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BRIDGING PROSPERITY: UNRAVELLING THE INTERPLAY OF PUBLIC BORROWING, GROSS CAPITAL FORMATION, AND ECONOMIC GROWTH IN THE NEPALESE ECONOMY

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Abstract

This study investigates the impact of public borrowing and total capital formation on Nepal's economic growth. The analysis relies on secondary data from publications from the Nepal Rastra Bank and economic surveys conducted in Nepal. The dataset has 34 consecutive yearly data points from 1988/89 to 2021/22. A causal correlational research design is used. It is guided by positivist research philosophy and deductive reasoning. The robust least square method is employed to explore the impact of independent variables. Research indicates that public debt and capital formation favourably and significantly affect Nepal's economic growth. The study demonstrates that a one-unit rise in public debt and capital formation leads to 0.2881 and 0.6205 unit increases in Nepal's economic growth, respectively. The positive impact of capital formation is more effective than public borrowing in promoting the economic growth of Nepal. Policymakers should focus on creating a business-friendly environment, enacting growth-oriented fiscal and monetary policies, efficiently allocating resources for infrastructure and technology, and managing public debt prudently to ensure sustainable and equitable economic development.

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Introduction

The government endeavors to acquire financial resources from domestic and foreign sources to augment tax revenues and fulfill financial requirements (Kamau, 2021). The combination of these external and internal loans is often referred to as public borrowing. Public borrowing is the act of the government obtaining finances by issuing bonds or borrowing money from other sources to finance its expenses when its revenue is insufficient. Using this mechanism, the government can address budget imbalances and allocate funds to public projects (Augustine & Rafi, 2023). Total capital formation is the increase in physical capital assets within an economy during a year. The physical capital assets include machines, tools, equipment, buildings, infrastructures, and other long-term investments that ultimately contribute to the economy's productive capacity (Uneze, 2013). Public borrowing can play a role in capital formation when funds are directed towards productive investments, such as infrastructure development, which enhances the overall capital stock and contributes to economic growth (Ventura & Voth, 2015).

Public loans and capital formation can have significant effects on economic growth. Public loans often finance large-scale infrastructure projects such as roads, bridges, airports, and utilities (Abdulkarim, 2023). These projects can stimulate economic development by improving transportation, communication, and energy infrastructure. Governments may use public loans to implement fiscal stimulus programs during economic downturns. It involves increased government spending to increase demand and economic activity, helping mitigate the impact of recessions. However, it is crucial to manage public debt carefully. Excessive borrowing can lead to a high debt burden, potentially crowding out private investment and potentially threatening overall economic stability (Ahlborn & Schweickkert, 2017).

Capital formation is the increase in real capital stock in an economy. It involves investment in productive assets such as machinery, technology, and infrastructure (Purba et al., 2019). Increased capital formation can enhance productivity and economic output. Capital formation is essential for sustained economic growth. It enables businesses to expand, adopt new technologies, and improve efficiency, contributing to long-term economic development. Investment in capital formation often leads to creating jobs, which, in turn, increases consumer spending and overall economic activity (Hilton, 2021).

The public loans used for capital projects can multiply within the economy (Elmendrof & Mankiw, 1999). Building a new highway creates jobs directly and improves transportation efficiency, benefiting various industries and fostering additional economic activities. Governments must strike a balance between using public loans and managing fiscal policy. Practical fiscal policies ensure that public loans are invested wisely, leading to sustainable economic development without excessive debt burdens. If public loans are used strategically to finance projects that enhance the overall business environment, private investors may be more inclined to invest, leading to increased capital formation.

Public borrowing and capital formation can boost a country's economy. Strategic planning, transparent governance, and borrowing for long-term, inclusive, and sustainable development are crucial. Any financial strategy requires rigorous management and responsibility to benefit the economy and population. In short, the intricate relationships among public borrowing, gross capital formation, and economic growth underscore the critical role of fiscal policies in shaping a nation's prosperity.

Effective public borrowing can fuel gross capital formation, providing essential resources for infrastructure development and productive investments. When managed carefully, this dynamic interaction contributes to sustained economic growth. However, a delicate balance is paramount, as excessive borrowing may lead to fiscal imbalances and hinder long-term development. Gross capital formation drives economic growth by increasing investment in infrastructure, machinery, and technology, which boosts productivity and output (Foldvari, 2014). When used effectively, public borrowing funds essential projects such as education, healthcare, and transportation, enhancing long-term economic capacity. Together, they stimulate demand, create jobs, and foster a sustainable development cycle.

This study aims to study the effects of government borrowing and total capital formation on Nepal's economic growth. It also compares the impacts of public borrowing and capital formation on promoting Nepal's economic progress. This study seeks to answer the following research questions:

1) How does gross capital formation affect Nepal's economic growth?
2) What is the effect of public borrowing on Nepalese economic growth?
3) To what extent do gross capital formation and public borrowing influence Nepal's economic growth?

