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Human Capital and Poverty Lessening of Nepal: Vector Error Correction Model

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Abstract

Human capital is widely recognized as the fundamental basis for a nation's ability to maintain a high standard of living. This paper aims to evaluate Nepal's human capital and its impact on poverty reduction. The study utilizes time series data spanning from 1990 to 2021. To achieve the objectives of this research, the Johansen cointegration, vector error correction model (VECM), and Granger causality methods are employed. The overall findings reveal that human capital formation is particularly effective and significant in reducing poverty in Nepal in the short term. There is strong evidence indicating that investing in health is crucial for sustainable poverty reduction. However, education spending appears to have only a temporary effect on poverty alleviation in Nepal. Additionally, education demonstrates a positive association with gross fixed capital formation, employment, gross enrollment, and HDI, but not with health spending. It's important to note that this study covers a limited observation period of 32 years, and proxies for variables such as poverty reduction and human capital are constrained. Nevertheless, this research contributes by employing updated time-series data and aims to address the literature gap regarding the relationship between human capital and poverty reduction in Nepal. To effectively combat poverty in Nepal, the government should need to finance healthcare and education. Simultaneously, a policy emphasizing investment in both education and healthcare should be implemented, as this will contribute to fixed capital formation and enhance the quality of life through employment and income generation.

Keywords: human capital, poverty, health, education, VECM

JEL classification: C32, E24, I22, I32, J24

Paper type: Research paper

Introduction

Worldwide prolonged poverty and low level of human capital development are ongoing debatable issues in the economy. Poverty reduction is the primary goal of the economic planning and government. To World Bank (2018), as the world experiences rapid technological advancement and change, more and better investments in people are needed. Along with raising incomes, promoting sustainable growth, and lowering poverty, these investments are beneficial on their own. From a macroeconomic standpoint, the development of human capital boosts labor productivity, encourages technological advancements, raises returns on investment, and makes growth more sustainable, all of which contribute to the fight against poverty (Son, 2010).

The twentieth century can even be referred to as the Age of Human Capital in the sense that a nation's level of living is largely determined by how successfully it develops and makes use of its population's skills, knowledge, health, and habits (Becker, 1995). Todaro and Smith (2012) state that human capital refers to the productive investments made in human beings, such as their skills, abilities, ideals, health, and locations, frequently as a result of financial investments in education, on-the-job training, and healthcare. Human capital encompasses education, health, and aspects of social capital (Barro, 2013a).

Education generally raises people's skill and, in turn, their incomes. According to this viewpoint, which is known as the human capital view, investing in people is akin to investing in capital. Increased production results from higher investments (Stiglitz and Rosengard, 2015). The human capital approach unifies the study of investments in health and education. Education, health, and other human capabilities that can boost production are together referred to as human capital by economists. In that sense, well-being is directly influenced by both health and education (Todaro and Smith, 2012). Thus, poverty can be reduced if there is an adequate level of financing for education and health. By being educated, a person can increase their income and contribute to the economy (Sen, 1999). Classical models of capital can encompass human capital in the form of education, health, and experience in addition to expanded physical capital. As a result, human capital is a source of economic development and thus contributes to poverty reduction (Lucas, 1988).

Barro (2013a) investigated the panel data of 100 countries covering 1960 to 1995 and he found that there is a positive relationship between education (secondary and higher levels' average years of school attainment of adult males other than females) with economic growth. This study indicated that well-educated women are not fully utilized in the economy of many countries. Similarly, to Barro (2013b), an increase in health increases a worker's productivity for given labor hours, physical capital, worker education, and experience. The effective rate of depreciation on human capital, which includes education and health itself, falls when mortality and disease rates are reduced in addition to this direct effect. By increasing demand for human

capital through this channel, an improvement in health indirectly boosts productivity in other ways. Thus, investment in education and health enhances the productivity of labor forces thereby its income, standard of living, and high-earning opportunities which ultimately helped to cube the poverty trap of the economy.

In Nepal, poverty is far more pervasive, severe, and acute in rural areas where it occurs at a rate of 44% compared to 23% in urban areas (ADB, 2002). In 2019, 17.4% of Nepalis—roughly five million people—are multidimensionally poor, and the MPI is 0.074. According to all variables combined, the greatest number of people lack adequate accommodation, clean cooking fuel, years of education, assets, and nutrition. According to the indicator weights, years of education and nutritional deprivation are the main causes of Nepal's persistent multidimensional poverty (NPC, 2021). With the Human Development Index (HDI) now at 0.579 and a life expectancy of 70 years, the plan's objectives are to raise these indicators (NPC, 2020). GNI per capita (at current price) is estimated to have increased by 10.8 percent to US $ 1381 for the fiscal year 2021/22 which was US$ 1246 in the year 2020/21 (MoF, 2022).

