HIGHER EDUCATIONAL ENROLLMENT, SCHOOL TEACHERS AND GDP IN NEPAL: A CAUSALITY ANALYSIS

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Abstract

Education-centered human capital theory acknowledges the role of education in the economic development of nations. With the emergence of endogenous growth theories in the 1980s one of the variables very extensively included in cross-country and country-specific empirical growth studies is education measured by enrollment in primary, secondary and higher level of education, average years of schooling and literacy rate. The aim of this paper is to investigate empirically the linkage between higher education and real gross domestic product of Nepal. This paper employs time series data on enrollment in higher education and teachers working in the lower secondary and secondary schools and gross domestic product of Nepal spanning the period 1975-2009 and investigates the causality in Granger's sense employing unit root and cointegration test tools. Evidence is in favour of causality running from real gross domestic product to enrollment in higher education but the causality relation between real gross domestic product and school teachers seems neutral.

Key words: enrollment in higher education, teachers in lower secondary and secondary schools, real GDP, unit root, cointegration, Granger causality, Nepal

INTRODUCTION

Education-focused human capital is one of the key variables included in empirical growth models. The theoretical basis for the straight inclusion of education in economic growth and development analysis is the education-centered human capital theory pioneered by Schultz (1961, 1975), Mincer (1958, 1974) and Becker (1962, 1975). This theory emphasizes the crucial role of education in earning and production. The theory is built on the assumption that formal education is highly instrumental and even necessary to improve the production capacity of a population. Nobel Laureate Becker states, "Human capital analysis assumes that schooling raises earnings and productivity mainly by providing knowledge, skills, and a way of analyzing problems" (1992, p.88). Endogenous growth theories pioneered by Lucas (1988) and Romer (1989) have directly included education-oriented human capital in growth models.

Inspired by these seminal works large number of cross-country and country-specific empirical studies have been made to investigate the impact of education on economic growth. The objective of the present paper is to investigate empirically the causal

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relation between the development of higher education and economic development in Nepal. Development of higher education is proxied by enrollment in higher education and teachers working in the lower secondary and secondary schools of Nepal and economic development is proxied by the real GDP of the country. Enrollment in higher level of education is chosen as an indicator of the development of higher education following previous studies but school teachers is the new variable added in this study as an alternate measure of higher education. Teachers working in the lower secondary level (grades 6 to 8) in the education system of Nepal need to have acquired minimum intermediate degree and secondary level teachers (grade 9 and 10) need to have bachelor degree as the academic qualification. Both of these formal educational degrees are parts of higher education or tertiary level of education. The number of teachers working in lower secondary and secondary schools represents the employment status of labour force with higher education. The sample period is 1975-2009.

EMPIRICAL LITERATURE ON EDUCATION–ECONOMIC GROWTH CAUSALITY

An empirical analysis examining the causality between education and economic growth was made by De Meulemeester and Rochat (1995).The objective of this study was to examine whether any causality existed between higher education and economic development in the six developed countries: Japan (1885-1975), United Kingdom (1919-1987), Italy (1885-1986), Sweden (1910-1986), France (1899-1986) and Australia (1906-1986). The level of economic development is measured by per capita real GDP and its growth rate and the level of higher education is proxied by the number of students per capita enrolled at higher education institutions and their growth rates.

The time series data for the study were gathered from publications of the governments of the countries concerned and also from previously published works of individuals and institutions. Unit root in the data is tested by employing the approach developed by Dickey-Fuller (1979, 1981). Similarly Johansen's methodology (Johansen and Juselius, 1990; Johansen, 1992) is applied to test for cointegration between the variables. Finally to test the causality between economic development and higher education Granger's (1969) approach is employed.

The results of the augmented Dickey-Fuller (ADF) test showed that the level values of the variables contained unit root, and they were not stationary. Stationarity of the variables was achieved in first differenced values which implied that the education and income variables considered in the study were integrated of order one, I (1).The cointegration test results derived from the application of the Johansen methodology were not in harmony with the hypothesis of cointegration; this rejected any stable linear combination of the time series enrollment in higher education and real GDP per capita even if the series exhibited first order stationarity in level values. However this result is not taken as surprising.

The results of the causality test showed the presence of uni-directional causality from higher education to economic development in the case of four countries: Japan (1885-1975), the United Kingdom (1919-1987), France (1899-1986) and Sweden (1910-1986). This indicated that the development of higher education contributed to growth in these countries, at least in the short run. However, no causal relationship was observed for Italy (1885-1986) and Australia (1906-1986). De Meulemeester and Rochat (1995) remarked that the absence of cointegration suggested the absence of a long-run stable linear relationship between per capita real GDP and higher education. Intuitively this result seemed to be consistent with the hypothesis of screening or credentialism which claims that higher education signals preexisting higher productivity and/or helps in sorting out individuals and hence facilitates the production process in the short run by reducing the costs of search. The absence of causality in the Italian and Australian cases implied that the relationship between higher education and economic development is not linearly mechanized.

Jaoul (2004) by using the notion of causality developed by Granger (1969), made an empirical study on the relationship between higher education and economic growth comparing France and Germany before the Second World War. The data on GDP and student number relating to France and Germany for the period 1899-1937 were compiled from different secondary sources.

