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A Dynamic Analysis of the Nexus of Human Capital Formation and Economic Growth: A Case of Pakistan

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ABSTRACT

Human centric policies play important role in materializing the dream of sustainable economic development. In this regard investigation of human capital formation (HCF) and its transmission mechanism to sustainable economic growth cannot be overlooked. This study aims to estimate and analyze the long run and short run dynamics between economic growth and HCF by employing ARDL technique of Pesaran et al. (2001) in case of Pakistan. The study uses time series data from 1972 to 2014 regarding the selected variables of HCF proxied by growth of secondary school enrollments (GEDU) and life expectancy at birth (LHLTH) along with other determinants of economic growth. Such variables include growth of fixed capital formation (GFCF), employed labor force (LELF), openness of the economy (LOPEN) and regime changes (REG. Variance Decomposition (VDCs) is estimated for further inferences. The estimated ARDL model indicates a stable long run relationship between economic growth and the components of HCF. The findings of the study are in conformity with the Mankiw–Romer–Weil (1992) model; however, the extent of influence of health indicator is much stronger than that of education indicator. After 'pre and post' time series diagnostic and reliability tests, the study reveals that HCF cannot be ignored while achieving sustainable economic growth and hence sustainable economic development. The study further indicates that though HCF is essential however; the importance of its different components is asymmetric. Based on the findings of the study, heavily weighted HCF components if targeted on priority bases will help accelerating economic growth in Pakistan, as investment in education alone will not be suffice unless the health sector is equally targeted.

Keywords: *Human Capital, Development, Education*

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INTRODUCTION

"Human capital" the knowledge, skill, aptitudes, attitudes, and other acquired traits which contributes to production (Goode, 1959) has been one of the earliest and well-known examples extending the basic concepts of economics to the broader disciplines of human and social behavior in the recent decades (Teixeira, 2014). Human capital is different from other physical assets with respect to its market returns to the proportion of labor supplied by workers (Hall & Johnson, 1980) and expenditure on it is classified as investment rather than consumption (Schultz, 1961).

Although economists have long been recognized the importance of people in the form of labor's contribution to the nation's wealth but have largely ignored the fact that people invest huge amount in themselves (Schultz, 1961). The positive contribution of the accumulation of human capital towards the growth of per capita income has been debated by both economists and policy makers. Though empirical evidences have been mixed, yet several endogenous growth theories and intuition both point towards the direct causal connection between human capital and economic growth (Kalaitzidakis et al., 2001).

Recently, endogenous growth models have incorporated social capital and studies have shown an increasing importance of human capital relative to social capital throughout the development process. Hence the provision of subsidies to formation of human capital is expected to contribute more to growth than that of social capital (Sequeira & Ferreira-Lopes, 2011). Although, the creation of human capital is the official business of government (Blewitt, 2005) however, individuals also take responsibility to invest in themselves by spending on education and skills. Such investments contribute not only to household income but also add to national income as well (Coffield, 1999 & 2000). Focusing the areas of education and health are therefore expected to directly add to growth, while make easier the implementation of different political, social and economic policies for the promotion of human welfare indirectly. Besides this, countries with higher level of human capital are found to be somewhat safeguarded from political turmoil and even enjoy sound economic position.

Pakistan, like many developing countries with large deposits of natural and population resources, suffers from low GDP growth, unemployment and poverty. Progress in other fields are not satisfactory and adequate progress has not yet been made in the field of education, as a consequent low literacy rate of only 58 percent limits the opportunity to acquire skill and technical knowledge towards the optimal exploitation of national resources in Pakistan. The budgetary allocation to education is stagnating at only 2 percent of GDP which is the lowest among South Asian countries (ESP, 2013-14). Moreover, the country is lagging behind the countries with similar socio-economic conditions in the race of Human Development Index. It is therefore imperative for a developing country like

Pakistan to allocate more resources to education and health as this will not only foster economic growth, but also benefit the poor segment of the society by improving their current and future standard of living (Khan, 2005).

Similarly, the inclusion of health indicator in the analysis along with education seems to be important, as return to investment in education by individuals and economy will increase when people enjoy good health and live long life. Since educating people is not only a long term process, but it also involves allocation of huge resources of a nation, hence equally targeting health sector would be a best strategy for a nation to take full advantage of its human resources. Growth theories use enrollment rates to proxy human capital, while health remain peripheral. The unavailability of time series data on health indicators and lack of framework within growth models are held responsible for such periphery (Arora, 2001). There are various channels through which health status of a country affects economic performance of a country. These channels can be both direct and indirect. With improvement in health, more output can be produced from a given stock of physical capital, technical knowledge and skill. It is the status of health of population that not only enhances the mental capabilities of population, but also determines the level of productivity per worker. Thus health should be treated as one of the ingredients of growth models and has recently been included in endogenous growth theory (Thomas et al., 1997; Bloom et al., 2004).

The story of health sector is not different than that of education sector. Traditionally, Pakistan has spent a meager amount on development in general and education and health in particular (Muhammad et al., 2007). The budgetary allocation to health sector in (Jul-March) 2014-15 was estimated to be Rs. 114.2 billion which stands as 0.4% of GDP (ESP, 2014-15). While, World Health Organization (WHO) recommends at least 5% of GDP to health sector for its member nations to meet the set targets (WHO, 2000). In this regard adequate progress has been made in developed nations so far and particularly in OECD and other European countries where more than 8% has been spent on health (Ahmad & Shaikh, 2008).

