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Optimal Public Debt Threshold for Nepal

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ABSTRACT

This study examines the optimal thresholds of public debt that can facilitate economic growth in Nepal. The effect of public debt on economic growth has been estimated through the non-linear relationship between public debt and GDP growth using 47 years of yearly time series data from FY 1974/75 to 2021/22. This paper also considers the relationship between economic growth and other several controlling variables, i.e. government debt, gross capital formation, trade openness, population growth, domestic saving rate, in Nepal's context. The ideal ratio of public debt for higher economic growth is found to be 35.44 percent of real GDP in Nepal. The tools used for time series data analysis include auto regressive distributive lag (ARDL) for long run structural modeling and error correction model for short run relationships. In the recent context of increasing volume of public debt, weakening revenue mobilization capacity of the government and volatility in GDP growth rate of Nepal, this study will be useful for the government and policy maker to adopt appropriate strategies to maintain optimal threshold of public debt for sustainable growth in Nepal. The result advocates that government should use public debt cautiously to facilitate economic growth through productive sector investments by maintaining appropriate level of public debt.

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1. INTRODUCTION

Public debt is the amount of borrowed money received from the residents of the country by the government, which is called domestic debt, and from foreign countries and non-residents, which is called external debt. Public debt is a special tool of fiscal policy of the government to meet its resource gap in the country. Total public debt including domestic debt and external debt are considered to find optimal threshold in the study.

The ability to meet debt servicing obligations without debt deferral or debt rescheduling is crucial as it may consequently cause debt crisis in the country. The use of debt should be in a sustainable way.

Economic theories propose that a moderate amount of debt can potentially boost economic growth for both developing and developed nations. The liquidity constraint hypothesis and debt overhang theory, previously explored by Krugman (1988), Sachs (1989), and Cohen (1992), aim to elucidate the effects of debt on economic growth. According to these theories, elevated debt levels hinder economic growth by crowding out investment due to increased government borrowing within the economy. A sharp increase in debt to GDP ratio can deteriorate debt sustainability. Therefore, it becomes imperative to find an optimal public debt threshold that facilitates growth in the country.

Study of debt sustainability is important to develop macroeconomic policies. The sophisticated IMF approach can be validated within the bounds of the underlying guesses only. Therefore, policy conclusions drawn from debts sustainability should be applied with proper care and considerations. Sacrificing growth to imprecisely known risks can be very costly (Wyplosz, 2007).

The GDP growth of Nepal decreased from 5.57 percent during the 1980s to 4.20 percent during the 1990s, whereas there was an increase in the growth rate to 4.29 percent during the 2010s from 3.39 percent during the 2000s. It shows that the GDP growth rates remained fluctuating in Nepal over the last four decades. The average growth rate of GDP was 4.56 percent during the last four decades.

On the other hand, fiscal deficit as percentage of nominal GDP decreased from 7.20 percent during the 1980s to 6.10 percent during the 1990s. However, the fiscal deficit witnessed an increase from 4.10 percent during the 2000s to 4.60 percent during the 2010s. In the past four decades, the average fiscal deficit as percentage of nominal GDP was 5.5 percent, which shows a moderate level of fiscal deficit. Public debt was 32.14 percent of GDP during the 1980s. This

ratio increased to 64.84 percent during the 1990s and then decreased to 50.72 percent during the 2000s. During the 2010s, public debt was 26.91 percent of GDP. In recent years, this percentage is gradually increasing and reached 41.43 percent in FY 2021/22.

A continuous current account imbalance is inevitable to determine external debt. During the 2000s, the current account balance on average was in surplus by Rs 9.32 billion, and it was in deficit by Rs 41.65 billion during 2010. There have been persistent current account deficits from FY 2016/17, and such deficits scaled up to the level of Rs. 623.32 billion in FY 2021/22. As a result, an External Debt to GDP ratio reached 21.14 percent in FY 2021/22 from 13.45 percent in FY 2016/17.

After FY 2010/11, there was an increment in the fiscal deficit to GDP ratio, debt to GDP ratio and current account deficit to GDP ratio. Such ratios were 28.09 percent, 3.3 percent, and 0.83 percent in FY 2010/11 and reached 41.43 percent, 4.2 percent, and 12.85 percent respectively in FY 2021/22. Similarly, the public debt to revenue ratio also surged up to 188.22 percent in FY 2021/22 from 114.53 percent in FY 2016/17.

Bhatta & Mishra (2020) estimated a quadratic bivariate model to find the growth maximizing debt ratio. The model was based on ARDL coefficients using time series data and found that the optimal level of public debt to GDP ratio is 33 percent in Nepal's context.

The main motivation of the study is the limited availability of prior investigations to find out the optimal public debt threshold, based on the relationship between government public debt and economic growth, using long time series data incorporating important and relevant controlling variables such as capital formation in Nepal. Additionally, the timing of this study holds significance due to Nepal's heavily reliance on public debt to support its annual budget. A notable surge of public debt in recent years in Nepal attributed to dwindling government revenues amidst sharp declines in government revenue mobilization makes it crucial for policymakers, the Ministry of Finance, and the central bank in Nepal to grasp the dynamism between public debt and economic growth. This study attempts to answer the research question: What is the optimal level of the public debt threshold for sustainable growth in Nepal? The study aims to shed light on determining the optimal level of public debt for sustainable growth in Nepal and its implications, thereby aiding in better understanding and informed decision-making. The findings of this study will have implications on both fiscal and monetary policy.

Based on the above backdrop, debt to GDP ratios increased during the 2010s, and such increase persisted continuously in forthcoming periods, provided that the twin deficits (both fiscal deficit and current account deficit) prevail and remain high. As a result, there may be sluggish

and volatile GDP growth rate with higher fluctuations in the exchange rate and interest rate. Suggesting appropriate public debt threshold for sustainable growth is the basic reason and motivation of this study in Nepal.

The main purpose of this study is to assess debt optimality in Nepal. The objectives of the study are specified into: (a) to investigate the relationship between public debt and economic growth in Nepal and (b) to find the optimal level of public debt that supports ideal economic growth.

Many studies have evaluated the debt threshold based on the causal relationship between public debt and economic growth from the perspective of developed countries. Results and conclusions drawn from those studies may not be equally applicable in developing countries like Nepal. This paper is an attempt to analyze the public debt threshold and to identify the optimal level of public debt that supports higher growth in Nepal.