Wagle (2008) concluded that the nation is being dragged deeper into a cycle of poverty as a result of this drain on resources, both financial and human. The continued flight of human capital and immediate action in the educational system can both significantly aid development efforts. To escape the poverty cycle, Nepal must assess the development models and methods it previously used and make necessary corrections. To keep the skilled labor here, the educational system must first be reformed.

Research Problems

Poverty stands as an enduring plague upon human civilization, causing widespread suffering and hardship. However, human capital offers a potential solution to alleviate this issue. It is important to note that human capital cannot fully develop in an environment of poverty, although it can persist to some extent. Unfortunately, Nepal currently faces weak human capital development. Investing in human capital, particularly in the domains of health and education, yields numerous benefits such as improved life outcomes, elevated work standards, increased productivity, enhanced job opportunities, and a rise in income that is sufficient to combat poverty. Regrettably, there is a dearth of research specifically examining the relationship between human capital and poverty alleviation in Nepal. Nevertheless, this study aims to address this knowledge gap through a compassionate approach and draws inferences from the following research questions.

RQ 1. Does human capital have a long-term and short-term impact on poverty lessening in Nepal?

RQ 2. Is there a causal connection between human capital and a decline in poverty in Nepal?

Research Objectives

The main objective of this study is to examine the relationship between poverty and human capital, operating under the assumption that enhancing human capital is crucial in alleviating poverty. Additionally, this study seeks to investigate the causal connection between human capital and poverty reduction specifically within the context of Nepal.

The Rationale of the Study

Theoretical analysis in the field of economics has long supported the notion that human capital plays a significant role in poverty reduction. These ideas serve as the theoretical foundation for this study. Human capital is regarded as the driving force behind community prosperity. With this belief in mind, this study aims to explore the relationship between human capital and poverty reduction. By addressing this research gap in the literature, this study can provide valuable insights for policymakers, government stakeholders, and scholars seeking to understand the interconnection between human capital and poverty, particularly within the context of Nepal.

Research Limitations

The study incorporates time series data exclusively from the years 1990 to 2021. Only a few numerical measures of poverty are covered. It does not support constructive viewpoints in this area. Although poverty is a multifaceted and relative notion, this research only considers per capita income as a proxy for poverty. As a result, having only one gauge to measure poverty is insufficient. However, human capital is a very crucial component, however, we assess the relationship between human capital and poverty by using some health and educational criteria.

To infer a conclusion, the rest of the paper broadly divides into four sections other than the introduction including methods and materials, a brief literature review, results and discussion, and conclusion and implication.

Brief Literature Review

Adam Smith introduced the study of human capital in 1776. Although he does not use the term 'human capital', he recognizes that the acquired and utilized skills of individuals are a crucial component of a nation's wealth and economic development (Eide and Showalter, 2010). In 1890, Alfred Marshall makes note of the family's role in making long-term investments in human capital (Eide and Showalter, 2010). As a result of investment in education, Shultz (1960) argues, labor productivity has increased.

According to the endogenous growth hypothesis, national policies on the investment of human capital are crucial to the advancement of the economy, and thereby obviously, it leads to improving human life and freeing from the poverty trap. An empirical study by Gruzine, Firsova, and Strielkowski, (2021) concluded that by encouraging new technologies, providing

many people with chances for personal growth, creating a lot of new jobs, and greatly raising productivity and incomes, it helped to generate human capital by learning from the historical experience of four industrial revolutions. Using pooled mean group (PMG) predictor, Moyo, Mishi, and Ncwadi (2022) reported that poverty levels decrease as human capital levels rise. Human capital, on the other hand, has a positive correlation with income inequality, which is a sign of unequal access to economic opportunities and the educational system.

An empirical study of Ethiopia and Peru provided crucial proof that to promote human development and, thus, eradicate poverty, it is essential to design and carry out health and cognition interventions that take into account their intricate relationships over childhood (Attanasio, Meghir, Nix, and Salvati, 2017). Olopade, Okodua, Oladosun, and Asaleye (2019) employed a panel fully modified least-squares cross-country analysis of 12 OPEC member nations and the study found that long-term progress in reducing poverty in OPEC member nations is influenced by the interactions between the many aspects of human capital development.

Education and health are crucial to human capital formation and poverty reduction through productivity and income mechanism. Dangal and Gajurel (2022) reported that higher education will affirm to boost the productivity of human capital in Nepal and also it should promote economic growth thereby reducing poverty. Adekoya (2018) employed VECM and Granger causality and revealed that government health spending and gross enrollment rate of Nigeria have a favorable long-term association with per capita income which was proxied as poverty. It has been discovered that access to health and education helps to reduce poverty in the economy. The idea is that giving individuals education, training, and skills empowers them. The productivity and income of the workforce both grow with better human resources. Thus, human capital can contribute to lessening the intensity of multidimensional poverty (Sharafat and Ahmad, 2013).

