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Effect of Capital Expenditure on Economic Growth in Nepal

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Abstract

The government of Nepal has allocated substantial funds to key Ministries with the aim of promoting economic development, primarily focusing on education, health, agriculture, and transportation sectors. Despite these increased expenditures, there is ongoing debate regarding the actual effect of government spending on economic growth. This research critically analyzes the effects of major government capital expenditure on economic growth in Nepal, specifically examining public spending in education, health, agriculture, and transportation. The study objectives include assessing how public capital expenditure in these sectors influences economic growth in Nepal. Using a causal relationship approach, the study utilizes secondary data obtained from the Ministry of Finance and Central Bureau of Statistics covering the period from fiscal year 1990/91 to 2021/22. The research formulated four hypotheses, including one suggesting that increased expenditure does not lead to higher Real Gross Domestic Product (RGDP). Methodologically, the study employs the Johansen cointegration test and Error Correction Method (ECM) to analyze the relationships among variables. Prior to analysis, the data underwent stationarity tests and necessary preprocessing for accuracy. The findings, based on short-run and long-run relationships identified through three cointegrating equations, indicate that expenditure on health, agriculture, and transportation significantly and positively correlates with RGDP at the 5% significance level. However, expenditures on education were found to be statistically insignificant in their effect on RGDP. Furthermore, the study reveals a positive and significant relationship between expenditure on agriculture and education. As a result, the study recommends that the government consider increasing allocations to health, agriculture, and transportation sectors to foster economic growth effectively. In conclusion, the research underscores the importance of targeted public capital expenditure in specific sectors to achieve sustainable economic growth in Nepal, highlighting nuances in the effect of government spending across different domains.

Keywords: education, health, agriculture, transportation, economic growth (RGDP).

1. Introduction

Every financial system strives to maintain employment, stable expenses, and rapid pr ofits, even when ensuring a balanced role, encouraging commercial enterprise freedom, assembli ng societal desires, promoting equitable wealth distribution, supporting new ventures, and priori tizing critical sectors.Governments throughout the world are boosting expenditures to achieve th ose objectives, investing in energy, healthcare, education, and business growth to strengthen the economy (Ogar et al., 2019). Investing in capital is critical to the long-term growth of a country's

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economy. However, managing and appropriately allocating capital prices every fiscal 12 months to achieve financial growth is difficult. As a rule of thumb, government spending — especially on capital projects — counts for the stability of the financial system. This approach aligns with the Keynesian economic theory, which holds that extra government expenditure increases demand normally and for this reason propels economic growth. Post-Keynesian economists contend, that more government expenditure, specifically on capital projects, can exacerbate monetary instability and in the end reason recessions. Wagner's rule of growing expenditure, however, contends that government spending outcomes from economic improvement as opposed to causes it. Government spending legal guidelines are critical for stimulating a financial boom due to the fact they hold stability between the country's sales and expenses (Al-Sharif & Bino, 2019). Policymakers have long debated whether government growth fosters or impedes economic advancement. Proponents of stronger government regard government projects, such as education and infrastructure, as critical "public goods." They also claim that higher government spending may boost economic growth by putting money into people's pockets. Proponents of smaller government argue that it is overly large and that increased expenditure hinders economic progress by diverting resources from the productive sector to the government, which spends them inefficiently (Modebe et al., 2012). Government expenditure and economic growth are two critical issues that have been central to studies in public finance. Their significance is linked to the important role of government spending in regulating the economy (Musa et al., 2020). To alleviate poverty, the government aims to promote economic development through capital expenditure, focusing on infrastructure projects like electricity, roads, railways, and educational and healthcare facilities. This strategy aims to enhance economic growth nationwide. Scholars debate the effect of government expenditure on economic growth: proponents suggest that investing in infrastructure, health, and education can boost productivity and output, while neoclassical theorists argue that increased capital spending could hinder economic performance by necessitating tax hikes or borrowing, potentially slowing aggregate economic activity (Amarchi & Chizoba, 2024). Effective public expenditure plays a crucial role in the sustainable economic and social development of the country. It can be divided into capital and recurrent expenditures of the nation. The overall economy of a nation depends on the capital and recurrent expenditures of the government in that country. From this, the amount of expenditure mentioned in the budget is invested in capital construction, and how much money can be found in the function of such capital? Overall national capital formation increases from spending on capital expenditures and increases in recurrent expenditures. In this regard, the sixteenth three-year plan for the nation has been ready for implementation by preparing the goal of raising the country to the level of a middle-income country by 2030 with the aim of the nation's sustainable development. Capital expenditure fell short of the government's aim, while recurring expenditure rises year after year; thus, development initiatives appear to have a direct effect. However, the Nepalese government's approved capital expenditure has not been spent properly. Different unreported statistics revealed that one-third of the overall authorized capital expenditure is not spent at the conclusion of each fiscal year. Effective capital expenditure helps the government, private sector, or society increase investment through sustainable development and will support maintaining high economic growth. Government capital expenditures need to be increased due to the overall development and prosperity of the nation, which helps reduce foreign aid and the circulation of internal resources. Especially the sixteenth periodic plan, which is focused on the capacity of taxation, the importance of capital expenditure, receiving foreign aid, and its effective utilization.

Nepal's capital expenditure status highlights various key trends and challenges. Over the past eleven months of the current fiscal year 2023/24, only 44.3% of the allocated capital expenditure budget has been utilized. Out of the total NPR 1,751 billion allocated for government expenditure, NPR 302 billion was designated for capital expenditure and NPR 307 billion for financing expenditure. Historically, actual spending in Nepal has often fallen short of expectations, primarily due to issues such as bureaucratic delays, insufficient project readiness, inefficient procurement processes, and frequent political interference. Over the past decade, only about 71% of the budgeted allocations have been disbursed, indicating inefficiencies in project implementation and budget execution. Recent efforts to enhance capital expenditure include reforms in the project approval process, improved planning and monitoring mechanisms, and amendments to the Public Procurement Act to streamline procedures. These initiatives aim to increase the efficiency and effectiveness of capital spending, which is crucial for addressing significant infrastructure deficits in sectors like energy, transport, and water supply.

Chart 1. Trend line of capital expenditure variables and Real Gross Domestic Product