The background information of this paper is described in Section I. Section II deals with the review of theoretical, empirical and existing national literatures whereas econometric model, estimation techniques and source of data and sample periods are dealt in Section III. In Section IV, results are discussed and analyzed regarding public debt threshold ratios and outcomes for public debt threshold using the model. Finally, conclusions are highlighted in section V of the paper.

2. LITERATURE REVIEW

This section offers review of theoretical literatures, empirical literatures and literatures related to the study of relationship between economic growth and public debt.

2.1 Theoretical Underpinnings

Debt sustainability helps make borrowing decisions and matches financing needs with its ability to repay. The International Monetary Fund (IMF) has classified countries' debt-carrying capacity into strong, medium, and weak categories in its Debt Sustainability Framework (DSF). An optimal threshold of public debt supports debt sustainability.

As explained by Washington (2015), the Domar Model focuses on enhancing the economic growth rate rather than worrying about increased debt levels. It suggests that the nation's capacity, rather than the government's capacity, is more important to meet its debt obligations. The increased levels of debt leading to an increase in growth should be evaluated in the analysis of debt sustainability.

One of the important traditional methods to examine debt sustainability is through debt indicators approach as referred by Gray (1998). The comparison is made by evaluating the ratio of debt stock and debt servicing to certain macroeconomic indicators, contrasting them with benchmark thresholds established for debt sustainability indicators accredited by international organizations.

The debt threshold indicators defined by the IMF/World Bank vary with those defined by the European Union (EU) and the Commonwealth. The EU has set threshold values for key fiscal parameters, including a fiscal deficit limit of 3 percent, a cap of 25 percent for public debt, a maximum of 15 percent for public debt servicing, a ceiling of 20 percent for domestic debt, and an external debt limit of 5 percent of GDP.

Debt Sustainability Assessments (DSA) helps to determine access to IMF financing ensuring that external debt remains sustainable and suggests debt threshold as a measure of a countries solvency.

As argued by Kidochukwu (2015), the debt sustainability limit under the International Monetary Fund (IMF) debt sustainability threshold of 45% for Nigeria and other low-middle income countries does not promote growth in Nigeria. The author's calculation indicates that adhering to this threshold leads to a negative growth of (-19.5%) and (-27.9%) respectively. The study found the sustainability threshold at 14.5% which corresponds with the highest and optimal growth rate of 6.3%. The study discoursed that sustainability aligns with the country's growth goals, unlike traditional debt sustainability analyses that focus on solvency as prescribed in SDF and proposed a new definition of debt sustainability as the threshold that maximizes the debt-output ratio while maintaining optimal growth in an economy.

2.2   Empirical Literature

The study by Ramos and Sosvilla (2017) examines the impact of government debt on per capita GDP growth across twelve Eurozone countries using time series data of 40 years from 1970. It reveals a nonlinear relationship between debt and growth, indicating a critical threshold beyond which a high government debt to GDP ratio adversely affects long-term economic growth, observed at around 90 percent to 100 percent of GDP.

Kharusi and Ada (2018) have investigated the relationship between government borrowing from external sources and economic growth in Oman. Their analysis, based on time series data spanning from 1990 to 2015, revealed a noteworthy negative impact of external debt on

economic growth. The study has recommended the use of external debt funds in the productive sector for growth in the economy.

The study by Rathnayake, Perera and Vaas (2022) shows that Sri Lanka's economic growth is negatively and significantly correlated with public debt, including both public domestic debt, and public external debt. Due to the negative consequences on economic growth, they recommended that the government of Sri Lanka set some borrowing limits.

2.3   Literature Related to Nepal

Alamgir and Ra (2005) have examined the debt sustainability of Nepal based on the projected values of macroeconomic variables from the Nepal Macro-economic Model. The article reveals that public debt in Nepal appears to be sustainable considering the magnitude and structure of debt and indicates that the debt to GDP ratio is expected to remain constant at the current level over the next five years. Moreover, results of stress tests generally disclosed modest effects of external shocks on the debt to GDP ratio.

Nepal has a narrow base for domestic resource mobilization and exports. Considering this fact, continuous monitoring of the sustainability of public debt is important. Nepal needs a convergence of favorable conditions to maintain sustainable GDP growth rates beyond the current level. Key indicators imply that Nepal's external debt burden is manageable, but caution is necessary to prevent unforeseen entrapment in debt (Alamgir & Ra, 2005).

Bhatta & Mishra (2020) have verified that exceeding the threshold ratio of 33 percent in debt accumulation may have adverse effects on the economic growth of Nepal.

The study by Sapkota (2023) examines the impact of public debt, categorized into internal and external debt, on Nepal's economic growth rate using time series data. The findings reveal that the influence of external debt on the economic growth rate remains consistent in both the long and short term when employing the ARDL approach. Additionally, the study identifies a long-term relationship between economic growth rate and both internal and external debt.

Mobilization of borrowing amounts should not be restrained only to the payment of interest and existing principal amounts but should also be mobilized for investment in the productive sector. Eventually, returns from such investment can enable repayment capacity. Therefore, the use of public debt in meaningful areas is crucial. (Nepal Rastra Bank in Fifty Years, 2005).

A review of above literatures show that there is both positive and negative relationship between public debt and its components and economic growth. However, most of these studies have

highlighted the need to set limit on public debt to reduce the negative consequences of excessive debt levels. This paper attempts to fill the gap by prescribing the optimal public debt threshold for sustainable economic growth in Nepal. Given the recent trend of increasing volumes of public debt, both external and internal debt, poor revenue mobilization capacity of the government, and instability of the GDP growth rate of Nepal, area of the study is highly demanding and relatively new in terms of determining the optimal public debt using comprehensive controlling variables. The outcomes of this study have significant implications for the policy makers to adopt an appropriate strategy to maintain the optimal threshold of public debt for sustainable growth in Nepal.

This paper has also included gross capital formation, which has a significant impact on the economic growth of a country, as suggested by prevailing economic growth theories and existing empirical studies, but not included in the paper written by Bhatta & Mishra (2020). To increase the validity of the results of this study from the econometric estimation of the model, results are also compared using the traditional public debt threshold suggested for developing countries by the international financial organizations.

3. METHODOLOGY OF THE STUDY

This section carry out the empirical estimation of the threshold public debt in Nepal. Based on the conceptual and theoretical foundations of the growth model, an econometric model is proposed at first. Secondly, estimated techniques are spelled out using the time series analysis method and lastly, sources of data and sample period are discussed.

