Human Capital and Economic Growth: Time Series Evidence from Pakistan

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Abstract

Human capital is generally considered as a positive contributor in the economic growth. In this study, we estimate this relationship using time series data of Pakistan for the period 1978 to 2007. A health adjusted education indicator for human capital is used in the standard Cobb-Douglas production function confirms the long run positive relationship between human capital and economic growth in Pakistan. Sensitivity analysis was also performed in order to check the robustness of the initial findings. The estimation results supported the findings of the previous studies that human capital is positively related to growth and also that the results are robust. The health adjusted education indicator was found to be a highly significant determinant of economic growth, which indicates that both the health and education sectors should be given special attention in order to ensure long run economic growth.

Key Words

Human Capital, Economic Growth, Education and Health

JEL Classification

E 24, I18, I21, O47.

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1. Introduction

Human capital is widely accepted as an important determinant of economic growth[3] and the importance of human capital accumulation is unconditionally acknowledged in existing exogenous and endogenous growth theories (Mankiw et al. 1992, Bergheim. 2005 and Howitt. 2005) however what still debatable is what factors should be considered as human capital. In most of the studies education or health related indicators are employed as a proxy for human capital.

Despite the importance of education and health sectors for economic growth of any country, these are still one of the most neglected sectors of the Pakistan economy. The regional comparison of public expenditures on education and health sectors as a percentage of GDP along with the other education and health indicators are presented in the table 1 below.

Table 1: Regional comparison of Education and Health expenditures

Countries	Public Expenditures on Education as a percentage of GDP	Public Expenditures on Health as a percentage of GDP	Life Expectancy at birth	Literacy Rate	Combined Gross Enrolment rate
Bangladesh	2.5	0.9	65.7	53.5	52.1
India	3.8	0.9	63.4	66.0	61.0
Maldives	7.1	6.3	71.1	97.0	71.3
Nepal	3.4	1.5	66.3	56.5	60.8
Pakistan	**2.3**	**0.4**	**66.2**	**54.2**	**39.3**
Sri Lanka	6.2	2.0	74.0	90.8	68.7

Source: UNDP, Human Development Report, 2007-8 and 2009-10.

The expenditure figures are from HDR 2007-08 and the values regarding life expectancy, literacy and enrolment are from HDR 2009-10. Public expenditure on education as a percentage of GDP is 2.3 in the case of Pakistan, which is the lowest in the South Asian region. The health sector in Pakistan is historically a low priority sector where the public expenditure

[3] See Bergheim, (2005).

as a percentage of GDP is usually constant at less than one percent[4]. The current figure is 0.4 percent which is also the lowest in South Asian countries. It is note worthy that the adult literacy rate of Bangladesh is slightly lower than Pakistan however the combined gross enrolment rate is much higher than Pakistan which indicates that the literacy rates in Bangladesh will be higher than Pakistan in the near future. Public expenditures on health as a percentage of GDP is lowest in the case of Pakistan it is less than half of the second lowest countries Bangladesh and India. Life expectancy at birth is moderate in Pakistan.

This study focuses on the role of human capital in economic growth of Pakistan using an annual data set from 1978 to 2007 and analyzes the relative importance of investment in human capital. The study is organized as follows. Section 2 discusses theoretical underpinning and empirical evidence regarding the subject, Section 3 presents modeling framework. Section 4 elaborates empirical findings and Section 5 concludes the study and discusses the policy implications.

2. Review of literature

2.1. Theoretical underpinning

Human capital is a key factor in explaining economic growth (Mankiw et al. 1992 and Bergheim, 2005), as it increases the output through various known empirically tractable and intractable channels. Human capital enables a worker to produce more output (Bergheim, 2005). As human capital increases the productivity of labor, demand for labor and hence employment and output rises. Moreover, as human capital is necessary for optimum utilization of physical capital. Increase in the stock of human capital in any economy attracts investment in physical capital which in turn increases output (Abbas, 2000 and 2001).

[4] Handbook of Statistics on Pakistan Economy, 2005 by State Bank of Pakistan.

Education which is probably the most important determinant of human capital (Bergheim, 2005) affects output through various channels. It increases knowledge which helps to produce more output in relatively smaller time and also it is intuitionally suggested that an educated person could learn much faster. Increase in the level of education also leads towards better health due to increase in the awareness of the benefits of healthy living, which in turn increases output. Moreover, education also enhances labor force participation in an economy particularly in the case of female participation[5] and output increases further, due to the higher labor force participation rate. Along with education, the role of experience is also very important in productivity growth. Experience generally reduces the chances of errors and increases output in a given time period.

