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Human Capital-Economic Growth Relationship: Finding the Most Relevant Level of Education in Pakistan

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Abstract: *The study employed annual dataset for the period 1981-2014 to find the most relevant level of education in terms of its contribution to the economic growth of Pakistan. The study used three models assuming gross enrolment rates at primary, secondary and tertiary level as human capital and found secondary education as the most relevant level of education for economic growth. The long run coefficients obtained through fully modified ordinary least square (FMOLS) are used to reconfirm the findings of dynamic ordinary least square (DOLS). Rolling window regression found that the human capital elasticity of aggregate output oscillated around zero in the sample period whereas CUSUM test found that the parameters of equation with secondary education as human capital are stable. It is recommended therefore that secondary education should be given preference in resource allocation to ensure long run economic growth of Pakistan.*

Keywords: Human Capital, Economic Growth, Education
JEL Codes: E24, O40, I20

Introduction

It is theoretically as well as empirically evident that human capital plays positive and significant role in the economic growth of a country. In one hand, human capital increases aggregate output through increasing productivity of labour and employment and at the other hand, it stimulates aggregate demand through increased income due to productivity and employment. With the passage of time, the availability of cross country reliable data sets enabled the researchers to empirically test the theoretical models establishing the contribution of human capital in economic growth of a country [1].

There has been a lot of work done in order to enlighten different aspects of the relationship between human capital and economic growth using cross sectional, time series and polled data techniques. Though the availability of cross country data sets helped in supporting the theoretically defined linkages between human capital and economic growth however, there are studies found human capital as insignificant or negatively related to the long run economic growth. This shows that there is still a lot of work to be done in this

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[1] See Qadri and Waheed (2014) for example.

area of study to explain the empirically found facts which are contrary to the theory and prior expectations [2].

In Pakistan, human capital is one of the most neglected sector despite declaring it as one of the most important sector in growth and development related policies. Even at present, the official documents state that "Pakistan Vision 2025 aims at substantial expansion in levels of education as well as improvements in the quality of education, increase public expenditure on education to reach 4.0 percent of GDP by 2018" which is very similar to the previous policy statements however, it is hard to find an evidence supporting a movement towards this target. For the past decade, public spending on education as percentage of GDP remained to be lowest as compared to the South Asian countries. It oscillated around 2 percent for the last 15 years and is 2.14 percent currently. Literacy rate, which is an important indicator associated with the stock of human capital in any country showed 2 percent decline in the year 2012-13 which is as alarming. Gross enrollment rate, an indicator related to the flow of human capital shows slight decline from 91 percent in 2012-13 to 90 percent during 2013-14 despite previous policy statements admitting education as the area of high priority [3].

The past is also evident of a priority shift from one level of education to another level of education ignoring the previously high priority level of education. It is very important for any country to prioritise the levels of education and give special focus to the high priority level of education in order to ensure long run growth and development. Even though few attempts have been taken in the past to enlighten the relationship between different levels of education and economic growth of Pakistan, the current study establishes the relationship by using relatively updated dataset and advanced econometric techniques as compared to the previous studies in this area.

The objective of this paper is to find out the most relevant level of education in terms of its contribution in the economic growth of Pakistan. It is important to know the level of education which contributes more in economic growth than the other levels in the long run to provide more resources to that particular sector for ensuring economic growth.

The study is organised in the following sections. Section 2 presents a brief review of studies on the subject, section 3 presents the methodology and estimation results while section 4 concludes the study and discusses policy implication associated with the found results.

Review of Literature

Ignoring few exceptions, the positive role of human capital in determining economic growth has been empirically established through time series and cross country studies. In most of such studies, education indictors are used to proxy human capital. Becker (1962) developed a theoretical model explaining the process of investment in human capital and its impact on current and future earnings. Barro (1991) found empirical evidence from cross country data set about the positive role of human capital in economic growth and income convergence.

[2] See Pritchett (2001) for details.

[3] Gross enrollment rate at the primary level excluding Katchi (prep).

Mankiw, Romer, and Weil (1992) also found human capital augmented growth equation as better specification in explaining economic growth. A brief review of some selected studies on this subject is presented as follows.