Unit root test was performed with the application of augmented Dickey-Fuller approach, cointegration and causality were the main tools used. Vector Autoregressive (VAR) modeling in the spirit of Sims (1980) is applied to investigate the causality. Johansen's methodology (1988) is employed to test whether the variables were cointegrated or not.

The empirical results of the augmented Dickey–Fuller test indicated that the time series were stationarized with first differences. The variables of interest were found integrated of order one, I (1), and cointegration test were further performed. The Johansen's test (1988) of cointegration between the total number of students and GDP rejected the presence of such relationship at the 5% significance level; so the causality test was performed from a VAR approach.

The number of students and GDP did not display a common long-run relation in Germany and France. For Germany, the causality test showed that higher education did not influence GDP. But the case of France was different, with higher education affecting GDP. The result showed no relation in Germany between GDP and the total number of students, either in the long run or in a contemporary relation. On the contrary, the total number of students seemed to be contemporarily linked to GDP in France. Thus in France the idea that economic growth should be a function of its human capita thus appeared to be proved.

The study concluded that the difference between France and Germany could therefore be explained by a difference in political aims: France first developed its education whereas Germany preferred to adapt its education system to the economy.

Francis and Iyare (2006) applied cointegration and vector error-correction models to analyze the causal relationship between education and development in Barbados, Jamaica, and Trinidad and Tobago using annual time series data from 1964 to 1998. Expenditure on education per capita is used as the proxy for education, while gross national income (GNI) per capita is the proxy for development. The data on public expenditure on education per head were obtained from Bulmer-Thomas and Shelton (2000); the data on Gross National Income (GNI) per capita came from the World Bank World Development Indicators Online Database.

The empirical methodology of the study consisted of the unit root tests, the cointegration test and the Granger causality test.

The empirical results of the unit root tests obtained by using the augmented Dickey-Fuller overwhelmingly supported the presence of unit roots (in terms of levels) in all the series for all countries. Clearly, for all three countries, both series appeared to be integrated of order one, I (1), since the null hypothesis of a unit root in the first difference is rejected in favour of the alternative hypothesis that the series, in first difference, are stationary. The results of the ADF test applied to the residuals of the cointegration equations suggested evidence of cointegration between GNI and ED in all countries. This finding is confirmed by the Cointegration Regression Durbin Watson (CRDW) statistic. These results justified a long run relationship between education and development in all of the countries.

Since the two variables were found cointegrated in all three countries, a Vector Error Correction Model (VECM) was estimated to determine the nature of causality between GNI and ED. The empirical results of the estimated VECM indicated a mixed set of outcomes. In both the short and long run, the evidence suggested that economic development was driving education in all three countries. However, education caused development in Jamaica in the short run. These results provided some evidence of bi-directional causality between education and economic development in the short in Jamaica. There is no evidence of causation running from education to development in either the short or long run in Barbados, and Trinidad and Tobago.

On the whole, the empirical results suggested that changes in the level of per capita gross national income caused changes in the level of per capita spending on education in all three countries. However, the empirical results do not confirm that improving the level of per capita spending on education contributed significantly to per capita gross national income in either Barbados, or Trinidad and Tobago. The researchers made the remark that this finding was rather interesting because it contradicted most of the theoretical expectations. Furthermore, this finding probably reflected some shortcomings in the available data.

Islam, Wadud and Islam (2007) carried a multivariate causality analysis to examine relationship between education and growth in Bangladesh using annual time series data from 1976 to 2003.Besides examining the relationship between growth and education two other variables capital and labour are included in the analysis. The annual time series data on real GDP, expenditure on education, capital, and labour were obtained from various issues of the Statistical Yearbook of Bangladesh, a publication of the Bangladesh Bureau of Statistics. Indexes of the data were prepared by the investigators with 1976 =100 as the base to track the evolution of the variables over the sample period. The levels of the indexes were transformed into logarithm in the econometric analysis.

The empirical methodology of study consisted of the unit root tests, the cointegration test and the Granger causality test. The augmented Dickey-Fuller (ADF) test is used to test for the presence of unit roots and determine the order of integration of the variables. The tests are done both with and without a time trend. Akaike method is used to choose the optimal lag length, and the maximum likelihood estimation method of Johansen and Juselius (1990) is used to test for cointegration between the variables.

The ADF test showed the presence of a unit root and hence the nonstationarity of the time series in their levels at the 5% level of significance. It was also found that the first difference of the series contained unit root and were nonstationarity. However, the nonstationarity problem vanished after second difference. Thus the GDP and expenditure on education variables were found integrated of order two, I (2).On the basis of Akaike Information Criteria, the optimum lag length was found to be one. In the Johansen's cointegration test both eigenvalue and trace tests were conducted, which generated same result. The cointegration test showed cointegrating relationship between GDP and annual expenditure on education.

Granger's causality (1969) test was performed following Granger Representation Theorem (Granger, 1988). The Granger's causality (1969) test was set in the vector error correction model (VECM) which uses the residual obtained from long-run cointegrating equation estimated by applying the ordinary least square (OLS) method in the Engle-Granger or augmented Engle-Granger framework. Using an F-test, the researchers found find bidirectional long run causality between education and GDP; the coefficients on the error correction terms (ECTs) in the GDP equation and in the education equation were found significant at the 1% level. This revealed that GDP growth and expenditure on education in Bangladesh were helping each other.

