Dynamic Relationship between Human Capital and Economic Growth in Sri Lanka: A Cointegration Analysis

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Introduction

In the current global trends of advancing technology and growing competition, improvement of human capital has become an imperative for every nation because it is indispensable for sustainable economic growth (Lucas, 1988; Barro, 1991; 1992; and Sala-i-Martin et.al., 2004). Education and health expenditures have been regarded as investment in human capital which promte economic development is recognise by School of Human Capital since in early 1960s.

The Keynesian School of Thought postulates that public expenditure contributes positively to income growth in the short run (Lucas, 1988). The positive relationship between spending on human capital and economic growth has been theoretically verified in endogenous growth theory (Lucas 1988). Marita and Mukhopadhuay (2014) confirm that investing in education and health accumulates human capital, and can lead to technological innovation to support productivity which would accelerate economic growth in the long run.

Kasthuri and Abhayaratne (2007) analysed the contribution of health and education expenditure on economic growth in Sri Lanka using a multiple linear regression model and they found positive relationship between these variables in the long run. **A**bbas (2001) and Duma

(2007) in their empirical studies, using an augmented production function found a positive relationship between human capital and economic growth in Sri Lanka, but Duma identified a very low contribution of human capital.Thus, growth theories predict positive contributions of human capital to economic growth.

Sri Lanka is one of the pioneers in public spending on education and health services. Its provision of free education and health services through since independence is credited with elevating its health and education indices to be almost on par with developed countries.

Karunathilaka (2008) showed that more than 95% of the education institutions and hospitals in the country are dominated by the government education and health systems. Sri Lanka has experienced an average annual growth rate of 4.74% in real GDP between 1970 - 2010 and the growth performance in the past has pushed per capita GDP based on Purchasing Power Parity to US $ 5834.26 in 2012 (CBSL, 2013).

However, the efficacy of public spending on human capital and its role on economic growth in Sri Lanka remains scantly researched in recent times and it is a widely debated issue. While past studies used either government expenditure or human capital indices, the simultaneous use of recent data on expenditure and indices of human capital is still neglected in Sri Lanka.

Objectives

This study focuses on examining the role of human capital in economic growth of Sri Lanka and investigates the cointegration relationships among endogenous variables in this study.

Methodology

The methodology used by Qadri and Waheed (2011) and Asghar et al. (2012) are modified to formulate an econometric model for this study that operationalizes GDP as a function of Capital (K), Labor (L), Education (E) and Health (H). The real capital expenditure on human capital, real labour (recurrent) expenditure on human capital; Educational Index; Health Index; and Real Per Capita GDP are used as proxies for K, L, E H and Y_t (Economic Growth) respectively (See Table 1 in Appendix A for calculation formulas) in this study.

The study is mainly based on secondary time series data from 1970 to 2013 that were collected from the annual reports of the Central Bank of Sri Lanka and World Development Indicator (WDI) Data Base and the value of all the variables were transformed into natural logarithm.

This study follows the Human Capital Model of Endogenous Growth Theory and Qadri and Waheed (2011) and Asghar et al. (2012) empirical studies to formulate the following model:

The Standard Cob-Douglas Model is: $Y_t = AK^{\alpha_1} L^{\alpha_2} E_t^{\alpha_3} H_t^{\alpha_4} e^{\varepsilon_t}$....... (1)

where, $\alpha_1, \alpha_2, \alpha_3, \alpha_4 > 0$ and represent the elasticity coefficients of endogenous variables - Capital (K), Labor (L) , Education Index (E) and Health Index (H) respectively. Y_t is the dependent variable which represents the real per capita GDP. A is total factor productivity and ε_t is white noise error term.

The Augmented Dicky-Fuller (ADF), Phillips Perron (PP) and Ng-Perron unit root tests were conducted to test the order of integration. The co-integration test was conducted using the Johansen approach to test long run relationship between variables.