This study endeavors to investigate the impact of HCF on economic growth in the context of Pakistan. To incorporate the effect of HCF on growth, the empirical calibration of the study is based on Mankiw et al. (1992) model. This model provides a suitable empirical framework to the analysis of factors determining growth in a country, while incorporating human capital besides physical capital. The aim of this study is two pronged; firstly the study employ recently developed time series econometric techniques to the analysis and secondly by including health indicator along with education indicator would properly proxy HCF. To this end, ARDL model is employed to identify both long run and short run dynamics between HCF and growth. It has been shown that ARDL technique has several advantages over other time series techniques of co integration. Particularly, this technique does not directly hang on testing the stationarity of the variables to be included in the model (Pesaran et al., 2001). Similarly, this approach is simple as compared to JJ-cointegration method. However, the approach breaks-down, when one or more variables become stationarity at 2nd difference.

LITERATURE REVIEW

A voluminous literature reveals that human capital play important role in determining growth potentials of a country (Lucas, 1988; Riley, 2012). Some studies (Romer, 1990; Mankiw et al., 1992) focus and investigate level effect of human capital, while others (Pistorius, 2004; Horwitz, 2005) analyze the rate effect. Mankiw et al. (1992), Barro (2001), Bassanini & Scarpetta (2001) and Freire-Seren (2001) have investigated the direct effect, while Lucas (1988), Romer (1990), Edwards (1997) and Loof & Anderson (2008) focused on the indirect effect. Economic growth, according to the indirect approach is facilitated by the human capital via the adoption and generation of new technologies. In the new growth theories, Romer (1990) and Lucas (1988) propound that accumulation of human capital generating constant or increasing returns is likely to determine long run sustained growth of per capita income. In contrast to the new growth theories, some authors (Portela et al., 2004; Cohen & Soto, 2001) argue that it would be quite erratic that the growth of human capital explains economic growth.

The insertion of human capital as explanatory variable in growth regression does not seem an easy task as it depends on theoretical and empirical specification. In the endogenous growth models, Lucas (1988) regress GDP growth on growth of human capital, while Romer (1990) uses the level of human capital as a regressor (Leeuwen, 2007). Furthermore, the proxies used for human capital in different empirical studies suffer from measurement problem (Krueger & Lindahl, 2001 and Portela et al., 2004) and hence these proxies seem to be imperfect measures of human capital including the average years of schooling (Leeuwen, 2007). In the existing literature, macro economists solely focus on human capital in growth equations and use education as proxy for human capital, while micro economists include health along with education component. They argue that to ensure growth in productivity, people need to be protected from diseases and therefore health is important ingredient besides education (Asghar et al., 2012).

In the past, studies on the relationship between HCF and growth were largely focusing on literacy and enrollment rates as the proxy variables, but some recent studies use 'average year of education.' However, each proxy has its advantages and limitations, but Leeuwen (2007) points that literacy rate is the obvious proxy when one uses the level of human capital and enrollment rate is more suitable when someone is interested in using growth of human capital. Similarly, average year of education is also extensively used by many studies to proxy growth of human capital. However, the growth of this proxy (i.e. in log form) is actually the growth of human capital, which will obviously reduce the effect of human capital on growth considerably.

In Pakistan, empirical literature on the relationship between HCF and growth is not even naïve, but also under developed. Nonetheless, the importance of HCF in the determination of growth cannot be overlooked. Different researchers have used different proxies for HCF in Pakistan. Some authors like Abbas (2000 & 2001); Khatak and Khan (2012); Kiani (2010) and Abbas & Foreman-Peck (2008) have largely focused on education as the primary source of HCF and used enrollment at different levels like primary, middle and higher education as proxy for HCF. While others like Asghar et al. (2012) and Khan (2005) added life expectancy at birth in their analyses.

A study by Salman et al. (2015) identifies a well established role of human capital in the acceleration of growth through its 'level effects' and 'rate effects'. The study employs different competing econometric techniques on a sample of 32 developing countries and confirms positive association between human capital components and growth. However, the authors point towards the sensitivity of the level of significance with different estimation techniques. The coefficients of both education and health are statistically insignificant in the panel data model, while accounting for the problem of endogeneity between the two in Two-Stage Least Square (2SLS) techniques, either of the variables has a significant positive relationship with economic growth. The proxy used for education makes the results of regression sensitive. The GMM technique, however, makes both the components of human capital significant. However, cross countries analyses often seriously ignore individual country's characteristics and time series analyses of the impact of human capital on growth are therefore preferred by many authors (Leeuwen, 2007).

Similarly, in another study Samar & Waqas (2014) examines the relationship between HCF and growth of Pakistan using time series data ranging from 1979 to 2010. They used Johansen Co-Integration method and the long run relationship. The study include GDP, Gini coefficient, education enrollment index, infant mortality rate and fixed capital formation in their model for estimation. Their study found a strong link between HCF and growth. Other studies also found long run relationship between HCF and growth employing the Johansen Co-Integration technique in the context of Pakistan. Such studies include Abbas and Foreman-Peck, (2008); Asghar et al. (2012) and Khatak & Khan (2012) to mention a few. While Ali et al. (2012) use OLS method and find a strong link between human capital (proxy by education enrollment index) and GDP growth. However, the application of OLS method in case of time series data leads to spurious results and therefore cannot be relied. Beside this, the method fails to isolate short-run effect from the long-run and even cannot compute the speed of adjustment.