A study by Josephine, Francis, Anlimachie, and Avoada (2021) used data from 2010–2018 which included data on 140 nations. The study revealed that economic growth had a negative impact on poverty while having a positive impact on human capital by comparing data from Africa, Europe, and Asia. The study suggests that investing in free universal pre-tertiary education as a way to fight poverty is important for ensuring sustainable global futures. In their study, Bhukuth, Roumane, and Terrany (2018) found that a household's wealth and consumption were influenced by the amount of human capital they had which is crucial to combat poverty.

An empirical study of poverty status in the USA was conducted after controlling for the direct effects of three dimensions of human capital (education, training, and health), as well as gender, race, and underemployment. As a result of this study, it was found that all of these proxies of human capital have positive effects on poverty reduction (Hong and Pandey, 2007).

It was suggested by Santos (2011) that policies aimed at reducing inequalities would reduce inequality in the long run by equalizing the quality of education. Behrman (2011) examines the relationship between various human capital initiatives aimed at reducing poverty and how improved living conditions for those in poverty on the left tail are likely to lead to a reduction in poverty rates. According to this study, schooling attainment increases have a significant impact on poverty and inequality reduction if they are targeted well.

Methods and Materials

Data and Its Sources

This study is intended to evaluate whether there is any evidence that human capital can retard the poverty situation in Nepal. For that, poverty is proxied by gross national income per capita. Similarly, health and educational financing by the government, gross enrollment at the secondary level, and human development index are proxied for human capital as explanatory variables, then employment and gross fixed capital formation are taken as control variables. Data under study over the period of 1990 to 2021 is exacted from world development indicators (WDI), the economy survey published by the Ministry of Finance (MoF), and the United Nations Development Programme (UNDP). Missing data are interpolated and transformed in logarithmic form. A description of variables of interest has presented in Table 1.

Table 1

Description of Variables of Interest

Proxies	Description	Unit of measurement	Source
PCI	Gross national income per capita	Local currency unit, current	WDI
HDI	Human development index	0-1 Index	UNDP
Health	Government expenditure on health	Rupees in crore	MoF
Edu	Government expenditure on education	Rupees in crore	MoF
Enrol	School enrollment, secondary (% gross)	% gross	WDI
Emp	Employment to population ratio, 15+ (modelled ILO estimate)	total (%)	WDI
GFCF	Gross fixed capital formation	Local currency unit, current	WDI

Note. WDI = World development index, UNDP = United Nations development programme, MoF = Ministry of Finance

Model Specification and Research Process

To evaluate the human capital as crucial to poverty lessening, this study applied the cointegration and vector error correction model (VECM) and then the causality model. This paper adopts the two model specifications for human capital and poverty lessening nexus. The model specification can be illustrated as follows:

$LnPCI_t = \Gamma_0 + \Gamma_1 LnHealth_t + \Gamma_2 LnEdu_t + \Gamma_3 LnEnroll_t + \Gamma_4 LnHDI_t + \Gamma_5 LnEmp_t + \Gamma_6 LnGFCF_t + \varepsilon_t$ ...(1)

All the variables of these models are transformed in logarithmic form and proxies as stated in Table 1. To estimate these equations, this study employed the unit root test, cointegration test, VECM, and Granger causality.

Unit Root Test

The test of stationarity is a prerequisite for assessing cointegration and causal relationships between time series variables. It discovers if any spurious or misleading relationship exists between them. The generally used methods to test the existence of unit roots are Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The following equation can be used to perform the ADF test for the null hypothesis that a time series has a unit root:

$$\Delta y_t = \beta_0 + \beta_1 t + \rho y_{t-1} + \gamma_1 \Delta y_{t-1} + \gamma_2 \Delta y_{t-2} + \ldots\ldots + \gamma_i \Delta y_{t-i} + \varepsilon_t$$

That is, $$\Delta y_t = \beta' D_t + \rho y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \varepsilon_t$$

where, y_t is the variable of interest such as PCI, HDI, Health, Edu, Enroll, Emp, GFCF; D_t is deterministic terms; ε_t is pure white noise error term, and k is the lag length and the optimal lag length. To determine whether the time series under test are stationary, the null hypothesis for the unit root is $\rho = 1$, while the alternative hypothesis is $\rho<1$. With the same hypothesis, the PP test for stationarity of series with regression as