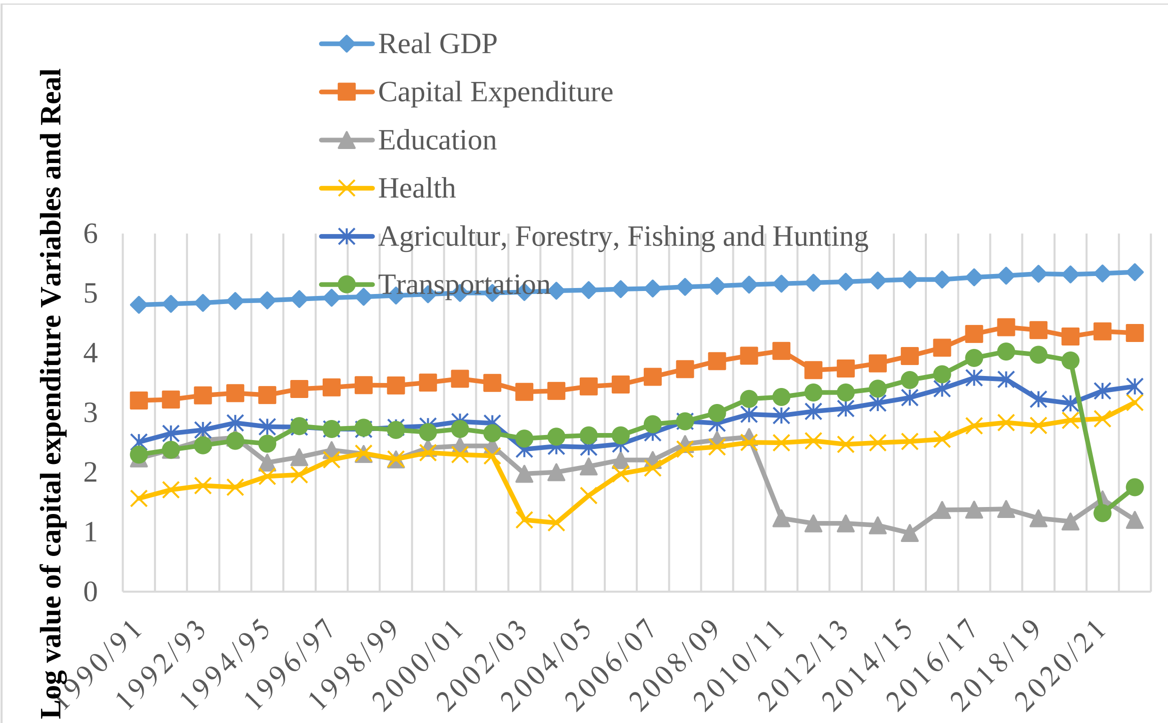
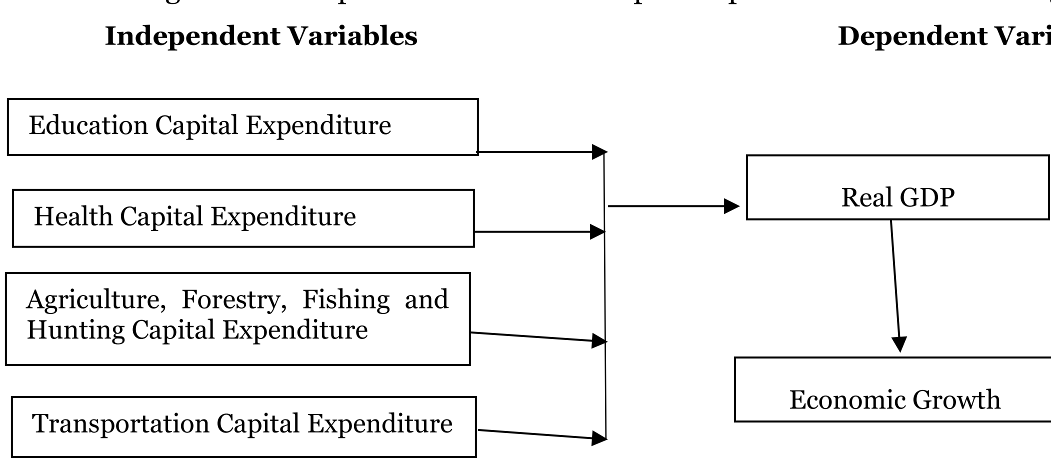


Figure 1. Conceptual frameworks of capital expenditure and economic growth



The figure 1 shows that the capital expenditure variables influence the economic growth. The RGDP growth in Nepal is influenced by various factors, particularly public spending components. The interaction among the primary determinants of economic growth, namely public capital spending on education, health, agriculture, and transportation, is depicted above.

1.1 *Research questions*

1. What is the nature and trend of capital expenditure and economic growth in Nepal?
2. Is there effect of capital educational expenditure on economic growth in Nepal?
3. Is there effect of capital health expenditure on economic growth in Nepal?
4. Is there effect of capital agriculture expenditure on economic growth in Nepal?
5. Is there effect of capital transportation expenditure on economic growth in Nepal?

1.2 *Objectives*

1. To assess the nature and trend of capital expenditure and economic growth in Nepal.
2. To examine the effect of capital educational expenditure on economic growth in Nepal.
3. To analyze the effect of capital health expenditure on economic growth in Nepal.
4. To reveal that the capital agriculture expenditure on economic growth in Nepal.
5. To examine the effect of capital transportation expenditure on economic growth in Nepal.

1.3 *Hypothesis*

1. H1: Capital expenditure on education has a significantly positive effect on RGDP growth.
2. H1: Capital expenditure on health has a significant positive effect on RGDP growth.
3. H1: Capital expenditure on agriculture has a significant positive effect on RGDP growth.
4. H1: Capital expenditure on transportation has a significant positive effect on RGDP growth.

2. Literature review and theoretical foundation

2.1 *Theoretical review*

Classical economists express the view that interference of governments in the economy does more harm than good, hence they give their prescription that most of the economic activities should be left to the private sector whose summary was given by Adam Smith in his *Wealth of Nations* in 1776. In Smith's one of magnum opus, he propagated a system of economic laissez-faire that takes the profit motive as its engine. Closely related to this is the fact that classical economists such as Ricardo and Smith held high government spending as a recipe for low economic development. According to classical economic theory, government expenditure is not a big driving force and minimal interference from government side is needed in a market economy. The principle behind this dichotomy is based on the idea that any change in money supply promptly affects all prices denominated in money without changing levels of real variables such as GDP and employment; this condition is also known as monetary neutrality. Classical economists were followers of free markets "invisible hand" trust and support minimum state intervention since they believed too much governance will slow down economic development (Thapa, 2018). The main proponents of endogenous growth theory are Paul Romer and Robert Lucas (1990). This theory emphasizes that for productivity to increase, the labor force must be continuously supplied with more resources, which include physical capital, human capital, and knowledge capital (technology). Thus, growth is driven by the accumulation of these factors of production, which in turn results from private sector investment. Consequently, the only way a government can influence long-term economic growth is through its effect on investment in capital, education, and research and development. This approach underscores that improved education, as well as any training or research that enhances human knowledge, is essential for achieving economic growth (Maingi, 2017). Peacock and Wiseman's study stands out as one of the most famous time-series studies in public finance. Their approach was based on the political theory of public decision-making, that governments tend to increase spending when citizens do not want higher taxes, and stressed the need for governments to comply with the wishes of their citizens. Taxes were viewed as a constraint on government spending, where economic growth would generally increase tax revenues on a stronger tax base, causing public spending to increase slowly, but that way this increase may deviate from what individuals perceive to be a better level of public spending than internal tax financing. This progressive increase in public debt will be canceled in times of major social upheaval, such as war, famine, or major disaster. These times created the need for substantial increases in public spending and led governments to raise taxes, which, although reluctant, were seen as socially acceptable in times of crisis — a thing that Peacock and Wiseman called the "displacement effect." They note that war financing often involves borrowing beyond the taxable capacity of states as well as subsequent debt payments. Furthermore, they provided the "unequal effects" of increased social awareness of social issues during times of violence, prompting governments to expand their roles to address these concerns because public tolerance of taxes did not return to pre-crisis levels (Taiwo & Taiwo, 2011). The German economist Ernst Engel, writing at the same time as Adolf Wagner in the 19th century, proved that consumer spending patterns change as family income rises. Over a century ago, it was noted that as family income increases, a smaller portion is allocated toward certain needs, such as work clothes. Most of the shares are allocated to other products, such as jewelry. Increases in average income can lead to small changes in the consumption of economic resources. Infrastructure investments such as roads, ports, electricity installations, and water supply infrastructure are critical in the early stages of national development, but as the economy progresses, public sector subsidies are predicted to decline because capital formation will decline over time. Engel's findings, commonly referred to as the declining share of food waste, compare private spending patterns with national spending patterns (Taiwo & Taiwo, 2011). Peacock and Wiseman were the first to propose this hypothesis in their study of expenditure in the public sector in the UK. They put forward that short-run social shocks combined with lack of funding are the main causes of an increase in public expenditures which then must be financed by higher taxes - this phenomenon is known as a displacement effect. The contrast between inadequate revenue and social productive spending for government activities brings about what can be called the inspection effect. People's adaptation to higher tax imposition levels for necessary public spending is named tax tolerance. Growing public expenditure is backed by various macro factors like population growth, urbanization, administrative requirements and welfare roles among others as well as meso factors like price inflation which increases the cost of providing public services/agencies (Okere et al., 2010). Sharma and Bista (2072) identified several drivers behind the increasing government expenditure in developing countries. These include expanding state activities, promoting economic development, enhancing social security, nationalizing industries, investing in agriculture, managing inflation, bolstering defense spending, facilitating urbanization, evolving public perceptions of government responsibilities, supporting economic growth, addressing population growth, managing inflationary pressures, improving living standards, and managing the costs associated with democratic governance. These factors collectively contribute to the upward trend in government spending in these nations. Keynes (1936) introduced the government spending to create jobs and utilize underemployed capital during recessions with high unemployment. His theory suggests that government spending is necessary to boost economic output and promote growth.

