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Original Article

Relationship Between Transport Expenditure in Public Investment and Economic Growth in Nepal

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Abstract

Nepal, focusing on the impact of capital and recurrent expenditures on GDP from 1980 to 2023. Using the ARDL bounds testing approach, the analysis confirms a long-run cointegration relationship between GDP and selected variables, such as expenditures on transportation and social sectors. The results indicate that recurrent and capital expenditures have a positive and significant effect on GDP in both the short and long run. The error correction term reveals a rapid adjustment toward equilibrium. Statistical tests confirm the absence of serial correlation and heteroscedasticity, while stability tests validate the robustness of the model. The findings highlight a shift toward a private-sector-led economy post-liberalization and underscore the importance of efficient expenditure management to foster sustainable economic growth. This study provides valuable insights for policymakers to design strategies that optimize public expenditure for long-term development.

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Introduction

Nepal's government aims to promote economic growth and development through various interventions and policies, with transport development being a core strategy. However, increasing expenditure on transportation has not yielded desired positive results. Public investment is crucial for influencing the economy's performance, as infrastructural investment creates direct and indirect jobs linked to economic growth. Some believe that in developing nations, heightened government spending might fail to achieve the desired productive outcomes due to significant and often volatile public debt levels. Elevated government consumption can stimulate employment, enhance profitability, and boost investments through its multiplier effects on overall demand. Establishing sustainable transport systems is crucial for achieving

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the goals outlined in the 2030 Agenda for Sustainable Development, with enhanced airport capacity being vital to accommodate the rapidly expanding global connections among urban populations. In Nepal, inadequate and unbalanced transport infrastructure is often blamed for underdevelopment and increasing regional disparity. To achieve ambitious economic growth, the National Planning Commission (NPC) has proposed new policy options, such as changing resource allocation patterns, increasing absorption capacity, and ensuring development-friendly policies.

The UN Conference (2016) emphasized that sustainable transport systems play a vital role in achieving the objectives of the 2030 Agenda for Sustainable Development. Reliable transport systems are essential for enhancing rural-urban connectivity and creating opportunities, thereby improving the livelihoods of the world's poorest communities. Moreover, in the most unstable regions globally, effective transport systems can contribute to fostering peace, security, and trade. While expanding airport capacity is critical for supporting the rapidly growing global connections among urban populations, developing a more integrated transport system is even more crucial. Such integration ensures a balanced approach to managing competing transportation modes in urban areas.

Economic growth refers to an increase in an economy's capacity to produce goods and services, measured in real or nominal values. It is often measured in real terms, adjusted for inflation. Economic development, on the other hand, includes social factors like education, health improvement, environmental protection, resource allocation, and sustainable development. GDP is a commonly used measure of economic growth, often adjusted for inflation. To support economic growth and development, improved transport services are needed to expand business investment. Advanced economies focus on addressing problems, scaling, managing, and repairing transport infrastructure, and leveraging technology to achieve set targets. Investing in transport infrastructure can help struggling economies like Nepal realize economic growth and remove potential barriers to fair trade (Solow, 1956).

Rostow's theory of growth highlights the importance of infrastructure, including roads, railways, and other capital investments, for economic growth. Developed infrastructure increases productive capacity and sustains development, while public expenditure on infrastructure enhances productivity by reducing production costs and making raw materials accessible. In developing countries, this effect is enormous, as it boosts private capital by providing access to education, health, and social amenities. Investment in transport infrastructure affects the economy by altering private sector investment and creating employment opportunities. However, in Nepal, government spending can both positively and negatively impact economic growth, with lower investment from both the government and households hindering development. This study aims to analyze the relationship between public expenditure on transportation and economic growth in Nepal, focusing on government expenditure and capital expenditure.

Public investment is also sought to control monopoly power in developing countries, ensuring that prices do not set above the marginal costs of products. Capital formation is crucial at the early stages of development when private savings are small. The lack of private incentives to engage in promising economic activities due to uncertainty about local markets, unreliable sources of supply, and the absence of technology and skilled labor is another major rationale for creating public enterprises. Additionally, some governments create SOEs to gain national control over strategic sectors of the economy, such as defense, foreign-owned enterprises, or key sectors for development purposes.

This study aims to analyze the relationship between public expenditure on transportation in Nepal and economic growth. It aims to identify the trend and structure of transportation expenditure of public investment and examine the relationship between public investment in transportation and economic growth.

The Study focuses on the Nepalese economy, highlighting the importance of public investment in national infrastructure for socio-economic growth. Public utilities are granted governmental franchise monopolies due to natural monopolies, which can lead to lower prices if multiple producers supply the market. Direct government control is also sought to prevent prices from exceeding marginal costs. Capital formation is crucial for early development, and lack of private incentives due to uncertainties in local markets, unreliable supply sources, and lack of technology and skilled labor also motivate the creation of public enterprises.