PP test: $\Delta Y_t = \beta' D_t + \rho Y_{t-1} + \varepsilon_t$

Test of Cointegration

The test of cointegration is to determine the plausible relationships among variables, under the hypothesis of a long-run equilibrium between non-stationary time series. As Granger (1986) notes, "A test for cointegration can be thought of as a pre-test to avoid 'spurious regression' situations" (p.226). Johansen and Juselius (1990) provide a model to evaluate the cointegration among variables. Both the maximum eigenvalue test and the trace test are terms used to describe the Johansen tests. The initial Johansen test compares the alternative hypothesis of cointegration between variables to the null hypothesis (r = 0) that there is no cointegration. More generally, the φ_{trace} is a joint test where the null hypothesis is r = 0 against the alternative hypothesis against r > 0 and φ_{max} is a test on each eigenvalue where the null hypothesis, r = 0, that the number of cointegrating vectors is *r* against an alternative hypothesis, r = 1, of *r* + 1. These two test statistics are:

$$\varphi_{trace}(r) = -T \sum_{i=1}^{k} ln(1 - \hat{\varphi}_i)$$

and $$\varphi_{max}(r, r+1) = -T\, ln(1 - \hat{\varphi}_{r+1})$$

where *r* is the number of cointegrating vectors under the null hypothesis, k is the number of lagged terms, T is the number of usable observations, and $\hat{\varphi}_i$ is the estimated *i*th ordered eigenvalue from the matrix. Naturally, the larger is $\hat{\varphi}_i$, the more large and negative will be $ln(1 - \hat{\varphi}_i)$, and consequently, the test statistic will be higher. The test of cointegration evaluates the presence of cointegration between variables of interest. If there is cointegration between variables of interest, then we estimate the VECM model otherwise VAR model will be employed.

VECM Model

Variables are referred to as cointegrated by Granger (1981) and Engle & Granger (1987) if they share a stochastic trend. The VAR form is not the most practical model when cointegrating relations are included in a system of variables. If this is the case, specific parameterizations are necessary to support the analysis of the cointegration structure. The most suitable solution to this problem is to use Vector error correction models (VECMs) (Lütkepohl and Krätzig, 2004). Generally, the vector error correction model (VECM) can be expressed as

$$\Delta Y_t = \Gamma_0 + \Gamma_i \sum_{i=1}^{n} \Delta Y_{t-i} + \Gamma_j \sum_{j=1}^{n} \Delta X_{t-j} + \hat{\varphi} ECT_{t-1} + \varepsilon_t$$

Where, ΔY_t = first difference of dependent variable at period t

ΔY_{t-i} = first difference of dependent variable with i period lags

ΔX_{t-j} = first difference of explanatory variables with j period lags

$\hat{\varphi}$ = short run coefficient of the error correction term ($-1 < \varphi < 0$)

ECT_{t-1} = error correction term with one period lag

ε_t = white noise or error term

Based on this VECM model, the targeted equations under the study can be written as follows:

$$\Delta PCI_t = \Gamma_0 + \Gamma_1 \sum_{i=1}^{n} \Delta PCI_{t-i} + \Gamma_2 \sum_{i=1}^{n} \Delta Health_{t-i} + \Gamma_3 \sum_{i=1}^{n} \Delta Edu_{t-i} + \Gamma_4 \sum_{i=1}^{n} \Delta Enroll_{t-i} + \Gamma_5 \sum_{i=1}^{n} \Delta HDI_{t-i} + \Gamma_6 \sum_{i=1}^{n} \Delta Emp_{t-i} + \Gamma_7 \sum_{i=1}^{n} \Delta GFCF_{t-i} + \hat{\varphi} ECT_{t-1} + \varepsilon_t \quad \ldots\ldots (3)$$

Granger Causality Test

Granger (1969) has presented a causality concept that has become quite popular in the field of econometrics. Granger causality examines the causal relationship between two variables of interest in a data set of time series. It is a test for determining whether one variable

of time series is useful in forecasting another variable of series. The test is based on the following model:

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i Y_{t-i} + \sum_{j=1}^{k} \beta_j X_{t-j} + \varepsilon_t$$

where X and Y represent the variable of interest of the presented time series analysis. α_0 is the constant, ε_t is the white noise sequence, α_i and β_j are coefficients, and k is the number of lagged terms. For the Granger causality test, longer lagged in a certain limit will be preferable which shows the dynamic features of the model. It is based on the null hypothesis of the variable under considerations does not cause or Granger cause the other variable.