2.2 *Empirical review*

Landau (1983) study explored the relationship between total investment in education and economic growth. Regression results revealed three key findings: Firstly, higher government expenditure coupled with low investment in education was associated with slower growth in low-income countries. Secondly, two other factors exhibited stronger correlations with government expenditure and investment in education than with low income itself. Cooray (2009) investigated the government's role in economic growth by expanding the neoclassical production function to include two dimensions of government: size and quality. The model incorporated government expenditure as a measure of size and governance as a measure of quality, and it was tested across a cross-section of 71 economies. Estimations were also conducted based on income distribution within the sample. Empirical findings indicated that both the size and quality of government play significant roles in economic growth. The study concluded that enhancing governance capacity is crucial for improving growth performance in the examined countries, emphasizing the importance of investing in governance to foster economic development.

Ebong et al. (2016) explained the effect of government capital expenditure on economic growth in Nigeria between 1970 and 2012. A multiple regression model was utilized to demonstrate the relationships among capital expenditures on agriculture, education, health, economic infrastructure, and economic growth. The study concluded that both the short-run and long-run effects of capital expenditures had differential effects on economic growth. One of the variables, agriculture, didn't exert any significant effect on growth in either the short run or the long run. Similarly, capital expenditure on education had a positive relationship with economic growth, while capital expenditure on health had a negative relationship. Furthermore, capital expenditure on human capital development through the social service sector tended to boost economic growth, unlike that of agriculture. Capital spending on agriculture must be increased to enhance the quality and long-term growth of Nigeria's agricultural industry. The agriculture industry offers several opportunities and makes important contributions to the entire economy. As it has been mentioned earlier, despite having a positive direction, the coefficient of government capital expenditure was statistically insignificant to explain the growth of the Nigerian economy. Further, from the analysis there, it was established that the government fiscal deficit was not a significant growth inhibitor for the Nigerian economy (Ogar et al., 2019). Ahuja and Pandit (2020) examined the relationship between public expenditure and economic growth using a more extensive panel data set covering 59 countries from 1990 to 2019. Our empirical results confirmed the unidirectional causality between economic growth and government expenditure, where the causation ran from public spending to GDP growth. The results largely supported the Keynesian framework, which asserted the importance of government expenditure in stimulating economic growth. Furthermore, the analysis revealed that after considering all control variables, such as trade accessibility, investment, and inflation, public spending positively affected economic growth. Regarding control variables, it was found that investment had a significant and positive impact on economic growth. Evidence from the regression estimates further displayed that trade openness encouraged development in developing countries. However, population growth and unemployment had a detrimental effect on economic growth. Waweru (2021) revealed how government capital expenditure contributes to economic growth in East African countries. The purpose of this study was to determine the influence of public capital investment on economic development in East African nations using panel data sets. The findings of the study show that capital spending has a strong beneficial influence on East African economic growth. It also proposed that in East African countries, increasing government spending on capital expenditures to accelerate economic growth would be desirable while dedicating less money to recurrent programs. Modebe et al. (2012) investigated the impact of recurring and capital expenditures on Nigeria's economic growth from 1987 to 2010. A three-variable multiple regression equation was applied, with recurring and capital expenditure as independent variables and GDP growth as the dependent variable. The study indicated that recurring government expenditure had a positive and insignificant influence on economic growth, whereas capital expenditure had a negative and insignificant impact on growth. Njoku et al. (2014) investigated the relationship between Nigeria's capital expenditure and the growth of its manufacturing sector from 1971 to 2012. The study used the Ordinary Least Squares (OLS) method to examine the relationship between capital expenditure and manufacturing Gross Domestic Product (GDP). Manufacturing GDP was treated as the dependent variable, while independent variables included exchange rate, interest rate, political stability (as a dummy variable), recurrent expenditure, money supply, index of energy consumption, credit to the private sector, degree of openness, and the rate of GDP growth. All variables used in the study were integrated of order one, except for political stability which was represented as a dummy variable. The results indicated a positive relationship between the rate of GDP growth, capital expenditure, money supply, economic openness, recurrent expenditure, and manufacturing output in Nigeria. In light of these findings, the paper recommended several measures. Firstly, it suggested increasing capital expenditure while reducing recurrent expenditure. Secondly, it emphasized the importance of managing government funds effectively to enhance the nation's production capacity and accelerate economic growth. Nkechukwu et al. (2013) analyzed a part and adding up the effects of separated capital expenditure on economic growth in Nigeria, this study adopted the cross-sectional data collected from 1981 to 2013 annually. It targeted capital expenditure in the social overhead in the areas of education, health, and agriculture and road construction in order to predict the level of economic growth. To confirm cause-effect relationship between these variables, Granger- causality tests were executed. This means that, in the long-run, economic growth depended on capital expenditure for education and for road construction. On the other hand, when it came to capital expenditure in agriculture and health, OLS revealed that economic growth had a long-run negative association. Finally, the results also revealed evidence of one-way causality from economic growth exciting capital expenditure on agriculture and road construction and from capital expenditure on education and health in to economic growth only. This put the adjusted r^2 at 33% which shows that a considerable proportion of the fluctuations in economic growth in Nigeria is still unaccountable by Capital expenditure. The debate over the relationship between government expenditure and economic growth has persisted for decades without clear consensus. This paper contributes further evidence on this relationship using the case of Malaysia. The study disaggregates government expenditure into operating and development expenditures, while also classifying expenditures by sector. The analysis employs the Ordinary Least Squares (OLS) technique to examine the fixed effects of government expenditure on economic growth over the past 45 years, from 1970 to 2014. The findings indicate a negative correlation between government expenditure and economic growth in Malaysia during this period. Specifically, the classification of government expenditure reveals that only expenditures in the housing sector and development expenditure significantly contributed to lower economic (Hasnul, 2015). Usman and Agbede (2015) investigated the relationship between government expenditure and economic growth in Nigeria using a co-integration and error correction model for the period 1970-2010. Time-series data sourced from the Central Bank of Nigeria was employed for the analysis. The results of the

Augmented Dickey-Fuller (ADF) unit root test indicated that all variables included in the model were non-stationary at their levels but integrated of order one, I (1). In the long run, the analysis revealed a positive and significant linear relationship between the two categories of government expenditure (capital and recurrent) and economic growth, measured by real GDP. However, in the short run, economic growth exhibited a positive and significant linear relationship with recurrent expenditure, while it showed a negative but significant relationship with capital expenditure. Further analysis using the Pairwise Granger Causality test within a Vector Error Correction Model indicated a unidirectional causality, where economic growth Granger-caused capital expenditure and recurrent expenditure Granger-caused economic growth. Additionally, bi-directional causality was observed between capital expenditure and recurrent expenditure. Based on these findings, the study recommended the importance of stimulating economic growth by allocating an appropriate proportion of government expenditure to capital expenditure in the national budget.