This study focuses on six segments. The rest of the sections are as follows: Part two presents the theoretical and empirical literature. In segment three, the research methods and materials are presented. In segment four, the data are presented and analyzed. Part five compares the results with previous studies conducted by various researchers. Section six covers the study's conclusions, policy implications, and limitations.

Literature review

Public borrowing and economic growth

Different logics are found regarding the causal relationship between public debt and economic growth by the classical, Keynesian, Ricardian, and modern monetary schools of thought (Hilton, 2021). Keynesian theory posits that public borrowing during recessions can stimulate demand and increase economic growth. Public borrowing can influence infrastructure, public services, and employment, increasing GDP (Keynes, 1936; Rustem, 2016).

Classical economists oppose public borrowing because it weakens the budget's financial discipline and repayment obligations; foreign debt generally interferes with the budget's natural flow (Borner et al., 2014; Diamond, 1965; Saungweme & Odhiambo, 2019). According to the neoclassical concept, public borrowing has a negative long-term effect on economic growth. The government expenditure from public borrowing lead to a crowding effect, where private investment declines as the government competes for limited financial resources (Domi & Dedak, 2018). Higher public debt can lead to increased interest rates, reducing private investment, which ultimately hurts capital accumulation and slows growth (Barro, 1974; Bernheim, 1989).

The monocausal theory of growth contends that public debt-financed expenditures have a fiscal multiplier effect on output, which is a tenet of Keynesian philosophy (Elmendrof & Mankiw, 1999). Ricardian equivalence theory (RET) states that public debt inevitably impacts economic growth (Ricardo, 1951; Afzal, 2012). Modern monetary theory (MMT) states that it is unrealistic to expect sovereign governments that issue debt in their currency to default (Wray, 2015). By promoting short-term economic development, the government's deficit would be sufficiently small to control inflation (Driessen & Gravelle, 2019). Table 1 summarizes the previous empirical studies on the nexus between public borrowing and economic growth.

Table 1: Summary of previous studies on navigating the impact of public loans and economic growth

Authors	Data (Country)	Dependent variable	Independent variable	Method	Results
Sapkota (2023)	1990-2021 (Nepal)	Economic growth	Public debt	ARDL	Negative effect of internal debt in long run and positive impact of external debt on economic growth.
Upadhyaya & Pun (2022)	1978-2020 (Nepal)	Economic growth	Public debt	Unrestricted VAR model	There is no significant causal relation between public debt and economic growth.
Regmi (2023)	1975-2021 (Nepal)	Economic growth	Public loan	Ordinary least square	Both internal and external debt contribute to Nepalese economic growth.
Atul & Sal (2014)	1996-2007 (23 OECD countries)	Economic growth	Public borrowing	General regression	Marginal insignificant negative impact of public debt on economic growth.
Dagan & Bigili (2014)	1974-2009 (Turkey)	Economic growth	Internal and external borrowing	Markov-Switching Method	Public borrowing and economic growth do not follow a linear path.
Wang et al. (2021)	1970-2018 (Low and middle-income countries)	Economic growth	External debt, interest rate spread, and institutional quality	Panel regression	Adverse growth effect of external debt.
Abubakar & Mamman (2021)	1970-2019 (37 OECD countries)	Economic growth	Public borrowing	Hausman and Taylor estimator	Public debt exerts a significant negative impact in the long run but is positive in the short run.
Svetlana & Mariia (2021)	2011-2019 (Ukraine)	Economic growth	Internal and external debt	Simple regression analysis	Domestic debt has a more positive impact on economic growth than external borrowing.

Authors	Data (Country)	Dependent variable	Independent variable	Method	Results
Kabemba & Kabwe (2024)	2011-2021 (Zambia)	Economic growth	Public debt, lending rate, exchange rate	ARDL	Public borrowing has a positive and significant impact on economic growth.
Egert (2012)	1960-2010 (NA)	Economic growth	Public debt	Non-linear threshold model, bivariate regression	Negative non-linear relationship between public debt and economic growth.
Panizza & Presbitero (2013)	Study of many articles (Advanced Countries)	Economic growth	Public debt	Library study method	There is no single relationship between debt and economic growth.
Chudik et al. (2017)	1965-2010 (40 sampled countries)	Economic growth	Public debt expansion	Threshold regression	There is no evidence for a universally applicable threshold effect in the relationship between public debt and economic growth.
Asteriou et al. (2020)	1980-2012 (Selected Asian Countries)	Economic growth	Public debt	ARDL	An increase in government debt negatively affects short-term and long-term economic growth.
Ssempala et al. (2020)	1980-2016 (Uganda)	Economic growth	Public debt	ARDL bound testing	A negative and significant impact of public debt on economic growth in the short run but a positive effect in the long run.
Saungwem et al. (2019)	1970-2017 (Zambia)	Economic growth	Public debt, Government debt services	ARDL bound testing	There is no proof that public debt had a statistically significant effect on economic expansion. It was also shown that adverse changes in public borrowing quickly and significantly affected GDP growth.
Abille & Kilic (2023)	1970-2019 (Ghana)	Economic growth	Public debt	Non-linear ARDL	Positive but insignificant economic effects in the short and long run.