Health and nutrition are also important elements of human capital. A healthier worker can contribute more in the production process than his unhealthy counterpart. There are several channels that define the contribution of health in production and output[6]. Like a healthier worker can produce more output than an unhealthy worker because of his higher physical and mental capabilities, vigor and stamina. In the same way, for a given level of all other factors, the economy can produce higher output if it has higher levels of health. Health is an important factor for determining the level of returns from education because a healthier person can learn more than an unhealthy one from a given level of education. In this way, improvement in health increases output due to increased strength and also due to more learning from a given level of education.

Nutrition has a strong link with productivity, output and economic growth. A person who intakes nutritious food is likely to be more productive due to high vigor and strength. In this

[5] See Mincer, (1996) for details.
[6] For more details about health contribution on economic growth, see Howitt, (2005).

way providing good nutrition is considered as an investment in human capital. Especially in the case of economic growth, education and health reinforce each other; being healthy is as important for economic growth as being educated (Taniguchi; Wang 2003).

Exogenous as well as endogenous growth theories acknowledge the contributions of human capital to economic growth and the theoretical models predict the role of human capital as a positive contributor. Empirically drawn conclusions in this issue have however been mixed.

2.2. Empirical Evidence

Mankiw et al. (1992) empirically examine the Solow growth model with and without human capital as a factor of production and find that the human capital augmented Solow model fits in explaining cross-country income variations. The study employs a data set of 121 countries from 1960 to 1985 and applies the method of OLS for estimation. The authors use Cobb-Douglas production function consisting of output as a dependent variable while labor, physical capital and human capital are explanatory variables. The study uses a variable "School" as a proxy for human capital. The variable School was constructed through taking the percentage of the people aged between 12 to 17 enrolled in secondary schools. This percentage was multiplied by working age population which is of school age (15 to 19). The augmented Solow model explained around 80% income variation across nations and the authors recommended this framework for further studies on economic growth.

Bernanke and Gurkanak (2001) re-examine the Mankiw, Romer and Weil (1992) framework, (henceforth MRW 1992) framework with an extended dataset and concluded differently. They also apply OLS method on an extended annual data set from 1960 to 1995. This study also uses a Cobb- Douglas production function with the same variable "School" as a proxy for human capital as used in the MRW (1992) framework. The results on the extended data

set was not in line with augmented Solow model and it was also found that long run growth rate is correlated with behavioral variables (like saving rates) so they end up with the conclusion that long run growth is endogenous, not exogenous.

Abbas (2000) uses a growth accounting framework to compare the affect of human capital on economic growth in Pakistan and India using OLS method on a dataset of 25 years from 1970 to 1994. The equation consisted of output as dependent variable while labor, physical capital and human capital were used as independent variables. In this study, enrolment rates at primary, secondary and higher secondary levels were taken as a proxies for human capital. The results varied with different proxies of human capital taken in the study (like primary schooling, secondary schooling and higher schooling). Secondary schooling was found to be positively related and significant in both the countries however primary education was found to be positively related in case of India at 1% level of significance and higher education was found positively related in case of Pakistan at 10% level of significance.

Abbas (2001) in a similar study empirically investigates the affect of human capital on economic growth in Pakistan and Sri-Lanka. The production function used in the study is a standard human capital augmented production function in which output growth depends on labor, physical capital and human capital. The OLS method was applied on an annual data series from 1970 to 1994. Enrolment rates at primary, secondary and higher secondary levels were taken as a proxy for human capital in the study. Human capital was found to be positively related with economic growth in Pakistan at 1% level of significance and at 5% level of significance in case of Sri-Lanka at secondary and higher secondary level respectively.

Wang and Yao (2001) analyzed China's rapid growth as a result of factor accumulation as well as TFP growth in the post reform period of 1978 to 1999. The study used an annual data set from 1953 to 1999 and employed growth accounting technique in which growth in labor, capital and human capital are inputs while the residual captures growth in TFP. The study used average schooling years of population aged between 15 to 65 years as a proxy for human capital. They conclude that in the pre reform period (1953 to 1977) growth was factor led and TFP growth was negative while in post reform period, factor accumulation as well as TFP growth played the role in the robust growth.