Significant relationship between government expenditure and economic growth in Nigeria. Consequently, the study recommends implementing fiscal discipline in government expenditures and establishing structural mechanisms to monitor capital spending rigorously. These measures are proposed to enhance the nation's human and social capital, fostering sustainable economic growth (Oyediran et al., 2016).

To evaluate the relationship between public expenditure on education and human capital on economic growth in Honduras from 1990 to 2020, the instrumental variables (IV) method was used, incorporating components of public spending on education and human capital, along with a set of control variables. The time series data were extracted from the World Bank online databases. The results showed that there was no correlation between public expenditure on education and economic growth. They also suggested that human capital was not contributing to economic growth, indicating that human capital accumulation was not fully developing. Finally, the control variables considered key by the literature and essential for social and economic development were found to be hindering sustained economic growth. Thus, the government and the population faced enormous challenges to overcome (Juan, 2022).

Thapa (2018) examined over the study period, government capital expenditure in Nepal exhibited an increasing trend but with occasional decreases in fiscal years like 1986, 1990, 1992, and others. Short-term effects of government capital expenditure on economic growth were negative due to reduced private investment, but long-term effects were positive, especially when funding projects with higher social returns than private investments. Despite occasional declines, real GDP showed steady growth, interrupted by decreases in years like 1977 and 1998, attributed to social movements. There was a positive relationship between real government capital expenditure, gross fixed capital formation, and government revenue, whereas real gross national saving showed an insignificant or negative relationship with real GDP. The study also found no Granger causality between government capital expenditure and GDP growth. Okonkwo et al., (2023) the study concluded that public expenditure aims to provide public amenities and distribute resources among citizens. Government spending in Nigeria encompasses consumption, transfers, and interest payments, with capital and recurrent expenditure being predominant. These are further categorized into administration, social and community services, economic services, and transfers. Recurrent expenditure, unlike capital spending, does not create future assets or reduce government liabilities, covering pensions, debt interest, subsidies, and salaries. This study scientifically examines the impact of disaggregated government capital expenditure (administration, social and community services, economic services, transfers, and government deficit) on Nigeria's economic growth rate from 1981 to 2021, including an evaluation of post-pandemic expenditure in 2021. Secondary data from the CBN statistical bulletin, 2021, were analyzed using the autoregressive distributed lag model due to mixed order of integration among variables. The bounds test revealed a long-term relationship between the variables, while the error correction model indicated a strong, positive association between administrative and economic services expenditure and Nigeria's economic growth rate.

3. Data and methodology of analysis

It is pertinent to use a descriptive design that focused on the government expenditure and economic growth of Nepal. To test the hypothesis an empirical econometric method was adopted fetching time series data from the just-released economic survey of the Ministry of Finance. Hypotheses were used to state the perceived causality between the announced research variables, and the Vector Error Correction Method was used to state the relation between them, as they were perceived to be in causation. The study has employed descriptive and analytical research designs. To examine the relationship between the variables of capital expenditure and economic growth, analytical research design is used. The study covers the 32 years' time period between the fiscal year 1990/91 to 2021/22 for the purpose of testing causality between various capital expenditure indicators and growth variables. This research used time series analysis based on census survey of 32 years period between 2010/11 to 2021/22.

3.1 *Augmented Dickey Fuller (ADF) Test*

There are several approaches for determining the unit root in time series data. This article uses the ADF test for the purpose. Because of its resilience and ability to eliminate autocorrelation from the model, the ADF is a better strategy for determining whether or not time series data sets are stable. The ADF Test may cause an issue with autocorrelation. Dickey Fuller devised the Augmented Dickey Fuller Test to address the problem of autocorrelation.

Dickey Fuller Models:

$$\Delta Y_t = \alpha + \gamma Y_{y-1} + a_i + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\Delta Y_t = \alpha + \beta_t + \gamma Y_{y-1} + a_i + e_t \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\Delta Y_t = \gamma Y_{y-1} + a_i + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

First model equation (1) has intercept only, second model equation (2) have both trend and intercept and third model equation (3) has no trend and no intercept.

These entire three models come to same decision all the time whether our variable y has unit root or not. To check, we set the following hypothesis:

Null Hypothesis ($H0$): Variable y is not stationary or got unit root.

Alternative Hypothesis ($H1$): Variable Y is stationary or doesn't have unit root.

To make the variable stationary, we should go for first differencing.

The following equations (4) and (5) the series of interest is Zt. The symbol Δ indicates the first difference of the series Zt, t in equation (2) is a time trend, and j is the number of lagged variables that are used to ensure the error term e is white noise. The optimal number of lags can be determined by various ways, for the purpose of this paper it is found by using the Akaike Information Criterion (AIC) for the significance of the estimated coefficients of these lagged variables.

$$\Delta Z_t = \alpha_1 + \pi_1 Z_{t-1} + \sum_{i=1}^{j} c_{1i} \ \Delta Z_{t-i} + e_{1t} \dots \dots \dots \dots \dots \dots \dots \dots \dots (4)$$

$$\Delta Z_t = \alpha_2 + \pi_2 Z_{t-1} + \beta t + \sum_{i=1}^{j} c_{2i} \ \Delta Z_{t-i} + e_{2t} \dots \dots \dots . . \dots \dots \dots (5)$$

Where, j is the number of lags. The ADF techniques tests the null hypothesis πi=0, against the alternative hypothesis πi<0. Rejection of the null hypothesis is an indication that the series Zt is stationary. In equation (1) the alternative hypothesis indicates the series is a mean-stationary and in equation (2) it indicates the series is a trend stationary (Thapa, 2018).

3.2 *Cointegration Test*

Once variables have been classified as integrated of order I(0), I(1), I(2), etc., it becomes possible to establish models that yield stationary relationships among these variables, facilitating standard inference. The essential criterion for achieving stationarity among nonstationary variables is referred to as cointegration. Testing for cointegration is a necessary step to empirically verify meaningful relationships in modeling. Cointegration is an econometric concept that suggests the presence of a stable long-term relationship among economic time series. When two or more series are individually nonstationary but a linear combination of them is stationary, they are considered cointegrated (Wei, 2006). If variables exhibit different trend processes, they cannot maintain a fixed long-run relationship with each other. Consequently, modeling the long-run becomes problematic, and conventional inferential methods based on standard distributions may not be valid. If cointegration is not found, it is advisable to continue working with variables in their differenced forms instead (Bo Sjo, 2008).

3.3 *The Johansen Test of Cointegration*

The Johansen test is considered the superior test for cointegration due to its desirable statistical properties. However, its weakness lies in its reliance on asymptotic properties, making it sensitive to specification errors in limited samples. Ultimately, some degree of judgment, combined with economic and statistical model building, is necessary.