Source: Author's own work.

In academic research, the Autoregressive Distributed Lag (ARDL) approach is often used as a model to examine the long-term impact of public debt on economic development. Numerous research, including those using ARDL and other methodologies, propose a detrimental long-term influence of public debt on economic development, while others indicate immediate beneficial consequences (e.g., Abubakar & Mamman, 2021; Asteriou et al., 2020). Internal and external debt sometimes exhibit divergent consequences, with some research finding favorable implications of external debt and adverse effects of internal debt (e.g., Sapkota, 2023). Numerous research studies, especially those using threshold and panel regression techniques, emphasize the non-linear correlation between debt and growth, indicating the lack of a universal threshold (e.g., Chudik et al., 2017). Evidence suggests that the influence of public debt on economic development varies across countries, and there is no universally applicable conclusion across all situations (e.g., Panizza & Presbitero, 2013).

Gross capital formation and economic growth

Harrod-Domar growth model suggests that capital accumulation is central to economic growth. Higher levels of gross capital formation led to increased output

and production capacity, which fostered sustained growth. According to this model, the capital investment rate is a crucial constraint to economic growth (Domar, 1946). The Harrod-Domar growth model focuses on the relationship between savings, investment, and economic growth. It suggests that economic growth is driven by the rate of savings and capital productivity, where higher savings lead to more investment and, thus, faster growth. However, it also highlights the problem of economic instability, as growth can be either too fast or too slow if savings and investment are not in balance.

In the Solow–Swan model, gross capital formation is essential to economic growth. However, the model introduces diminishing returns to capital, meaning that while increased investment initially leads to more significant growth, its impact diminishes over time. In this context, technological progress and improvements in labour productivity have become the main drivers of sustained growth (Solow, 1956). In the Solow-Swan model, gross capital formation, or investment in physical capital like machinery and infrastructure, is crucial for economic growth. The model posits that increased capital accumulation enhances productivity, allowing for higher output per worker. However, due to diminishing returns on capital, continuous growth requires technological advancements and improvements in labour productivity and capital formation.

Endogenous growth models, proposed by Romer, emphasize the role of investment in human capital, research and development (R&D), and innovation. In these models, gross capital formation can lead to sustained growth by enhancing technological progress and productivity improvements (Romer, 1990). The endogenous growth model emphasizes that economic growth is primarily driven by factors within the economy, such as innovation, human capital, and knowledge, rather than external forces. It suggests that investments in research, education, and technological development can lead to sustained, long-term growth without diminishing returns in traditional models. Table 2 summarizes previous studies on the nexus between gross capital formation and economic growth in different countries.

Table 2: Key information about the previous studies regarding the impact of capital formation on economic growth

Researchers	Data (country)	Dependent variable	Independent variable	Methods	Findings
Topcu et al. (2020)	1980-2018 (124 countries)	Economic growth	Natural resources, energy consumption, and gross capital formation	Panel VAR and Granger causality test	Positive and negative effects of capital formation on economic growth in high- and low-income countries, respectively.
Ntamwiza & Masengesho (2022)	1990-2017 (Rwanda)	Economic growth	Capital formation and FDI	Error correction model (ECM)	Positive association between capital formation and economic growth in the short and long run. Nearly 89.3 % of variation depends upon independent variables.
Boamah et al. (2018)	1990-2017 (18 Asian countries)	Economic growth	Financial depth and capital formation.	Robust least square	Positive and significant impact on economic growth.
Aslan & Altinoz (2021)	1980-2018 (Developing countries of Europe, Asia, Africa, and America)	Economic growth	Natural resources and economic growth	Panel Vector Autoregression	Capital formation negatively affects economic growth in European, Asian, and American countries. But there is a positive effect in African countries.
Dahal & Luintel (2021)	1987/88-2019/20 (Nepal)	Economic growth	Capital formation and gross national saving	ARDL bound testing approach	Gross capital formation has a positive significant impact on GDP growth.