Duma (2007) studies the sources of growth in Sri Lanka using annual data from 1980 to 2006. They also employed the growth accounting frame work. A human capital augmented Cobb-Douglas production function was used in the study where output growth was taken as a dependent variable while growth in labor, growth in physical capital and growth in human capital were taken as explanatory variables. Total factor productivity is the residual in the equation which captures all the unexplained variations in output growth. As the data on average years of schooling was not available, the author followed a different process to create a variable that could be used as a proxy for human capital in the study. The author found a very low contribution of human capital to growth. From 1980 to 2006, human capital only contributed around 10% of output growth while physical capital and labor contributed 17% and 27% respectively. The major contribution to growth was TFP which contributed around 46%. The author justified the results on the ground that in the period after 1980's there was a slow down in the labor intensive product line along with a rapid growth in the output of capital intensive industries with higher productivity level. They ended up with the conclusion that in explaining Sri Lanka's sources of growth after 1980's, TFP played a significant and dominating role.

Abbas and Foreman-Peck (2007) use the co-integration technique for estimating the affect of human capital on economic growth of Pakistan in the period 1961 to 2003. In this study, the stock of human capital was used as a proxy for human capital which was calculated through the perpetual inventory method by using the secondary enrolment data. Another proxy for human capital used in the study was health expenditures as a percentage of GDP. They found an increasing return to physical and human capital specially in case of investing in health sector.

Madsen et al. (2008) studied Indian growth using a data set of 1950 to 2005 and a dataset of 590 firms from 1993 to 2005 to find evidence of endogenous growth in India. A human capital augmented production function was used in the study and the method of co-integration was adopted for estimation. They found very little support to the endogenous growth hypothesis as the TFP and research activity were not found to have a long run relationship. Instead of endogenous growth, the study showed that Indian growth could be characterized a Schumpeterian .They found a long run relationship between research activity and product varieties. The study also found strong international spillover effects on the Indian economy.

3. Modeling Framework

In the former studies, a standard Cobb-Douglas production is employed where real GDP, real GDP growth or real GDP per working age population are taken as dependent variables. The investment GDP ratio, gross domestic investment or capital stock (through perpetual inventory method) are taken as capital input while data for labor force or employment used to incorporate the labor input.

The input of the core variable human capital is captured through various methods in different studies. In the Mankiw, Romer and Weil (1992) framework, a variable School was taken as a

proxy of human capital which was constructed through taking the percentage of working age population (12 to 17) enrolled in secondary schools. This percentage was multiplied by working age population that is of school age (15 to 19). Although there is a difference in the age ranges in the two components of the variable "School" but this imperfect match-up is not likely to create a major bias according to Barnanke and Gurkaynak (2001) which also used the same variable with extended dataset. Wang and Yao (2001) constructed a proxy for human capital by taking the average schooling of population age 14 – 65. Duma (2007) derived the data for average years of schooling as this was unavailable. At first, maximum educational attainment of employed people is taken at each level (as a share of the total) and multiplied by the number of years of schooling in each grade level. The sum is multiplied by the number of employed people to get the average year of schooling of the work force.

The production function in the current study is a standard Cobb-Douglas production function with labor, physical capital and human capital as input factors.

$$YL_t = A_t K_t^{\alpha} L_t^{\beta} EH_t^{\gamma} \quad \text{.....(I)}$$

And the log converted form of this function is as follows.

$$\text{Log } YL_t = \log A_t + \alpha \log K_t + \beta \log L_t + \gamma \log EH_t \quad \text{.....(II)}$$

Where $\log YL_t$ is the log of real GDP per worker as a dependent variable, $\log A_t$ is the log of the constant term, $\log K_t$ is the log of physical capital which is proxied through investment-GDP ratio. $\text{Log } L_t$ is the log of labor input measured through labor force and $\log EH_t$ is the log of the variable (EH) which is human capital input in the production process. In the current study, a new proxy for human capital is constructed. The variable (EH) is constructed through

taking enrolment rates at primary level and than multiplied the value with the health indicator (expenditure on health as a percentage of GDP). This variable is a relatively better measure of human capital input, as the other proxies for human capital either focused on education or health indicators alone. The measure used in this study is an education indicator, adjusted for health and the variable EH_t expresses the notion that health is an important factor of determining the returns from education and improvement in health tends to increase the learning from a given level of education. Data for all the required variables was taken from Pakistan Economic Survey (2008), Labor Force Survey (2006) and Handbook of Statistics on Pakistan Economy (2005). With the help of equation II, the relative importance of all three input factors can be studied which can be beneficial for identifying the high priority area in order to achieve sustainable economic growth.

4. Model Estimation and Results

4.1 Model Estimation

Model estimation begins with the analysis of the order of integration of each variable using Augmented Dickey Fuller (ADF) and Philips-Perron (PP) test for this analysis. The null hypothesis for this testing is that the series contain unit roots and the result for ADF and PP test are reported in table 2.