Results and Discussion

Descriptive Analysis

The nature and distribution of data are crucial to the econometric analysis of the proposed relationship. Table 2 summarises the overall descriptive statistics of sampled variables. There are 32 years of observation of GNI per capita having an average value of Rs. 46946.99. The standard deviation of PCI is Rs. 44750.04 and has maximum and minimum values of Rs. 144923.30 and Rs. 5489.27 respectively. The table also shows that the average government expenditure on education is greater than the expenditure on health as compared with 32 years of observation. The mean value of expenditure on health and education is Rs. 1415.16 crores and 2975.78 crores respectively and having a standard deviation of Rs. 1519.15 crores and Rs. 3012.05 crores respectively. The mean and standard deviation of gross secondary school enrollment were 51.62 percent and 15.31 percent. The average HDI of Nepal is 0.51 in all 31 observations. The maximum and minimum HDI for the entire period of observation is 0.61 and 0.40. The mean employment to population ratio (15 plus) is 82.22 percent. According to all 31 observations, a maximum of 84.44 percent of the economically active population is employed. The average and maximum value of gross fixed capital formation of 32 years of observation is Rs. 34500 crore and Rs. 130000 crores respectively and having a standard deviation of Rs. 41000 crores.

Table 2

Summary of Descriptive Statistics of Variables

Variables	Mean	Max.	Min.	Std. Dev.	Obs.
GNI per capita (LCU, current)	46946.99	144923.3	5489.27	44750.04	32
Govt. Health Spending (crore)	1415.16	4951.31	66.06	1519.15	32
Govt. Education Spending (crore)	2975.78	10859.01	179.95	3012.05	32
School enrollment, secondary (% gross)	51.62	85.52	32.99	15.31	31
Human Development Index (HDI)	0.51	0.61	0.4	0.07	32
Employment to population ratio, 15+ (%)	82.22	84.44	73.7	2.48	31
Gross fixed capital formation (crore)	34500	130000	1670	41000	32

Stationarity Test

The stationarity test is essential to apply the Johansen cointegration and VECM model. It assures the statistical robustness of the model which reduces the possibility of spurious relations between variables. Table 3 reports the unit root test results based on ADF and PP tests.

Table 3

Results of Unit Root Test

	At Level		At First Difference		
	With Constant	With Constant & Trend	With Constant	With Constant & Trend	Order of Integration
Unit Root Test Table (Augmented Dickey-Fuller: ADF)					
LnPCI	-0.29	-1.87	-3.55**	-3.48*	I(1)
LnHDI	-2.43	0.34	-3.18**	-3.58**	I(1)
LnHealth	-0.84	-1.85	-5.64***	-5.75***	I(1)
LnEdu	-2.25	-3.13	0.25	-0.31	
LnEnroll	0.13	-2.18	-3.78***	-3.84**	I(1)
LnEmp	2.90	-1.65	-1.58	-3.17	I(1)
LnGFCF	-1.1	-1.95	-3.81***	-3.71**	I(1)
Unit Root Test Table (Phillips-Perron: PP)					
LnPCI	-0.52	-1.67	-3.55**	-3.48*	I(1)
LnHDI	-2.09	-0.37	-3.18**	-3.58**	I(1)
LnHealth	-0.85	-2.03	-5.63***	-5.75***	I(1)
LnEdu	-2.11	-3.09	-9.26***	-17.62***	I(1)
LnEnroll	0.31	-1.67	-3.52**	-3.81**	I(1)
LnEmp	-0.01	-2.63	-7.11***	-7.68***	I(1)
LnGFCF	-0.93	-2.00	-3.77***	-3.66**	I(1)

Notes. (*) significant at 10%; (**) significant at 5%; and (***) significant at 1%.

Table 3 reports the t-statistic which is inserted from the ADF-based stationarity test. ADF and PP unit root test is applied to confirm the stationarity of the series with a null hypothesis—there is a unit root for the series. All the values of t-statistics are significant at first difference except LnEdu. ADF test confirms that all variables of interest except LnEmp are stationary at the first difference, that is I(1). However, the PP test has evidence that all variables are stationary at first difference. The PP test confirms that all the series are stationary at integrated order 1 which supports conveying the series for further evaluation. Thus, the targeted models of this study are the Johansen cointegration, VECM, and Granger causality. To employ

the Johansen cointegration and VECM, one period lag will be adopted due to the small size of the observation.

Cointegration Test

The stationarity test supports that the Johansen cointegration test can be employed. To evaluate the long-run relationship between the targeted variable—LnPCI and explanatory variables—LnHDI, LnHealth, LnEdu, LnEnroll, LnEmp, and LnGFCF. To investigate the long-run relationship, the Johansen cointegration trace and maximum eigenvalue test are employed. The summary of these tests in Table 4 suggests that there is cointegration among the variables of interest and thus long-run association between them.