Since the four variables (GDP, expenditure on education, capital and labour) considered in the study significantly rose from 1984, the researchers redid the analysis for the sub-sample after 1984. It took three differences to attain stationarity, which was rather unusual; and even then cointegration of the relevant variables was not achieved. Observing this it was asserted that no long-run relationship between education and growth could be established by confined the analysis for the period 1984 -2003. The researchers' remark was that such a result could be due to the shorter sample period (1984-2003) under consideration and the larger number of differences taken to achieve stationarity, which reduced the degrees of freedom. The final remark of the investigators was that as GDP growth and educational expenditure in Bangladesh were working in tandem and in studying causality between education and growth, especially in the developing economy, these results could provide a benchmark of comparison for future research work.

Thus there are inconsistencies in the findings of the causal relation between education and economic growth. The results obtained from cross-country and country specific studies would not be applicable in all countries and regions. The present researcher could not locate any empirical studies carried to investigate the causality relation between higher education and economic development of Nepal. It seems therefore to address the causality relation between higher education and economic development in Nepal.

VARIABLE DEFINITIONS AND DATA

The variables of interest of this study are level of real GDP of Nepal and number of students enrolled in higher education. The data on the GDP and students enrollment in higher education are taken from Economic Surveys of the fiscal years 1994/95, 2003/04, 2008/09 and 2009/10 published by Ministry of Finance of the Government of Nepal (1995, 2004, 2009, and 2010). The data on number of teachers(TECH) working in the lower secondary and secondary schools of Nepal is taken from the Economic Survey of the fiscal year 2009/10 published by the Ministry of Finance of the Government of Nepal(2010).

The information on implicit GDP deflator also comes from aforementioned Economic Surveys of different fiscal years. Government Finance Statistics volumes I and III published by Nepal Rastra Bank (2008, 2010) were also used to gather the required data. The GDP deflator is available with different base years. For the preset study GDP deflator is rebased to fiscal year 1984/85=100 and series were prepared for the entire period 1974/75-2008/09.This GDP deflator is used to change the nominal GDP to real GDP. For the empirical estimation both enrollment number and real GDP were transformed into natural logarithms (ln).The sample period of data coverage is 1975-2009.

ECONOMETRIC METHODOLOGY

Unit Root Test

Stationarity of a time series is tested through unit root tests. Testing for causality between two variables implies the specification of the dynamic relationship linking them. Therefore first of all it is required to investigate the time series properties of the variables under consideration: enrollment in higher education and real GDP of Nepal. It is necessary to find out whether the variables are stationary in levels or in first or higher order differences, and afterwards if they are cointegrated or not. Indeed it is dangerous to regress non-stationary variables as the result would be spurious or nonsense regression (*see* Gujarati, " The Phenomena of Spurious Regression" 2003,806-807; the "spurious regression" problem; Granger and Newbold, 1974). A time series X, is defined as weakly stationary or covariance stationary or integrated of order 0 denoted as I(0) if its mean and variance are time-invariant and its autocovariances between the two time periods are only dependent on the time span separating observations(Gujarati,2003,p.797). Similarly, a series is defined as being integrated of order *d* if it is necessary to differentiate it *d* times in order to get a stationary I(0) series.

In order to test for the stationarity of a series X, (i.e., testing for the presence of a unit root) we use the well-known Dickey-Fuller or augmented" Dickey-Fuller test (Dickey and Fuller, 1979, 1981). Even if there are different tests for unit roots described in the literature, the augmented Dickey-Fuller (ADF) test has become the most popular of many competing tests (Elder and Kennedy, 2001, p.138). It consists in estimating by ordinary least square (OLS) an equation such as (1):

$$\Delta X_t = a_0 + a_1 T + b_0 X_{t-1} + \sum_{i=1}^{k} b_i \Delta X_{t-i} + e_t \qquad (1)$$

where Δ is a difference operator, T is a trend and e, is a disturbance term. The procedure is testing for $b_0 = 1$ (null hypothesis of unit root) using a *t*-test generally called as *tau* statistic. The alternative hypothesis is that $b_0 < 0$; that means the time series is stationary. Practically we reject the null hypothesis of non-stationarity if b_0 is adequately statistically negative. Failing to reject the null is equivalent to failing to reject the existence of a unit root or stochastic trend in the data series. Critical values are obtained from Dickey and Fuller (1979).However in Econometric Software packages the critical values is given.

Two major issues in performing ADF tests are the inclusion (or not) of an intercept term, a trend term, or both, and the selection of the truncation lag.ADF test results are very responsive to the presence of intercept and trend terms, and to the number of lags included. In general, including too many deterministic-regressors results in lost power, whereas not including enough of them increases the probability of not rejecting the unit-root null.

Johansen's Cointegration Test

Cointegration is an econometric property of time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated. A vector of time series variables x_t is cointegrated if each element is integrated of order one, I (1), but there exists a nonzero vector λ (called the cointegrating vector) such that $\lambda \times x_t$ is integrated of order zero, I (0). The idea is that two variables may be cointegrated if they both bounce around, but there is some long-term "equilibrium" relationship between the two. Economic theory often suggests that certain subset of variables should be linked by a long-run equilibrium relationship. Although the variables under consideration may drift away from equilibrium for a while, economic forces or government actions may be expected to restore equilibrium.

