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Higher Education and Economic Growth in Nepal: An ARDL Bounds Test Co-integration Approach

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Abstract

The study examines the connection between higher education and economic growth of Nepal over the period (1990-2024) using time series data techniques with an ARDL bounds test co-integration approach. It's outcomes (short-run and long-run) coefficients demonstrate that higher education has a highly significant and positive influence on economic growth in the country. The outcomes imply that investment in higher education plays a role of major contributor for poverty alleviation and fostering the sustainable economic growth in Nepal. The study also found that investment and government expenditure variables positively affect Nepalese economic growth performance. Conversely, inflation demonstrates a negative relationship with economic growth, though its impact is statistically significant at 1%. The empirical outcomes concluded that investing in higher education can boost the Nepalese economy and increasing the sustainable economic growth in Nepal.

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Introduction

At present education has been basic component of human capital development which plays a key contributor for economic development in the universe. In this point, higher education is a means for transferring skills and innovative knowledge of sustainable economic development around the world (Becker, 1964; Mankiw, et al. 1992). Therefore, it is believed that

connection of higher education and economic growth are very crucial for making effective and efficient education policies in every county. Over the three and half decades, endogenous growth theory in particular focused on the relation between growth economic and higher education, which highlighted the knowledge spillover and human capital are key drivers of economic growth performance (Lucas, 1988; Romer, 1990).

In the 21 century, a lager number of empirical research have focused on linkage between higher education and economic growth using several methods and various quality of data. Similarly, it also includes different county or region or cross country or panel cross section (see for example, Barro, 2001; Musila and Belassi, 2004; Njong, 2010; Hanueshek and Woessmann, 2012; Barro and Lee, 2013; Jalil and Idrees, 2013; Wang and Liu, 2016; Dissou et al., 2016; Rathanasiri, 2020; Okerekepti, 2022; Ni, et al., 2023). These previous research in higher education have a positive existence on performance economic growth. However, some other studies found a negative influences on economic growth performance (see for example, Devarajan et al., 1996; Omodero and Kalanechi, 2020; Pimar, 2022).

In recent years, a few number of empirical research in Nepalese context focus on linkage between higher education and economic growth. Dahal (2016), applying an OLS method for (1995-2013) time period of Nepal, found that higher education significantly influenced economic growth performance. Likewise, Khanal (2023) investigated an OLS approach for (1985-2022) period of time in Nepal and his study found that higher education enrollment positively influenced GDP. However, Dangal and Gajurel (2019) employing an ARDL model found that public funding in education have negatively influence on economic growth**.** Many existing research in this field relies on earlier datasets and does not adequately account for recent structural changes in the economy, evolving higher education policies, and the rapid expansion of tertiary enrolment. Furthermore, the dynamic short run as well as long run linkage between higher education and economic growth have not been sufficiently explored using a contemporary econometric approach such as an auto-regressive distributed lag (ARDL) model.

Therefore, the aim of this study is to investigate the nexus between higher education and economic growth in Nepal employing updated data (1990-2024) and a robust time-series data framework within an ARDL cointegration approach. The ARDL approach is especially suitable for the Nepalese context as it allows for the estimation of both short-run as well as long-run dynamics in the presence of variables integrated of different orders.

Methods

Econometric methods have been employed for the research, however, first we have made a brief discussion of the variable.

Variable Description

The study adopts secondary data from Nepal during (1990-2024) time period to investigate the long-run equilibrium and short-run relationships dynamic adjustments among higher education, economic growth. It has three macroeconomic control variables such as investment, government expenditure and inflation. All the annual secondary data are taken from the World Bank (WB, 2025).

Economic growth *(Y)*, the dependent variable, is measured using the natural logarithm of real Gross Domestic Product (GDP). It serves as a widely accepted macroeconomic indicator of aggregate economic performance (Barro, 2001). The primary independent variable representing higher education *(HE)* is school enrollment at the tertiary level, expressed as the gross enrollment ratio (percent of total population eligible). The research incorporates three macroeconomic control variables. First, investment *(INV)* variable is calculated by gross fixed capital formation (percent of GDP). The second, control variables (*GOV*) are measured by general government final consumption expenditure percent of GDP. And, the final control variable, inflation (INF) is measured as consumer prices (annual percent).