Fafchampas & Quismbing (1998) investigate the relationship between productivity, labor allocation and human capital in four districts of Pakistan using household survey data. The study showed that individuals are more likely to shift labor resources from farm to off-farm activities with the higher level of education. The study implied that education enhances productivity in off-farm sector, thereby providing the opportunities to the entrants to earn higher income. Studies by Malik (2006); Abbas & Foreman-Peck (2008); and Qadri & Waheed (2011) arrive at the conclusion that HCF plays indispensible role in influencing economic development and the relationship is found to be positive and statistically significant in the context of developing country like Pakistan.

Kalaitzidakis et al. (2001) employ nonparametric techniques to uncover the possibility of non-linear relationship between HCF and development. This study like some influential studies focuses on average years of schooling in order to proxy human capital. The study pinpointed differences in the growth effect of both educational attainment by gender and level of education. Interestingly, their study found non-linearity in the relationship between HCF and growth. There exist some studies that did not find any significant impact of HCF on a country's economic growth. For example the studies of Benhabib and Spiegel (1994) and Pritchett (1996) found such impact to be statistically insignificant. They even argued that the effect can even be negative. But this relationship is simple to be isolated from other factors determining growth. The relationship therefore seems to be quite complex and is likely to be influenced by the existing stock of human capital (Kalaitzidakis et al., 2001). In this regard, a strand of research shows that return to investment in human being in the form of allocation to education and health is found to be diminishing. Furthermore, the failure of some studies to find clearer picture regarding the relationship between the two phenomena may be attributed to the inappropriate methodologies used. According to Leeuwen (2007) specification of equation may play an important role in the determination of positive association between HCF and growth, while the study by Topel (1999) reveals that it was the wrong specification of the model that possibly made the effect negative and insignificant in the study of Benhabib & Spiegel. The study by these authors used log specification of education in their study and the log-log specification is based on the assumption that education enters linearly in Cobb-Douglas production function (Leeuwen, 2007). While, Temple (1999) in his influential work argued that it was due to the outliers in the data set and therefore re-estimated the model of Benhabib and Spiegel with Least Trimmed Least Squares (LTS) technique. Contrarily, Temple (1999) in his study found significant positive effect of human capital proxied by educational attainment on economic growth. Rao & Shankar (2012) posit that Temple could not make any distinction between permanent and actual yearly growth impact of human capital and therefore they re-estimated the model of Temple with slight modification to get the permanent growth effects. After all, the study found significant permanent effect but smaller than that of Temple (1999).

In a study, Qadri & Waheed (2011) constructed an index from the multiple of health expenditure and primary school enrollment to proxy HCF. These authors claim that their constructed index is a good proxy for HCF as compared to the use of different levels of education as proxy in different studies. The study reveals a strong and positive association between HCF and economic growth in the context of Pakistan. Alam et al. (2010) investigated the causal link between social expenditure and growth in ten Asian developing countries including Pakistan. Using Panel Co-integration techniques, their study showed that expenditure on education, health and social welfare programs have a long run relationship with growth for the sample countries. Similarly, Barbiero & Cournède (2013) investigated the impact of public spending on education, health and other areas on long-run growth. Using Co-integration and ECM for a panel of OECD countries, their results showed that compositional changes of public expenditures in favor of education, health and transport raise the long-run growth in these countries. The study further indicated that such structural changes in government spending take more than five years to be reflected in the long-run growth.

After a thorough survey of the literature on HCF-growth nexus, it is evident that different researchers have employed different econometric techniques for both time series and panel data and have drawn different conclusions. Despite disagreement among different authors on the relationship, majority of the study reveals positive impact of HCF on a country's growth performance.

MATERIALS AND METHODS

Data and Empirical Methodology

To ascertain the dynamic relationship between growth and HCF, time series data over a period ranging from 1972 to 2014 were utilized. The data were obtained from Economic Survey of Pakistan (ESP) and World Development Indicators (WDI) published by World Bank (Definitions of variables, their measurement, and sources of data are reported in appendix-3). The bounds testing procedure of Pesaran et al. (2001) was employed to estimate the effect of HCF on growth in the context of Pakistan. Brief outlines of this procedure are presented as follows:

$$\Delta \ln(PCI)_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta \ln(PCI)_{t-i} + \sum_{i=0}^{n} \psi \Delta(GFCF)_{t-i} + \sum_{i=0}^{n} \phi \Delta \ln(ELF)_{t-i}$$
$$+ \sum_{i=0}^{n} \delta \Delta(GEDU)_{t-i} + \sum_{i=0}^{n} \pi \Delta \ln(HLTH)_{t-i} + \sum_{i=0}^{n} \xi \Delta \ln(OPEN)_{t-i} + \sum_{i=0}^{n} \varpi \Delta(REG)_{t-i}$$
$$+ \lambda_1 \ln(PCI)_{t-1} + \lambda_2 (GFCF)_{t-1} + \lambda_3 \ln(ELF)_{t-1} + \lambda_4 (GEDU)_{t-1} + \lambda_5 \ln(HLTH)_{t-1} \quad (1)$$
$$+ \lambda_6 \ln(OPEN) + \lambda_7 (REG) + \mu_i$$

The coefficients in this equation such as $\beta,\psi,\varphi,\delta,\pi,\xi$ and ϖ capture the short run relationship, while λ_1, λ_2, λ_3, λ_4, λ_5, λ_6 and λ_7 measure the long run impact of explanatory variables in the model. Then the null of no co integration is tested as:

H_0: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = 0$ (no Co-integration relationship)

H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq \lambda_7 \neq 0$

If the hypothesis of no Co-integration is rejected, then long-run parameters through equation (2) would be estimated. Similarly the short-run dynamics would be captured and estimated via equation (3).