The model is:

$\log Y_t = \alpha_0 + \alpha_1 \log K_t + \alpha_2 \log L_t + \alpha_3 \log E_t + \alpha_4 \log H_t + \varepsilon_t$......... (2)

Error correction model (ECM) was employed to test the short-run relationship between variables as well as the long-run equilibrium of the variables using the following model:

$$\Delta \log Z_t = \alpha_0 + \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Phi_i^* \, \Delta \log Z_{t-i} + \varepsilon_t \quad \text{.............................. (3)}$$

$\boldsymbol{\Pi}$ and $\boldsymbol{\Phi}^*$are functions of the Φ's. If $\Pi = 0$, then there is no cointegration. If Π has full rank, K, then the x's cannot be I(1) but are stationary and $\Pi = \alpha\beta^{'}$ where α is the error correction term or(5×1) cointegrating vector, $\beta^{'}$ is the (1×5) vector of coefficients $Z_t = [Y_t, K_t, L_t, E_t, H_t]^{'}$, vector of endogenous variables, Z_{t-i} is the lagged value of the variables and ε_t is the white noise error term.

Results and Discussion

The unit root tests confirmed that all the variables are stationary at their first difference, suggesting that all variables considered are integrated in order one; lag length selection tests suggested the use two of lags as optimal lag length. The trace statistics of Johansen and Juselius cointegration technique identified three cointegrating relations in the system of equations at 5% level of significance. Table 2 in Appendix A shows the results of ECM and the first panel of this Table shows the short-run positive relationship between real per capita GDP and health index and no significant relationship found between real per capita GDP and education index. The second panel of the same Table identifies three cointegrating relations which confirm the long-run relationship among the regressors. The 1st co-integrating vector shows a positive correlation between real per capita GDP and health index and negative interaction between real per capita GDP and education index in the long-run at only 10% level of significance. The negative impact of education on GDP can be explained by two reasons: (1) due to grade repetition in all levels of education among students a delay to enter the labor force, which may have no immediate impact on growth,

(2) a mismatch between educational qualification and demand for labor in both public and private sectors may lead to limiting the use of labour in production soon after schooling.

Panel 3 of Table 2 in Appendix A denotes the coefficients of speed of adjustment, which explain how the above model adjusts towards long-run equilibrium. A negative and significant error correction coefficient (-0.23) of real per capita GDP (1^{st} elements of Coint-Eq1) reveals that 23% disequilibrium is corrected each year which implies that per capita GDP growth moves downward towards a long run equilibrium path. The significant and negative error correction coefficient (-0.77) of real capita expenditure on human capital (2^{nd} elements of Coint-Eq2) reveals that 77% disequilibrium is corrected each year. The significant and negative error correction coefficient (-0.24) of real labour expenditure on human capital (3^{rd} elements of Coint-Eq3) indicates a 24% disequilibrium which is corrected each year.

Conclusion and Policy Recommendations

Annual data from Sri Lanka has been used to analyze dynamic linkage between human capital variables and per capita GDP growth rate. The unit root tests confirmed stationarity at first difference level for all variables. Both Johansen and Juselius cointegration test and VECM cointegrating vectors identified that economic growth has a long run positive relationship with health and a negative relationship with education while the capita expenditure on human capital and the labor (recurrent) expenditure on human capital has no relationship with economic growth in Sri Lanka. VECM test also revealed a positive relationship between health and economic growth in short-run. But the VECM test on identifying long run equilibrium suggested only three cointegrating equations for real per capita GDP growth, the real capital expenditure on human capital and real labour expenditure on human capital and the error correction coefficients of these variables are significant and negative which suggest that 23%, 77% and 24%

disequilibrium errors are corrected each year for the above variables respectively. The study confirms that the health component of human capital has a significant impact on economic growth of Sri Lanka in long-run. Therefore, special attention needs to be given by the government on health sector improvement.