Barro (1991) used a data set of 98 countries for the period 1960-85 to analyse different determinants of economic growth and cross country income convergence. The study used outcome based flow indicator of human capital and found that the growth rate of per capita GDP is positively related with the initial stock of human capital whereas the initial stock of physical capital is found to be negatively related with the same. The study found evidence of income convergence if the human capital stock of poor country exceeds the stock of human capital in a typical low income country.

Mankiw et al. (1992) used a data set of 121 countries for the time period 1960-85 to find evidences supporting Solow model with and without human capital. The authors employed OLS to estimate the model with and without human capital where an outcome based indicator of human capital was used. It was found that the model with human capital input explained cross country income differences better than the model without human capital. Because of this reason, the authors suggested to use model with human capital in explaining the process of economic growth in the future studies.

Benhabib and Spiegel (1994) analysed the role of human capital in the process of economic growth using cross country regression estimates associated with physical and human capital from exogenous as well as endogenous growth standpoint. In the model based on exogenous growth theory, the coefficient of human capital was found to be statistically insignificant. This insignificance was invariant in six different specifications. In another model based on endogenous growth theory, the coefficient of human capital was found to be significant and this result was robust in the same six specifications.

Mehrara and Musai (2013) used a data set of 101 developing countries to test the relationship between human capital and economic growth for the period 1970-2010. The study employed panel cointegration and causality analysis and found strong positive evidences of relationship between human capital and economic growth. The study used a proxy for human capital based on enrollment rates at all levels and spending on education as percentage of GDP so that the established relationship is sensitive to the weightages assigned to the principal variables. Moreover, despite establishing human capital- economic growth relationship, the long run coefficient of human capital was neither reported nor discussed in the study.

Abbasa and Foreman-Peck (2007) used the stock of human capital which is calculated through secondary enrollment data to test the human capital-economic growth relationship in Pakistan during 1961-2003. The study also used health expenditures as proxy for human capital. The study employed co-integration technique to test the long run relationship between human capital and economic growth. The study found evidences of positive and statistically significant relationship between human capital and economic growth of Pakistan.

Qadri, Jawaid, and Arif (2009) employed Engle Granger two step procedure and Johansen cointegration method to find the impact of primary, secondary and higher education enrollment to the economic growth of Pakistan. The study found primary education as most important in terms of its contribution to the economic growth. Though the objective

of this study is important, the variable used as well as the methodology employed needs appropriate adjustments. In particular, instead of using enrollments at different levels, usage of enrollment ratio is more suitable in this context.

Qadri and Waheed (2011) tested the human capital-economic growth relationship by using a health adjusted education indicator as a proxy for human capital. The study used annual dataset from 1978 to 2007 and applied Johansen cointegration technique to confirm long run relationship between human capital and economic growth of Pakistan. The coefficient of human capital was found to be positive and statistically significant. The results were found to be in-variant when tested through sensitivity analysis inclusion of variable approach.

Khattak and Khan (2012) used OLS and Johansen cointegration technique to test the strength of relationship between human capital and economic growth of Pakistan. The study used gross enrollment rate at elementary and secondary level as proxy for human capital in two different specifications using dataset from 1971 to 2008. The study found evidence of long run relationship through Johansen cointegration test however the long run coefficients of both specifications are neither reported nor discussed in the study.

Imran, Bano, Azeem, Mehmood, and Ali (2012) used education and health spending as proxies for human capital to test its relationship with economic growth of Pakistan from an annual dataset of 1973-2002. The study used cointegration technique to test the relationship and found evidence of long run relationship however, the coefficient of education is found to be statistically insignificant which might be the outcome of misspecification of education and health indicators. Instead of using these spending in absolute values, the values as percentage of GDP could have given more logical results.

Despite of sufficient empirical evidence regarding the positive contribution of human capital in the economic growth of an economy, the extent of contribution found to be changed with the different human capital indicators. Besides econometric reasons, this is a reflection of the fact that all indicators of human capital are not equally important. From social perspective, all levels of education can be equally important however when it comes to the resource allocation decision, economic importance of different levels of education are also taken into consideration.

