.605836			-3.192902		
Variables	First Difference					
	Constant			Constant & Trend		
	C.V	T.Stat:	Prob:	C.V	T.Stat:	Prob:
DlnPD						
1% Level	-3.588509	-5.178634	0.0001	-4.180911	-5.166464	0.0006
5% Level	-2.929734			-3.515523		
10% Level	-2.603064			-3.188259		
DlnTO						
1% Level	-3.596616	-3.993804	0.0036	-4.205004	-4.439353	0.0055
5% Level	-2.933158			-3.526609		
10% Level	-2.606857			-3.194611		
DlnBD						
1% Level	-3.577723	-5.978301	0.0000	-4.192337	-6.011585	0.0001
5% Level	-2.925169			-3.520787		

10% Level	-2.604867			-3.191277		
DlnINF						
1% Level	-3.588509	-8.229023	0.0000	-4.180911	-8.146949	0.0000
5% Level	-2.929734			-3.515523		
10% Level	-2.603064			-3.188259		

Source: Authors' Calculations (Eviews 9).

Estimated Result Based on ARDL (3,5,4,4) Model.

After careful consideration, we determined that ARDL technique necessitated incorporating series into order, denoted as I (2). To avoid this challenge, we hired improved Dickey-Fuller test, which uses maximum lag, ensuring robustness in our analysis. The results, as presented in Table 1, clearly showed that all variables demonstrate integration of order 1, denoted as I (1). This pivotal insight positioned us favourably to apply autoregressive distributed lag (ARDL) method, enabling a comprehensive examination of capability correlation between public debt and budget deficit in Pakistan, particularly given absence of integration of order 2 in our series. Before we adopted ARDL bounds test for co-integration, we meticulously focused on selecting correct lag duration. We meticulously carry out this essential step by using Akaike Information Criteria (AIC), defined as $AIC = -2(1/T) 2(K/T)$, where T represents the entire wide variety of observations & K denotes quantity of parameters. This methodological refinement ensured the attainment of most excellent lag specifications, improving robustness and reliability of our next analyses.

Table 2

Autoregressive Distributed Lag Bounds Test, Using: ARDL (3,5,4,4) Model. Included obs: 39

Null Hypothesis: No Long-Run Relationships Exist		
Test Statistic	Value	K
F-statistic	7.594282	3
Critical Value Bounds		
Significance	Lower Bound	Upper Bound
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66

Source: Authors' calculations (E views 9).

Table 3 reveals the profound insights derived from the estimated long-run coefficients within the selected ARDL (3, 5, 4, 4) model, which exhibit remarkable significance at the 5% level of statistical confidence and are adorned with the anticipated directional indicators. At the 5% significance level, the coefficient of trade openness (TO) is statistically highly significant and negative (-0.759). This means that, over the long run, an increase of one unit in trade openness (TO) will lead to a 75.9% decrease in Pakistan public debt growth (PD), signalling fundamental change in country's economic dynamics. In this linking, key finding about positive -oriented coefficient of the budget deficit (BD) is that it is thus statistically significant at 5% significance level.

This empirical confirmation strengthens claim that there is a demonstrable correlation between budget deficits and growth of public debt in Pakistan. Holding every other variable constant, a single unit increase in the budget deficit signals a significant 49.8% increase in the public debt, highlighting the severity of fiscal imbalances. For this reason, our findings are consistent with those of Folorunso et al. (2013), Qehaja and Qehaja (2018), and Musah (2023). Furthermore, at highly esteemed five percent significance level, inflation-related coefficient (INF) demonstrates its inherent significance, with a positive coefficient of 0.267 and strong statistical support. This sheds light on the complex dynamics that underlie relationship amid inflation and public debt, explaining why simple 1% increase in inflation triggers a significant 26.7% increase in Pakistan public debt (PD) growth trajectory over long-term time periods as evident from the statistical results.

Table 3

Estimated Long-Run Coefficients using: ARDL (3,5,4,4) Model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnTO	-0.759577	0.135687	-5.597990	0.0000
lnBD	0.498542	0.085781	5.811814	0.0000
lnINF	0.267920	0.129392	2.070602	0.0523
C	1.634976	0.938799	1.741562	0.0978

Source: Authors' calculations (Eviews 9)

The dynamic coefficients from estimated ARDL (3,5,4,4) model are shown in Table 4. Akaike information criteria were used to choose lag. As outlined in Table 4, ECM (-1)/ECT-1 coefficient of -0.256250 emerges statistically significant at the 5% level, boasting an anticipated probability value of 0.0000 – underscoring its substantive relevance. This information strengthens claim of co-integration, showing a strong short-term link between variables described in equation (1). With a discernible feedback coefficient of -0.256250, the analysis elucidates the commendable tuning pace from states of disequilibrium to equilibrium. This coefficient captures dynamic process over that system rectifies deviations, steering it closer toward harmonious equilibrium state.