After the test of stationarity of a time series, another step involves test of cointegration. In view of the limitations encountered in the Engle-Granger (1987) procedure (for the limitations see Enders, 2008,pp.347-348), we have employed Johansen (1988, 1991) and Johansen and Juselius (1990) cointegration test to identify the existence of any cointegrating relationship between per capita GDP and enrollment in higher education in Nepal. Johansen's procedure involves maximum likelihood estimates of all the cointegrating vectors. Generally if two time series as nonstationary or integrated of order one, I (1), the future values of a variable are not predictable based on past values. But there are still chances that two time series may share a common trend which means that two variables are cointegrated if they have a long term equilibrium relationship between them. Johansen (1988, 1991) and Johansen and Juselius (1990) derive maximum likelihood procedures for testing for cointegration in a finite–order (i.e., p-th order) Gaussian vector autoregression (VAR) as

$$Y_t = \lambda + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t \qquad (2)$$

where Y_t is an n×1 vector of variables (that are integrated of order one) being jointly modelled; λ is a vector of constants-also known as drifts; A_i is a matrix of parameters (i=1, 2,…, n); and ε_t is an n×1 vector of unobserved, sequentially independent, jointly normal error terms (also known as innovations) with mean zero and (constant) covariance matrix; p is the order of vector autoregression (VAR).

Just as the augmented Dickey-Fuller test formulation, the VAR given in equation (2) can be rewritten as

$$\Delta Y_t = \lambda + \pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \qquad (3)$$

where $$\pi = \sum_{i=1}^{p} A_i - I \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

Johansen (1988, 1991) and Johansen and Juselius (1990) propose two different maximum likelihood statistics for testing the rank of the coefficient matrix "Π" in equation (3) and hence for testing the number of cointegrating vectors in equation (3). The two statistics of significance are trace test of the stochastic matrix and maximum eigenvalue test of the stochastic matrix which are represented by equations:

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \log\left(1 - \lambda_i\right) \qquad (4)$$

$$\lambda_{max} = -T \log\left(1 - \lambda_{r+1}\right) \qquad (5)$$

Here T is the sample size and λ_i is the i^{th} largest eigenvalue. The trace statistic (λ_{trace}) tests the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *k* cointegrating vectors, whereas in the maximum eigenvalue statistic (λ_{max}) tests the null hypothesis of *r* cointegrating vectors against the alternative of *r+1* cointegrating vectors. We use the maximum eigenvalue statistic (λ_{max}) to improve the power of the test by limiting the alternative to a cointegrating rank just one more than under the null.

Granger Causality Test

This paper employs Granger's (1969) causality test approach to investigate the causal relationship between real GDP of Nepal and enrollment in higher education. Granger introduced a concept of causality in which, broadly speaking, a variable Y is said to be Granger caused by another variable X if current values of Y can be predicted with better accuracy by using past values of X. It can be seen that Granger's concept of causality does not imply an "event-outcome" relationship, but rather is based on predictability. In other words, the finding that X Granger causes Y implies that X has significant incremental predictive power in the evolution of Y.

Many tests of Granger-type causality have been derived and implemented, including Granger (1969), Sims (1972), and Geweke, Meese and Dent (1983), to test the direction of causality between variables of interest of the researcher(s). Notable studies, for example in the area of education and economic growth, are De Meulemeester and Rocha (1995) investigating the causality between higher education and economic growth in six highly developed countries and Magali (2004) examining the causality between higher education and growth in France and Germany before the Second World War among others. Guilkey and Salemi (1982) have examined the finite sample properties of these common causality tests and suggested that the Granger-type tests should be used in preference to the others.

There are four different potential results from a bivariate Granger causality test:

i. Lagged X terms (in a regression of Y on lagged values of Y and X) may be statistically different from zero as a group and the lagged Y terms are not statistically different from zero. Hence here we have X Granger causing Y.

ii. Lagged Y terms (in a regression of X on lagged values of Y and X) may be statistically different from zero as a group and the lagged X terms are not statistically different from zero. Hence here we have Y Granger causing X.

iii. Both sets of X and Y terms are statistically different from zero (in the two regressions outlined above) and so we have bi-directional causality.

iv. Both sets of X and Y terms are not statistically different from zero (in the two regressions outlined above) and so X and Y are independent of each other.

There are three ways for the application of Granger causality tests (Oxley and Greasley, 1998).The first stage involves testing for the order of integration, with the data defined as the logarithm of the levels of the variables, using the Augmented Dickey Fuller (ADF) statistic. The second stage is conditional on the outcome of the first stage tests, and it involves investigating bivariate cointegration utilizing the Johansen's (1988, 1991) maximum likelihood approach. If bivariate cointegration exists then either unidirectional or bidirectional Granger causality must also exist, although in finite samples there is no guarantee that the tests will identify it. Then on the basis of the bivariate cointegration results a multivariate model of cointegration may be investigated to examine interaction effects, taking the error term from this cointegrating regression as a measure of the error correction term (ECM) to capture the short run dynamics of the model. The third stage (or second if bivariate cointegration is rejected), involves constructing standard Granger-type causality tests, augmented where appropriate with a lagged error-correction term.