Literature Review

The theory, developed in the 1980s to address the weaknesses of the neoclassical model, posits that technology is exogenously determined and explains growth through internal processes. Proponents of the theory, such as Romer (1986) and Schumpeter (2006), emphasize the importance of enhancing a country's human capital and technological progress for efficient production. Unlike the neoclassical model, which prioritizes physical capital, this theory highlights human capital as key to improving the rate of return. Productivity improvement is attributed to investments in human capital and faster innovations. The model also includes increasing returns to scale for capital investment and underscores the need for research and development to support technological progress, with the state playing a crucial role in long-term economic growth through infrastructure investment (Serven, 2010).

Smith (1776) argued that economic growth results from the profit motive, leading classical economists to advocate for free markets and limited government intervention focused on defense, internal order, and public works. In contrast, Keynes (1936) criticized the classical view, proposing that government intervention is necessary in the short term, as free markets lack self-balancing mechanisms for full employment. Keynesian economists contend that employment depends on effective demand, advocating for increased government spending during recessions and reduced spending during inflation, positioning public sector expenditure as a key driver of economic growth.

Barilee and Benvolio (2021) explored the relationship between Nigerian government expenditure on transportation and per capita income, concluding that while no long-run cointegration was found, there was a significant positive short-run relationship between transportation spending and per capita income. Almeida, Ferreira da Silva, and Cirino Araujo (2021) developed a theoretical model to examine the connection between transportation infrastructure and economic development, highlighting the importance of effective transportation spending for growth, with their econometric analysis supporting the positive influence of such investments. Kenneth, Ikegwuru, and Mac-Kingsley (2020) analyzed the impact of transportation infrastructure investments on Nigeria's economic growth, finding that these investments significantly contribute to economic growth and recommending that the government prioritize them as a source of revenue. Feng Zhu, Xu Wu, and Wei Penga (2021) studied the causal relationship between road transportation and economic growth in China, revealing bi-directional causality in most provinces, with unidirectional causality in certain regions, indicating that road transportation and economic growth are mutually supportive in China.

Tripathy, Srikanth, and Aravalath (2016) investigated the connections between infrastructure investment and economic growth over both short and long-term horizons. Their findings revealed no short-term correlation among gross domestic product, capital formation, government revenue, and exports. However, a long-term association was identified between economic growth, domestic investment, inflation, and government revenue. To foster growth and development in the Indian economy, greater focus should be directed toward capital formation, government income, and inflation management. Striking a balance among these factors remains vital for sustained economic progress.

Pereira and Andraz (2005) studied the impact of public investment in transportation infrastructure on Portugal's economic performance from 1976 to 1998, finding that such investments positively affect private investment, employment, and output, with one euro in public investment increasing long-term output by 9.5 euros. Pradhan and Bagchi (2012) examined the relationship between transportation infrastructure (road and rail) and economic growth in India from 1970 to 2010, discovering bidirectional causality between road transportation and economic growth, and suggesting that expanding transport infrastructure and capital formation would promote substantial economic growth in India. Ekpung (2014) analyzed public infrastructure spending and economic growth in Nigeria, using data from 1970 to 2010, and found bidirectional causality between road transport infrastructure and economic growth, recommending increased transport infrastructure to drive growth and capital formation. Enya and Ezeali (2021) investigated public investment in infrastructure and its effect on Nigeria's economic growth, concluding that while investment in technology, education, and power positively affects the economy, transport infrastructure has a negative relationship with growth.

Kanel (1988) examined the relationship between public expenditure and economic growth in Nepal from 1965 to 1981, finding that public expenditure grew significantly after 1970, with development expenditure growing faster

than recurrent expenditure. Shrestha (2009) analyzed the effect of public expenditure on economic growth in Nepal, concluding that an increase in expenditure would boost growth if the productivity of expenditure exceeds the interest rate, with physical infrastructure playing a key role.

Aryal (2011) studied the trend and structure of public expenditure in Nepal, finding no significant relationship between public expenditure and economic growth, although the share of public expenditure in GDP had been increasing. Rasaily and Poudel (2019) explored the impact of government expenditure on economic growth in Nepal, finding a long-term relationship and suggesting that both current and capital expenditure should be utilized together for growth.

Kharel and Adhikari (2021) investigated the economic effect of government spending on Nepal' s growth, stating that despite an increase in government expenditure, the efficiency of spending was poor and fiscal deficit was high; they suggested that fiscal expenditure on capital be the focus of development plans. One study (link) by Dhungel (2020) analyzed the correlation of infrastructure development with economic growth in Nepal, finding a stable relationship between both variables in the long-run, with infrastructure development leading to improved efficiency and competitive markets. Kunwar (2019) examined the long-run and short-run relationship between public expenditure and suggesting that the speed of adjustment towards equilibrium.