Econometric Methods

In this work, we used the ARDL bounds-testing method of Pesaran et al. (2001) to investigate the long-run as well as short-run connections between Nepalese higher education and economic growth for (1990-2024) period of time. Here, we present an ARDL model that incorporates economic growth, higher education, and three macroeconomic control variables: investment, government expenditure, and inflation. The following is a representation of this model:

$$\Delta \ln Y_t = a_0 + \sum_{i=0}^{\kappa} \theta_i \Delta \ln Y_{t-i} + \sum_{i=0}^{\kappa} \varphi_i \Delta \ln HE_{t=i} + \sum_{t=0}^{\kappa} \pi_i \Delta \ln INV_{t-i} + \sum_{i=0}^{k} \eta_i \Delta \ln GOV_{t-i}$$

$$+ \sum_{i=0}^{k} \gamma_i \Delta \ln INF_{t-i} + \beta_1 \ln Y_{t-1} + \beta_2 \ln HE_{t-1} + \beta_3 \ln INV_{t-1} + \beta_4 \ln GOV_{t-1} + \beta_5 \ln INF_{t-1} + \varepsilon_t \quad (1)$$

Where, the symbols have their usual meaning. The symbol Δ refers to first difference, α represent constant, Y denotes economic growth, HE is higher education, GOV refers to government expenditure, INV indicates investment, and INF stands for inflation, Ln denotes the natural logarithm, t is the time trend, k refers to optimal lag length, ε_t denotes error term.

The first stage in the ARDL bounds test method is to use an F-test to determine whether the variables of higher education, economic growth, government expenditure, investment, and inflation have a long-run relation or not. The null hypothesis in the equation (1) is $H_N = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$, indicates that the non-existence long-term correlation among the variables. On the other hand, a long-term connection is suggested by an alternative hypothesis like $H_A : \beta_1 \# \beta_2 \# \beta_3 \# \beta_4 \# \beta_5 \# 0$.

Once co-integration is confirmed, the long run coefficients are calculated utilizing an optimal ARDL specification determined by an AIC (Akaike Information Criterion). The second step is to use a short-run dynamic ECM (Error Correction Model) to find out how quickly an ARDL model returns to long-run equilibrium after short-run shocks (Pesaran et al., 2001). Equation (1) is used to implement the ECM, which is represented as:

$$\Delta \ln Y_t = a_0 + \sum_{i=0}^{k} \theta_i \Delta \ln Y_{t-i} + \sum_{i=0}^{k} \varphi_i \Delta \ln HE_{t-i} + \sum_{i=0}^{k} \eta_i \Delta \ln GOV_{t-i} + \sum_{i=0}^{k} \psi_i \Delta \ln INV_{t-i} + \sum_{i=0}^{k} \gamma_i \Delta \ln INF_{t-i} + \delta_i ECT_{t-i} + \varepsilon_t \quad (2)$$

Where, δ refers to speed of the adjustment. A statistically significant and negative error-correction term indicates stable long-run adjustment dynamics (Narayan, 2005).

Finally, stability tests were utilized to assess an ARDL approach's goodness of fit. In particular, the stability tests of the long-run parameters based on recursive residual estimates was assessed using the cumulative sum of recursive residuals (CUSUM) and of squares of recursive residuals (CUSUMSQ), as suggested by Brown et al., (1975).

Results and Discussions

Before calculating an ARDL approach, it is essential to assess the order of integration. In this context, this work applies most common ADF (Augmented Dickey-Fuller) unit root test, which is proposed by Dickey and Fuller, (1979).

Table 1. *Analysis of ADF unit root test results*

Varibales	With trend and intercept	
	Level	Second difference
lnY	-1.8729	-7.7116***
lnHE	-4.2002**	-0.7916***
lnInv	-3.0076	-6.1612***
lnGOV	-2.7558	-6.6193***
lnINF	-4.9260***	-5.1796***

Source: Eviews 12 Output.
*** *indicate satatistical significance at 1 percent.*
** *indicate statistical significance at 5 percent.*

Table 1 reports the outcomes of the ADF unit root test of variables such as economic growth, higher education, investment, government expenditure, and inflation. All the variables of the null hypothesis of ADF unit root test have been highly rejected in their second difference with trend and intercept. While employing the level with trend and intercept, we found the ADF unit root test of null hypothesis is hard to deny**.** The analysis evident shows that the second difference of each variable is stationary and integrated.