Researchers	Data (country)	Dependent variable	Independent variable	Methods	Findings
Opadeji et al. (2023)	1991-2021 (Nigeria)	Economic growth	Capital formation and infrastructure	Vector error correction model (VECM)	Gross capital formation does not have a significant impact on economic development.
Kwatra (2023)	2010-2021 (Oman)	Economic growth	Gross capital formation and gross national saving	Granger causality and dynamic ordinary least square (DOLS)	No long-run cointegration exists between current price GDP growth and gross capital formation.
Bakare (2011)	1993-2009 Nigeria	Economic growth	Capital formation	Multiple regression analytical method	Results support the Harrod –Domar growth model, which proves that the growth rate of national income is directly or positively related to the savings ratio and capital formation.
Qayyum & Zaman (2019)	1980-2017 (Pakistan)	Economic growth	Internal trade, gross capital formation, total labour force	Johnsen cointegration test, Granger causality test	Positive impact of total capital formation on economic growth in Pakistan.
Bal et al. (2016)	1970-2012 (India)	Economic growth	Capital accumulation	ARDL bound testing	A long-term equilibrium relationship between capital formation and economic growth in the Indian economy. Capital formation has a positive effect on economic growth.
Ajose & Oyedokun (2018), Dada (2017), Abu & Usman (2010) as well as Jolo & Koc (2023)	On different dates and countries	Economic growth	Capital Formation. Trade openness. Remittance etc	Different types of Regression analysis (ARDL, simple regression. Robust, quantile, etc.)	Positive and significant impacts of total capital accumulation on economic development.
Buryk et al. (2019)	2006-2018 (Global level)	Economic growth	Capital formation, public borrowing	Cluster and discriminant analysis	Both negative and positive effects of public borrowing on the economy. Public borrowing positively impacts economic downturns but hurts economic growth when the GDP borrowing ratio exceeds forty percent.
Sharma & Mittal (2021)	1980/81-2016/17 (India)	Economic growth	Capital formation, exchange rate, total revenue	ARDL	Multiplier effect of capital formation on economic growth in the Indian economy.
Wami (2021)	1993-2019 (India)	Economic growth	Capital Formation, trade openness	ARDL Bound Testing	Positive impact of capital formation on economic progress in India.

Researchers	Data (country)	Dependent variable	Independent variable	Methods	Findings
Salmon (2021)	2010-2020 (Different countries)	Economic growth	Public debt growth	Threshold regression analysis	Public debt detrimentally impacts economic expansion. This finding supports the debt overhang theory.
Upadhyaya & Pun (2022)	1978-2020 (Nepal)	Economic growth	Public Debt	Unrestricted Vector autoregressive	There was no discernible causal link between Nepal's governmental debt and economic expansion.
Moreano et al. (2024)	1996-2019 (15 Latin Countries)	Economic growth	Remittance. Capital change, structural transformation	Panel autoregression (PVAR)	Positive impact of capital formation on economic growth.

Where: ARDL = Autoregressive distributed lag model, FDI = Foreign direct investment, VAR = Vector autoregression, DOLS = Dynamic ordinary least square, VECM = Vector error correction model

Source: Author's own work.

Studies on the impact of capital formation on economic growth employ various econometric methods, with the Autoregressive Distributed Lag (ARDL) model and Vector Autoregression (VAR) being the most commonly used. Findings reveal mixed effects of capital formation on economic growth, with positive impacts in countries like India, Nepal, Rwanda, and Pakistan. At the same time, some regions, such as Europe and parts of Asia, report adverse effects. Factors like public borrowing, financial depth, and infrastructure also influence the relationship. The evidence shows that capital formation's effect is context-dependent, varying across regions and income levels.

The current body of research presents contradictory results: while previous studies emphasize the detrimental consequences of public borrowing, they underline the beneficial influence of capital accumulation. Nevertheless, a discernible disparity exists in comprehending the separate and combined impacts of capital accumulation and government debt. This research seeks to close this gap by examining the intricate interactions among these elements and clarifying their contributions and possible synergies.

Materials and methods

This study uses a causal correlational research design. The positivist research philosophy guides this study and is deductive. It is a pure quantitative analysis. It is based on secondary data. Thirty-four annual data points collected from the Nepal Rastra Bank and the Ministry of Finance of Nepal from 1988/89 – 2021/22 are used in this study. Descriptive statistics, unit root testing, the Kolmogorov–Smirnov test for normality, and the robust least squares method were used in the analysis. The robust least square regression model especially searches for the impact of public loans and gross capital formation on economic growth. The confidence ellipse, coefficient confidence interval, and normality test of residuals are used to check the model for diagnostic purposes. Three variables, GDP growth, capital formation, and public borrowing, are used in the study. The GDP is the dependent variable, and capital formation and public debt are the independent variables. In this sense:

$$GDP\ growth = f(Public\ Loan, Total\ Capital\ Formation) \quad (1)$$

Symbolically,

$$CPGDP = f(PBL, TCF) \quad (2)$$

After the data of the variables are converted into logarithmic form:

$$LNCPGDP = f(LNPBL, LNTCF) \quad (3)$$

The general form of a simple linear regression equation is as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \mu_t \quad (4)$$

Y_i is the observed response variable of the i_{th} observation, X_i is the predictor variable for the ith observation, β_o is the intercept, β_1 is the slope, and μt is the error term. The traditional least square function minimizes the sum of squares of residuals. It is modified as given below:

$$Min\ \beta_0\beta_1 \sum_{i=1}^{n} (Y_i - (\beta_0 + \beta_1 X_i))^2 \quad (5)$$