Research Methodology

The study examines the relationship between public expenditure on transportation and economic growth in Nepal using quantitative techniques. Qualitative methods include summation and graphical presentations. Quantitative analysis uses unit root testing, Johansen co-integration test, auto regressive distributed lag model, and error correction model. The dependent variable is GDP, with explanatory variables including labour force, gross fixed capital formation, total expenditure, capital expenditure on transportation, recurrent expenditure, and inflation rate. Data is sourced from Nepal Rastra Bank publications, economic surveys, and internet research.

$$Y = AK^{\alpha}L^{\beta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, Y represents the real income, K is capital investment on transportation, L indicates the recurrent expenditure on transportation, A refers to technology whereas α and β are production elasticities with respect to capital and labour.

Even though the study looks the relation between expenditure in transportation and economic growth an infrastructural aspect of transport is capital. After confining the Cobb-Douglas technology to α +β = 1, the study obtains a constant ret of returns to scale.

Model of the empirical equation of this study is as follow:

$$Y_t = \beta_0 + \beta_1 LF_t + \beta_2 GFCF_t + \beta_3 ET_t + \beta_4 CET_t + \beta_5 RET_t + \beta_6 INF_t + \varepsilon \ldots\ldots\ldots\ldots (2)$$

Where, Y =Gross Domestic Product (GDP)

LF_t = Labour Force

$GFCF_t$ = Gross Fixed Capital Formation

TE_t = Total Expenditure

CET_t = Capital Expenditure on Transportation

RET_t = Recurrent/ wages Expenditure on Transportation

INF_t = Rate of Inflation

β_0 = Constant

β_1, β_2, β_3 = Coefficient

ε = error term

To conduct modeling, testing for stationarity is a fundamental step, typically performed using the Unit Root Test. The Augmented Dickey-Fuller Test, introduced by Dicky and Fuller (1979), is employed for this purpose. Additionally, co-integration analysis is carried out. The error correction mechanism, initially developed by Sargan

(1964) and later refined and popularized by Engle, Granger, and Weiss (1987), is utilized to address disequilibrium and describe both short-term and long-term equilibrium relationships within the model. Furthermore, the various assumptions that support the validity of the model are carefully examined.

To examine long run and short run relation between expenditure on transportation and economic growth, ARDL Model and ECM was used. If there are cointegration, it can be said that there exist stable relationship between variables. The Error Correction Model (ECM) is employed to analyze the short-term dynamics of the relationship. Based on equation (2), the ECM is specified accordingly:

$$\Delta Y_t = \beta_0 + \beta_1 \Delta LF_{t-1} + \beta_2 \Delta GFCF_{t-1} + \beta_3 \Delta ET_{t-1} + \beta_4 \Delta CET_{t-1} + \beta_5 \Delta RET_{t-1} + \beta_6 \Delta INF_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots (3)$$

The Auto-Regressive Distributed Lag (ARDL) Model, introduced by Pesaran and Pesaran (1997) and further refined by Pesaran et al. (2000), is favored over traditional co-integration techniques. This preference arises from its flexibility, as the ARDL approach can be applied irrespective of whether the regressors are purely I(0), I(1), or a combination of both. Additionally, the ARDL model is highly robust and particularly effective for studies with small sample sizes. Given these advantages, the ARDL model is adopted for this study.

Data Analysis and Results

For the connection between the boarders of neighbouring countries the various plans are put forward by government of Nepal. To achieve the goals and targets government of Nepal amendments five year plans and implements it. However, unsuccessful implementation and loopholes in the policy hindered the government's plan.

Trend and Pattern Analysis of Government Expenditure

Observing the changes in share of public expenditure on GDP the trend of economic growth can be analysed. The prominent factors to determine the economic growth are government capital expenditure (CE) and recurrent expenditure (RE). Other main components associated with economic development are government expenditure on other main headings like expenditure on economic and social sectors. Some major components are briefly analysed.

Trend and Pattern Analysis

The economic growth trend can be analyzed mainly by observing on the changes in share of public expenditure on GDP. The government total capital expenditure (CE), total recurrent expenditure (RE). capital expenditure on transportation (CET) and recurrent expenditure on transportation (RET) are the main factors to determine the economic growth. Similarly, the government expenditure on other headings like expenditure on economic and social sectors, are also the components which are associated with economic development of the nation. Hence, they are briefly analyzed.