3.1 Econometric Model

In the context of Nepal, this paper has used an econometric model that establishes the relationship of public debt and various other factors to economic growth to identify the optimal public debt to GDP ratio for maximizing growth. The chosen dependent variable is the real gross domestic product (RGDP) growth rate, and public debt ratio is taken as an independent variable. Additional control variables are also included to investigate the non-linear effects of government debt on the economic growth of Nepal. A bivariate quadratic growth equation is employed, and the results obtained are consistent with Checherita-Westpal and Rother (2012) to validate the presence of a non-linear relationship between the GDP growth rate and public debt.

The relationship between debt and growth is analyzed through an appropriate multivariate regression model, employing additional relevant control variables in the specifications with the latest available time series data. The basic regression model shown in equation 1 is obtained

from the augmented model proposed in equation (2) to find the optimal public debt threshold applying the usual ceteris paribus condition hold in this causal empirical analysis as below:

The basic model used to estimate debt threshold is:

$$RGDP_t \ = \ \beta_1 \, PDR_t + \beta_2 \, Sq\_PDR_t \ \dotfill \ (1)$$

The augmented econometric model used in this study is:

$$RGDP_t = \beta_0 + \beta_1 \, PDR_t + \beta_2 \, Sq\_PDR_t + \beta_3 \, TOR_t + \beta_4 \, GCFR_t + \beta_5 \, POPGR_t + \beta_6 \, GDSR_t + \varepsilon_t \dotfill (2)$$

where, RGDP is the percentage of real economic growth rate based on real Gross Domestic Product (GDP) at purchaser's price, PDR is the percentage of total public debt outstanding to nominal GDP with an expected positive coefficient for β_1, Sq_PDR is the square of public debt ratio with an expected positive coefficient for β_2 and subscript t is the time in years of the variables considered. Other controlling variables such as TOR is the Trade Openness and is calculated based on the percentage of the total volume of trade to nominal GDP of the year. GCFR is the percentage of gross capital formation on nominal GDP. POPGR is Population growth rate in each year and is estimated using exponential growth from census data of 1971, 1981, 1991, 2001, and 2011 by National Statistics Office for National Accounts. The gross domestic saving ratio is the percentage of gross domestic saving to nominal GDP.

To account for the non-linear relationship, squared terms of public debt are included, following the approach of Checcherita-Westpal and Rother (2012) as well as Jernej, Aleksander, and Miroslav (2015).

The control variables employed in this study are conventional factors used in empirical analysis and are often found to be statistically significant drivers of economic growth, as referenced in the literature, including works by Checcherita-Westpal and Rother (2012), Panizza & Presbitero (2014), Wright and Grinade (2014), and Romer (2012). The incorporation of these variables allows for an examination of whether public debt influences economic growth while considering alternative factors affecting growth.

3.2   Estimation Technique

This paper employs both traditional threshold debt ratios and econometric models using time series data from the last 47 years to assess conditions of public debt optimality. The paper observes whether those conditions are embraced in the case of Nepal and identifies the reasons that ensure optimal public debt threshold. To deal with the problems in time series data, stationary test, cointegration test using bound test for long run relationships, and error

correction model for short run dynamics among variables are applied. For residual diagnostics, LM serial correlation test and heteroskedasticity test, as well as Normality test are applied. The stability diagnostic test using recursive cusum squares residuals is used and plotted on a chart to test model stability.

The anticipated coefficient for public debt ratio (PDR) is expected to be positive, while the coefficient for the square of PDR should be negative. These signs signify a concave non-linear relationship between public debt and economic growth, indicating that moderate levels of debt promote growth, but higher levels of debt have an adverse impact on growth.

3.3   Sources of Data and Sample Periods

The paper has used secondary time series data published by the Government of Nepal (GON), Ministry of Finance, Financial Controller General Office and Nepal Rastra Bank from fiscal years 1974/75 to 2021/22. The data were retrieved from the website of World Bank (https://databank.worldbank.org), Ministry of Finance, GON, Economic Surveys published by the Ministry of Finance, GON, Quarterly Economic Bulletin, Nepal Rastra Bank etc.

4.   RESULTS ANALYSIS

This section presents the results regarding public debt sustainability using two different approaches: the threshold of debt indicators approach and the conditions of debt sustainability.

4.1   Descriptive Analysis

Descriptive statistics of the variables contained within the model cover the data from 1974/75 to 2021/22 for identifying the optimal public debt ratio, which is presented in the following Table 1.

Table 1: Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Real GDP Growth Rate	4.32	4.41	10.03	-2.37	2.5	47
Public Debt to GDP Ratio	40.00	40.26	66.76	6.98	18.97	47
Square of PDR	1952.59	1621.16	4457.14	48.74	1547.38	47
Trade Openness Ratio	41.30	43.81	64.04	22.27	10.156	47
Gross Capital Formation Ratio	25.13	24.31	41.38	15.13	6.81	47
Population Growth Rate	1.78	2.10	2.66	-0.49	0.65	47
Gross Domestic Saving Ratio	10.88	10.89	15.30	3.64	2.61	47

The above Table 1 provides descriptive statistics for each variable, including mean, median, maximum, minimum, standard deviation, and the number of observations. It is important to

note that the variables are expressed as percentages of GDP, except for the population growth rate.

Details of public debt sustainability indicators of Nepal are presented in Annex 2. Annex 2 shows that that the public debt outstanding was Rs. 21.02 billion in the 1980s, which elevated sharply to Rs 155.91 billion in the 1990s and it continued to ascend in the decade of the 2000s. It further reached the level of Rs. 2010.13 billion in FY 2021/22. The average growth in public debt was 32.01 percent during the 1980s which sharply plunged down to 5.15 percent during the 2000s, and then began to increase again reaching15.89 percent in FY 2021/22. Some of ratios of debt indicator to GDP in the last four decades are presented in the following Figure 1.