The empirical VAR (Vector Autoregression) is formulated with lags and dummy variables to ensure that the residuals become a white noise process. A well-specified model is more demanding compared to an ARIMA model. We test for all components in the residual process because the critical values are determined based on a normal distribution of the residuals. Typically, we assume that the system is integrated of order one (I(1)). If there are indications of I(2) variables, we will transform them to I(1) before establishing the VAR. By using the difference operator Δ = 1 – L, or L = 1 – Δ, the VAR in levels can be transformed into a vector error correction model (VECM).

$$\Delta X_t = \beta_i \Delta X_{t-1} + \cdots + \beta_{k-1} \Delta X_{t-k-1} + \Pi X_{t-1} + \mu_0 + \varphi D_t + \varepsilon_t \dots \ \ . . (6)$$

Where βi\beta_iβis and Π\PiΠ are matrices of variables. The lag length in the VAR is kkk lags on each variable. After transforming the model using L=1−ΔL = 1 - \DeltaL=1−Δ, we 'lose' one lag at the end, resulting in k−1k - 1k−1 lags in the VECM.

$$\Delta X_t = \sum_{i=1}^{k-1} \beta\, i \Delta X_{t-i} + \cdots + \prod X_{t-1} + \mu_0 + \varphi D_t + \varepsilon_t \ldots \ldots \qquad \ldots \ldots \ldots (7)$$

The number of cointegrating vectors corresponds to the number of stationary relationships in the Π-matrix. If there is no cointegration, all rows in Π must be zero. If there are stationary combinations or stationary variables in Π, then some parameters in the matrix will be non-zero. To address this, we can use a mathematical technique: the rank of the Π-matrix determines the number of independent rows in Π and, therefore, the number of cointegrating vectors. The rank of Π is given by the number of significant eigenvalues found in Π ^Π^. Each significant eigenvalue represents a stationary relationship. Under the null hypothesis of {x}t~I(d)\{x\}_t \sim I(d){x}t ~I(d), with d>1d > 1d>1, the test statistic for determining the significance of the eigenvalues is non-standard and must be simulated. Johansen originally derived two tests for this purpose: the Maximum Eigenvalue Test and the Trace Test.

3.3 *CUSUM Test*

The CUSUM test utilizes a plot of the cumulative sum of recursive residuals to detect structural breaks in data. When this cumulative sum exceeds a critical threshold, it indicates a significant change in the underlying structure at the point where the sum begins to deviate towards this threshold. The CUSUM test operates with the following formulas:

$$W_t = \sum_{j=k+1}^{t} \frac{w_t}{\hat{\sigma}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (10)$$

With

$$\partial^2 = \frac{\sum_{j=k+1}^{T} (Wt - \bar{W})^2}{T-k-1} \ldots \ldots \ldots \ldots \ldots \ldots \ldots . \ldots (11)$$

And

$$\bar{W} = \frac{\sum_{j=k+1}^{T} W_t}{T-k} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . . \ldots \ldots (12)$$

Where k is the minimum sample size for which we can fit the model.

3.4 *CUSUMSQ Test*

The CUSUM-OF-SQUARES test, akin to the CUSUM test, tracks the cumulative sum of squared recursive residuals, normalized by the total sum of these squared residuals across all observations. The CUSUMSQ, as the second test statistic, utilizes cumulative sums of squared residuals to detect structural changes in the data.

$$S_t = \frac{\sum_{k+1}^{t} w_j{}^2}{\sum_{k+1}^{T} w_j{}^2} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . . \ldots (13)$$

With, t = k + 1, … , T

The expected value of St is

$$E(S_t) = \frac{t-k}{T-k} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . . \ldots (14)$$

The CUSUM of Squares test evaluates departures from an expected value line, which typically trends towards zero at T=k. It assesses the significance of these departures by comparing them to parallel lines drawn above and below the expected value line at a distance cs. This critical distance cs depends on the sample size T−k and the chosen significance level α\alpha. The CUSUM of Squares test generates a plot of Vt, with a pair of 5 percent critical lines. Similar to the CUSUM test, if the plot moves outside these critical lines, it indicates instability in the parameter or variance being tested.

3.5 *Granger Causality Test*

Granger causality is a statistical concept that defines causality based on the ability to predict future values. If a variable X1 "Granger-causes" another variable X2, it means that past values of X1 provide information that improves the prediction of X2, beyond the information already contained in the past values of X2 alone. This concept was introduced by Clive Granger in 1969 and is mathematically formulated using linear regression models for stochastic processes. Granger causality is typically tested within the framework of linear regression models. For example, consider a bivariate linear autoregressive model involving two variables, X1 and X2:

$$X_{1,t}=a_0+\sum_{i=1}^{p}a_iX_{1,t-i}+\sum_{j=1}^{q}b_jX_{2,t-j}+\epsilon_{1,t}$$

$$X_{2,t}=c_0+\sum_{k=1}^{p}c_kX_{2,t-k}+\sum_{l=1}^{q}d_lX_{1,t-l}+\epsilon_{2,t}$$

In the context where k represents the maximum number of lagged observations included in the model, matrix AAA contains coefficients that represent the influence of each lagged observation on the predicted values of X1(t) and X2(t). The terms $\epsilon 1$ and $\epsilon 2$ denote residuals (prediction errors) for each respective time series. If the variance of $\epsilon 1$ (or $\epsilon 2$) decreases due to the inclusion of terms from X2 (or X1) in the first (or second) equation, it implies that X2 (or X1) Granger-causes X1 (or X2). Specifically, X2 Granger-causes X1 if the coefficients in A12collectively differ significantly from zero. This hypothesis can be tested using an F-test where the null hypothesis is A12=0, assuming covariance stationary for X1 and X2. The strength of a Granger causality effect can be quantified by the natural logarithm of the corresponding F-statistic (Geweke, 1982). Additionally, model selection criteria such as the Bayesian Information Criterion (BIC, (Schwartz, 1978)) or the Akaike Information Criterion.

3.6 *Normality Test*

According to the Jarque-Bera test, the Jarque-Bera statistic is less than the probability threshold, indicating that our data is not normally distributed. However, the Central Limit Theorem states that when the number of observations exceeds thirty, we can conclude that our data is approximately normally distributed.

3.7 *Homoscedasticity Test*

Homoscedasticity refers to the assumption in regression analysis that the variance of the residuals (errors) remains constant across all levels of the independent variables. This assumption is crucial because heteroscedasticity, the presence of non-constant variance, can lead to inefficient estimates and affect the validity of statistical tests, leading to misleading conclusions. To ensure the robustness of a regression model, it is essential to test for homoscedasticity before proceeding with multiple regression analysis. A common way to check for homoscedasticity is through visual inspection of residual plots. By plotting the residuals against the fitted values (predicted values), one can visually assess whether the variance of the residuals remains constant. In a plot where homoscedasticity is present, the residuals will scatter randomly around the horizontal axis with no apparent pattern. If the plot reveals a funnel shape (either widening or narrowing) or any systematic pattern, it suggests heteroscedasticity. While visual methods are helpful for an initial assessment, they are subjective and can be supplemented with formal statistical tests for a more rigorous evaluation.

The Breusch-Pagan test is a widely used formal statistical test for detecting heteroscedasticity. It involves regressing the squared residuals from the original regression model on the independent variables. The test statistic, calculated as n×R2n \times R^2n×R2 (where nnn is the sample size and R2R^2R2 is the coefficient of determination from the auxiliary regression), follows a chi-square distribution with degrees of freedom equal to the number of independent variables. A significant test statistic (low p-value) indicates the presence of heteroscedasticity, suggesting that the variance of the residuals is not constant. White's test is another robust method for detecting heteroscedasticity. It is more general than the Breusch-Pagan test as it does not rely on the assumption that heteroscedasticity is a function of the independent variables. Instead, it involves regressing the squared residuals on the independent variables, their squares, and cross-products. Similar to the Breusch-Pagan test, the test statistic follows a chi-square distribution, and a significant result indicates heteroscedasticity. White's test is particularly useful because it can detect more complex forms of heteroscedasticity. Testing for homoscedasticity is a crucial step in regression analysis to ensure the reliability of the model's estimates and the validity of statistical inferences. Visual methods like residual plots provide an initial check, while formal statistical tests like the Breusch-Pagan and White's tests offer a more rigorous assessment. By identifying and addressing heteroscedasticity, researchers can improve the accuracy and efficiency of their regression models, leading to more credible and robust conclusions.