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Appendix A

Table 1: Method of Calculation of Exogenous Variables

Proxies for Capital and Labor	Proxies for Education and Health
$\begin{matrix}\text{RCE}\\ \text{on HC (K)}\end{matrix} = \frac{\text{TCE on E and H}}{\text{Deflator}}$	$\begin{matrix}\text{Eduction}\\ \text{Index}\end{matrix} = \left[\frac{2}{3} * \text{ALI}\right] + \left[\frac{1}{3} * \text{GEI}\right]$ Where, $\text{ALI} = \frac{\text{ALR}-0}{100-0}$ and $\text{GEI} = \frac{\text{CGER}-0}{100-0}$
$\begin{matrix}\text{RLE}\\ \text{on HC (L)}\end{matrix} = \frac{\text{TRE on H and E}}{\text{Deflator}}$	$\begin{matrix}\text{Health}\\ \text{Index}\end{matrix} = \left[\frac{\text{LE}-25}{85-25}\right]$ where LE: Life expectancy

Note: RCE on HC denotes the Real Capital Expenditure on Human Capital, TCE on H and E denote the Total Capital Expenditure on Education and Health, RLE on HC denotes the Real Labor Expenditure on Human Capital and TRE on H and E represent the Total Recurrent Expenditure on Health and Education. We followed Asghar et al (2012) to calculate education and health index. Where, ALI denotes Adult Literacy Index, GSEI represents Gross Enrolment Index and CGER is the combined gross enrolment rate. CGER is combined primary, secondary and tertiary gross enrolment index with one third weightage.

Table 2: Results of VECM

Panel 1					
Short-run Relationship					
Variables	D(lnY)	D(lnK)	D(lnL)	D(lnE)	D(lnH)
$D(lnY_{t-1})$	−0.30 (−1.34)	0.06 (0.04)	−0.69 (−0.33)	0.009 (0.05)	0.07** (1.99)
$D(lnY_{t-2})$	−0.02 (−0.13)	−0.27 (−0.24)	−0.47 (−0.29)	0.02 (0.19)	−0.04 (−0.14)
$D(lnK_{t-1})$	0.04 (0.82)	0.70** (2.24)	−0.37 (−0.84)	−0.01 (−0.31)	0.01 (1.45)
$D(lnK_{t-2})$	0.0002 (0.006)	0.05 (0.22)	−0.34 (−1.01)	−0.012 (−0.50)	0.008 (1.29)
$D(lnL_{t-1})$	−0.01 (−0.33)	−0.25 (−1.04)	0.87 (2.55)	0.02 (1.07)	−0.004 (−0.70)
$D(lnL_{t-2})$	0.002 (0.08)	0.06 (0.35)	0.49*** (1.86)	0.02 (1.26)	−0.004 (−0.82)
$D(lnE_{t-1})$	0.13 (0.43)	−2.10 (−1.04	0.19 (0.07)	−0.36*** (−1.75)	−0.02 (−0.41)
$D(lnE_{t-2})$	0.19 (0.69)	1.80 (0.98)	2.79 (1.08)	0.05 (0.29)	−0.09*** (−1.93)
$D(lnH_{t-1})$	−1.64 (−0.51)	−33.3 (−1.57)	4.08 (0.13)	1.79 (0.81)	1.00*** (1.84)
$D(lnH_{t-2})$	1.48 (0.46)	18.7 (0882)	−21.7 (−0.72)	−2.12 (−0.96)	−0.10 (−0.19)
C	0.001	0.013	0.012	0.0003	0.0007
Panel 2					
Long-run Relationship (From Cointegrating Vector)					
$DlnY = 0.04 + -0.91DlnE(-1)^{*} + 0.404DlnH(-1)^{*}$ (1.85) (1.67)					
$DlnK = 0.03 + +0.93DlnE(-1) - 3.25DlnH(-1)$ (-0.64) (1.01)					
$DlnL = 0.02 + +1.05DlnE(-1) + 1.59DlnH(-1)$ (-0.57) (-0.39)					
Panel 3					
Speed of Adjustment					
Coint-Eq1 $EC_{1(t-1)}$	−0.23*** (−1.68)	−0.12 (−0.09)	−0.46 (−0.25)	−0.16 (−1.20)	0.12* (3.76)
Coint-Eq2 $EC_{2(t-1)}$	−0.01 (−0.09)	−0.77* (−3.48)	0.70 (0.98)	0.04 (0.77)	−0.02 (−1.63)
Coint-Eq3 $EC_{3(t-1)}$	0.01 (0.12)	0.05 (0.14)	−0.24* (−4.74)	−0.03 (−0.98)	0.01 (0.82)

Note: * denotes significant at 1% level, ** represents significant at 5% level and *** shows significant at 10% level