Table 1

Share of Recurrent*, Capital, and Total Expenditure on GDP Mid-July

Year	GCE	GRE	GTE	GCE% on TE	GRE % on TE	total %
1980-1984	18912.5	8428.3	27340.8	0.691732	0.308268229	100
1985-1989	40836.8	20978.3	61815.1	0.660628	0.339371772	100
1990-1994	86092	48040	134132	0.641845	0.358154654	100
1995-1999	123254.1	128769.3	252023.4	0.489058	0.510941841	100
2000-2004	124012	275616.5	399628.5	0.310318	0.689681792	100
2005-2009	223282.3	504783.8	728066.1	0.306679	0.693321389	100
2010-2014	310248.7	1377664	1687913	0.183806	0.816193914	100
2015-2019	933118.9	3234435	4167554	0.223901	0.776099146	100
2020-2023	189084.7	902049.4	1091134	0.173292	0.826708177	100

**Principal repayment expenditures (PR) are included in RE because only after 1999 PR was separated from RE. Hence, the PR is added in RE even after 1999,Where: Recurrent expenditure (RE), capital expenditure (CE), total expenditure (TE)*

Share of Public Expenditure

Prior to 1999, Nepal's government spending was divided into two main categories: capital expenditures and recurring expenditures. The current expenditures on public consumption that do not generate any productive assets, such as interest payments, subsidies, wages and salaries, pensions, and other current transfers, are referred to as recurrent expenditures. On the other hand, capital expenditures are the government's development expenditures that are connected to the growth of economic and other sectors and the expansion of capital formation.

Table 2

Share of Recurrent*, Capital, and Total Expenditure on GDP Mid-July

Fiscal Year	Share of RE on GDP	Share of CE on GDP	Share of TE on GDP	% of RE on TE	% of CE on TE	% of TE
1980-1984	5.456	12.097	17.553	31.283	68.717	100
1985-1989	6.318	12.110	18.428	34.360	65.640	100
1990-1994	6.461	11.769	18.230	35.532	64.468	100
1995-1999	8.891	8.975	17.866	50.631	49.369	100
2000-2004	10.270	5.472	15.742	68.545	31.455	100
2005-2009	11.092	5.716	16.808	70.093	29.907	100
2010-2014	13.260	3.861	17.121	80.704	19.296	100
2015-2019	16.778	5.854	22.632	78.239	21.761	100
2020-2023	20.03	4.830	24.860	82.671	17.329	100

**Principal repayment expenditures (PR) are included in RE because only after 1999 PR was separated from RE. Hence, the PR is added in RE even after 1999.Where: Recurrent expenditure (RE), capital expenditure (CE), total expenditure (TE)*

Table 4.2 shows an increasing trend of recurrent expenditure share to GDP over the study period, with capital expenditure increasing up to 1989 and decreasing until the end of the period. Total expenditure increased from 1989 to 2004, with a five-fold increase in the first five years and a two-fold increase in the last five years. The share of Recurrent Expensive (RE) on GDP increased from 4.082 to 20.03, and the share of Total Expensive (TE) on GDP increased from 11.751 to 24.860. The percentage of RE to TE increased from 34.807 to 82.671 percent, with the lowest percentage in 1980-1984 and the highest in 2020. The government's role in development has been reduced after liberalization, leading to a private sector-led economy.

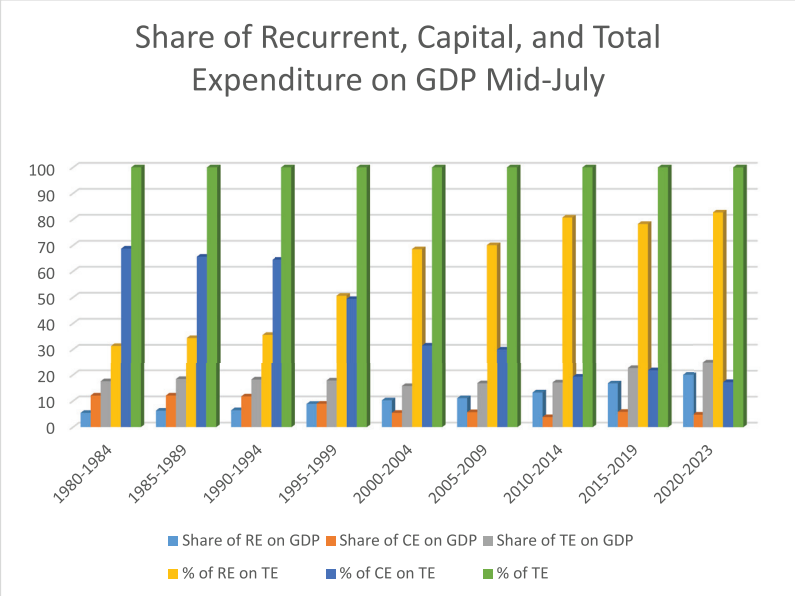

Figure 1 Share of Recurrent, Capital, and Total Expenditure on GDP Mid-July

The study reveals that the share of government expenditure (CE) on GDP is higher than that of revenue (RE) at the beginning of the study period. From 1990-1994, there was a balance between RE and CE. From 2010 to 2014, CE to GDP was the lowest. The increasing trend of TE to GDP indicates that government expenditure is greater than GDP, indicating slower GDP growth. The curvatures of CE and TE share on GDP remained consistent until 2015-2019, suggesting that TE share is guided by CE share to GDP. The increasing recurrent expenditure and decreasing capital expenditure are alarming for developing countries like Nepal, as both promote growth by increasing demand for goods and services.