Figure 1: Debt Indicator on GDP (%)
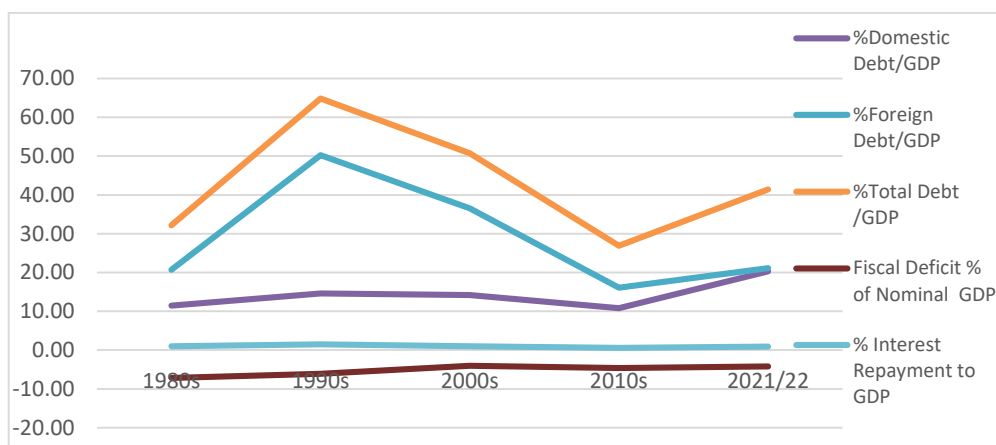
The Figure 1 shows that both total public debt to GDP and domestic debt to GDP ratio increased in 1990s from 1980s whereas such ratios decreased in both 2000s and 2010s.

The graph of public debt to GDP ratio, including all other controlling variables, are plotted in Figure 2 below to understand the trend behavior of those variables.

Figure 2: Trend in economic growth, public debt and other variable of Nepal
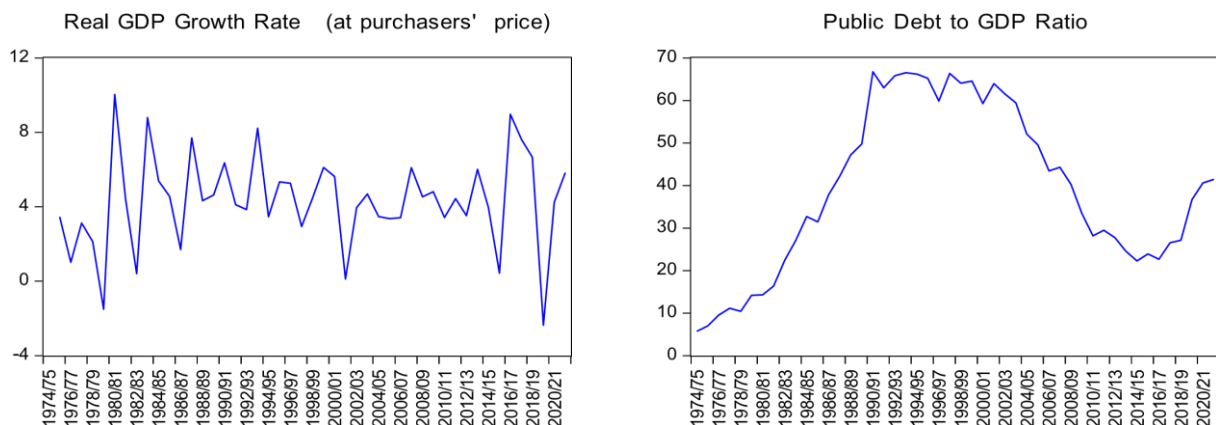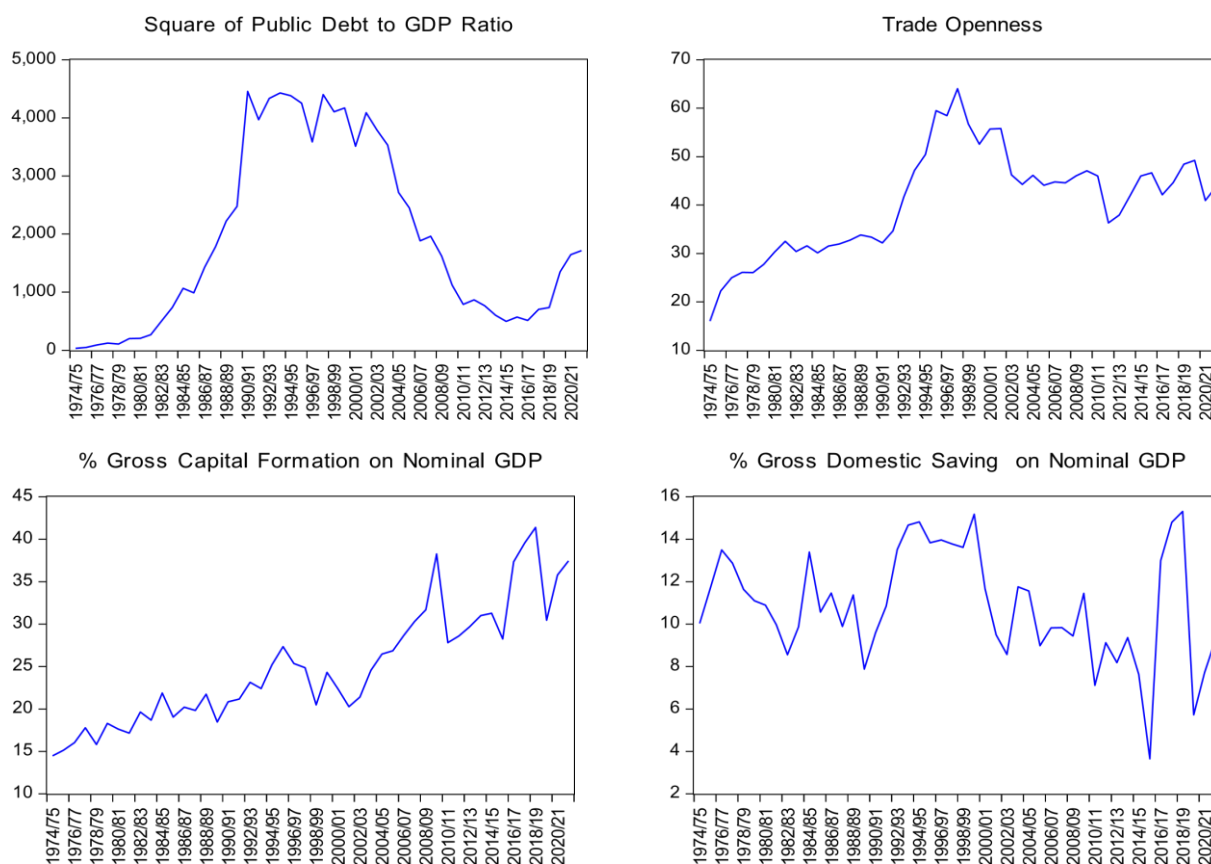
The second Chart in Figure 2 shows that public debt to GDP ratio was increasing before the 1990s, whereas it was decreasing until FY 2014/15. From observation, there is no noticeable seasonal pattern or trend in all the variables in the graphical plot except for gross capital formation which has trend behaviour.