Methodology and Estimation

To find out the most relevant level of education in the context of economic growth, the study used real GDP as dependent variable whereas labor, physical capital and human capital are taken as inputs in the production process.

In studying human capital-economic growth relationship, the choice of right proxy for human capital is crucial as different proxies presents different aspects of human capital therefore an implicit imperfection is there in establishing the said linkages. The proxies of human capital can be divided into cost, income and output based proxies.

The cost based proxies use indicators associated with spending on education or/and health and the opportunity cost of attending school. The income based proxies such as the one constructed by Mulligan and Sala-i Martin (1997) assumes that aggregate output

depends on two inputs namely human capital and non-human capital input. This approach captures quality differences across regions and time. In most of the studies, outcome based human capital proxies are used. The outcome based proxies are further divided into stock indicators such as adult literacy rate and flow indicators like enrollment rates at different levels of education.

The outcome based proxies are widely used due to availability of reliable cross country datasets which made it easy to study the role of human capital in cross country income differences. In the present study, Human capital is proxied through Gross enrollment rate as a flow of human capital. The log transformation of a general growth model is presented as follows:

$$log(y_t) = \alpha_o + \alpha_1 log(L_t) + \alpha_2 log(K_t) + \alpha_3 log(H_t) + \epsilon_t \quad (1)$$

In this model, Y_t represents real GDP at time t, L_t represents the labor input proxied through labor force at time t, K_t represents capital input at time t and Ht is the human capital input at time t whereas ϵ_t is the white noise error term in the model. In order to find the most important level of education in terms of statistical significance and magnitude, the study uses three different models of growth as follows:

$$log(y_t) = \alpha_o + \alpha_1 log(L_t) + \alpha_2 log(K_t) + \alpha_3 log(P.E_t) + \epsilon_t \quad (2)$$

$$log(y_t) = \alpha_o + \alpha_1 log(L_t) + \alpha_2 log(K_t) + \alpha_3 log(S.E_t) + \epsilon_t \quad (3)$$

$$log(y_t) = \alpha_o + \alpha_1 log(L_t) + \alpha_2 log(K_t) + \alpha_3 log(H.E_t) + \epsilon_t \quad (4)$$

Model 2, 3 and 4 use gross enrollment rate at primary, secondary and tertiary education respectively. The dataset for GDP, labor force and gross fixed capital formation which is used as proxy for capital is taken from Pakistan Bureau of Statistics whereas the data for gross enrollment is taken from UNESCO dataset. All the data used in this study is from 1981 to 2014.

Test of Stationarity

Prior to test the long run relationship between variables in equation 2, 3 and 4, it is important to check the order of integration associated with all variables. The order of integration is tested through Augmented Dickey Fuller (ADF) and the results are presented as follows:

The results show that all variables included in the study are integrated of order one which is a prior condition for long run relationship. The results show that the variables included in the equations 2, 3 and 4 can be cointegrated.

Table 1
Stationarity Testing by Augmented Dickey Fuller

Variables	Level		First difference	
	C	C&T	C	C&T
Yt	-1.425	-2.793	-3.4	-3.576
Lt	0.018	-1.93	-5.284	-3.414
Kt	-1.886	-2.08	-5.134	-4.768
P.Et	0.517	-2.035	-6.782	-6.878
S.Et	0.155	-1.409	-5.134	-5.153
H.Et	4.62	2.146	-3.453	-5.136

Critical values with constant (C) and Constant with trend (C&T) at 5 percent and 10 percent are -2.954, -3.552 and -2.616, -3.210 respectively.
Source: Authors' estimation

Test for Co-integration

To confirm this indication of cointegration, the study used (Johansen & Juselius, 1990). This method tests the evidence of cointegration through trace statistics and maximum Eigen value statistics. The results of Johansen and Juselius method are presented as follows.