$$\ln(PCI)_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \ln(PCI)_{t-i} + \sum_{i=0}^{n} \psi (GFCF)_{t-i} + \sum_{i=0}^{n} \phi \ln(ELF)_{t-i} + \sum_{i=0}^{n} \delta (GEDU)_{t-i}$$
$$+ \sum_{i=0}^{n} \pi \ln(HLTH)_{t-i} + \sum_{i=0}^{n} \xi \ln(OPEN)_{t-i} + \sum_{i=0}^{n} \varpi (REG)_{t-i} + \mu_i \quad (2)$$

The ECM involves estimation of the following equation:

$$\Delta \ln(PCI)_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta \ln(PCI)_{t-i} + \sum_{i=0}^{n} \psi \Delta(GFCF)_{t-i} + \sum_{i=0}^{n} \phi \Delta \ln(ELF)_{t-i}$$
$$+ \sum_{i=0}^{n} \delta \Delta(GEDU)_{t-i} + \sum_{i=0}^{n} \pi \Delta \ln(HLTH)_{t-i} + \sum_{i=0}^{n} \xi \Delta \ln(OPEN)_{t-i}$$
$$+ \sum_{i=0}^{n} \varpi \Delta(REG)_{t-i} + \eta(ECM)_{t-1} + \mu_i \quad (3)$$

EMPIRICAL ANALYSIS AND RESULTS

Before formally testing co integration relationship between growth and a set of explanatory variables, stationarity checking of the variables are required. For this purpose, ADF and Phillips-Perron (PP) tests are employed to determine the order of integration of the variables to be incorporated in our model. Although, ARDL is not subject to pre-testing the stationarity of the underlying variables, such analysis of unit root will be helpful in identifying whether the application of the model is possible or not. The test results for checking stationarity of variables via ADF and PP are shown in tables 1 and 2 respectively. The results indicate that the underlying variables are a mix of I(0) and I(1) and none of the variable is found to be I(2). Thus the employment of ARDL model to the analysis of long-run relationship is justified and can be relied. From both the tests of unit root, it is clear that the variables like HLTH and OPEN are stationary at levels [i.e. I(0)], while PCI, FCF, ELF and EDU become stationary at first difference [i.e. I(1)].

Table 1. Unit Root Estimation Based on ADF Tests

Variables	Augmented Dickey Fuller (ADF) Test			
	With drift		With drift & trend	
	Level	1st Difference	Level	1st Difference
PCI	0.258	-4.121*	-2.980	-4.107**
FCF	-1.237	-4.576*	-2.804	-4.600*
ELF	-1.799	-7.183*	-1.989	-7.157*
EDU	3.115	-3.718*	-1.023	-4.448*
HLTH	-9.003*	-1.892	-2.653	-0.726
OPEN	-2.912***	-6.980*	-3.648**	-6.871*

Note: *, **, *** represents significant at 1%, 5% and 10% level of significance respectively.

Now reverting to the test of Co-integrating relationship, the bound F-stat. calculated on the basis of AIC[1] is reported in table 3. This F-statistic value (F-stat = 6.948) is not less than the lower bound value and even does not fall between inconclusive bands. More clearly, the value exceeds the upper bound value [I(1) =4.43] at 1% level of probability and therefore the null hypothesis of no long-run is rejected and therefore indicates the existence of long-run relationship between growth and the set of explanatory variables. For robustness checking, the Wald F-stat. is also estimated via SIC. Since the criterion of lag selection play important role in the establishment of co integration, the study therefore endeavored to estimate the model via stricter criterion of lag selection (SIC). Again the co integration relationship is confirmed based on SIC. The result is reported in appendix-5.

Table 2. Unit Root Estimation Based on Philips-Perron Test

Variables	Philips-Perron Test			
	With drift		With drift & trend	
	Level	1st Difference	Level	1st Difference
PCI	0.229	-4.176*	-2.347	-4.168**
FCF	-1.227	-4.575*	-1.989	-4.551*
ELF	-1.799	-7.337*	-1.920	-7.765*
EDU	2.476	-3.774*	-0.799	-4.224*
HLTH	-7.162*	-2.162	-3.857**	-0.538
OPEN	-2.912***	-8.481*	-3.761**	-8.258*

Note: *, **, *** indicate significance at 1%, 5% and 10% level of probability respectively.

The long run coefficients of the ARDL model are being estimated and reported in table 4, while short-run dynamics are presented in table 5 respectively. The analysis reveals that HCF plays imperative role in determining economic growth in case of Pakistan. The results indicate that both education and health coefficients are highly significant at 1% and in conformity with the expected signs. Every 1% increase in education improves economic growth by 1.24% on average in the long run and 1% improvement in health leads to improvement in growth by 4.80% on average in the long run.

Table 3. Bound Test of HCF-Economic Growth Model

F-Statistics (Wald-Test) = 6.948; based on AIC Criterion		
Level of Significance	**Lower Bound Value I(0)**	**Upper Bound Value I(1)**
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23
R^2=0.787	F-Statistics = 5.0922 Prob (0.000)	
Adj.R^2=0.633	Durbin-Watson Stat =2.422	

The findings of this study are in conformity with the findings of Malik (2006); Abbas & Foreman-Peck (2008); Qadri & Waheed (2011); Asghar et al. (2012) and Samar & Waqas (2014) in case of Pakistan. These studies have found the positive relationship between economic growth and HCF using different econometric methodologies and proxies for HCF but are not free from criticism. Similarly, Salman et al. (2015) also found the direct relationship between the two in panel of 32 developing countries including Pakistan. Remarkably, the results indicate impact of GFCF on growth to be statistically insignificant; however, its expected sign is in conformity with the endogenous growth theories. Similarly, openness of the economy does not seem an important variable explaining growth in the country and therefore confirming the findings of Rodriguez & Rodrik (1999). Interestingly, regime shifts have negative impact on growth, though it is insignificant in Pakistan. This may imply that consistency in macroeconomic policies is equally important in determining growth prospects of a country, which unfortunately lacks in democratic regimes. Historically, military governments remained more stable than democracy in Pakistan and hence their socio-economic policies were consistent and result oriented.