Empirical Analysis

This study analyzes Nepal's economic growth using annual GDP data and recurrent expenditure to understand labor and capital expenditure. Data from the Ministry of Finance Nepal is used to analyze the Nepalese economy from 1980 to 2020. The study uses deflate values of inputs as a proxy for physical quantities, and capital stock and unit of labor are obtained using capital formation index and GDP.(De Loecker, 2011).

Summary Statistics of Descriptive Analysis:

Descriptive analysis shows the overall description of selected variables. It provides insight into the distribution and variation of the data of the study. Four variables are analyzed, namely log of GDP (LNGDP), log of gross total expenditure (LNGTE), log of gross capital expenditure (LNGCE), log of gross recurrent expenditure (LNGRE), log of capital expenditure on transportation (LNCET), log of recurrent expenditure on transportation (LNRET), and log of inflation (LNINF).

Table 3

Descriptive Statistics of the variables

Variables / Description	N	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
LNRGDP	38	12.88934	12.8255	14.66555	11.87116	0.775139	0.813141	3.091405
LNLF	38	16.2227	16.25689	16.63664	15.75033	0.262483	-0.18601	1.747165
LNGFCF	38	8.551185	8.748174	11.77905	5.404028	1.909663	-0.01384	1.911118
LNTE	38	8.551184	8.748174	11.77905	5.404028	1.909663	-0.01384	1.911117
LNCET	38	8.37645	8.380117	11.84513	5.878576	1.653607	0.40288	2.222877
LNRET	38	5.744329	5.316642	9.754387	2.970414	2.014973	0.656213	2.211735
LNPUE	38	7.313305	7.38435	10.55888	3.921973	1.785018	0.06433	2.344081
LNPRE	38	8.173634	8.328246	11.49613	5.146331	1.981088	-0.0247	1.772295
LNINFA	38	2.858649	2.898381	3.367296	1.930071	0.249742	-0.96526	5.678009

Source: Researchers own calculations, By EViews 10

The above table shows that LNRGDP has 12.88934 mean and 12.8255 median. It has the maximum value of 14.66555 and minimum value is 11.87116 whereas the Std. Dev. is 0.775139. Similarly, LNLF has 16.22270 mean, 16.25689 median and it has 12.36297, 15.75033 maximum and minimum value respectively. The mean value of LNGFCF is 8.551185, maximum 11.77905 and Skewness value is -0.013841. Likewise, LNTE has 8.748174 median and 8.551184 mean. It has -0.01384 Skewness and 1.911117 Kurtosis. Similarly, the mean value of LNCET is 8.762619, median 8.500207 and std. deviation is 0.672970. Likewise, LNRET has 8.400931 maximum values and 5.157905, minimum value.LNINF has 2.858649 mean and 2.898381 median.

Unit Root Test

This study aims to achieve stationary time series analysis by using the ADF test to avoid spurious regression problems in time series econometric modeling. The sequential test tests intercept only and trend and intercept. The results show all variables are suffering unit root at level, indicating spurious level form series. First difference

data is employed for unit root testing, resulting in completely unit root-free level forms and integrated series. This level form data is suitable for empirical analysis, particularly empirical models. The unit root results are reported in Table 4.

Table 4

ADF Unit Root Test Result

Name of	Level		First difference		Second difference		Decision
Variable	t-Statistic	Prob	t-Statistic	Prob	t-Statistic	Prob	
LNRGDP	1.0725	0.9967	-6.3903	0.0000			I(1)
LNLF	-2.1713	0.2192	-8.1402	0.0000			I(1)
LNGFCF	0.3754	0.9051	-3.3713	0.0175			I(1)
LNCET	1.0190	0.9961	-7.1008	0.0000			I(1)
LNRET	1.3661	0.9792	-5.9087	0.0000			I(1)
LNPUE	-0.8600	0.7919	-6.6251	0.0000			I(1)
LNPRE	-0.0390	0.9497	-6.8649	0.0000			I(1)
LNINFA	-5.4615	0.0000					I(0)

Source: Author's Calculation through E-Views 10.

The data series is converted to logarithms and tested for stationarity. Variables are found to be non-stationary, and the ADF test is verified after the first difference. If stationary on level, the model is considered I (0), but stationarity is shown in the first difference, integrating to I (1). The ARDL approach is used instead of Engel Granger and Johansen, as all variables used in the analysis must be integrated level and first difference. The dependent variable is non-stationary and integrated of order 1.

ARDL Bound Test for Cointegration:

The unit root results reported in table 2 shows thatall the series of the variables are stationary at first difference but the variable LNINFA is stationary at I(0). Thus, researcher applies bounds testing approach to co-integration to test short run as well as long run relationship between variables.