Table 2: The Correlation Matrix

Variables	Real GDP Growth Rate	Public Debt to GDP Ratio	Square of PDR	Trade Openness	Gross Capital Formation	Population Growth	Gross Domestic Saving
Real GDP Growth Rate	1.00	**0.12**	**0.09**	0.05	0.22	0.06	0.36
Public Debt To GDP Ratio	**0.12**	1.00	0.98	0.66	0.03	0.04	0.24
Square Of PDR	**0.09**	0.98	1.00	0.62	-0.08	0.16	0.32
Trade Openness	0.05	0.66	0.62	1.00	0.48	-0.35	0.16
Gross Capital Formation	0.22	0.03	-0.08	0.48	1.00	-0.74	-0.05
Population Growth	0.06	0.04	0.16	-0.35	-0.74	1.00	0.53
Gross Domestic Saving	0.36	0.24	0.32	0.16	-0.05	0.53	1.00

The matrix stated in Table 2 shows a positive correlation between public debt and real GDP growth in Nepal. The coefficient of correlation between the public debt to GDP ratio (PDR) and real gross domestic product (RGDP) has been observed as 0.12. Intuitively, public debt is positively correlated with the square of public debt (SPDR), which is confirmed by the matrix presented in Table 2.

The scatter plot depicted in Figure 3 illustrates a positive correlation between debt and real economic growth.

Figure 3: Scatter Pot of Public Debt and Real Economic Growth
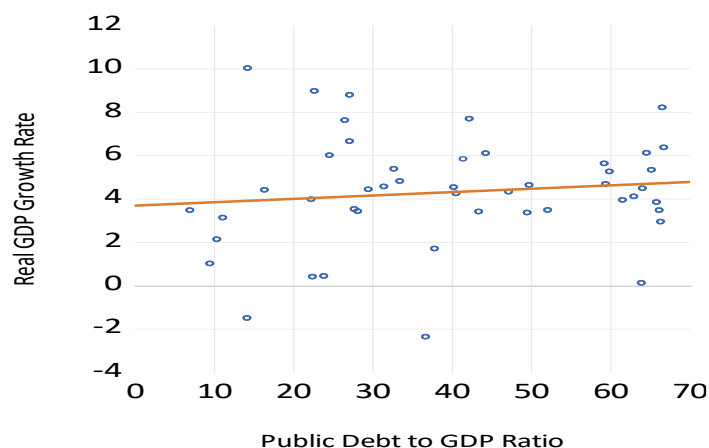
This implies that a higher debt ratio is correlated with increased economic growth.

4.2   International Comparison of Debt Threshold

Some of the debt burden thresholds and benchmark for Low Income Countries (LIC) as per the guidance note prepared by IMF and World Bank staff are given in Table 3.

Table 3: Public Debt Burden Threshold and Benchmark

Variable	Capability to Utilize public debt	% Public Debt/GDP	% External debt to GDP[2]	% External Debt to Export
Thresholds[2] in (PV) for LIC	Weak	35.0	30.0	140.0
	Medium	55.0	40.0	180.0
	Strong	70.0	50.0	240.0

Source: Nepal in Debt Sustainability Framework[3]

Benchmark for Nepal, 2020		70.0	55	240
Actual Data (PV): Nepal	2019	25.1	12.4	142.7
Actual Data : Nepal	2021/22	**41.43**	**21.14**	**512.84**
	2023	38.3	13.4	158.1
Projection (PV): Nepal	2024	39.5	13.4	154.6
	2025	40.5	13.1	150.0

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[2]   The Guidance Note on debt sustainability framework for low income countries prepared by IMF and World Bank staff and completed on December 26, 2017. Website: https://www.imf.org/en/About/Factsheets/Sheets/2023/imf-world-bank-debt-sustainability-framework-for-low-income-countries.

[3]   Nepal: Debt Sustainability Analysis; IMF Country Report No. 20/155; April 27, 2020. Retrieved from Website: https://www.imf.org/en/publications/dsa?country=NPL&fm=&fy=&tm=&ty=#search-section.

The IMF and the World Bank's Debt Sustainability Framework (DSF) has classified countries' debt-carrying capacity into three categories strong, medium, and weak categories. According to Nepal's Debt Sustainability Analysis by IMF: 2020, Nepal's composite indicator score is 3.28, which indicates a strong debt-carrying capacity of the Nepal and falls under overall low risk of debt distress. The outcomes of various debt sustainability indicators, using the traditional threshold approach, distinctly reveal that the overall status of public debt in Nepal has consistently hovered around the critical level of 25 percent of GDP in 2010s, as indicated by the EU and the Commonwealth public debt threshold indicators. Additionally, it aligns with the World Bank's (2004) sustainable debt threshold indicator, which sets the limit for debt stock to GDP at 50 percent.

Based on the export of Nepal in FY2021/22, external debt is excessively higher (i.e. 512.85 percent) than the given threshold. Public debt to GDP reached 41.43 percent in FY 2021/22. Table 3 shows that Nepal falls under a strong debt-carrying capacity for debt serving as referred by IMF.

4.3 Econometric Results

After summarizing the data and variables through descriptive analysis and verifying them through simple correlational analysis and scatter plot to observe the relationship between the variable of interest (i.e. public debt ratio) and other controlling variables on real GDP growth rate, stationarity test is conducted on the time series data.

To check for the stationary on the time series data, unit root test for all relevant variables at the level and first difference before applying estimation technique are presented in the following Table 4 and Table 5.

Table 4: Unit Root Test at Level

Method	Statistic	Probabilities [#]
ADF - Fisher Chi-square	38.51	0.00
ADF - Choi Z-stat	-2.33	0.01

\# Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution.

Variables	Prob.	Lag	Max Lag	Observation
D(Real GDP Growth)	0.00	2	9	44
Public Debt to GDP Ratio	0.05	4	9	43
Square Of PDR	0.60	0	9	47
Trade Openness Ratio	0.14	0	9	47
Gross Capital Formation Ratio	0.98	8	9	39
Population Growth	0.57	1	9	45
Gross Domestic Saving Ratio	0.00	0	9	47

Table 5: Unit Root Test at First Difference

Method	Statistic	Probabilities [#]
ADF - Fisher Chi-square	169.51	0.00
ADF - Choi Z-stat	-10.83	0.00

Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution.