The estimates of ECM are presented in Table 5. The sign and significance are in conformity with the theory of the ARDL methodology. The ECM indicates causality in at least one direction and in the present study it is not only negative but is highly significant. The computed coefficient of ECM_{t-1} = -0.429 which in-

Table 4. Estimated Long Run Coefficients ARDL (1 3 3 3 0 0 0) based on Akaike Information Criterion Dependent Variable (LPCI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFCF	0.218	0.244	0.893	0.382
LELF	0.275	0.100	2.749	0.012
GEDU	1.242	0.261	4.749	0.000
LHLTH	4.803	0.129	37.087	0.000
LOPEN	0.015	0.066	0.231	0.819
REG	-0.025	0.018	-1.373	0.184
C	-14.415	0.601	-23.985	0.000

Table 5. Short Run Estimates of the Model ARDL (1 3 3 3 0 0 0) based on Akaike Information Criterion Dependent variable (ΔLPCI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ΔGFCFt	0.039	0.047	0.831	0.415
ΔGFCFt-1	0.012	0.038	0.331	0.744
ΔGFCFt-2	-0.082	0.039	-2.101	0.047
ΔLELFt	-0.250	0.066	-3.770	0.001
ΔLELFt-1	0.020	0.081	0.248	0.806
ΔLELFt-2	-0.204	0.076	-2.693	0.013
ΔEDUt	0.137	0.047	2.923	0.008
ΔEDUt-1	-0.104	0.054	-1.947	0.064
ΔEDUt-2	-0.124	0.053	-2.334	0.029
ΔLLEBt	2.063	0.555	3.718	0.001
ΔLOPENt	0.007	0.028	0.232	0.818
ΔREGt	-0.011	0.006	-1.812	0.084
ECMt-1	-0.429	0.116	-3.708	0.001

dicates that 42.9% of the disturbance from the equilibrium is corrected each year when a shock occurs. Diagnostic tests confirm that the conventional problems of heteroscedasticity and serial correlation in the disturbances are not evidenced. The model also passes RESET test of specification and J.B test of normality. This implies that the model is not only correctly specified but the errors are also normally distributed. For structural stability, CUSUM and CUSUM Square tests are conducted and the graphs are provided in appendix no.6 and the model also passes this test.

In the next step, VDCs are computed from an estimated VAR. From the computed VDCs given in Appendix-2, it is evident that both education (GEDU) and health (HLTH) i.e. HCF in the presence of other variables play imperative role in the determination of growth and development in case of Pakistan. At the one-year horizon, the fraction of forecast error variance of Pakistan's economic growth attributable to variations in GFCF, LELF, GEDU, LHLTH,LOPEN, and REG are 0.01%, 6.69%, 3.67%, 43.75%, 1.57% and 1.14% respectively. However, the explanatory power of education and health increases over the extended time horizon and education reaches at maximum (17.53%) at 7th year, while that of health (85.72%) at 4th year. Moreover, from the analysis it is evident that own shock is quite high for education and health at 61.01% and 85.96% respectively, while that of growth of fixed capital formation (GFCF), employed labor force (LELF), economic growth (LPCI), openness (LOPEN), and regime changes (REG) are 83.51%, 58.17%, 43.17%,9.61%, 5.89%respectively. From the VDCs analysis it can be inferred that health is the most exogenous variable in the system.

CONCLUSIONS AND POLICY RECOMMENDATIONS

Human capital not only determines and enhances economic growth of a nation, but also broadens the mental horizon of the people. In this regard, the dream of sustainable economic growth cannot be realized without human centric policies. The study aims to analyze and explore 'how and in how many ways' human capital influences growth prospects of a country? The estimated ARDL model indicates a stable long run relationship between growth and the components of HCF in the context of Pakistan. The findings of the study are in conformity with Mankiw et al. (1992) model; however, the extent of influence of health is much stronger than that of education. After 'pre and post' time series diagnostic and reliability tests, the study reveals that HCF cannot be ignored while achieving MGDs and hence sustainable economic development. The study further reveals that though HCF is essential for growth and development, however, the importance of its different components is asymmetric. Based on the findings of the study, heavily weighted HCF components if targeted on priority basis may help accelerate sustainable growth in the country, as investment in education alone will not suffice unless the health sector is equally targeted.

Table 6. Diagnostic Checking

Problem	Test-Statistics	Probability	Conclusion
Normality	Jarque-Bera=0.599	0.741	Normality Exists
Serial Correlation	Breusch-Godfrey LM Test=1.673	F(1,21)=0.21	No Serial Correlation
Heteroskedasticity	Breusch-Pagan-Godfrey=0.891	F(16,22)=0.597	No Heteroskedasticity
Specification	Ramsey RESET=0.013	F(1,21)=0.911	Correctly Specified

Note: Normality is conducted via Jarque-Bera test, Auto correlation via Breusch-Godfrey LM test, Heteroskedasticity via Breusch-Pagan-Godfrey test and, specification via Ramsey RESET test.