Table 4

Summary of Cointegration Equations under Trace and Maximum Eigenvalue Test

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No intercept, no trend	Intercept, no trend	Intercept, no trend	Intercept, trend	Intercept, trend
Trace	6	5	4	5	4
Maximum Eigenvalue	4	2	2	3	3

Table 4 reports the φ_{trace} and φ_{max} test summary. There are cointegrating equations at the 5 percent level of significance with every model underlying under the Johansen cointegration test. An intercept-and-not-trend linear model with four cointegrating equations based on trace and two based on maximum eigenvalues is applied in the paper. This model a has small size of cointegrating equations following the φ_{max} test. Hubrich, Lütkepohl and Saikkonen (2001) suggested that the φ_{max} test is more powerful if the sample size is too small. Thus, linear with intercept and no trend model has been applied to evaluate the short and long-run dynamics between variables under study. The results of the λ_{trace} and λ_{max} test have demonstrated in Table 5.

Table 5

Results of Unrestricted Cointegration Rank Trace and Maximum Eigenvalue Test

Test	H_0	H_1	Eigenvalue	Statistic	Critical Value (0.05)	Prob.
φ_{trace}	r = 0	r = 1	0.947037	208.1299	125.6154	0.0000
	r ≤ 1	r = 2	0.778166	125.8612	95.75366	0.0001
	r ≤ 2	r = 3	0.653953	83.69803	69.81889	0.0026
	r ≤ 3	r = 4	0.582422	53.98497	47.85613	0.0119
φ_{max}	r = 0	r = 1	0.947037	82.26865	46.23142	0.0000
	r ≤ 1	r = 2	0.778166	42.16319	40.07757	0.0287

Note. r indicates the number of cointegration vectors.

Table 5 demonstrates the results of Johansen cointegration rank tests. Both φ_{trace} and φ_{max} are significant at 0.05 level of significance. The result of φ_{trace} statistic indicates that there are four cointegrating equations and φ_{max} statistic reveals that there are two cointegrating vectors. These results confirm that there is a cointegration between human capital and poverty reduction. As a result, the Johansen cointegration test offers evidence of long-term relationships between human capital and the alleviation of poverty. Now, the VECM is employed with one period lag and only one equation has been targeted to achieve the objective of this paper.

Long- and Short-run Dynamics

To estimate the short-run and long-run associations between human capital and poverty lessening, Johansen cointegration and VECM have been employed. Johansen's cointegration of the selected model reports the normalized cointegrating coefficient as presented in Table 6.

Table 6

Normalized cointegration Coefficients

LnPCI	LnEdu	LnHealth	LnEnroll	LnEmp	LnHDI	LnGFCF
1.000	0.013	-0.084	-0.084	5.386	-1.851	-0.423
	(0.01748)	(0.02045)	(0.04923)	(0.78593)	(0.26008)	(0.02781)

Note. Standard error in parentheses

Table 6 presents the results of the normalized cointegration coefficient and the signs should be reversed to estimate the long-run relationship between human capital and poverty lessening. The LnHealth, LnEnroll, LnHDI, and LnGFCF have positive and the rest of the variables—LnEdu, LnEmp has negative associations with LnPCI in the long run.

Moreover, the negative and significant coefficient of error correction term (ECT_{t-1}) reveals that there is a long-run association between human capital and poverty lessening. The ECT_{t-1} is –0.747331 where the p-value is 0.0154 that the model will therefore converge back to the long-run equilibrium encompassing 74.73% in period t+1 (current year) if it receives shock in period t (previous year). This indicates that any poverty imbalance from the previous year (measured by the LnPCI) can be quickly adjusted back in the current year by 74.73%. The short-run impact of all indicators of human capital on poverty is presented with the VECM form in Table 7.

Table 7

Vector Error Correction Model Outputs

	Coefficient	Std. Error	t-Statistic	Prob.
ECT_{t-1}	-0.747	0.282	-2.649	0.015
$\Delta LnPCI_{t-1}$	0.395	0.278	1.420	0.171
$\Delta LnHealth_{t-1}$	-0.080	0.064	-1.251	0.225

	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta LnEdu_{t-1}$	0.051	0.014	3.633	0.002
$\Delta LnEnroll_{t-1}$	0.249	0.152	1.640	0.117
$\Delta LnGFCF_{t-1}$	-0.131	0.192	-0.682	0.503
$\Delta LnHDI_{t-1}$	1.782	2.133	0.836	0.413
$\Delta LnEmp_{t-1}$	4.975	2.057	2.419	0.025
C	0.064	0.031	2.019	0.057
R-squared	0.651942	Durbin-Watson statistic		1.729475
Adjusted R-squared	0.512718	F-statistic		4.682701 (0.002397)