The three-stage procedure leads to three alternative approaches for testing causality. In the case of cointegrated data Granger causality tests may use the I (1) data because of the superconsistency properties of estimation. With two variables X and Y the test specification are:

$$X_t = a + \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{j=1}^{n} \beta_j Y_{t-j} + u_t \qquad (6)$$

$$Y_t = b + \sum_{i=1}^{q} \lambda_i Y_{t-i} + \sum_{j=1}^{r} \theta_j X_{t-j} + v_t \qquad (7)$$

where u_t and v_t are zero-mean, serially uncorrelated, random disturbances and the lag lengths m, n, q and r are assigned on the basis of minimizing Akaike's Final prediction Error (FPE).

Secondly Granger causality tests with cointegrated variables may utilize the I (0) data, including an error-correction mechanism (ECM) term. Christiano and Ljungquist (1988) pointed out that if the variables are co-integrated, a vector autoregressive (VAR) model in differences is misspecified. Under this case, the vector error correction (VEC) model suggested by Engle and Granger (1987) is the appropriate choice. In other words, if the time series appear to be cointegrated, causality has to be investigated within the framework of an error correction model as specified in equations 8 and 9.

$$\Delta X_t = a + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j} + \psi\, ECM_{t-1} + u_t \qquad (8)$$

$$\Delta Y_t = b + \sum_{i=1}^{q} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{r} \theta_j \Delta X_{t-j} + \pi\, ECM_{t-1} + v_t \qquad (9)$$

where ECM is the error-correction mechanism term.

The one period lagged value of the error term ECM_{t-1} is the estimated error of the cointegrating regression obtained from ordinary least squares (OLS) estimation. The logic behind this model is that generally a long-run equilibrium relationship between two economic variables exists. But, in the short run there can be disequilibrium. Therefore, the error correction mechanism corrects a proportion of disequilibrium in the next period, that is, the ECM links short-run variations of the series to the disequilibrium error (i.e., the gap between actual behaviour and the long-run relationship given by the cointegrating vector). Hence, the error correction process is an instrument of reconciling short-run and long-run behavior. In the error correction models 8 and 9, coefficients $\alpha_i, \lambda_i, \beta_i$ and θ_i are the short-run dynamic coefficients, and ψ and π are the long-run coefficient; u_t and v_t are white-noise residuals. The absolute value of ψ determines how quickly the equilibrium is restored.

Thirdly if the data are integrated of order one, I (1), but not cointegrated valid Granger-type tests require transformations of the time series to generate stationarity. This means in the absence of cointegration, a vector autoregression (VAR) needs to be constructed using first differences of the variables. In this case ECM term is excluded from the specification of equations (8) and (9), and the tests employ formulations as of equations (10) and (11) without the ECM term:

$$\Delta X_t = a + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-j} + u_t \quad (10)$$

$$\Delta Y_t = b + \sum_{i=1}^{q} \lambda_i \Delta Y_{t-i} + \sum_{j=1}^{r} \theta_j \Delta X_{t-j} + v_t \quad (11)$$

Thus if the level values of the variables are not stationary, the Granger causality test is based on the estimation of dynamic relationships between first differentiated variables. In identifying the causal relationship, the t-statistics explains the existence of long-run causality, while the significance of F-statistic indicates the presence of short-run causality.

With optimum lag lengths determined on the basis of minimizing Akaike's Final prediction Error (FPE), the hypotheses of Granger causality tests based upon equations 6 and 7 involve the following:

Y Granger causes X if the null hypothesis, $H_0 : \beta_1 = \beta_2 = \beta_3 = ... \beta_n = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\beta_j \neq 0$, $j = 1,2,.., n$.

X Granger causes Y if the null hypothesis, $H_0 : \theta_1 = \theta_2 = \theta_3 = ... \theta_r = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\theta_j \neq 0$, $j = 1,2,.., r$.

For equations 8 and 9 Granger causality tests involve the following:

ΔY Granger causes ΔX if the null hypothesis, $H_0 : \beta_1 = \beta_2 = \beta_3 = ... \beta_n = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\beta_j \neq 0$, $j = 1,2,.., n$, or $\psi \neq 0$ (See Granger, 1986).

ΔX Granger causes ΔY if the null hypothesis, $H_0 : \theta_1 = \theta_2 = \theta_3 = ... \theta_r = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\theta_j \neq 0$, $j = 1,2,.., r$, or $\pi \neq 0$ (See Granger, 1986).

In this case, however, we have to note that as there is the possibility of inferring causality from the significance of ψ or π alone the causal nexus is altered, that is, causality runs from the past *level* to the current rate *change* without any lagged change effects.

Finally for non-cointegrated data, Granger causality tests, based upon equations 10 and 11 in particular, involve the following:

ΔY Granger causes ΔX, if the null hypothesis, $H_0 : \beta_1 = \beta_2 = \beta_3 = \ldots \beta_n = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\beta_j \neq 0$, $j = 1,2,.., n$.

ΔX Granger causes ΔY if the null hypothesis, $H_0 : \theta_1 = \theta_2 = \theta_3 = \ldots \theta_r = 0$ is rejected against the alternative hypothesis $H_1 :=$ at least one $\theta_j \neq 0$, $j = 1,2,.., r$.

EMPIRICAL RESULTS AND DISCUSSION

The empirical results are discussed under the sub-headings unit root, cointegration and causality.