APPENDIX NO.1

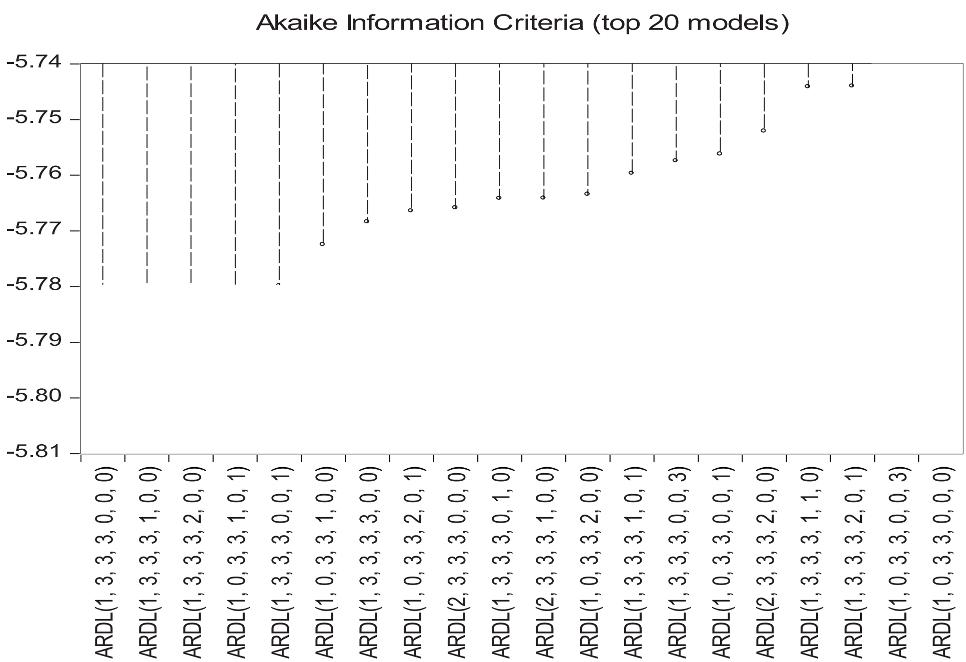

Figure 1. Top 20 models based Akaike Information Criterion

APPENDIX No.2 % of Forecast Variances Explained by Innovation in

Variance Decomposition of LPCI:								
Period	**S.E.**	**LPCI**	**GFCF**	**LELF**	**GEDU**	**LHLTH**	**LOPEN**	**REG**
1	0.014157	100.0000	.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.023437	43.16771	0.012397	6.688417	3.670163	43.75202	1.568066	1.141229
3	0.041781	13.59924	0.220226	3.960873	1.196770	79.96369	0.564692	0.494508
4	0.082103	6.306901	0.334381	2.447360	3.894601	85.72269	0.146729	1.147339
5	0.124243	6.296940	0.448950	1.100574	10.27232	79.61426	0.065063	2.201890
6	0.148715	6.784837	0.621544	1.418609	16.10385	71.21209	0.199528	3.659539
7	0.154971	6.491523	0.573049	3.925077	17.53231	65.57943	0.899523	4.999088
8	0.181369	5.979377	0.838035	6.275253	13.53857	68.33465	1.194015	3.840107
9	0.262811	6.772092	0.859364	4.725212	13.20985	71.73796	0.594279	2.101240
10	0.366874	7.176347	0.562800	2.894799	16.27895	70.45045	0.424771	2.211880
Variance Decomposition of LPCI:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.054097	5.816023	94.18398	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.060215	9.562708	83.51084	0.188249	0.152175	5.289177	1.115631	0.181216
3	0.095881	12.65066	34.71682	0.158162	17.47110	33.86204	0.827192	0.314023
4	0.117055	8.943801	23.34784	0.892815	26.20986	39.01692	0.570842	1.017923
5	0.125830	8.456627	20.24616	0.861373	25.63052	40.49294	2.487618	1.824755
6	0.131762	7.725414	18.82364	0.981748	23.39863	43.15824	4.054886	1.857444
7	0.150193	6.131417	15.02778	0.812654	18.66515	54.08487	3.375825	1.902296
8	0.177074	5.269144	10.85536	1.569088	16.31587	61.81463	2.435586	1.740324
9	0.212158	5.498869	8.004099	3.345655	16.23527	63.50464	1.709817	1.701645
10	0.251398	6.762707	5.972900	4.678767	16.20023	63.15942	1.227164	1.998814
Variance Decomposition of LELF:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.030607	10.57494	0.077495	89.34756	0.000000	0.000000	0.000000	0.000000
2	0.046776	7.741545	0.285661	58.17103	2.954975	29.47995	1.129293	0.237551
3	0.113611	8.763166	0.066195	10.58849	4.533557	75.75847	0.192535	0.097592
4	0.258584	8.434252	0.272524	2.065406	10.34705	78.00170	0.352550	0.526519
5	0.398567	8.849089	0.332460	1.179374	15.18333	73.08341	0.153101	1.219232
6	0.511606	8.569432	0.375325	1.818822	19.16754	67.66524	0.392808	2.010829
7	0.596695	8.046542	0.278727	2.914409	20.41499	64.70894	0.857070	2.779324
8	0.655061	7.615151	0.463430	4.876536	20.26687	62.43839	1.127364	3.212254
9	0.691745	7.114336	0.628243	7.894642	19.49634	60.35488	1.253791	3.257768