$LNGDP = \beta0 + \beta1LNLF + \beta2LNGFCF + \beta3LNRCET + \beta4\ LNRRET + \beta5\ LNTE + \beta6\ LNINFA$ ……..1

$LNGDP = \beta0 + \beta1LNLF + \beta2LNGFCF + \beta3LNRCET + \beta4\ LNRRET + \beta5\ LNTE + \beta6\ LNINFA + \varepsilon$ …….2

Where

LNRGDP= log of Real Gross Domestic Product

LNLF= Log of Labour Force

LNGFCF= Log of Gross Fixed Capital Formation

LNRCET= Log of Real Capital Expenditure on Transportation

LNRRET= Log of Real Recurrent Expenditure on Transportation

LNTE= Log of Total Expenditure

LNINFA = Log of Adjusted Inflation

ε = Error term

$\beta0$= Intercept

$\beta1$, $\beta2$, $\beta3$, $\beta4$, $\beta5$ and $\beta6$ = Coefficient

Equation (1) represents the economic model and equation (2) represents the econometric model of the study.

In the unit root test, the variables are found stationary at first difference thus, ARDL regression has been used in the analysis.

The augmented Auto-Regressive Distributed Lag (ARDL) bounds test for co-integration includes an additional F-test applied to the lagged levels of the independent variables in the ARDL equation. This extra step helps verify

the existence of a co-integrating relationship among the variables. The Result of ARDL Bound test is as follows.

Table 5

Bound test result

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.636690	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's Calculation through E-Views 10.

The study examines the long and short-run relationship between selected variables on Nepal's economic growth using the ARDL model. The study uses the bound test (F-statistics) to explain the co-integration relationship among variables. The optimal lag order of the ARDL model is set based on the Akaike Information Criterion, and the adjusted sample is 1980-2023. The results indicate a long-run relationship between GDP and rest variables, with an F-statistic of 8.636690, exceeding the 1% critical value for the upper bound. The study rejects the hypothesis of no long-run relationship and accepts the alternative hypothesis of a long-run co-integration relationship.

Short-run Dynamics Results of ADRL Process

The Error Correction Model (ECM) examines both the short-term dynamics and the long-term impacts of variables. A negative and statistically significant error correction coefficient strongly supports the presence of co-integration among the variables. The outcomes of the error correction representation, corresponding to the second step of the ARDL method for co-integration, are presented in Table 6.

Table 6

ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLF(-1), 2)	24.45795	3.975882	6.151578	0.0002
D(LNGFCF(-2), 2)	6316.974	3506.938	1.801279	0.1052
D(LNTE(-1), 2)	62.36645	3558.340	0.017527	0.9864
D(LNCET(-3), 2)	0.197447	0.075995	2.598151	0.0288
D(LNRET, 2)	0.121075	0.048928	2.474561	0.0353
D(LNRET(-1), 2)	0.588857	0.077218	7.625911	0.0000
D(LNINFA)	-0.350260	0.090146	-3.885488	0.0037
CointEq(-1)*	-1.726785	0.149461	-11.55341	0.0000
R-squared	0.942657	Durbin-Watson stat		1.864660
Adjusted R-squared	0.856642			

Source: Author's Calculation through E-Views 10.

Table 6 shows a short-run association between real gross domestic product (LNRGDP) and dependent variables. The negative coefficient of the one-period lagged error correction term (CointEq-1) supports co-integration of the dependent variable with its regressors. The size of (CointEq-1) is -1.726785, indicating that about 172% of the system's disequilibrium converges back to long-run equilibrium. The positive and statistically significant short-run coefficients related to LNLF, LNGFCF, LNTE, LNCET, LNRET, and LNINFA indicate their importance in affecting LNRGDP in the short run, indicating a positive short-run dynamic effect of selected regressors.
The ECM model correctly explains the RGDP with a R2 value of 0.9426, explaining 94.26 percent of the variance.

The adjusted R2 value of 0.8566 explains 85.66 percent of the variance, with 14.34 percent due to other factors. The estimated coefficient of LNLF is negative and significant at a 1% level, indicating a positive short-run impact of LNLF on Nepal's economic growth. This supports the positive effect of physical capital on economic growth in both long and short run dynamic models.

The short-run coefficient of LNCET in Nepal is positive and significant at a 5% level, indicating that a one-percent increase in LNCET leads to a 0.1974 percentage point increase in real GDP in the short run. This supports the positive effect of physical capital on economic growth in Nepal, supported by both long and short-run dynamic models.

Serial Correlation LM Test Result

The serial correlation test assesses whether the residuals in a regression model are correlated with one another. A key assumption of regression analysis is that the error terms are uncorrelated, a condition known as no serial correlation.The result of the serial correlation is given in details in Table 7.

Table 7

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.283716	Prob. F(2,7)	0.7612
Obs*R-squared	3.074321	Prob. Chi-Square(2)	0.2150

Source: Author's Calculation through E-Views 10.

Table 7 provides the detailed results of the serial correlation test. The probability values of the F-statistic and the observed R-squared are approximately 0.7612 and 0.2150, respectively, both exceeding the 5% significance level ($p > 0.05$). This supports the null hypothesis, indicating no serial correlation in the residuals. As a result, the assumption of no serial correlation in error terms, required for the Ordinary Least Squares (OLS) method, is satisfied.