Variables	Prob.	Lag	Max Lag	Observation
D(Real GDP Growth)	0.00	2	9	43
D(Public Debt to GDP Ratio (PDR))	0.07	1	9	45
D(Square of PDR)	0.03	1	9	45
D(Trade Openness Ratio)	0.00	0	9	46
D(Gross Capital Formation Ratio)	0.00	7	9	39
D(Population Growth)	0.00	0	9	45
D(Gross Domestic Saving Ratio)	0.00	2	9	44

All variables are not found to be stationary at the level and first difference individually. The results based on ADF test show that both level stationary I(0) and first difference stationary I(1) at a five percent level of significance are present. Such a mixed level of stationary demands consideration for the possibility of a long-run equilibrium relationship among the variables of interest and controlling variables with real GDP growth rate.

The ARDL Model is used to test for cointegration because (a) it allows cointegration test regardless of whether the underlying regressors are integrated of order one I (1) or order zero I(0), (b) ARDL generates unbiased estimates for the long run model and (c) ARDL can be used despite a small sample size.

Therefore, a cointegration test is conducted to check whether variables are integrated of different orders using the Bounds test (where the Null Hypothesis: No levels relationship) for cointegration proposed by Pesaran, Shin and Smith (2001) using the autoregressive distributed lag (ARDL) model. The co-integration test is conducted by using the autoregressive distributed lag 2 for annual data to avoid losing more degree of freedoms. Here, the unrestricted VAR is not chosen assuming that the variables are cointegrated and finding long run cointegration exists in the model estimation from the test.

Table 6: Cointegration and bounds test

Test Statistic	Value	Significance	I(0)	I(1)
		10%	1.99	2.94
F-Bounds Test		5%	2.27	3.28
Selecting optimal lag 2	8.172476	2.5%	2.55	3.61
		1%	2.88	3.99

The results of cointegration and bound test are shown in Table 6. Since the F-statistic (calculated) is greater than the critical value for the upper bound I(1), the variables are found cointegrated and there exists a long run relationship based on the Bounds test.

When there is cointegration, both the long-run and short-run models are valid. The ARDL model is used to analyze the long-run relationships, and the ECM model is used to analyze the short-run relationships.

From Long-run estimation of the equation (2) using ARDL model is presented as below:

$$RGDP_t = \delta_0 + \delta_1 PDR_t + \delta_2 Sq\_PDR_t + \delta_3 TOR_t + \delta_4 GCFR_t + \delta_5 POP\_G_t + \delta_6 GDS\_G_t + \varepsilon_t \dots\dots\dots\dots\dots(3)$$

Results of the estimation of long-run are presented in the following Table 7.

Table 7: Long-run estimation results

Variables	Coefficients
Public Debt to GDP Ratio (PDR)	0.19 **
	(0.07)
Square of PDR	-0.00 **
	(0.00)
Trade Openness Ratio	0.08
	(0.05)
Gross Capital Formation Ratio	-0.06
	(0.06)
Population Growth	0.19
	(0.66)
Gross Domestic Saving Ratio	0.13
	(0.18)
Constant	-1.42
	(2.29)
R-squared 0.65 and Durbin-Watson stat 1.99	

Note. Dependent variable is Real GDP growth. Selected Model: ARDL(2, 2, 1, 0, 0, 0, 2). Values in parenthesis are standard errors. P-value of test refers to the probability of rejecting the null that beta coefficients are zero. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The results for equation (3) after Long-run estimation are as follows:

$$RGDP_t = -1.42 + 0.19 PDR_t - 0.00 Sq\_PDR_t + 0.08 TOR_t - 0.06 GCFR_t + 0.19 POP\_G_t + 0.13 GDS\_R_t \dots..(4)$$

The Table 7 shows that there is statistically significant relationship between public debt to GDP ratio and real GDP growth at 5 percent level. One percent increase in public debt to GDP ratio increases real GDP growth by 0.19 percent in the long run. Similarly, significant long-run relationship is found between square of public debt to GDP ratio.

From the fit of the long-run cointegrating relationship with the dependent variable, i.e. real GDP growth rate, by extracting and subtracting the EC term from the dependent variable to

extract just the long-run relationship, the following graph in Figure 4 can be plotted, showing the long-run relationship with actual GDP ratio.

Figure 4: Long run relationship with actual GDP ratio
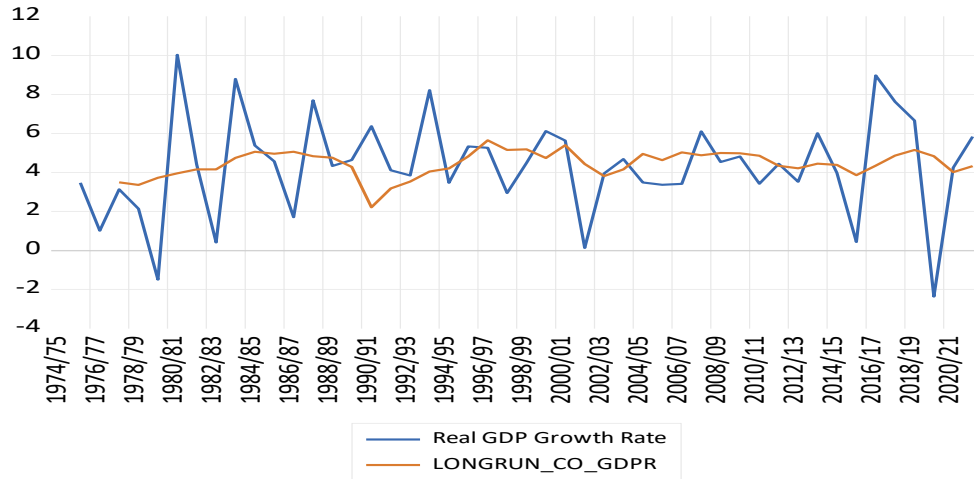
After confirming the long-run relationship, an error correction representation is developed and estimated from the following reduced form equation.

$\Delta RGDP_t = -1.567$ *Cointegration equation*$_{t-1}$ $+ \Delta 0.173$ *RGDP* $_{t-1}$ $- \Delta 0.335$ *PDR*$_t$ $+ \Delta 0.193$ *PDR*$_{t-1}$ $+ \Delta 0.003$ *Sq_PDR*$_t$ $+ \Delta 0.626$ *GDSR*$_t$ $+ \Delta 0.390$ *GDSR* $_{t-1}$ .... (5)

Results of the estimation of short-run coefficients are presented in the following Table 8.