Unit Root Test Results

The results of Dickey-Fuller unit root test for the variable enrollment in higher education in Nepal is given in Table 1.The variable 'lnENRLH' is the natural logarithms of enrollment in higher education and 'dlnENRLH' is the change in or the growth rate of enrollment in higher education.

Table 1: Unit Root Test of Series Enrollment in Higher Education in Nepal

Variable and Status	Constant	Trend	Lag length	τ-statistic	Test Critical Values
Level : lnENRLH	Yes	Yes	0	-1.966148 (0.5983)*	1% : -4.252879 5% : -3.548490 10%: -3.207094
Level : lnENRLH	Yes	Yes	1	-1.773787 (0.6945)*	1% : -4.262735 5% : -3.552973 10%: -3.209642
First difference: dlnENRLH	No	No	0	-5.805992 (0.000)*	1% : -2.636901 5% : -1.951332 10%: -1.610747
First difference: dlnENRLH	No	No	1	-2.522101 (0.0134)*	1% : -2.636901 5% : -1.951332 10%: -1.610747

Note: *indicates MacKinnon (1996) one-sided p-values.

The unit root test of the level values of the variable 'lnENRLH' indicates that the variable is non-stationary; it contains unit root; the variable does not possess a constant mean and covariance over time. The computed tau (τ)-statistic of the variable lnENRLH with no lag is "-1.966148" which in absolute term is less than the test critical values (-4.252879, -3.548490 and -3.207094) at the conventional level of significance.

The unit root test of the first differenced values of the enrollment variable 'dlnENRLH' indicates that the variable is stationary; it is integrated of order one, I (1).The computed tau (τ)-statistic of the variable dlnENRLH with no lag is "-5.805992" and with one period lag is "-2.522101".As the computed tau-static is more negative than the test critical values the variable is stationary in the growth rates (i.e., in first difference).

The Dickey-Fuller unit root test of the variable teachers in schools in Nepal is given in Table 2.The variable 'lnTECH' is the natural logarithms of total teachers working in the lower secondary and secondary schools of Nepal and 'dlnTECH' is the change in or the growth rate of teachers in schools.

Table 2: Unit Root Test of Teachers in Schools in Nepal

Variable and Status	Constant	Trend	Lag length	τ-statistic	Test Critical Values
Level : lnTECH	Yes	Yes	0	-2.797269 (0.2079)*	1% : -4.252879 5% : -3.548490 10%: -3.207094
Level : lnTECH	Yes	Yes	1	-3.215241 (0.0989)*	1% : -4.262735 5% : -3.552973 10%: -3.209642
First difference: dlnTECH	No	No	0	-3.895207 (0.003)*	1% : -2.636901 5% : -1.951332 10%: -1.610747
First difference: dlnENRLH	No	No	1	-2.324619 (0.0216)*	1% : -2.639210 5% : -1.951687 10%: -1.610575

Note: *indicates MacKinnon (1996) one-sided p-values.

The unit root test result indicates that the variable school teacher contains a unit root with or without one lag. It is of integrated of order one, I (1) as the first difference of this variable exhibits its stationarity property.

The results of Dickey-Fuller unit root test for the variable real GDP of Nepal for the period 1975-2009 is given in Table 3.The variable 'lnRGDP' is the natural logarithm of the real GDP of Nepal and 'dlnRGDP' is the change in or growth rate of real GDP.

Table 3: Unit Root Test of Series Real GDP of Nepal

Variable and Status	Constant	Trend	Lag length	t-statistic	Test Critical Values
Level : lnRGDP	Yes	Yes	0	-2.582841 (0.2899)*	1% : -4.252879 5% : -3.548490 10%: -3.207094
Level : lnRGDP	Yes	Yes	1	-2.186626 (0.4810)*	1% : -4.262735 5% : -3.552973 10%: -3.29642
First difference: dlnRGDP	No	No	0	-2.979187 (0.0041)*	1% : -2.636901 5% : -1.951332 10%: -1.610747
First difference: dlnRGDP	No	No	1	-1.666829 (0.0897)*	1% : -2.639210 5% : -1.951687 10%: -1.610579

Note: * indicates MacKinnon (1996) one-sided p-values.

The unit root test of the level values of the variable 'lnRGDP' indicates that the variable is non-stationary; it contains unit root; the variable does not possess a constant mean and covariance. The computed tau (τ)-statistic of the variable lnRGDP with one lag is "-2.186626" which in absolute term is less than the test critical values (-4.262735, -3.552973, and -3.29642) at the conventional levels of significance.

The unit root test of the first differenced values of the real GDP variable 'dlnRGDP' indicates that the variable is stationary; it is integrated of order one, I (1).The computed tau (τ)-statistic of the variable dlnRGDP with no lag is "-2.979187" and with one period lag it is "-1.666829".As the computed tau-static is more negative than the test critical values the variable is stationary in the growth rates (i.e., in first difference).

Johansen's Cointegration Test Result

The Johansen's cointegration test investigating the long run equilibrium relation between enrollment in higher education in Nepal and real GDP of the country is given in Tables 4 and 5.Table 4 exhibits the Eigenvalue test and Table 5 displays the results relating to maximum Eigenvalue test.