Heteroscedasticity Test Result

For both the standard OLS estimation and the ARDL model, it is assumed that residuals exhibit constant variance, also referred to as homoscedasticity. This test evaluates whether the variance of residuals remains consistent over the study period. One of the fundamental statistical assumptions in time series data and OLS is that the error terms for all observations share a common or constant variance. The detailed results of this test are presented in Table 8.

Table 8

Heteroskedasticity Test

F-statistic	0.972144	Prob. F(28,12)	0.5489
Obs*R-squared	28.45539	Prob. Chi-Square(28)	0.4405
Scaled explained SS	2.645879	Prob. Chi-Square(28)	1.0000

Source: Author's Calculation through E-Views 10.

Table 8 shows that the observed R-squared and the probability value of the F-statistics are 0.4405 and 0.5489, respectively, which both clearly surpass the 5 percent significance level. This indicates that the null hypothesis that is, that there is no heteroscedasticity in the residuals is accepted. Thus, homoscedasticity is present.

Stability Test Results

To evaluate the stability of long-run coefficients and short-run dynamics, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) tests were utilized. Figures 3 and 4 illustrate the stability of the error

correction model's estimated coefficients, supported by graphical representations of the CUSUM and CUSUMQ statistics. As noted by Bahmani-Oskooee (2004), the null hypothesis cannot be rejected if these plots remain within the critical bounds at the 5% significance level.