The table presents the long-run dynamics (ECT_{t-1}) and short-run dynamics with the help of VECM modeling. The VECM model based on the above estimations can be written as follows:

$$\Delta LnPCI_t = -0.747331\ ECT_{t-1} + 0.395\Delta LnPCI_{t-1} - 0.080\Delta LnHealth_{t-1} + 0.051\Delta LnEdu_{t-1} + 0.249\Delta LnEnroll_{t-1} + 1.782\Delta LnHDI_{t-1} - 0.131\Delta LnGFCF_{t-1} + 4.975\Delta LnEmp_{t-1} + 0.064$$

The negative and significant ECT_{t-1} also reveals that there is long-run causality between explanatory variables which are proxied to human capital and the dependent variable which is proxied to poverty lessening. The estimated VECM reveals that there is a positive and significant relationship between the previous year's LnEdu and LnPCI. Similarly, there are positive relations of LnEmp at one period with LnPCI. However, a targeted variable LnHealth has negative but not significant effects on LnPCI. Similarly, there is no sufficient evidence that LnGFCF causes to reduce poverty significantly. It is negatively influenced by LnPCI but not significant at all. Moreover, all other variables of interest consisting of previous year LnPCI, LnEnroll, and LnHDI have been positively beneficial to curb poverty, however, these are not significant. Thus, in the Nepali context, education is the most important component for human capital formation thereby reducing poverty. While a 1 percent rise in spending on education can help to increase GNI per capita by 0.051 percent. On the other hand, the employment to economically active population ratio also reveals that it will be supportive of lessening poverty in Nepal. It is clearly shown in the table that a 1 percent increase in LnEmp can rise LnPCI by 4.975 percent.

The estimated VECM is statistically robust and fit. The value of R^2 implies that independent variables can be explained the dependent variable by 65.19%. Thus, it shows the data of this model is well fit. On the other hand, the Durbin-Watson statistic is 1.729475 which implies that there is no autocorrelation because it lies in the accepted range. F statistic (4.682701) also significant at 0.001 level indicates that the overall model is well-fitted and robust.

Residual and Stability Diagnostic

Further robustness and goodness of fit of the VECM, some diagnostic and stability tests have been performed. For that, heteroskedasticity, serial correlation, normality, and CUSUM tests are performed.

Table 8

Residual and Stability Diagnostic Tests Outcomes

Tests	Observed R^2	Prob. χ^2	Hypothesis accepted
Breusch-Godfrey Serial Correlation LM Test	2.213504	0.3306	No serial correlation
Heteroskedasticity Test: Breusch-Pagan-Godfrey	11.53836	0.6433	No heteroskedasticity
Normality Test (Jarque-Bera)	1.104148	0.575754	Residuals are normally distributed

Table 8 reports the residual and stability test results. The results reveal that there is no serial correlation, no heteroskedasticity, and residuals are normally distributed at 0.001 level. It confirms that the employed VECM is robust and well-specified. The plot of CUSUM and CUSUMSQ lies on the 5 percent level of critical boundaries which implies the VECM parameters are stable and have the accuracy to estimate the short and long-run relationship between human capital and poverty lessening.

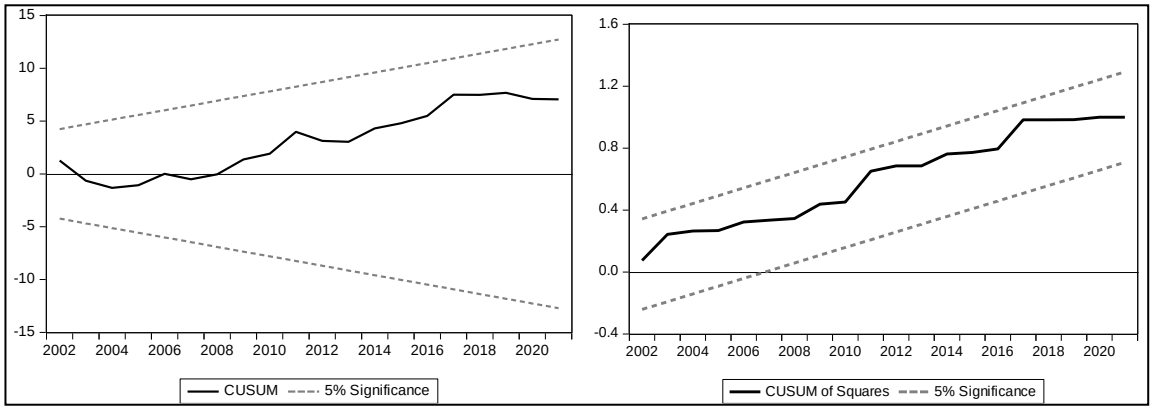

Figure 1. The plot of CUSUM and CUSUM of Squares

Causality between Variables of Interest

The causal connection between variables of interest can be explored by applying pairwise Granger causality. Granger causality has been employed to estimate any cause of human capital to poverty reduction in Nepal. The estimated results are presented in Table 9.