Table 2
Test of Co-integration: Johansen and Juselius

Variables	Null Hypothesis	Trace Statistics	5 percent critical values	Max Eigen Value Statistics	5 percent critical values
Equation 2	None	63.294	54.079	28.688	28.588
	At most one	34.606	35.193	17.906	22.3
Equation 3	None	73.678	63.876	38.354	32.118
	At most one	35.324	42.915	18.027	25.823
Equation 4	None	47.808	40.175	25.92	24.159
	At most one	21.888	24.276	12.405	17.797

Source: Authors' estimation

As shown in the table 2, the null hypothesis of no cointegration vector is rejected in all the three equations at 5 percent level of significance through trace and maximum Eigen value statistics whereas no other hypothesis could be rejected confirming the existence of long run relationship between the variables in all the three models in the study. Having established the existence of long run relationship between variables in equations 2, 3 and 4, it is relevant to compare the magnitude and statistical significance of the long run coefficients in these three equations.

Long Run Coefficients through Dynamic Ordinary Least Square (DOLS)

Since the long run parameters estimated through Johansen and Juselius (1990) can be biased because of misspecification in the other equations, a better way of estimating the coefficients is to use dynamic ordinary least square (DOLS). This method is preferable in case of small sample and in case of dynamic sources of bias in the coefficient estimation process as proposed by Stock and Watson (1993). This method includes leads and lags

of first differences of independent variables to deal with endogeniety issue and cope with serial correlation through GLS method [4]. To estimate the long run coefficients associated with equation 2, 3 and 4, dynamic ordinary least square method is used and the results are presented in the Table 3.

Table 3
Long run coefficients of equation 2, 3 and 4 by DOLS

	Equation 2			Equation 3			Equation 4		
Variables	**Coefficient**	**t- stats**	**Prob (t-stats)**	**Coefficient**	**t- stats**	**Prob (t-stats)**	**Coefficient**	**t- stats**	**Prob (t-stats)**
L	0.721	0.667	0.513	0.361	2.036	0.057	0.852	2.184	0.04
K	0.788	4.337	0	0.773	7.577	0	0.584	2.577	0.017
H	-0.309	-0.238	0.815	0.199	1.992	0.062	-0.04	-0.579	0.569
C	3.642	2.074	0.053	3.151	3.552	0.002	4.64	2.629	0.015
Adj R_2		0.985			0.985			0.983	
D.W.		1.085			0.718			0.487	

All variables are in log form. Variable 'H' represents human capital here which is proxied through gross enrollment in primary, secondary and tertiary education in the equation 2, 3 and 4 respectively.
Authors' estimation.

The table shows that human capital is found to be insignificant in equation 2 and 4. The model 3 found positive and statistically significant contribution of human capital in the economic growth of Pakistan. It means that secondary education is likely to be the most relevant sector in terms of its contribution in the economic growth. The result is similar to the one found in Abbas and Mujahid-Mukhtar (2000); Abbas and Nasir (2001).

Among other possible reasons of statistically insignificant coefficients associated with primary and tertiary education, it seems more realistic that the primary education is associated with agriculture sector in terms of its contribution in GDP and agriculture sector is less productive sector of Pakistan as compared to the other counter parts leaving small room for human capital to contribute. At the other hand, tertiary education is generally associated with services sector however the type of education provided in the tertiary level is inconsistent with the need of service sector which might result in insignificant coefficient of human capital. It order to be more confident about this finding, it is preferable to re-estimate the equations 2, 3 and 4 through another procedure namely fully modified ordinary lease square (FMOLS) method.

Long Run Coefficients through fully modified Ordinary Least Square (FMOLS)

In order to check the consistency of previous results, the long run coefficients are estimated again through fully modified ordinary least square (FMOLS). This method was developed by Phillips and Hansen (1990) to test the consistency of coefficients estimated through OLS. This method is developed in order to get optimal estimates of cointegrating equations, (Bakker & Felman, 2014). Moreover, this method provides reliable estimates in case of small sample size and adjust the estimates to eliminate the effect of serial correlation and

[4]Recently Jawaid and Saleem (2017) has adopted the same methodology.

endogeniety associated with the existence of cointegrating relationship, (Kalim & Shahbaz, 2009) [5]. The results of FMOLS are presented in the table 4 as follows.