Table 8: Short-run estimation results

Variables	Coefficients
D(RGDP (-1))	0.17
	(0.11)
D(Public Debt to GDP Ratio)	-0.33 *
	(0.00)
D(Public Debt to GDP Ratio (-1))	0.19 ***
	(0.06)
D(*Sq*_PDR)	0.00
	(0.00)
D(Gross Domestic Saving Ratio)	0.63 ***
	(0.10)
D(Gross Domestic Saving Ratio (-1))	0.39 ***
	(0.11)
CointEq(-1)*	-1.57 ***
	(0.18)
R-squared 0.86 and Durbin-Watson stat 1.99	

Note. Dependent variable is Real GDP growth. Selected Model: ARDL(2, 2, 1, 0, 0, 0, 2).

Values in parenthesis are standard errors. P-value of test refers to the probability of rejecting

the null that beta coefficients are zero. *** p<0.01, ** p<0.05, * p<0.1

Table 8 shows that the lagged error correction term (ECM-1) is statistically significant and negative. This result indicates the cointegration among the variables: real GDP growth, public

debt to GDP ratio and gross domestic saving. The absolute value of the coefficient of error correction term (i.e. 1.57) implies that the system is convergent, yet, has oscillatory adjustment process.

4.4 Diagnostic Test

The diagnostic test results for the model are detailed in Table 9. The Chi-square and F statistic using the Breusch-Godfrey Serial Correlation LM Test shows that there is no serial correlation in the residuals of the model at the 5 percent level of significance. A higher P value (21 percent and 35 percent) reveals a failure to reject the null hypothesis (H_0 = no serial correlation exists in the estimation of the model) at the 5 percent level of significance.

The White test results indicate that the residuals exhibit homoscedasticity, suggesting consistent variance across the observations. A higher P-value (10 percent and 7 percent) reveals a failure to reject the null hypothesis (H_0 = homoskedasticity exists in the estimation of the model) at the 5 percent level of significance. Additionally, the Jarque-Bera value and a higher P-value of 83 percent, tested at a 5 percent level of significance, affirm the normal distribution of the residuals in the model.

Table 9: Diagnostic test results

Diagnostic test	Chi-square	F Statistic	Jarque-Bera
Breusch-Pagan-Godfrey Serial Correlation LM	3.17	1.10	
P Value	0.21	0.35	
Heteroskedasticity: White test	19.86	1.88	
P Value	0.10	0.07	
Normality test			0.37
P Value			0.83

To test model stability, this study has applied the stability diagnostic test using recursive cusum squares residuals. In Figure 5, the cusum squares falls within the band of 5 percent level of significance and shows the model is stable.

Figure 5: Plotting the results of recursive residuals of cusum-squares

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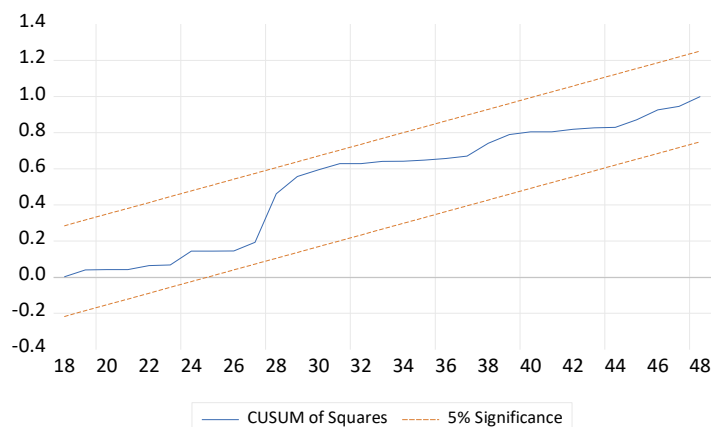
### 4.5   Relationship Between Public Debt and Economic Growth

The debt coefficients displayed in Table 7 reveal a non-linear concave relationship in the debt-growth dynamic. In the long-run, specifications of the ARDL model, the positive coefficient of debt, coupled with the negative sign of the debt square, suggests that the relationship is characterized by diminishing returns. This finding implies that low debt to GDP ratios positively impact economic growth, up to a specific threshold. Beyond this threshold, the detrimental effects of the square term in the public debt equation outweigh the initial positive contributions of debt (Bhatta & Mishra, 2020).

This paper primarily concentrates on exploring the correlation between public debt and economic growth. A bivariate model has been employed to calculate the optimal threshold for public debt that maximizes growth. The plotted graph aids in discerning the presence of a relationship resembling a Laffer curve. Figure 5 illustrates a representation of the econometric results derived from the following estimated quadratic bivariate equation using the basic equation (1) derived from long run cointegrated equation (4) using partial derivative.

Real GDP Rate = 0.187546 PDR - 0.002646 Square of PDR

The concave curve in Figure 5 depicts an inverted U-shaped relationship between economic growth rates and the public debt to GDP ratio.

Figure 5: Optimal level of public debt for economic growth of Nepal
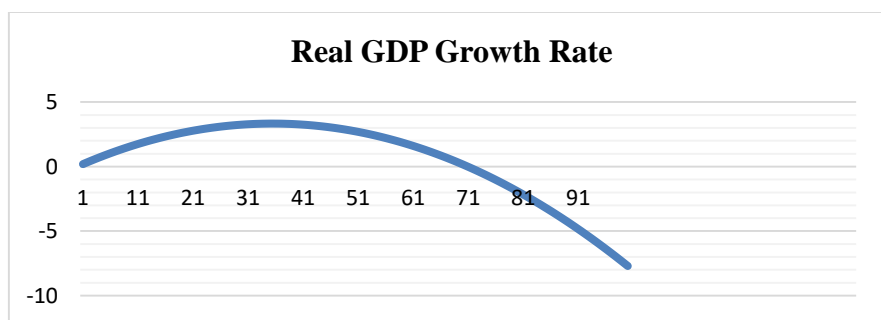
The findings indicate that Nepal experienced higher growth rates when public debt-to-GDP ratio was at 35.43 percent.

The benchmark, as indicated by Reinhart and Rogoff (2010) for high-income countries, is set at 90 percent. Butkus and Seputine (2018) discovered that debt turning points range from 46 percent to 229 percent of GDP in high-income countries and from 8 percent to 145 percent of GDP in low-income countries. Additionally, it has been recognized that nations exhibiting superior governance quality and lower trade deficits tend to have a higher threshold level for debt.