Table 2. *ARDL bounds cointegration test*

Model for estimation			Critical bounds value	
	F-Statistics	Significance Level (%)	lower bound I(0)	Upper bound I(1)
lnY = f(lnINV, lnGOV, lnINF)	14.7036	1%	3.29	4.37
		5%	2.56	3.49
		10%	2.20	3.09

Source: Eviews 12 output

The ARDL bounds cointegration test outcomes are present in Table 2. The computed *F*-statistic (14.7036) exceeds the critical values of the upper bound value (4.37) at 1 percent significance. Therefore, the study concludes that bounds test results support the cointegrating relation among variables: higher education, economic growth, investment, government expenditure, and inflation during (1990-2024) study period.

Table 3. *Long-run estimated coeffients*

	Dependent Variable: lnY			
Varibales	Coefficients	Standard error	*T*-statistic	Probability
lnHE	0.8162	0.2005	4.0699***	0.0066
lnInv	0.6943	0.2337	2.9696***	0.0250
lnGOV	1.0415	0.2237	4.6556***	0.0035
lnINF	-0.3154	0.0878	-3.5915***	0.0115
C	7.7420	2.7585	2.8066**	0.0309

Source: Eviews 12 Output
** *indicate statistical significance at 5 percent.*
*** *indicate statistical significance at 1 percent.*

The estimated coefficient of long-run outcomes are given in Table 3. At 1 percent level, the estimated coefficient of higher education is positive as well as statistically significant. This finding indicates that from 1990 to 2024, higher education played an important function in Nepal's economic development. The finding indicates that for every 1 percent growing in higher education, economic growth leads by about 0.82 percent. This outcome is in line with earlier studies by Masatoshi (2025); Okerekeoti (2022) and Nowak and Dahal (2016). However, our findings contradict with those of Pimar (2022) and Duwal and Acharya (2023), who found that higher education has a negative effect on economic growth.

This study determined that each variable of the ARDL model has an expected sign with regard to the long-run estimated coefficients of control variables. The long-run estimated coefficient of investment variable has positive as well as significantly influence economic growth performance, indicating that a 1 percent rise in investment would enhance economic growth by about 0.69 percent. This outcome is in line with research by Duwal and Suwal (2024), who found that investment has positive influence economic growth. Similarly, government expenditures variable has a pleasing effect on Nepal's economic growth, which shows that the government expenditures variable has a positive effect. It presents that a 1 percent growth in government expenditures, Nepalese economic growth rising by about 1.04 percent. Our findings are consistent with those of Mallick and Dash (2015) for India and Okerekeoti (2022) for Nigeria. In case of the inflation, the long-run estimated parameter has a negative and highly significant at 1 percent. It demonstrates that for every 1 percent improvement in inflation, economic growth is lowered by about 0.32 percent.

Table 4. *Short-run estimated coefficients with ECM*

Dependent Variable: ΔY				
Varibales	*Coefficients*	Standard error	*T*-statistic	Probability
ΔHE	0.2699	0.0462	5.8471***	0.0011
ΔInv	0.7176	0.0857	8.3754***	0.0002
ΔGOV	0.3054	0.1073	2.8198**	0.0371
ΔINF	-0.0778	0.0099	-7.8029***	0.0002
ECT_{t-1}	-0.5675	0.0446	-12.7177***	0.0000

Source: Eviews 12 Output
*** indicate statistically significant at 5 percent.*
**** indicate statistical significance at 1 percent.*

Table 4 shows the outcomes of the ARDL short run coefficients with ECT. From 1990 to 2024, the study finds that higher education, investment, and government expenditures variables had a significant positive impact on economic growth in Nepal. This means that

these variables (higher education, government expenditures and investment) are supportive simulators on Nepalese economy. The estimated coefficient of inflation has a negative and significant effect on economic growth at the 1 percent level. According to table 4, the coefficient of an error correction (ECT_{t-1}) has a negative as well as very significant at 1 percent. This supports the awaited convergence procedure in long run relation of each variable like higher education, economic growth, investment, inflation and government expenditures.