Table 4
Long run coefficients of equation 2, 3 and 4 by FMOLS

	Equation 2			Equation 3			Equation 4		
Variables	**Coefficient**	**t- stats**	**Prob (t-stats)**	**Coefficient**	**t- stats**	**Prob (t-stats)**	**Coefficient**	**t- stats**	**Prob (t-stats)**
L	0.746	0.761	0.335	0.426	0.231	0.076	0.814	0.331	0.02
K	0.736	0.186	0	0.67	0.122	0	0.571	0.168	0.002
H	-0.088	0.98	0.929	0.397	0.173	0.029	0.012	0.082	0.882
C	3.252	1.676	0.062	3.667	1.069	0.002	4.866	1.272	0.001
Adj R_2		0.964			0.966			0.975	
D.W		0.738			0.749			0.685	

All variables are in log form. Variable 'H' represents human capital here which is proxied through gross enrollment in primary, secondary and tertiary education in the equation 2, 3 and 4 respectively.
Authors' estimation

The table shows that human capital is found to be statistically insignificant in two out of three models. The coefficient of human capital is significant and positive in case of human capital as enrollment rate in the secondary education which is the model 3 in this study. The results re-confirm previous results reported in the table 3 where model 3 was found to be the one revealing enrollment rate in the secondary education as contributing factor of economic growth. The results imply that the positive contribution of secondary education in the long run economic growth is consistent.

Stability of Long-Run Parameter: A Rolling Window Analysis

To test whether the long run coefficient of human capital in the model 2 is stable in the sample period or not, rolling window method is employed [6]. This method estimate the coefficient of independent variables for every time interval in the sample period start from at least 5th time period from the starting point of data series. Since, the relevant variable is human capital for the model 2, the results of rolling window regression for human capital is presented in the table 5 and figure 1.

Table 5
Coefficient of human capital estimated through rolling window regression

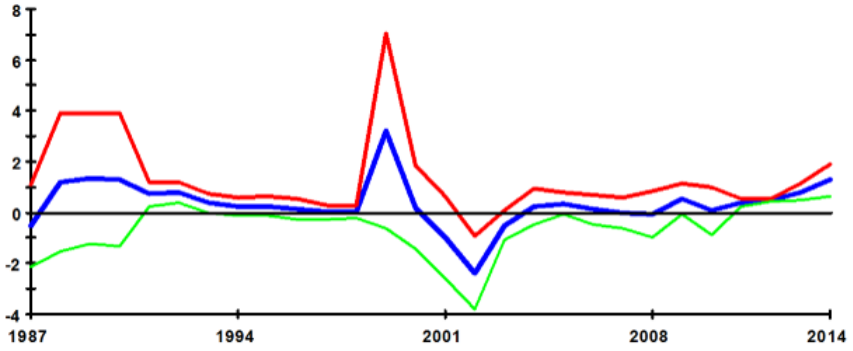
Year	**Coefficient**	**Year**	**Coefficient**	**Year**	**Coefficient**	**Year**	**Coefficient**
1987	-0.632	1994	0.097	2001	-1.855	2008	0.118
1988	2.983	1995	0.123	2002	-1.92	2009	0.446
1989	2.728	1996	0.178	2003	-0.546	2010	0.45
1990	1.922	1997	2.973	2004	-0.275	2011	0.531
1991	0.88	1998	3.894	2005	0.255	2012	0.515
1992	0.689	1999	-0.756	2006	-0.229	2013	0.47
1993	0.23	2000	-2.819	2007	2.297	2014	1.88

Note: Coefficient shows long run elasticity.
Authors' estimation

[5] See Jawaid and Waheed (2017) for example of using FMOLS.
[6] As a recent reference for this, see Jawaid, Abbas, and Saleem (2017).

In the figure 1, red and green lines indicate two standard deviation bands representing upper and lower bounds whereas the blue line represents coefficients of human capital for all observations from 1985 to 2014. The variables in rolling window regression are in the log form as presented in the equation 2 which can be interpreted as long run elasticities. Similarly, the coefficient of human capital presented in the table 5 can be interpreted as human capital elasticity of aggregate output in the economy.