Excessive level of public debt has implication on fiscal and monitory policy as well as financial stability.

Higher levels of debt constrain fiscal policy by limiting the ability of governments to implement expansionary policy during economic depressions. A significant budget allocation to pay interest offers less room for fiscal stimulus packages and the discretionary spending on critical areas such as infrastructure, education, and healthcare. This limitation reduces the capacity of government to stimulate economic, possibly delaying periods of recession.

Similarly, higher level of debt brings challenges for monetary policy due to upward pressure on interest rates since debt becomes riskier as the level of debt increases. It causes central bank to opt for tight monetary policy to stabilize financial markets, triggering to higher borrowing costs for businesses. Elevated debt level reasons for limited space for monitory policy to respond economic shocks.

Excessive public debt can also pose risks to financial stability, investor confidence, and exchange rate. Fears about the sustainability of public debt can lead to instability in bond markets and potentially triggering broader financial market destruction. Elevated public debt can influence exchange rate movements, with currency depreciation occurring. As a result, such financial instability can have wider implications for economic growth and overall macroeconomic stability.

An appropriate level of public debt helps to maintain discipline fiscal and monitory policy.

5. CONCLUSIONS

The relationship between public debt and economic growth has been analyzed through a non-linear relationship, utilizing time series annual data spanning from fiscal year 1974/75 to fiscal year 2021/22. A quadratic bivariate model utilizing ARDL coefficients has been calculated to determine the optimal public debt threshold that facilitate economic growth. The ideal ratio of public debt to GDP for Nepal is found 35.43 percent.

The estimation of the threshold for the public debt ratio in Nepal found in this paper is similar to the level calibrated by Bhatta & Mishra, (2020).

Joint IMF and Nepal Bank-Fund Debt Sustainability Analysis (DSA), 2020 shows that Nepal's composite indicator score is 3.28, which signals a strong debt-carrying capacity and low risk of external debt distress. The objective of DSF is to assist low-income countries in making borrowing decisions and it typically focuses on solvency and do not ensure no growth deficit.

As a result, IMF's sustainability threshold (which is higher than the optimal threshold derived in this study) suggested for Nepal may not be appropriate to facilitate economic growth and is suboptimal.

Due to non-availability of data relating to interest rate and maturity of debt for each deal and categories of internal debt and external debt, present value of debt is not calculated while using public debt threshold in this study. Therefore, use of present value of debt would have given true picture while determining appropriate debt threshold indicator.

Results based on indicators of the sustainable threshold depict that both public debt and external debt have been increasing in recent years. Therefore, expansion and diversification in exports from domestic production may largely be helpful in improving the external debt threshold by reducing the external debt burden and increasing domestic production. Borrowed capital should be directed towards productive endeavors, ensuring debt repayment while facilitating the attainment of growth targets.

Excessive debt to GDP ratio poses challenging in macroeconomic management, resulting uncertain outlook for growth. Efforts to enhance the debt situation can be made by either raising taxes or cutting expenditures to reduce the fiscal deficit.

Recently, the increase in expenditure has been higher than the rate of increase in revenue mobilization. As a result, public debt may increase rapidly in the future to meet the fiscal deficit and may lead to exceeding the threshold prescribed by the IMF/World bank and others.

The policy implication of the finding is to maintain optimal public debt and use public debt in a sustainable way that allows the government and central bank an adequate policy space that facilitates the effectiveness of fiscal and monetary tools to respond to economic shocks and achieve their policy objectives.

Excessive deficit in financing causes debt crisis, pressure to future generations for repayments, crowding out effect and higher interest payment burden. Therefore, this study suggest not to exceed the optimal level of public debt set with the growth maximizing debt threshold. Debt accumulation should closely correspond with the country's aims for sustainable economic development, emphasizing not just debt repayment but also the promotion of the highest possible level of growth attainable.

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Annex 1: Indicators of Public Debt Sustainability

Amount in Rs 10 Million

Variable and Year	1980s	1990s	2000s	2010s	FY 2021/22
Domestic Outstanding	719.75	3448.01	9511.12	29690.01	98428.52
Foreign Debt Outstanding	1382.16	12143.14	23313.77	43290.43	102584.70
Total Debt Outstanding	2101.92	15591.16	32824.89	72980.43	201013.20
Public Debt Growth Rate	32.01	17.59	5.15	14.15	15.89
% Domestic Debt/GDP	11.47	14.59	14.19	10.82	20.29
% Foreign Debt/GDP	20.67	50.25	36.53	16.09	21.14
% Total Debt /GDP	32.14	64.84	50.72	26.91	41.43
Fiscal Deficit	-429.34	-1388.03	-2803.65	-14026.10	-20246.40
Fiscal Deficit % of Nominal GDP	-7.19	-6.13	-4.08	-4.61	-4.17
Revenue excluding grant	503.33	2549.26	8754.15	49441.05	106795.90
% of total debt to revenue	363.63	635.81	426.81	157.81	188.22
Revenue including Grant	624.20	2939.56	10407.46	52843.03	109387.50
Total Expenditure	1053.54	4327.59	13211.11	66869.13	129633.90
Recurrent Expenditure	349.17	2010.74	7783.75	44311.23	96156.42
Capital Expenditure	704.38	2218.30	4120.51	13412.81	21637.68
Financing expenditure	0.00	98.55	1306.85	9145.06	11839.77
Interest Repayment	65.61	342.02	666.84	1446.57	4502.88
% Interest Repayment to GDP	1.02	1.46	1.02	0.56	0.93
% Interest Repayment to Total Debt	3.18	2.26	2.02	2.07	2.24
% Interest Repayment to Revenue	9.29	12.48	7.23	3.08	4.12
Principal Payment	50.26	342.02	664.84	5037.29	7675.36
Debt Servicing	115.87	684.04	1331.67	6483.86	12178.24
% Debt Servicing on GDP	1.72	2.92	2.03	2.47	2.51
% Debt Servicing on Revenue	15.65	24.96	14.43	13.25	11.13
Primary Balance	-363.73	-1046.01	-2136.82	-12579.50	-15743.50
Interest on Foreign Debt	16.97	114.50	210.24	347.35	744.20
Grants	120.87	390.30	1653.31	3401.98	2591.66
Current Account	-294.81	-1113.28	952.69	-957.82	-62332.50
Current Account as % of GDP	-4.41	-5.17	1.53	0.51	-12.85
GDP (Current Price)	5654.06	24115.91	68979.69	268154.30	485162.50