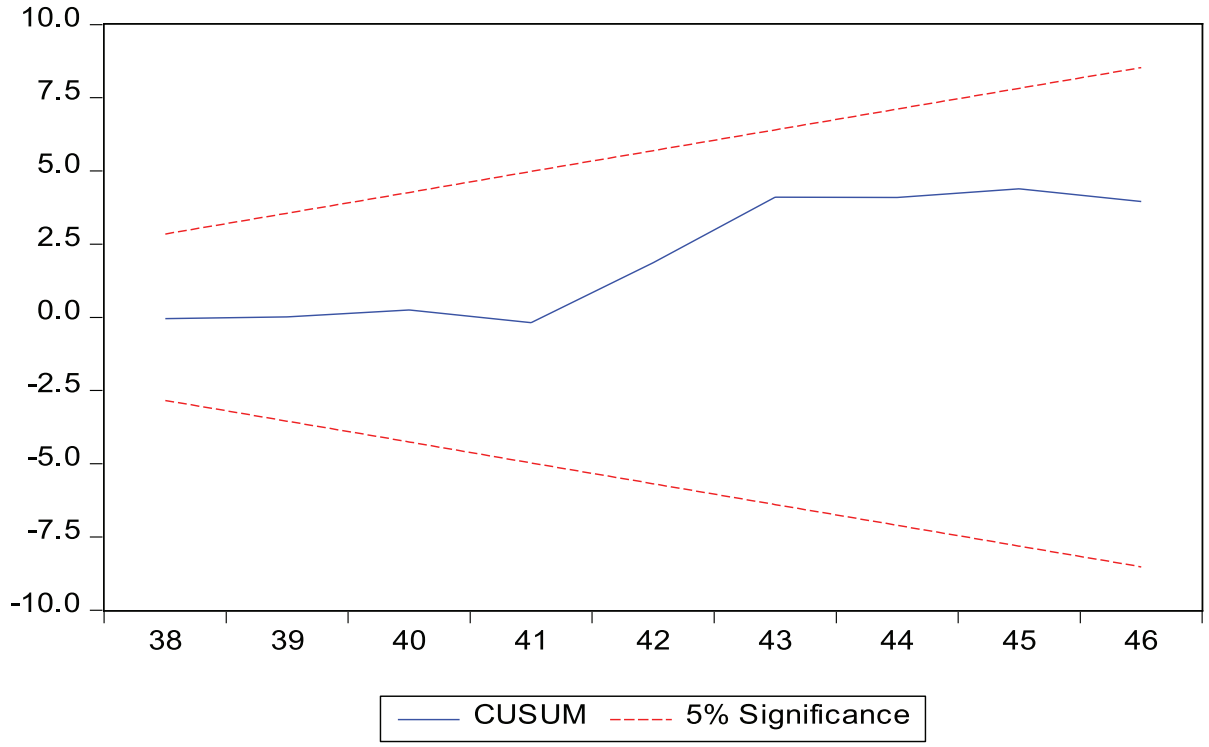

Figure 3 Plot of Cumulative Sum of Recursive Residuals

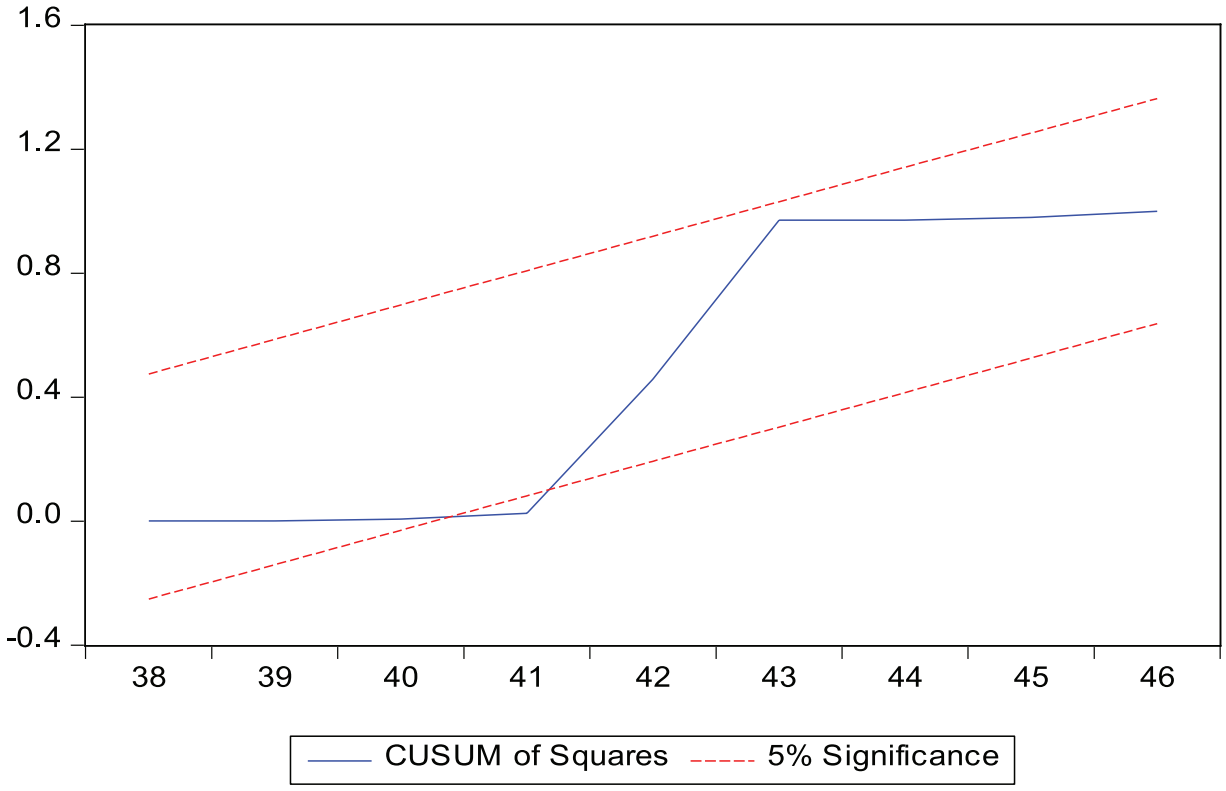

Figure 4 Plot of Cumulative Sum of Square of Recursive Residuals

From Figures 3 and 4, it is evident that the CUSUM and CUSUMQ plots lie within these boundaries, confirming that the model remains stable and does not exhibit structural instability throughout the study period.

The diagnostic test findings further validate that this model is free from issues such as incorrect functional form, serial correlation, heteroscedasticity, and instability. These results align with the foundational assumptions of ordinary least squares and time series models, which include stationarity, normality, linearity, absence of serial correlation, and homoscedasticity.

Findings and Conclusion

The study identifies significant trends and relationships between government expenditure and economic growth in Nepal. Over the study period, recurrent expenditure as a share of GDP showed a consistent increase, rising from 4.08% to 20.03%, while capital expenditure initially increased until 1989 but subsequently declined. The ARDL bounds testing confirmed a long-run cointegration relationship between GDP and selected variables, with an F-statistic exceeding critical values. In the short run, both recurrent and capital expenditures, particularly in transportation, exhibited a positive and significant impact on GDP. The error correction term indicated a rapid adjustment back to long-run equilibrium, with about 172% of disequilibrium corrected annually. The statistical analysis validated the absence of serial correlation and heteroscedasticity in the residuals, ensuring the reliability of the model. Additionally, stability tests using CUSUM and CUSUMQ confirmed the structural stability of the model. The findings also highlighted a shift toward a private-sector-led economy post-liberalization, reducing the government's direct role in development activities. The ECM model demonstrated high explanatory power, explaining over 94% of the variance in GDP, further supporting the robustness of the study's results.

The study highlights the pivotal role of government expenditure in fostering economic growth in Nepal. Recurrent and capital expenditures, particularly in transportation and social sectors, have significant short- and long-term impacts on GDP. Policy measures aimed at optimizing capital allocation and ensuring efficient expenditure management can further enhance economic growth. The robustness of the findings, supported by statistical validations and stability tests, underscores the reliability of the results, providing valuable insights for policymakers to design strategies for sustainable development.

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