Table 4

Error Correction Estimation Results for the ARDL (3,5,4,4) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(lnGPD(-1))	0.048484	0.111196	0.436023	0.6677
D(lnGPD(-2))	-0.436920	0.124998	-3.495426	0.0024
D(lnTO)	-0.109821	0.040413	-2.717457	0.0137
D(lnTO(-1))	0.049838	0.036906	1.350399	0.1928
D(lnTO(-2))	0.049797	0.023924	2.081489	0.0512
D(lnTO(-3))	-0.032029	0.023920	-1.339026	0.1964
D(lnTO(-4))	0.140609	0.026359	5.334319	0.0000
D(lnBD)	0.099471	0.027206	3.656230	0.0017
D(lnBD(-1))	0.043290	0.031865	1.358536	0.1902
D(lnBD(-2))	0.007369	0.029403	0.250633	0.8048

D(lnBD(-3))	0.097169	0.027998	3.470497	0.0026
D(lnINF)	0.040889	0.017749	2.303720	0.0327
D(lnINF(-1))	-0.073025	0.020277	-3.601394	0.0019
D(lnINF(-2))	-0.039865	0.019039	-2.093893	0.0499
D(lnINF(-3))	-0.044060	0.018998	-2.319261	0.0317
CointEq(-1)	-0.256250	0.037796	-6.779778	0.0000
CointEq = lnGPD - (-0.7596 * lnTO + 0.4985 * lnBD + 0.2679 * lnINF + 1.6350)				

Source: Authors' calculations (Eviews 9)

Table 5

Pairwise Granger Causality Test. Sample 1975-2020: Lags: 2

Null Hypothesis	Observations	F-Statistics	Probability
lnBD does not Granger Cause lnPD	44	4.73880	0.0144
lnPD does not Granger Cause lnBD		0.79378	0.4593

Source: Authors' calculations (Eviews 9)

Table 5 displays the results of the pairwise Granger causality test, proposed by [Granger \(1969, 1988\)](#), amid variables public debt & budget deficit, when lagged by two periods. The findings demonstrate that, at 5% level of significance (probability = 0.0144), we cannot accept the null hypothesis, budget deficits (BD) do not cause public debt (PD). As result, budget deficits have an impact on public debt.

Stability and Diagnostic Tests of ARDL (3,5,4,4) Model.

Tables 5, 6, and 7 serve as bastions of validation, successfully traversing the diagnostic gauntlet inherent in ARDL (3, 5, 4, 4) model. The famous [Breusch-Godfrey \(1978\)](#) serial correlation LM test confirms that there is no serial correlation amid error terms. Table 5 tableau reassuringly reveals that P-value surpasses 5% significance threshold, removing potential heteroscedasticity in our version. This congruence finds resonance in [White's \(1980\)](#) heteroscedasticity test, which offers further vindication of our model's robustness. In the crucible of statistical scrutiny, the regression specification error Test (RESET), as delineated by [Ramsey \(1969\)](#), emerges as beacon of validation, illuminating the path towards model adequacy. Our model is free of the evil of misspecification, as demonstrated by strong p-value that is higher than 5% level and threshold. Furthermore, Figure 2's results from the Jarque-Bera normality test, developed by Jarque-Bera (1980, 1987), provide strong evidence for the normality of the error terms. We follow the steps laid out by [Pesaran and Pesaran \(1997\)](#), use level-of-stability tests. [Brawn et al. \(1975\)](#) created CUSUM and CUSUM) tests, which we trust to ensure stability. Therefore, these tests, in their unwavering resolve, confirm the enduring stability of our model in the face of the statistical uncertainty.

Table 6

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.096740	Prob. F(2,17)	0.3565
Obs*R-squared	4.457019	Prob. Chi-Square (2)	0.1077

Source: Authors' calculations (Eviews 9).

Table 7*Heteroscedasticity Test: ARCH*

F-statistic	0.855531	Prob. F(19,19)	0.6314
Obs*R-squared	17.98176	Prob. Chi-Square (19)	0.5237

Source: Authors' calculations (Eviews 9).