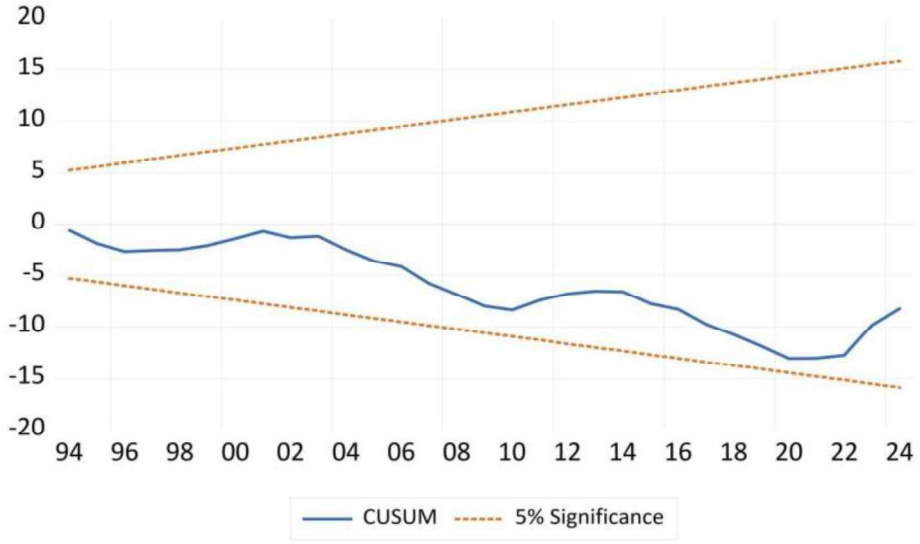

Fig. 1: Plot of the CUSUM statistic

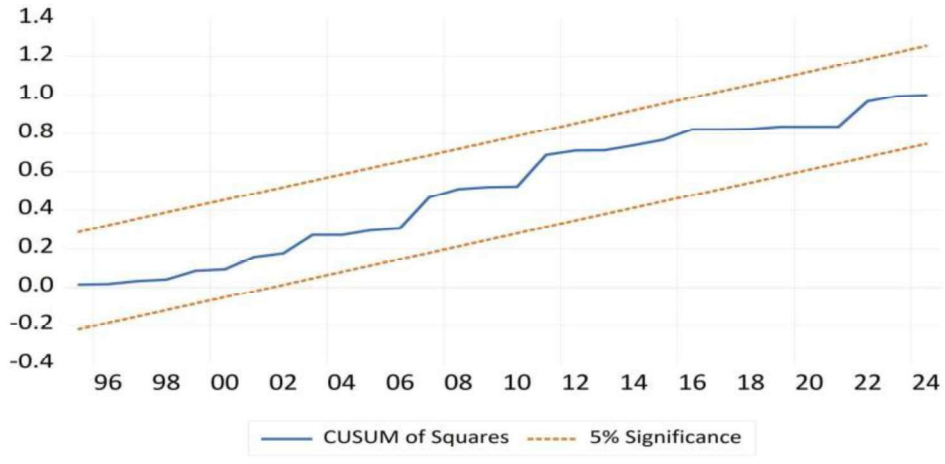

Fig. 2: Plot of the CUSUMSQ statistic

Figs. 1 and 2 present cumulative sums of squares of recursive residuals (CUSUMQ) and of recursive residuals (CUSUM) statistics. These predicted coefficients appear to demonstrate stability throughout period from 1990 to 2024, as evidenced by the CUSUM and CUSUMSQ statistics, remaining inside the 5 percent critical value bounds.

Conclusion

The present study investigated the relationship between higher education and economic growth of Nepal employing recent data (1990-2024) and an ARDL cointegration approach. Initially, we utilized the ADF unit root test to find out the order of integration for the variables. The long run as well as short run impacts of higher education, investment, inflation and government expenditure on economic growth were then investigated using the ARDL bounds test cointegration approach. The outcomes of the ADF test found that each of the variables (higher education, economic growth, government expenditure, investment and inflation) are integrated as well as stationary.

An ARDL bounds test outcomes indicated that computed *F*-statistics are greater than an upper bound value. It shows that there was a cointegrating relation with connection among the selected variables during 1990-2024 the study period. This empirical work found that the coefficients of higher education have a significant as well as positive consequences in economic growth. It indicates that higher education has a key function of Nepalese economic growth. Similarly, the study found that the investment, and government expenditures have supportive and significant impression on economic growth during the research period. This means that investment, and government expenditures variables had a favourable impact on Nepalese growth performance. On the other hand, it has been found that variable of inflation has a non-supportive effect on Nepalese economic growth.

This research only analyzed the relation of economic growth on higher education and observed supportive effect in Nepalese economic growth. Future work can investigate the effect of economic growth on higher education, primary education as well as secondary education in a combined form.

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