Figure 1
Daily Coefficient of human capital through rolling window regression



- Dependent variable: Log (Y_t)., Number of regressors:04
- Coefficient of S.E$_t$ (_____) and its two S. Errors (_____ and _____) bands based on rolling OLS
- Source: Authors' estimation

The table 5 and figure 1 show that the elasticity oscillated around zero throughout the period of 1987 to 2014. An overall decline can be observed in the elasticity from 1988 which is the year of a regime shift in Pakistan. This continued till 1994 and followed by a smooth increase in 1995 and 1996 and a sharp increase in the two subsequent years. The coefficient was found to be negative from 1999 to 2006 with exception to 2005 and remained positive for rest of the sample period which might be because of a regime shift in 1999. The economic indicators in the period 1999-2006 gradually improved moved in positive direction causing employment to increase. The economic expansion might result in falling gross enrollment in that period causing human capital elasticity to be negative that period. It was positive and stable from 2009 to 2013 than increased sharply in 2014.

Test for Parameter Stability through CUSUM

In order to test the stability of the parameters in the equation 3, cummulative sum of the recursive residuals (CUSUM) test is used. The results of this test is presented in the figure 2 where recursive residuals are plotted against plus/minus two standard errors at every point. Residuals inside the two standard error bands indicate parameter stability and vice versa.

Figure 2
Test for variance stability through CUSUM

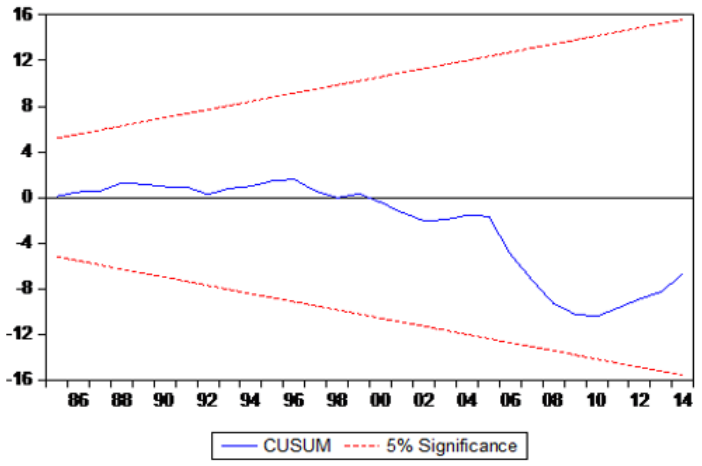


Figure 2 shows that recursive residuals are inside the 95 percent bands implies that the parameters of equation 3 are stable. The results obtained through DOLS and FMOLS show that secondary education is the most relevant level of education in terms of its contribution to long run economic growth. Moreover, it is also observed that a regime shift in Pakistan is generally followed by a decline in the magnitude of relationship between human capital and economic growth which might be because of entirely different economic conditions after a regime shift in Pakistan.

Conclusion

The contribution of education as human capital in the process of economic growth is uncontroversial however, it is important to know the level of education which is most relevant in terms of its magnitude of contribution and statistical significance. The study used three models assuming gross enrollment rates at primary, secondary and tertiary level as human capital and found secondary education as the most relevant level of education for economic growth. The study found the evidence of long run relationship between human capital and economic growth of Pakistan in case of models in the equation 2, 3 and 4. When estimated through dynamic ordinary least square method (DOLS), the coefficient of human capital is found to be insignificant in case of assuming primary and tertiary education as human capital presented in the equation 2 and 4. Fully modified ordinary least square (FMOLS) reconfirmed the previous findings. Rolling window regression found that the coefficient of human capital proxied through gross enrollment in secondary education presented as equation 3 oscillated around zero throughout the sample period. The coefficient interpreted as human capital elasticity of aggregate output which showed slightly decreasing trend in the first half of the sample period and smoothly increasing trend in the other half of the sam-

ple period. CUSUM test found that the parameters of equation 3 are stable. The study found that secondary education is the most important level of education in terms of its contribution in the growth process. It is non-controversial to increase education spending to all levels of education in order to ensure individual, social and economic development of Pakistan, it is recommended that preference should be given to secondary level of education in terms of resource allocation in order to ensure long run economic growth.

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