Table 4: Johansen Cointegration Test between GDP and Higher Level Enrollment: Trace Test

Hypothesized No of CE(s)	Eigen value	Trace-Stat.	5% Critical Value	1 % Critical Value
None	0.227352	9.794715	15.41	20.04
At most one	0.038132	1.282968	3.76	6.65

Table 5: Johansen Cointegration Test between GDP and Higher Level Enrollment: Maximum Eigenvalue Test

Hypothesized No of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	1 % Critical Value
None	0.227352	8.5111747	14.07	18.63
At most one	0.038132	1.282968	3.76	6.65

As the computed trace test statistics of Table 4 and maximum eigenvalue statistics of Table 5 are less than the 5 % and 1 % critical values, the variables do no not possess the property of long run cointegration. This indicates the possibility of spurious correlation between enrollment in higher education and real GDP of Nepal.

Johansen's cointegration result between GDP and school teachers in given in Tables 6 and 7.

Table 6: Johansen Cointegration Test between GDP and School Teachers: Trace Test

Hypothesized No of CE(s)	Eigenvalue	Trace-Stat.	5% Critical Value	1 % Critical Value
None	0.316645	16.99598	25.32	30.45
At most one	0.125652	4.431126	12.25	16.25

Table 7: Johansen Cointegration Test between GDP and School Teachers: Maximum Eigenvalue Test

Hypothesized No of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	1 % Critical Value
None	0.316645	12.56445	18.96	23.65
At most one	0.125652	4.431126	12.25	16.26

Johansen's cointegration test between real GDP and school teachers indicates no cointegration between these two variables. As the computed trace test statistics of Table 6 and maximum eigenvalue statistics of Table 7 are less than the 5 % and 1 % critical values, the variables do no not possess the property of long run cointegration. This indicates the possibility of spurious correlation between teachers employed in lower secondary and secondary level schools and real GDP of Nepal.

Granger Causality (GC) Test Result

The Johansen's cointegration test indicated that enrollment in higher education in Nepal and real GDP of the country over the period 1975-2009 do not exhibit cointegrated relationship. Hence the Granger causality test is performed on the first difference of the data. The results are given in Table 8.

Table 8: Granger Causality Test: Enrollment in Higher Education and Real GDP

Null Hypothesis	Lags	Obs.	F-stat.	Prob.
dlnRGDP does not Granger cause dlnENRLH	1	33	7.17976	0.01185
dlnENRLH does not Granger cause dlnRGDP			2.88201	0.09993
dlnRGDP does not Granger cause dlnENRLH	2	32	7.25404	0.00301
dlnENRLH does not Granger cause dlnRGDP			0.72113	0.49533
dlnRGDP does not Granger cause dlnENRLH	3	31	8.00196	0.00072
dlnENRLH does not Granger cause dlnRGDP			0.66026	0.58454

The Granger causality (GC) test provides the statistical evidence that causality clearly runs from real GDP to enrollment in higher education (dlnRGDP Granger cause dlnENRLH) and it does not run the other way round (dlnENRLH does not Granger cause dlnRGDP). As the F-statistic with one, two or three period lag(s) is significant we reject the null hypothesis that real GDP does not Granger cause enrollment in higher education; we accept the alternate hypothesis that the level of economic development proxied by the level of real GDP enables people to pursue higher education. Higher education needs financing; increase in real GDP increase people's real income and makes them able to enroll in higher education. Even if there is evidence of Granger causality link from enrollment in higher education to real GDP with one period lag, F-statistics is insignificant with the increase in the order of lag. The suggestion is that level of real GDP Granger causes enrollment in higher education in Nepal.

Teachers working in the lower secondary and secondary schools represent the labour force employed in the education sectors. Johansen's cointegration test between real GDP per capita and school teachers showed no cointegration and the Granger causality test is performed on the first difference of the variables .The results are given in Table 9.

Table 9: Granger Causality Test: School Teachers and Real GDP

Null Hypothesis	Lags	Obs.	F-stat.	Prob.
dlnTECH does not GC dlnRGDP	1	33	0.00364	0.95227
dlnRGDP does not GC dlnTECH			0.00142	0.97023
dlnTECH does not GC dlnRGDP	2	32	0.01266	0.98742
dlnRGDP does not GC dlnTECH			0.00504	0.99498
dlnTECH does not GC dlnRGDP	3	31	0.01125	0.99832
dlnRGDP does not GC dlnTECH			0.39730	0.75613

The Granger causality (GC) test provides no statistical evidence on the causality between real GDP and employment in schools represented by lower secondary and secondary schools of Nepal. The causality runs neither from real GDP to schools teachers nor from school teachers to real GDP. As the F-statistic with one, two or three period lag(s) is low and statistically insignificant we accept the null hypothesis that school teachers does not Granger cause real GDP and the hypothesis that real GDP does not Granger cause teachers employment in schools. In the language of Granger's causality test this means that the relation between real GDP and school teachers is neutral; they do not influence each other.