Table 8*Ramsey RESET Test.*

	Value	Df	Probability
T-statistic	0.559234	18	0.5829
F-statistic	0.312743	(1, 18)	0.5829

Source: Authors' calculations (Eviews 9).

DISCUSSION

The results of this study provide clear insights into the relationship between trade openness, budget deficits, and public debt in Pakistan. The application of the Augmented Dickey-Fuller (ADF) test revealed that the variables in study were non-stationary at their levels but became stationary upon first differencing, confirming they are integrated of order one, I(1). This aligns with the findings of [Dickey and Fuller \(1979\)](#). Employing ARDL (3,5,4,4) model, study found robust evidence of a long-term co-integration relationship among the variables, as indicated by an F-statistic of 7.594282, which surpasses the critical value bounds at the 1% significance level. This suggests strong long-term equilibrium relationship amid public debt (PD), trade openness (TO), budget deficit (BD), and inflation (INF) in Pakistan. The long-run coefficients indicate significant impacts of the independent variables on public debt. Specifically, trade openness has a significantly negative coefficient (-0.759), implying that increasing trade openness by one unit would decrease the public debt growth by 75.9%. This conclusion is also supported by the theoretical rationale that better trade openness may increase economic efficiency & reduce the need to rely on public debt ([Folorunso et al., 2013](#); [Qehaja & Qehaja, 2018](#); [Musah, 2023](#)). On the other hand, budget deficit and inflation both have a positive coefficient (0.498 and 0.267) so if either variable increases by 1%, it will lead to significant increase in public debt at 49.8% and 26.7%.

The results of this study are consistent with a line of existing studies ([Matsawali et al., 2012](#); [Hassan et al., 2018](#)) which demonstrates destructive effects that fiscal imbalances and inflation cause on public debt system. The coefficient of Error Correction Model (ECM) -0.256250 says that there is a short-term dynamic adjustment process which further supports the finding that dynamics of deviations from the long-term equilibrium are corrected at a rate of 25.625% per period. The results of Granger causality test in study show that there is unidirectional causality from budget deficit to public debt and it confirms almost completely (e.g., ca. 95%) that budget deficits affect/deal with public debt/loans in Pakistan only. This becomes an important point for those who make policy decisions, who must focus on the necessity of strict fiscal discipline system. Overall, the findings underline the importance of trade openness in reducing public debt and adverse effects of budget deficits and inflation on public debt. These results provide

valuable guidance for policymakers in Pakistan, suggesting that enhancing trade openness and controlling budget deficits and inflation are vital for sustainable economic growth and debt management.

CONCLUSION

The main purpose of our research was to investigate how trade openness and budget deficits can impact public debt. Thus, we were able to determine that trade openness has the potential to reduce Pakistan's public debt, while study outcomes revealed that budget deficit has been enhancing and promoting country's public debt. We found that variables in our study – public debt, trade openness, budget deficit, and inflation – are all related. The fact that the F-statistic value we obtained (7.594282) exceeds upper bound demonstrates this. Moreover, the sign of trade openness' coefficient, which is -0.759 (negative), produces evidence and shows that a 1% increase in trade openness will bring a 75.9% reduction in public debt growth in Pakistan. On the other hand, both budget deficit and inflation have positive coefficients of 0.498 and 0.267, respectively. This indicates that a 1% increase in the budget deficit and inflation will result in an increase of 49.8% and 26.7% in growth and enhancement of public debt, respectively. This indicates a positive relationship amid public debt, budget deficit, and inflation in Pakistan. We therefore conclude that budget deficit and inflation are main factors causing increase in public debt in Pakistan. The trade openness can significantly contribute towards reduction of public debt.

Pakistan's government should adopt very prompt and drastic measures to reduce the budget deficit by curtailing the non-development expenditures, and it should avoid the practice of increasing the money supply frequently to control inflation. Moreover, Pakistan's government should prefer to more actively participate in international and free trade to overcome the crucial problem of the balance of payments deficit by increasing export earnings, which will prove to be conducive to reducing dependence on the public debt. As our results show, trade openness in Pakistan can play a significant and effective role in reducing public debt. Pakistan may combine external and the local debt to pay its budget deficit. Given the current economic downturn, the Pakistani government should examine and prioritise allocating all future loans to the progressive and revenue-generating projects and initiatives. Pakistani trade openness, budget imbalances and government debt research are lacking. Future research could look at how workers' remittances reduce state debt and current account deficit as they offer external financing & economic stability. This gap may lead to comprehensive public debt management plan.

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