In this analysis, the robust least square method is used. The robust least square method can address the problem of outliers in the variables. The robust least squares approach is used to mitigate the impact of outliers when the model fits the data. It modifies the conventional least squares method to reduce the influence of outliers that may distort the estimates. This approach becomes advantageous in cases where the data includes noise or errors that do not follow a normal distribution, therefore assuring more dependable esti-

mations. The robust ordinary least squares replace the squared loss function with a robust loss function (Zaman, 2001). The Huber loss combines a quadratic loss for small residuals and a linear loss for more significant residuals. The Huber loss function is defined as follows:

$$P(r) = \begin{cases} \frac{1}{2}r^2, \ for \mid r \mid \leq K \\ K(\mid r \mid -\frac{1}{2}K, \ for \mid r \mid > K \end{cases} \quad (6)$$

where r represents the residuals and K is a turning parameter determining the points at which the loss function transitions from quadratic to linear. Now, the robust least square objective function (Hawkins & Khan, 2009) becomes the following:

$$Min\beta_0\beta_1 \sum_{i=1}^{n} P(\beta_0 + \beta_1 X_i))^2 \quad (7)$$

The minimization process involves finding the values of β_0 and β_1 that minimize this robust loss function. Robust least squares (RLS) is a regression analysis technique that minimizes the impact of outliers by using robust statistical methods, such as M-estimation, to provide more reliable parameter estimates in the presence of data deviations from the assumptions of traditional OLS. M-estimation is a statistical method used to estimate model parameters by minimizing the objective function that represents a discrepancy between observed data and model predictions, often enhancing robustness against outliers and deviations from underlying assumptions (Khan et al., 2021).

Let $\overline{\beta}_0$, $\overline{\beta}_1$ and $\overline{\beta}_2$ be the robust coefficients; the robust least square regression equation is specified as:

$$LNCPGDP = \overline{\beta_0} + \overline{\beta_1} * LNPBL + \overline{\beta_2} * LNTCF + \mu \quad (8)$$

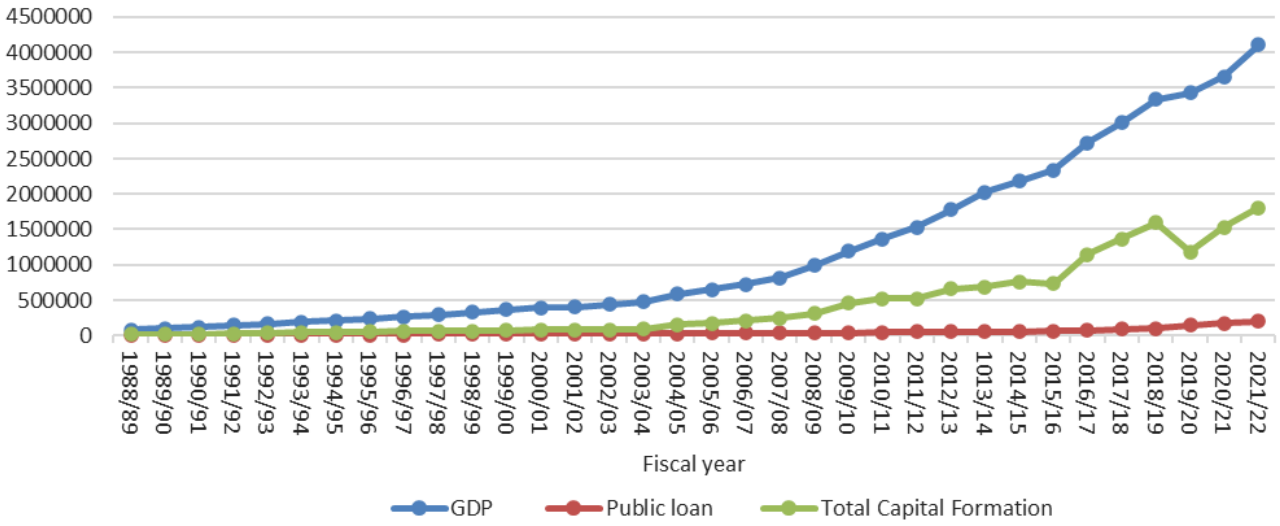
In equation 8, LNCPGDP, LNPBL, and LNTCF represent GDP growth in the current price, LNPBL represents public loans, and LNTCF represents total capital formation after taking logarithms. Where $\overline{\beta}_0$ is the intercept, and where $\overline{\beta}_1$ and $\overline{\beta}_2$ are the coefficients of the dependent variables, total public loans and capital formation, respectively.

Presentation and analysis

Condition of variables

A graphical representation of the variables and descriptive statistics are presented to show the conditions of the variables. Figure 1 presents the conditions of the dependent and independent variables (GDP), such as total capital formation and public borrowing in Nepal. The GDP, public borrowing, and total capital formation all increase with slight variations.