10	0.728264	6.670533	0.591595	11.01228	18.19591	59.26545	1.195892	3.068336
Variance Decomposition of GEDU:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.052926	6.655596	0.882669	21.22166	71.24007	0.000000	0.000000	0.000000
2	0.057206	14.27376	0.840434	18.16483	61.00645	1.174614	3.586943	0.952973
3	0.070486	9.615676	0.680605	12.02041	40.96008	33.19888	2.760923	0.763423
4	0.161162	9.999219	0.198304	2.318282	15.55175	70.44646	0.922799	0.563192
5	0.248905	11.55200	0.130763	0.978699	14.76690	70.84286	0.691255	1.037513
6	0.300868	10.97627	0.439156	1.059098	20.27063	64.10528	0.694312	2.455260
7	0.317378	10.03320	0.436987	2.629529	22.70417	58.63477	1.721319	3.840026
8	0.333547	9.267958	1.103851	5.931087	20.56569	56.75602	2.483570	3.891819
9	0.383079	8.664898	2.153273	7.421599	18.95322	57.71360	1.995667	3.097744
10	0.434320	8.758100	1.962811	6.844689	20.93152	56.58825	1.635671	3.278958
Variance Decomposition of LHLTH:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.000794	4.645822	0.221391	1.656865	3.568070	89.90785	0.000000	0.000000
2	0.003104	6.126453	0.085444	1.021212	6.574419	85.95915	0.070591	0.162727
3	0.007315	7.129537	0.015597	0.529817	9.721163	82.09584	0.020079	0.487968
4	0.013449	7.453998	0.026281	0.221504	12.53190	78.81101	0.029101	0.926202
5	0.021110	7.580005	0.024186	0.094770	14.78706	75.94003	0.126338	1.447620
6	0.029257	7.574955	0.012606	0.230162	16.58860	73.31265	0.297499	1.983519
7	0.036689	7.411244	0.023080	0.775027	17.88501	70.86521	0.545002	2.495429
8	0.042659	7.134026	0.070921	1.914864	18.51237	68.62747	0.821959	2.918394
9	0.047168	6.842385	0.139137	3.844972	18.43501	66.56233	1.018772	3.157393
10	0.050892	6.620590	0.173536	6.581426	17.80097	64.62555	1.044173	3.153762
Variance Decomposition of LOPEN:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.076439	0.512722	27.07489	7.096031	5.273350	2.652974	57.39003	0.000000
2	0.198637	0.422050	4.704188	5.647845	5.753968	73.78727	9.608970	0.075709
3	0.416096	4.893340	1.109544	1.954628	8.012702	80.96935	2.422619	0.637817
4	0.563238	7.348475	0.698822	1.218533	13.40165	74.76121	1.323677	1.247639
5	0.629917	7.100473	0.836732	1.764616	17.29348	68.51530	1.959267	2.530127
6	0.652245	6.630288	0.810433	3.835372	17.91104	63.95300	2.975221	3.884654
7	0.731439	6.395503	1.385034	7.448944	14.91057	63.98369	2.692388	3.183877
8	0.965032	6.983510	1.240318	7.110156	14.51966	66.35589	1.558244	2.232222
9	1.205581	7.395485	0.833453	5.259349	18.00857	64.70047	1.192366	2.610300
10	1.320013	6.899013	0.806041	4.433508	20.87755	61.10578	2.113007	3.765103

Variance Decomposition of REG:								
Period	S.E.	LPCI	GFCF	LELF	GEDU	LHLTH	LOPEN	REG
1	0.251420	1.033573	0.174261	0.395868	10.10476	12.97341	0.511897	74.80623
2	0.910136	3.235985	0.800807	0.216463	3.661395	85.98974	0.204142	5.891472
3	2.078933	5.330673	0.196562	0.358305	8.994718	83.12866	0.212153	1.778931
4	3.126867	6.007735	0.310592	0.223720	14.66556	76.74305	0.264786	1.784562
5	4.164859	5.559581	0.309908	0.365456	17.11552	73.53940	0.662296	2.447835
6	5.087693	5.714022	0.247187	0.819045	17.49561	71.62584	0.849130	3.249170
7	5.592176	5.547171	0.341596	2.552890	18.05892	68.58343	1.111456	3.804534
8	5.808641	5.182049	0.396860	5.526409	17.79895	65.42425	1.524992	4.146484
9	5.949436	4.942397	0.437156	9.404972	16.98032	62.53507	1.584939	4.115146
10	6.113666	4.723828	0.415686	13.95918	16.14888	59.29556	1.557863	3.898995
Cholesky Ordering: LPCI GFCF LELF GEDU LHLTH LOPEN REG								

APPENDIX No.3

A. Variables Definitions, Measurement and Data Source

Variables Definition	Measurement	Data Source
GDP Per Capita	Constant at 2005 US$	WDI
Gross Fixed Capital Formation	Constant at 2005 US$ in Millions	WDI
GDP	Constant at 2005 US$ in Millions	WDI
Exports of Goods and Services	Constant at 2005 US$ in Millions	WDI
Imports of Goods and Services	Constant at 2005 US$ in Millions	WDI
Life Expectancy at Birth	Years	WDI
Employed Labor Force	Percent of Population	ESP
Secondary School Enrollments	Numbers	ESP
Regime Changes	Dummy [1=democracy, 0=otherwise]	ESP