Table 9

Pairwise Granger Causality Tests

Variables	LnPCI	LnHealth	LnEdu	LnEnroll	LnHDI	LnGFCF	LnEmp
LnPCI	-	3.49922*	3.41603**	0.74763	3.41682**	1.06025	2.08448
LnHealth	0.30215	-	0.25444	0.23514	2.47477	0.07004	1.33638
LnEdu	1.11402	4.21838*	-	0.07944	1.97279	0.73945	1.06148
LnEnroll	5.24522*	2.46801	2.56560**	-	2.76088**	6.27505*	6.17369
LnHDI	2.30150	2.31245	11.7487*	0.74256	-	2.70865**	0.81859
LnGFCF	3.90914*	2.43179	8.13066*	0.49240	2.08691	-	7.33208
LnEmp	1.48731	0.23115	68.8140*	0.95908	0.92683	2.62605**	-

Notes. (***) Significant at 10%; (**) Significant at 5%; (*) Significant at 1%.

Table 9 reports the F-statistic of pairwise Granger causality tests taking 2 periods lag. The result reveals that there is only one bidimensional causality between LnEmp and LnGFCF. However, LnPCI does Granger cause LnEnroll and LnGFCF. The results also support that there is a unidirectional causality moving from LnHealth to LnPCI, LnEdu to LnPCI, and LnHDI to LnPCI. It has strong evidence that LnHealth, LnEdu, and LnHDI case the LnPCI which implies that spending on health and education and HDI have a connection to lessening poverty. Similarly, there is a unidirectional causal connection running from LnHealth to LnEdu. LnEdu does Granger cause all variables except LnHealth. There is no causal connection of LnEnroll to all other variables. There is a unidirectional causal connection from LnHDI to LnEnroll, LnGFCF to LnEnroll, LnGFCF to LnHDI, LnGFCF to LnEmp, LnEmp to LnEnroll, and LnEmp to LnGFCF.

Conclusion and Implication

The study makes an effort to understand how human capital formation can lessen poverty in Nepal. This study uses GNI per capita income (LnPCI) as the proxy of the poverty level and spending on health (LnHealth), spending on education (LnEdu), Gross enrollment in secondary level (LnEnroll), human development capital (LnHDI), employment ratio of the economically active population (LnEmp), and gross fixed capital formation (LnGFCF) are taken as exogenous variables as a human capital proxy. This study employs VECM and Granger causality including time series data from 1990 to 2021.

All the variables of the study are stationary at first difference. The result of Johansen cointegration reveals that there is a long-run association between human capital and poverty lessening in Nepal. The study is also concluded that there is positive long-run relation between spending on health and gross enrollment at the secondary level with GNI per capita. It is also

discovered that HDI and gross fixed capital have a positive impact on GNI per capita. However, there is a negative association between spending on education and the employment ratio with GNI per capita. Moreover, the error correction term also suggests that there is a significant impact of human capital on poverty reduction in Nepal. This study suggests that government spending on education is not effective at all to curb poverty in Nepal. This study reports that there is a positive and significant relationship between government spending on education in poverty reduction in the short run. In the short run, when the ratio of economically active population increases the per capita income increases thereby reducing poverty. However, spending on health, gross fixed capital formation, HDI, and gross enrollment on the secondary level are not significantly influenced by increasing the income of individuals and reducing poverty in the short run. A major component of human capital, health, is negative but not significant. Moreover, gross enrollment and HDI have positively beneficial to curb poverty but are not significant.

The result also indicates that LnHealth, LnEdu, and LnHDI do Granger cause LnPCI. This study reveals that government spending on health and education and improving HDI are beneficial to improve the poverty situation in Nepal. The findings also indicate that spending on education has a significant connection to all other variables including GNI per capita, gross enrollment, HDI, gross fixed capital, and employment ratio except spending on health. These results insights that education is crucial to human and physical capital formation and reducing poverty in Nepal.

The overall findings reveal that human capital formation in the short run is more effective to reduce poverty in Nepal than most of the literature reviewed in the above section. Furthermore, education has a positive connection to gross fixed capital formation, employment, gross enrollment, and HDI but not with spending on health. Health is a crucial one in poverty lessening sustainably. However, spending on education is only a temporary phenomenon to reduce poverty in Nepal. These findings suggest that the sustainable benefits of education are not assured in the Nepali context to reduce poverty. Thus, the government should invest more in health and education, and at the same time, the policy of harvesting mostly educational crops and as well as health crops should be formulated to reduce poverty in Nepal which will contribute the fixed capital formation and improve the quality of life via employment and income accumulation.

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