Figure 1: Conditions of public borrowing, total capital accumulation, and GDP



Source: Author's own work.

Table 3 shows the results of crucial statistics of the study variables, such as gross domestic product (GDP), total capital formation, and public borrowing. The GDP has a high mean, indicating a relatively high average economic output. Public debt has the lowest standard deviation value. Therefore, the average amount of public debt is more representative. All the variables have a positive skewness value, indicating a right-tailed or positively skewed distribution (mean > median > mode). Kurtosis values indicate leptokurtic distributions, signifying heavy tails and potential outliers. Compared with GDP and public borrowing, total capital formation has the highest coefficient of variation, indicating relatively high variability in capital formation.

Table 3: Summary statistics of the variables

Base	GDP	TCF	PBL
Mean	1196364.00	440023.300	46624.260
Median	621750.00	166071.900	31965.500
Maximum	4105540.00	1807290.000	201330.000
Minimum	85831.00	16392.000	6996.400
Std. Dev.	1211471.00	530020.300	46879.290
Skewness	1.02	1.251	1.916
Kurtosis	2.72	3.322	6.185
Coefficient of variation	101.26	120.450	100.550
Observations	34.00	34.000	34.000

GDP = Current price GDP of Nepal, TFC = Total capital formation, and PBL = Public loan (All the data are measured in millions of rupees)

Source: Author's own work.

Nomality check of the dependent variable

The outcomes of the Kolmogorov–Smirnov test used to check normality are presented in Table 4. The one-sample Kolmogorov–Smirnov test assesses whether a sample follows a specified distribution. The test is applied to check if the data distribution is normal, with parameters calculated from the data (mean = 13.410, std. deviation = 1.167). The test statistic is 0.094, and the asymptotic significance (p-value) is 0.200. A Monte Carlo significance is also provided, with a p-value of 0.614. The 99% confidence interval for the test statistic is between 0.602 and 0.627. Since the p-values are more significant than the commonly used significance level of 0.05, there is insufficient evidence to reject the null hypothesis that the data follow a normal distribution. In short, based on the one-sample Kolmogorov–Smirnov test, there is no strong indication that the gross domestic product (LNCPGDP) data deviates significantly from a normal distribution. Therefore, system equations can be run for prediction.

Table 4: Outcomes of the Kolmogorov–Smirnov test to check normality

One-Sample Kolmogorov–Smirnov Test			
			LNGDP
N			34.000
Normal Parameters	Mean		13.410
	Std. Deviation		1.167
Most Extreme Differences	Absolute		0.094
	Positive		0.087
	Negative		-0.094
Test Statistic			0.094
Asymptotic Sig. (2-tailed)			0.200
Monte Carlo Sig. (2-tailed)	Sig.		0.614
	99% Confidence Interval	Lower Bound	0.602
		Upper Bound	0.627

Source: Author's own work.

Stationarity checking of variables

Unit root testing is a method used to determine whether time series data are stationary and contain a unit root. A unit root indicates that the variable is affected by random shocks and tends to return to its means over time, suggesting a lack of long-term trend or stability. A unit root test is used to test and validate the stationarity of the data. Data stationarity is necessary for accurate modelling, forecasting, and economic analysis. The results of unit root testing are presented in Table 5.

Table 5: Results of unit root testing

Variables	Base	Level		First Difference	
		Intercept	Trend and intercept	Intercept	Trend and intercept
LNCPGDP	ADF value	1.697	-4.181	-3.987	-4.089
	P Value	0.432	0.015	0.004	0.015
	t-Value	-2.954	-3.603	-2.957	-3.558
LNPBL	ADF value	0.634	-1.294	-5.777	-5.904
	P Value	0.988	0.871	0.000	0.000
	t-Value	-2.954	-3.558	-2.957	-3.558
LNTCF	ADF value	-0.547	-2.258	-6.081	-6.028
	P Value	0.869	0.444	0.000	0.000
	t-Value	-2.954	-3.553	-2.957	-3.557
Decision		Economic Growth (LNCPGDP) is stationary at level		Public debt (LBPBL) and Total capital formation (LNTCF) are stationary after the first difference	

Source: Author's own work.

Economic growth (LNCPGDP) does not include a unit root. According to the unit root test findings, there is no need for differencing to establish stationarity, which indicates that growth is stable at this level. This finding is supported by the intercept and trend and intercept models' low p-values and significant ADF values. However, their high p-values and nonsignificant ADF values show that public debt (LNPBL) and total capital formation (LNTCF) are currently nonstationary. Nevertheless, LNPBL and LNTCF become stationary after taking the first difference, as shown by their p-values falling to zero and the ADF values being significant. This suggests that order one, or I(1), is integrated with these variables. As a result, LNPBL and LNTCF show long-term patterns that need differencing for study, but LNCPGDP is stable over time.