3.8 *Multicolinearity Test*

Multicollinearity is a statistical phenomenon observed when two or more predictor variables in a multiple regression model are highly correlated, providing redundant information about the response variable. This redundancy implies that one predictor variable can be accurately predicted from others with a significant degree of accuracy. In such cases, the coefficient estimates in the regression model may fluctuate unpredictably in response to minor changes in the model or data.

To detect multicollinearity, Variance Inflation Factors (VIF) and Klein Lawrence R's rule of thumb are commonly used. The VIF measures how much the variance of a regression coefficient is inflated due to multicollinearity. Higher VIF values indicate stronger multicollinearity. Klein Lawrence R's rule of thumb suggests that smaller tolerance values indicate greater multicollinearity. Tolerance is computed as 1−Ri21 - R_i^21−Ri2, where Ri2R_i^2Ri2 represents the R2R^2R2 value from regressing one predictor variable against all others.

In practice, researchers often conduct auxiliary regressions of each independent variable against the remaining explanatory variables to obtain R2R^2R2 values and compute tolerance to assess the degree of multicollinearity present in the regression model.

3.9 *Test of Parameters Stability*

To assess the stability of both the long-run parameters and short-run movements in the estimated equations, the research relies on cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests. These tests are applied to the residuals of the Error Correction Model (ECM). Here's how the hypothesis of stability testing is framed:

Hypothesis of Stability Testing

Null Hypothesis (H_0): Parameters are stable over time.

This implies that there are no significant structural changes in the coefficients of the regression model, indicating stability in the long-run relationships and short-run dynamics captured by the model. Alternative Hypothesis (*H1*): Parameters are not stable over time.

This suggests that there are significant structural changes in the coefficients of the regression model, indicating instability in the long-run relationships and short-run dynamics.

In summary, the research relies on CUSUM and CUSUMSQ tests to examine the stability of parameters in the estimated equations, particularly focusing on the residuals from the ECM. These tests provide insights into whether the relationships captured by the model remain stable over time or if there are structural changes that require further investigation or model refinement.

4. Empirical analysis

Table 1. Summary of descriptive statistics

	LOG_AGRI...	LOG_EDUC...	LOG_HEALTH	LOG_REAL...	LOG_REAL...
Mean	2.908928	1.917057	2.252303	5.084089	2.900449
Median	2.825475	2.183946	2.322477	5.07671	2.73924
Maximum	3.583426	2.591499	3.169674	5.3548	4.023623
Minimum	2.386267	0.982271	1.1529	4.805705	1.31597
Std. Dev.	0.332447	0.558044	0.486573	0.163377	0.618392
Skewness	0.425547	-0.395722	-0.469474	-0.001534	-0.080463
Kurtosis	2.331783	1.490817	2.753241	1.881017	3.16839
Jarque-Bera	1.561166	3.872023	1.256686	1.66951	0.072336
Probability	0.458139	0.144278	0.533475	0.433981	0.964478
Sum	93.08568	61.34583	72.07369	162.6908	92.81437
sum Sq. Dev.	3.426156	9.653799	7.33936	0.827457	11.85468
Observations	32	32	32	32	32

Table 2. Pearson correlation matrix for selected years of Nepal

	Real GDP	Education	Health	Agriculture	Transportation
Real GDP	1.000 --------				
Education	-0.782 0.000	1.000 --------			
Health	0.772 0.000	-0.562 0.0008	1.000 -------		
Agriculture	0.777 0.000	-0.685 0.000	0.873 0.000	1.000 -------	
Transportation	0.440 0.0116	-0.478 0.0057	0.365 0.0400	0.446 0.0104	1.000 -----

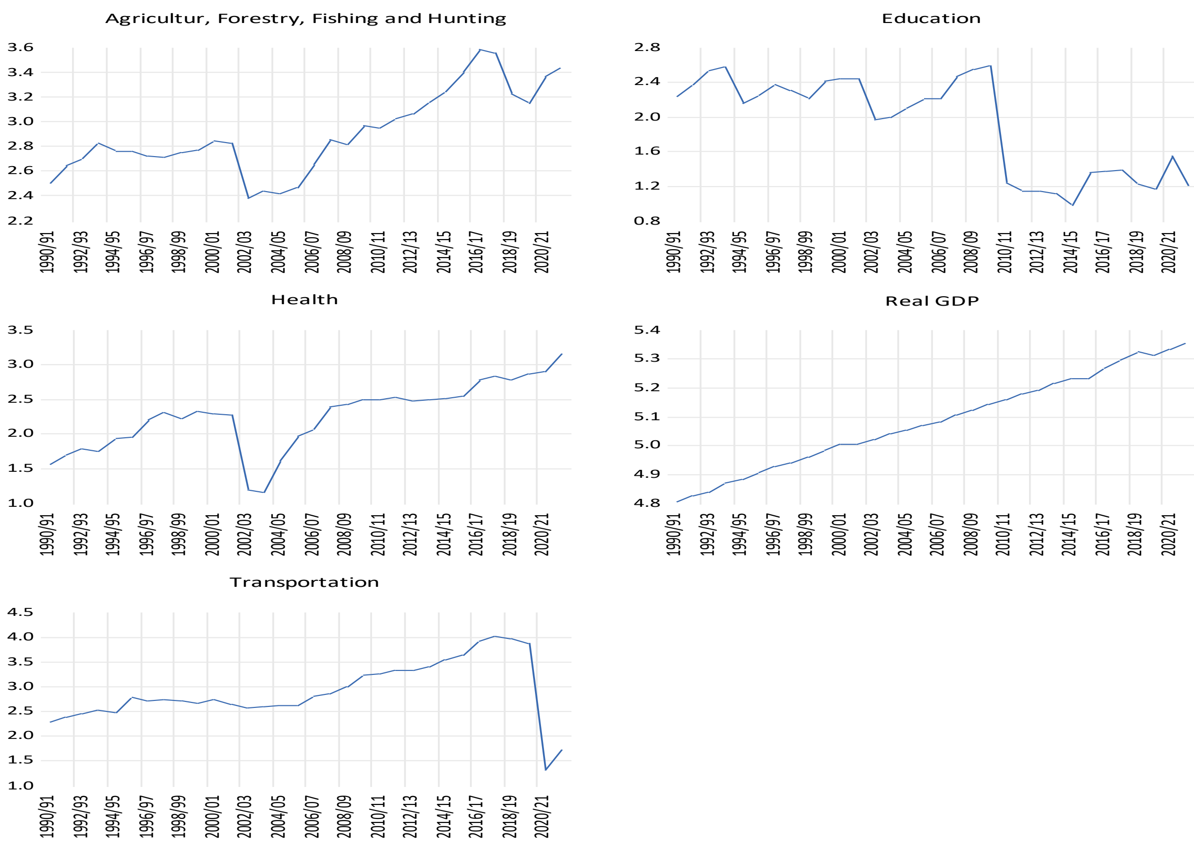


Figure 2. Multiple difference graphs of variables

Table 3. The ordinary Least Square Model

Variables	**Coefficient**	**Std. Error**	**t-Statitic**	**Prob.**
Log_Education	-0.149612	0.08067	-1.854629	0.0746
Log_Health	0.476014	0.088252	5.393784	0.0000
Log_Real RGDP	0.029352	0.348136	0.084312	0.9334
C	1.87173	1.757053	1.065267	0.2962
Log_Transportation	0.035394	0.050354	0.050354	0.4881
R-squared	0.820804	Mean dependent var		2.908928
Adjusted R-squared	0.794257	S.D. dependent var		0.332447
S.E. of regression	0.150794	Akaike info criterion		-0.803198
Sum squared resid	0.613952	Schwarz criterion		-0.574177
Log likelihood	17.85117	Hannan-Quinn criter.		-0.727284
F-statistic	30.91836	Durbin-Watson stat		0.94644
Prob(F-statistic)	0.000000			