Possible Explanation for the Absence of Cointegration

The findings of the this study on no cointegration between enrollment in higher education in Nepal and real GDP of the country are similar to the findings of De Meulemeester and Rochat (1995) in the case of Italy (1885-1986) and Australia (1906-1986). De Meulemeester and Rochat (1995) remarked that the absence of cointegration suggested the absence of a long-run stable linear relationship between per capita real GDP and higher education in those countries for the period under the study. Intuitively this result seemed to be consistent with the hypothesis of screening or credentialism which claims that higher education signals preexisting higher productivity and/or helps in sorting out individuals and hence facilitates the production process in the short run by reducing the costs of search. But it does not add anything to individuals in terms of labour productivity and its contribution to development might be weak. In the long run, on-the-job training might well be more important (Arrow, 1962). Even if education increases individual productivity as pointed out by human capital theorists, it requires that the human capital accumulated by elders has to be at least partially handed down to the next generations in order to obtain any macroeconomic effect of growth. The absence of causality in the Italian and Australian cases implied that the relationship between higher education and economic development is not linearly mechanized. One of the suggestions is that education can promote growth only if its content (the curriculum) is designed towards such an objective. Second, it is also very important that both the social, political and economic structures and the technological level of the society to which the educational system belongs should be suitable for graduates to make use of their accumulated knowledge. It would not be wrong to relate this explanation in the context of Nepal too. Nepal's higher education to a large extent is more theory laden and less equipped with practical and skill based character.

Neo-institutionalists like North (as cited in De Meulemeester and Rochat, 1995, p.556) view that educational and occupational choices may be influenced by the incentives structure created by the institutional framework. Depending on the relative balance or imbalance between these choices, higher education can or cannot promote growth. Intuitively, each field taught at university level might be favourable to growth provided that it is not "over-supplied" in relation to the socioeconomic needs of the nation. Additionally, qualitative elements like the reluctance of economic decision-makers in relation to formal knowledge may help in explaining differences in terms of the contribution of higher education to growth between countries whose quantitative developments are of similar magnitude. Fox and Guagnini (as cited in De Meulemeester and Rochat, 1995) suggested that the Italian efforts towards engineering might have oversupplied in comparison with the state of their technological and economic development during period 1885-1986. An educational system has to be designed in accordance with the actual needs of the economy. An economic and technological threshold has to be attained before the development of higher education can promote economic development. When resources are scarce, over-expansion of the educational system or some of its components (i.e., higher education *versus* primary education in less developed countries) can be adverse to growth.

De Meulemeester and Rochat (1995, p.556) on the non-causality relation of higher education to economic growth in the Australian case, have pointed out that Australia was among the eight richest countries in the world before World War I although it was an exporter of primary goods and raw materials. Such a path of development did not require a highly educated manpower as in an industry-based development. This element might be the reason for the lack of causality between higher education and growth in less industrialized countries such as Australia. However, this concept of threshold should be relatively more educational than economic. Analysts have emphasized on the basic need of some minimum level of educational attainment for a certain section of the population if an economy is to progress. This argument has been developed formally by Azariadis and Drazen (1990). Introducing a concept of "threshold externalities" in the accumulation of human capital, they showed that sustainable differences in *per capita* growth rates could emerge even among economies with identical structures (i.e., within similar social institutions). Nepal is a predominantly an agricultural economy and it lacks sufficient opportunity to absorb the manpower with tertiary level of education. Moreover people with higher education degree have a growing tendency of looking for "white collar job" as opposed to "blue-collar job". As Nepal's industrial sector is very small and hardly marginally growing the market for increasing number of higher education graduates is small.

Teachers' job in schools of Nepal is a white collar job. Scholars have argued that allocation of educated talents have great impact in economic growth. Analyzing the impact of the allocation of educated talents Murphy, Shleifer and Vishny (1991) have concluded that a country's most talented people typically organize production by others, so they can spread their ability advantage over a larger scale. When they start firms, they innovate and foster growth, but when they become rent seekers, they only redistribute wealth and reduce growth. Occupational choice depends on returns to ability and to scale in each sector, on market size, and on compensation contracts. In most countries, rent seeking rewards talent more than entrepreneurship does, leading to stagnation. They found that countries with a higher proportion of engineering college majors grow faster; whereas countries with a higher proportion of law concentrators grow more slowly. Hvide (2003) also analyzed the implication of the "Allocation of Talent" for economic growth of nations. This study focuses on two forces. First, education adds to a worker's information capital and, thus, may change his/her self-confidence. Second, performance contracts give a worker incentive to choose a sector according to his/her abilities. When workforce with particular level of education is over or under supplied in the economy, it will have no impact in output growth. Even if teachers working in lower secondary and secondary schools of Nepal are part of the employed labour force, they are not entrepreneurs and they do not directly produce machines, equipments and innovate technology applicable to increase production of physical products.

CONCLUSION

The relation between higher education and economic development is definitely not straight forward and hence it deserves further inquiry both on theoretical and empirical grounds with ideally supported by other approaches which take into account more sociological, institutional and/or curriculum related aspects. Lee and Psacharopoulos (1979) and Benavot (1991) have argued that the quality of education may be as contributive as the quantity of education to the economic strength of nations. Has the time come to reassess the modality of imparting higher education in Nepal? Is it being over or under supplied? Is there mismatch between higher education quality and needs of the economy? There is the need to make Nepalese higher education more practical than a theoretical; labour force with theory laden formal higher education credential cannot contribute more to economic growth. The time has come to revisit the syllabus and teaching-learning modalities. Theoretical learning should be assisted by data and case studies; acquiring an educational degree through rote learning would contribute less in real life situations. Nepalese higher education should be made globally competitive by improving its quality and by making it oriented to more skill-learning so that it would contribute significantly in productivity increase of the economy.

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