The data are stationary when variables are cointegrated at different levels. The robust least squares (RLS) method can be used in cases where variables are integrated at various levels, such as some being integrated at level I(0) and others at first difference I(1) (Greene, 2019; Hamilton, 1994).

Robust least squared method

Robust least squares is a regression method that minimizes the impact of outliers in the data by assigning lower weights to them during the fitting process. This approach aims to provide a more reliable estimate of the regression parameters in the presence of influential data points. The robust least squares method (RLS) results are presented in Table 6.

Table 6: Results of the robust least squares (RLS) method (Dependent Variable: LNCPGDP)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.9088	0.1930	15.0717	0.0000
LNPBL	0.2881	0.0509	5.6558	0.0000
LNTCF	0.6205	0.0321	19.3043	0.0000
Robust Statistics				
R-squared	0.8057	Adjusted R-squared		0.7921
Deviance	0.1413	Scale		0.0559
Rn-squared statistic	7067.6420	Prob (Rn-squared stat.)		0.0000
No robust Statistics				
Mean dependent var	13.4104	S.D. dependent var		1.1671
S.E. of regression	0.0771	Sum squared resid		0.1843

Source: Author's own work.

As depicted in Table 6, public loans positively and significantly impact Nepal's economic growth. A one-unit increase in government debt results from a 0.2881 unit increase in Nepalese economic growth. Similarly, total capital formation positively and significantly impacts Nepal's economic growth. A one-unit increase in total capital formation results in a 0.6205 unit increase in Nepal's GDP. The robust ordinary least squares (ROLS) regression equation is estimated as follows:

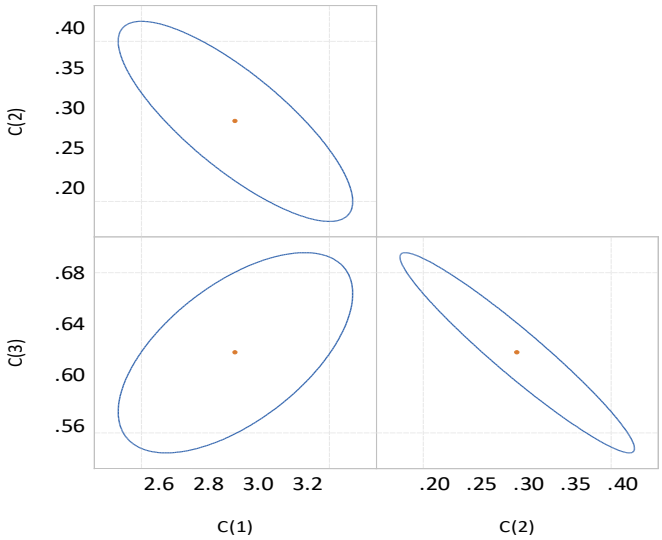
This model has a high R-squared value of 0.8057, which is more than 60%, indicating that 80.57% variation in Nepal's economic growth depends on capital

formation and public borrowing debt. From the analysis of robust and non-robust statistics, it is concluded that they are more reliable in the presence of outliers. The deviance value is 0.1413. In ROLS, deviation refers to measuring how much the

Diagnostic checking of the model

Diagnostic checking of a model involves assessing the adequacy of a statistical model by examining its assumption and identifying potential issues or deviations from expected behavior. It includes evaluating residuals, checking for outliers, examining model fit, and ensuring the model's underlying assumptions are met. Figure 2 shows the confidence ellipse.

Figure 2: Confidence ellipse



Source: Author's own work.

The ellipse's centre corresponds to the mean or centroid of the data points. A larger ellipse indicates more significant variability, whereas a smaller ellipse suggests lower variability. The shape of the ellipse represents the covariance structure of the data. In other words, it shows how the variables are correlated. A more elongated ellipse indicates a stronger correlation, whereas a more circular ellipse suggests a weaker or no correlation. In this figure, the correlation coefficients of the variables are related. This means that the residuals are not highly correlated.

Table 7 presents coefficient estimates and their 95% confidence intervals for variables in a regression model with 34 observations. The coefficient of public borrowing is 0.2881, and the 95% confidence interval is 0.3919 to 0.1842 from high to low. Similarly, the coefficient of total capital formation is 0.6205, and the 95% Confidence Interval is 0.6861 to 0.5549 from high to low, respectively. For each coefficient, the confidence interval indicates the range within which we are 95% confident that the actual population value lies. In practical terms, it helps assess the precision and reliability of the estimated coefficients in the regression model.