Table 4. Multiple Regression Test results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.960053	0.267638	18.53271	0.0000
LOG_EDUCATION	-0.144370	0.038333	-3.766166	0.0008
LOG_HEALTH	0.157704	0.063421	2.486628	0.0194
LOG_AGRICULTUR FORESTRY FISH...	0.008967	0.106359	0.084312	0.9334
LOG_TRANSPORTATION	0.006729	0.028056	0.239859	0.8123
R-squared	0.773320	Mean dependent var		5.084089
Adjusted R-squared	0.739738	S.D. dependent var		0.163377
S.E. of regression	0.083348	Akaike info criterion		-1.988973
Sum squared resid	0.187568	Schwarz criterion		-1.759952
Log likelihood	36.82356	Hannan-Quinn criter.		-1.913059
F-statistic	23.02766	Durbin-Watson stat		0.430635
Prob(F-statistic)	0.000000			

Table 5. Homoscedasticity Test

F-statistic	6.483089	Prob. F (4,27)	0.0009
Obs*R-Squared	15.67728	Prob. Chi-Square (4)	0.0035
Scaled Explained SS	4.663831	Prob. Chi-Square (4)	0.3236

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	0.033582	0.013379	2.510103	0.0184
LOG_EDUCATION	-0.000854	0.00 1916	-0.445872	0.6592
LOG_HEALTH	-0.005370	0.003170	-1.693900	0.1018
LOG_AGRICULTUR_FORESTRY_FISH...	-0.002851	0.005317	-0.536330	0.596 1
LOG_TRANSPORTATION	-0.00 1963	0.00 1402	-1.399410	0.1731
R-Squared	0.489915	Mean dependent var		0.00586 1
Adjusted R-Squared	0.414347	S.D. dependent var		0.005444
S.E. of regression	0.004166	Akaike info criterion		-7.980931
Sum Squared resid	0.000469	Schwarz criterion		-7.751909
Log likelihood	132.6949	Hannan-Quinn criter.		-7.9050 16
F-statistic	6.483089	Durbin-Watson stat		1.415969
Prob (F-statistic)	0.00086 1			

Table 6. Multicollinearity Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.07163	329.9512	NA
Agriculture	0.011312	446.5066	5.579028
Education	0.001469	26.91805	2.042017
Health	0.004022	0.004022	4.249400
Transportation	0.000787	31.84566	1.3432100

Table 7. Granger Causality Test results

Null Hypothesis:	Obs	F-Statistic	Prob.
D(LOG_EDUCATION) does not Granger Cause D(LOG_AGRICULTUR_FORESTRYFISHING_AND_HUNTING)	29	0.14676	0.8643
D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING) does not Granger Cause D(LOG_EDUCATION)		0.24723	0.7829
D(LOG_REAL_GDP) does not Granger Cause D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING)	29	1.52156	0.2387
D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING) does not Granger Cause D(LOG_REAL_GDP)		2.64551	0.0916
D(LOG_HEALTH) does not Granger Cause D(LOG_AGRICULTUR FORESTRY_FISHING_AND_HUNTING)	29	1.25047	0.3044
D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING) does not Granger Cause D(LOG_HEALTH)		1.07174	0.3582
D(LOG_TRANSPORTATION) does not Granger Cause D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING)	29	0.93536	0.4063
D(LOG_AGRICULTUR_FORESTRY_FISHING_AND_HUNTING) does not Granger Cause D(LOG_TRANSPORTATION)		4.78939	0.0178
D(LOG_REAL_GDP) does not Granger Cause D(LOG_EDUCATION)	29	0.47780	0.6259
D(LOG_EDUCATION) does not Granger Cause D(LOG_REAL_GDP)		0.22620	0.7992
D(LOG_HEALTH) does not Granger Cause D(LOG_EDUCATION)	29	0.05022	0.9511
D(LOG_EDUCATION) does not Granger Cause D(LOG_HEALTH)		0.09072	0.9136
D(LOG_TRANSPORTATION) does not Granger Cause D(LOG_EDUCATION)	29	1.12697	0.3406
D(LOG_EDUCATION) does not Granger Cause D(LOG_TRANSPORTATION)		0.09513	0.9096
D(LOG_HEALTH) does not Granger Cause D(LOG_REAL_GDP)	29	0.44529	0.6458
D(LOG_REAL_GDP) does not Granger Cause D(LOG_HEALTH)		1.42886	0.2592
D(LOG_TRANSPORTATION) does not Granger Cause D(LOG_REAL_GDP)	29	1.81135	0.1851
D(LOG_REAL_GDP) does not Granger Cause D(LOG_TRANSPORTATION)		4.45784	0.0226
D(LOG_TRANSPORTATION) does not Granger Cause D(LOG_HEALTH)	29	0.33516	0.7185
D(LOG_HEALTH) does not Granger Cause D(LOG_TRANSPORTATION)		0.06998	0.9326

Table 8. Unit Root Test for RGDP

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		- 0.424471	0.8928
Test critical values :	1% level	-3.661661	
	5% level	-2.960411	
10% level		-2.619160	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_REAL_GDP(-1)	-0.004624	0.010892	-0.424471	0.6744
C	0.041179	0.055309	0.744520	0.4626
R-squared	0.006175	Mean dependent var		0.017713
Adjusted R-squared	-0.028095	S.D. dependent var		0.009315
S.E. of regression	0.009445	Akaike info criterion		-6.424423
Sum squared res id	0.002587	Schwarz criterion		-6.331908
Log likelihood	101.5786	Hannan-Quinn criter.		-6.394265
F-statistic	0.180175	Durbin-Wats on stat		2.367154
Prob (F-statistic)	0.674355			

Table 9. Unit Root Test for education

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.331304	0.6023
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_EDUCATION(-1)	-0.134870	0.101306	-1.331304	0.1935
C	0.228416	0.204084	1.119224	0.2722
R-squared	0.057596	Mean dependent var		-0.033239
Adjusted R-squared	0.025099	S.D. dependent var		0.310007
S.E. of regression	0.306092	Akaike info criterion		0.532476
Sum squared resid	2.717069	Schwarz criterion		0.624991
Log likelihood	-6.253375	Hannan-Quinn criter.		0.562633
F-statistic	1.772370	Durbin-Wats on stat		1.920051
Prob (F-statistic)	0.193460			

Table 10. Unit Root Test for health

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.158846	0.6792
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_HEALTH(-1)	-0.111785	0.096462	-1.158846	0.2560
C	0.300248	0.218890	1.371681	0.1807
R-squared	0.044258	Mean dependent var		0.051782
Adjusted R-squared	0.011302	S.D. dependent var		0.246774
S.E. of regression	0.245376	Akaike info criterion		0.090290
Sum squared resid	1.746071	Schwarz criterion		0.182805
Log likelihood	0.600502	Hannan-Quinn criter.		0.120448
F-statistic	1.342924	Durbin-Watson stat		1.564582
Prob (F-statistic)	0.255973			

Table 11. Unit Root Test for agriculture

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.899612	0.7749
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_AGRICULTUR.	-0.069989	0.077799	-0.899612	0.3757
C	0.232488	0.226332	1.027196	0.3128
R-squared	0.027149	Mean dependent var		0.030096
Adjusted R-squared	-0.006397	S.D. dependent var		0.137283
S.E. of regression	0.137722	Akaike info criterion		-1.064821
Sum squared resid	0.550052	Schwarz criterion		-0.972306
Log likelihood	18.50473	Hannan-Quinn criter.		-1.034663
F-statistic	0.809301	Durbin-Watson stat		1.589175
Prob(F-statistic)	0.375737			