B. Variables' Construction

I. Openness = [X+M]/GDP

Where X represents exports of goods and services

M shows imports of goods and services

GDP is Gross Domestic Product

LOPEN = log of Openness

II. Growth of Gross Fixed Capital Formation (GFCF) = $\ln FCF - \ln FCF_{t-1}$

Where lnFCF is log of gross fixed capital formation and

$\ln FCF_{t-1}$ is lag of the log of gross fixed capital formation

III. Growth of Education (GEDU) = $\ln SSE - \ln SSE_{t-1}$

Where lnSSE is log of secondary school enrollments and $\ln SSE_{t-1}$ is the lag of log of secondary school enrollments

IV. Employed Labor Force as Percent of Population = [ELF/Pop]*100

ELF is employed labor force and

POP is total population

LELF = log of ELF as percent of population

V. Life Expectancy at Birth = HLTH

Where LHLTH = log of HLTH

VI. Per Capita GDP = PCI

Where LPCI = log of PCI

VII. Regime Changes = REG

Where REG is dummy variable takes the values of "1" for democratic governments and "0" for military governments.

APPENDIX No. 4 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	346.0357	NA	6.64e-17	-17.38644	-17.08786	-17.27931
1	618.8630	433.7254*	7.16e-22*	-28.86477	-26.47606*	-28.00772*
2	651.3668	40.00468	2.14e-21	-28.01881	-23.53999	-26.41185
3	717.4198	57.58473	1.90e-21	-28.89332*	-22.32439	-26.53645

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

APPENDIX No. 5

A. Bound Test of HCF-Economic Growth Model

F-Statistics (Wald-Test) = 4.565; based on Schwarz Information Criterion		
Level of Significance	**Lower Bound Value I(0)**	**Upper Bound Value I(1)**
1%	3.15	4.43
5%	2.45	3.61
10%	2.12	3.23
R^2=0.560	F-Statistics = 4.381 Prob (0.000)	
Adj.R^2=0.432	Durbin-Watson Stat =2.09	

B. Estimated Long Run Coefficients ARDL (1,0,1,1,0,0,0) based on Schwarz Information Criterion Dependent Variable (LPCI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFCF	0.460175	0.283391	1.623813	0.1145
LELF	0.186001	0.225312	0.825530	0.4154
GEDU	1.160788	0.500966	2.317102	0.0273
LHLTH	4.731736	0.271040	17.457691	0.0000
LOPEN	0.015551	0.134271	0.115816	0.9085
REG	-0.053207	0.047144	-1.128611	0.2677
C	-13.750738	1.177101	-11.681872	0.0000

C. Short Run Estimates of the Model ARDL (1,0,1,1,0,0,0) based on Schwarz Information Criterion Dependent variable (ΔLPCI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GFCF)	0.085571	0.039744	2.153025	0.0392
D(LELF)	-0.215913	0.070700	-3.053922	0.0046
D(GEDU)	0.092621	0.044800	2.067446	0.0471
D(LHLTH)	0.879880	0.391662	2.246531	0.0319
D(LOPEN)	0.002892	0.025048	0.115449	0.9088
D(REG)	-0.009894	0.005375	-1.840604	0.0753
ECM(-1)	-0.185953	0.083077	-2.238329	0.0325

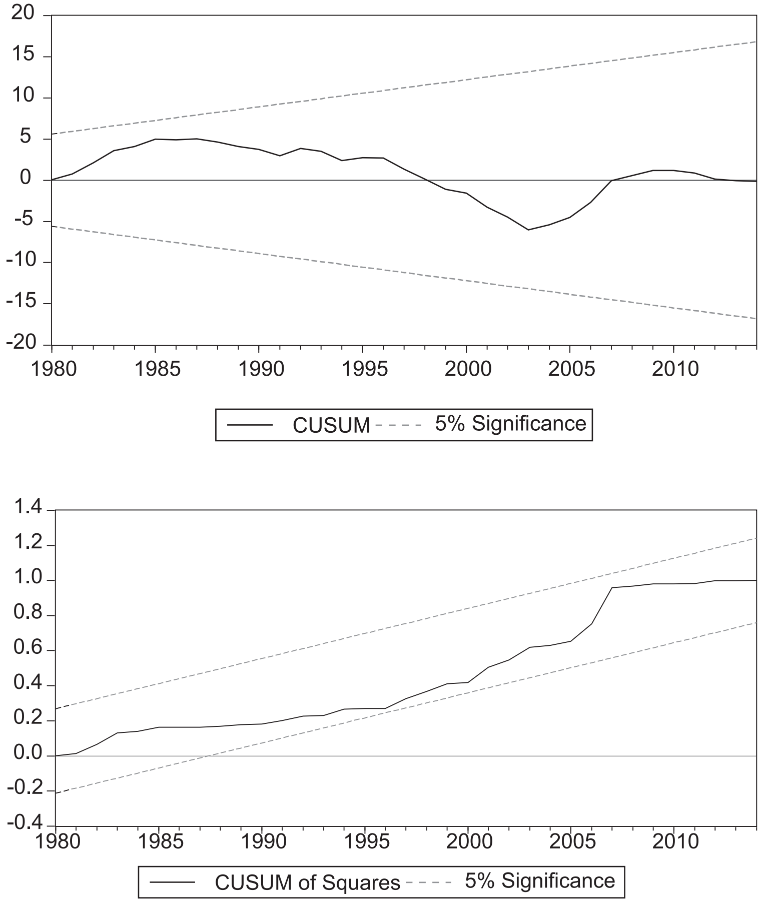

Figure 2. The Bound test results based on Schwarz Information Criterion

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