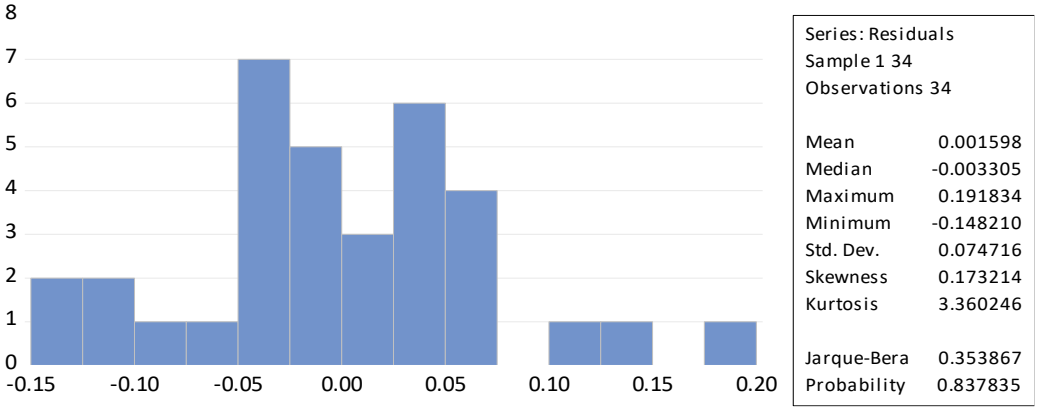
Table 7: Coefficient Confidence Intervals

Variable	Coefficient	95% Confidence interval	
		Low	High
C	2.9088	2.5152	3.3025
LNPBL	0.2881	0.1842	0.3919
LNTCF	0.6205	0.5549	0.6861

Source: Author's own work.

Figure 3 represents the normality test. The p-value of the normality LM test is 0.837835, which is greater than 0.05. This ensures that the residuals are not normally distributed.

Figure 3: Normality test of residuals



Source: Author's own work.

Discussion

The primary objective of this study is to examine the impact of total capital formation and public borrowing on Nepalese economic growth. The findings revealed that public borrowing positively and significantly impacts Nepal's economic growth. However, various studies have shown the negative impact of public loans on economic growth. This finding does not align with the research outcomes reported by Doman (1994), Asterious et al. (2020), and Chudik et al. (2017); however, Upadhyaya and Pun (2022) reported no significant relationship between public borrowing and GDP growth in Nepal. The findings of this study are aligned with the research findings of Regmi (2023), Svetlana and Mariia (2021), and Kabemba and Kabwe (2024). The positive relationship between public loans and economic growth may be attributed to increased government spending on key infrastructure projects, stimulating economic activity. Adequate public borrowing can also enhance social and human capital development, fostering a skilled workforce and improved productivity. Additionally, well-managed public debt may signal investor confidence, attracting foreign investments and contributing to overall economic expansion.

Capital formation has a positive effect on Nepal's economic growth. This finding aligns with the outcomes reported by Bal et al. (2016), Sharma and Mittal (2021), Wami (2021), Jolo and Koc (2023), and Dada (2017). However, the finding of Topcu et al. (2020), which is related to low-income countries, does not align with this finding. The findings of Aslan and Altinoz (2021) and Opadeji et al. (2023) do not align with this finding. Capital formation promotes economic growth by increasing the availability of productive assets such as machinery and infrastructure, leading to increased productivity and efficiency. This accumulation of capital assets enables businesses to expand operations, create employment opportunities, and ultimately contribute to sustained economic development.

Capital formation is more effective than public borrowing in promoting economic growth. Capital formation is more effective than public debt, as it involves the creation of tangible assets and infrastructure, directly contributing to increased productivity and long-term economic growth. On the other hand, public debt may pose risks of financial instability and interest burdens, potentially impeding economic development without prudent management.

Conclusion and policy implications

This study explored the influence of public borrowing and total capital formation on Nepal's economic growth. Capital formation and public loans have individual and joint impacts on economic growth. One unit increase in public debt and total capital formation resulted from 0.2881 and 0.6205 unit increases in Nepal's GDP, respectively. The formation of total capital is more responsible for increasing Nepal's economic growth. An 80.57% variation in GDP depends on public borrowing and total capital formation in Nepal.

Both public loans and total capital formation contribute positively to economic growth, but total capital formation appears to have a relatively more significant impact; policymakers should prioritize policies that encourage and facilitate increased total capital formation. This could involve creating a conducive business environment to attract private investments, implementing supportive fiscal and monetary policies, and ensuring efficient allocation of resources for infrastructure development and technological advancements. Simultaneously, policymakers should be cautious in managing public loans to prevent excessive debt burdens, providing a balanced approach that optimizes the benefits of both public loans and total capital formation for sustained and inclusive economic growth.

This study is based on the secondary data. It only includes 34 data points, spanning from fiscal year

1988/89 to 2021/22 are included. It uses only two dependent variables: public loan and capital formation, which determine economic growth in the Nepalese economy. The robust least square method explores the impact of public borrowing and capital formation on economic growth. There are many untouched variables, data countries, methods, and countries. Therefore, further research is necessary by adding more variables, data points, countries, processes, tools, and techniques.

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