Table 12. Unit Root Test for transportation

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.038455	0.2698
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_TRANSPORTATION(-1)	-0.291432	0.142967	-2.038455	0.0507
C	0.838428	0.428134	1.958331	0.0599
R-squared	0.125328	Mean dependent var		-0.017689
Adjusted R-squared	0.095167	S.D. dependent var		0.486653
S.E. of regression	0.462917	Akaike info criterion		1.359803
Sum squared resid	6.214474	Schwarz criterion		1.452319
Log likelihood	-19.07695	Hannan-Quinn criter.		1.389961
F-statistic	4.155300	Durbin-Watson stat		1.874079
Prob(F-statistic)	0.050715			

Table 13. Johansen Long Run Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05Critical Value	Prob.**
None	0.550545	63.85521	69.81889	0.1364
At most 1	0.492584	40.66334	47.85613	0.1996
At most 2	0.384137	20.98907	29.79707	0.3583
At most 3	0.183604	6.931898	15.49471	0.5856
At most 4	0.035528	1.049070	3.841465	0.3057

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.550545	23.19187	33.87687	0.5158
At most 1	0.492584	19.67427	27.58434	0.3641
At most 2	0.384137	14.05717	21.13162	0.3604
At most 3	0.183604	5.882829	14.26460	0.6283
At most 4	0.035528	1.049070	3.841465	0.3057

LOG_AGRIC.	LOG_EDUCA.	LOG_REAL_.	LOG_HEALTH	LOG_TRANSPORTATION
3.120650	-5.022311	19.29099	4.697268	-16.49195
7.968036	2.045293	12.53428	-5.919736	-2.997666
8.937287	1.051311	16.82681	3.775396	-12.23511
-1.358441	1.263055	13.75633	-0.017532	-0.556413
-14.82953	2.572343	-17.13896	-0.491608	15.15192

Unrestricted Adjustment Coefficients (alpha):					
D(LOG_AGRI.	0.024853	-0.016106	-0.053602	0.011707	0.011509
D(LOG_EDU...	0.034084	-0.037405	-0.144399	-0.025291	-0.022664
D(LOG_REA...	-0.003278	0.000591	-0.001247	-0.002333	0.000396
D(LOG_HEA...	0.016050	0.063104	-0.110533	0.013809	0.013128
D(LOG_TRA...	0.178855	0.109204	0.038728	-0.043937	0.020806

D(LOG_AGRI..	0.077557
	(0.08625)
D(LOG_EDU...	0.106365
	(0.20867)
D(LOG_REA...	-0.010231
	(0.00522)
D(LOG_HEA...	0.050088
	(0.16231)
D(LOG_TRA...	0.558145
	(0.20993)

Economic growth and sector-specific indicators from 1990/91 to 2021/22, highlighting trends in Real GDP, Capital Expenditure, Health, Education, Agriculture, Forestry, Fishing, and Hunting, and Transportation. Real GDP remains consistently high and stable around 5 throughout the period, indicating robust and steady economic growth. Capital Expenditure initially fluctuates slightly but remains around 3 for most of the period, with a slight upward trend observed towards the end. Health starts at around 1.5 and shows a general upward trend, peaking at around 2.5 by 2021/22, with some fluctuations, especially around 2001/02 and 2010/11. Education begins at just below 2, with minor fluctuations throughout the period, but decreases significantly around 2004/05 and stabilizes at a lower value around 1. Agriculture, Forestry, Fishing, and Hunting starts around 2, showing slight fluctuations but generally stable. A downward trend starts around 2011/12, with values remaining above 1.5. Transportation is initially stable around 2 but shows significant fluctuations starting from 2012/13, with a noticeable drop around 2019/20 and subsequent recovery. Key observations include the stability of Real GDP, suggesting sustained economic performance. Capital Expenditure remains steady with a slight increase, indicating potential investments in infrastructure and development. The gradual increase in Health suggests growing investment or focus on the healthcare sector. The significant drop in Education and its stabilization at a lower value may indicate shifts in policy or funding. The gradual decline in Agriculture, Forestry, Fishing, and Hunting may suggest structural changes in the economy or challenges in the sector. Recent volatility in Transportation could be due to external factors like global economic conditions or internal policy changes. Overall, the analysis shows economic stability with specific sectoral shifts, particularly in education and transportation. Further investigation into policy changes and external economic conditions could provide deeper insights into these trends.

The study investigated the effect of government capital expenditure on economic growth in Nepal from 1990/91 to 2021/22, using the Johansen approach and Vector Error Correction Model (VECM). The analysis revealed three cointegration relationships among the variables over the long term. Health spending was found to positively and significantly affect Real GDP (RGDP) due to its role in economic stabilization. Capital expenditures on education, agriculture, and transportation were also significantly interrelated at a 5% significance level, and a significant long-term relationship between health expenditure and transportation was observed.

The research aimed to explore the correlation between government capital expenditure and economic growth, using real RGDP as a proxy for economic growth and real government capital expenditure as the independent variable. Descriptive analysis and the Augmented Dickey-Fuller (ADF) test were employed to examine the nature, trends, and stationarity of the variables, which were found to be stationary at the first difference.

The Johansen Cointegration test indicated a long-run relationship among the variables, and VEC models were used for further analysis. The VEC Granger causality test assessed causal relationships, while the stability of long-run coefficients was tested using CUSUM and CUSUM of squares, and serial correlation was examined using the LM test. The study found that growth exhibited increasing trends with fluctuations, particularly a decrease in government capital expenditure over eleven fiscal years. The model's goodness-of-fit, with an R-squared value of 82%, suggests that 82% of the variation in RGDP is explained by variations in the independent variables.

The unit root tests showed that all variables except transportation were stationary at the first difference. Cointegration tests, using trace and max-eigen statistics, confirmed a significant long-term relationship among the variables at a 5% significance level, indicating that capital expenditure on education, health, agriculture, transportation, and RGDP are integrated and move together in the long run.

5. Conclusion

The study examined the effect of government capital expenditure on economic growth in Nepal from fiscal year 1990/91 to 2021/22. Over the period, government capital expenditure showed an overall increasing trend, though there were periods of decrease in certain fiscal years, such as 2001, 2011, and 2018. In the short run, these expenditures initially negatively impacted economic growth by reducing private investment. However, in the long run, they contributed positively to economic growth, particularly when financing projects with higher social returns than private investments. Therefore, increasing government capital expenditures is beneficial for long-term economic growth.

The study found that capital expenditures in health, agriculture, and transportation positively and significantly impacted economic growth in Nepal. Conversely, capital expenditure on education had a negative impact on economic growth. Real GDP demonstrated steady growth over the study period, which can be attributed to technological advancements, infrastructure improvements, and better education and healthcare. Social and political factors, including significant student protests and subsequent political changes, also influenced the overall economic environment.

Social indicators of development have improved over time, influenced by the increase in real GDP. There is a statistically significant positive relationship between real government capital expenditure, real gross fixed capital formation, real government revenue, and terms of trade. However, the relationship between real gross national saving and real GDP is insignificant or negative. Both government capital expenditure and real GDP exhibited increasing trends, with real GDP growing at a faster rate compared to the slower growth of real government capital expenditure.

The study also indicated a causal relationship between government capital expenditure and economic growth, as shown by Granger causality tests. Specifically, it found that real GDP does not Granger cause government capital expenditure and vice versa. This suggests that while government capital expenditure influences economic growth, the reverse causal relationship is not significant in this context.

Overall, the study highlights the complex dynamics between government spending, economic growth, and social development indicators in Nepal. It emphasizes the importance of strategic investment and policy decisions in fostering long-term economic prosperity. The main objective of the study was to examine the specific effect of government capital expenditure on economic growth, revealing that all capital expenditure variables, except education, positively impacted Nepal's economic growth performance.

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