Table 2: Test for Stationarity

	ADF Test				Philips-Perron Test			
	Level		First difference		Level		First difference	
Variables	C	C & T	C	C & T	C	C & T	C	C & T
Real GDP per worker(YL)	-2.065	-1.274	-4.189	-4.724	-2.221	-1.234	-4.213	-4.709
Investment, GDP ratio(K)	-2.246	-2.050	-4.233	-4.268	-1.551	-1.414	-4.168	-4.194
Labor Force (L)	1.202	-0.670	-4.360	-4.651	1.543	-0.579	-4.299	-4.579
Human Capital(EH)	-1.822	-1.114	-4.359	-4.609	-2.217	-1.114	-4.455	-4.966

Note: Critical Values for these tests with intercept (C), Intercept and trend (C&T) on level at 1% are -3.679 and -4.309 respectively. At 5% the critical values are -2.967 and -3.574 respectively. Critical Values for intercept (C), Intercept and trend (C&T) on first difference at 1% are -3.689 and -4.323 respectively. Lag length is selected as per AIC.

Source: Authors' estimation.

ADF test shows that all the variables which are non stationary at level, become stationary at first difference. So the variables in the equation II are in fact integrated of order (1). The findings of PP test support the results of ADF test. The result indicates the chances of long run relationship between the variables in equation II. To confirm this indication through cointegrating regression Durbin Watson (CRDW), OLS method is applied and reported in table 3.

Table 3: Long Run Determinants of Economic Growth

Variable	Coefficient	Standard Error	t-Statistic	Probability
Constant	7.180	0.310	23.106	0.000
K	0.285	0.123	2.310	0.029
L	0.613	0.083	7.378	0.000
EH	0.269	0.043	6.143	0.000
Adjusted R-squared	0.949	F-statistic		163.026
Durbin-Watson statistics	0.740	Probability (F-statistic)		0.000

Note: Dependent variable is YL, and included observations are 30.
Source: Authors' estimation

All the variables in the regression are in log form. The Durbin Watson statistic here is the cointegrating regression Durbin Watson (CRDW) which can provide an indication about

cointegration equations. The (CRDW) statics is 0.740 which is higher than the critical value which indicates the possibility of cointegration between variables[7].

4.2 Empirical analysis of long run relationship

The evidences of long run relationship between the explanatory and explained variables in the equation II are tested through Johansen technique (Johansen, 1988, 1991 and Johansen and Juselius, 1990). and the results are reported in table 4. This co-integration method recommends two statistics to check the long run relationship; trace statistics and maximum Eigen value test.

Table 4: Cointegration Test through Johansen and Juselius Method

Null Hypothesis	Alternative Hypothesis	Trace Statistic	Critical Value on Five percent	Probability
r = 0	r > 0	67.770	54.079	0.001
r ≤ 1	r > 1	29.198	35.192	0.191
r ≤ 2	r > 2	15.387	20.261	0.205
r ≤ 3	r > 3	5.512	9.164	0.231
Null Hypothesis	Alternative Hypothesis	Max-Eigen Statistic	Critical Value on Five percent	Probability
r = 0	r > 0	38.571	28.588	0.001
r ≤ 1	r > 1	13.811	22.299	0.479
r ≤ 2	r > 2	9.875	15.892	0.345
r ≤ 3	r > 3	5.512	9.164	0.231

Source: Author's estimation

* Where "r" is the number of co-integrating vectors

The null hypothesis in the trace statistics is that there is no co-integrating vector, was rejected at 1% and the other null hypotheses about the absence of more than one cointegrating vectors could not be rejected which implies that there is only one co-integrating vector in the equation II. The finding of one co-integrating vector was further supported by the results of

[7] See Banerjee et al, 1993 for details.

the maximum Eigen value test in which the null hypothesis that there is no co-integrating vector was rejected at 1% and no other null hypothesis could be rejected which implied that there is only one co-integrating vector in the equation II. So, it is empirically confirmed that there is a stable long run relationship among the variables included in the equation II and the coefficients of these variables as reported in the table 3 are in fact the long run coefficients of these variables. It can be noted that the long run coefficient of human capital (in table 3) is lower than of the physical capital which implies that the return on human capital would be lower than the returns of physical capital in the long run.

4.3. Sensitivity Analysis

The findings of the study illuminate the role of human capital in the economic growth of Pakistan however we have still to demonstrate the robustness of their finding. The strength of the findings is analyzed through the procedure called sensitivity analysis. Following equation was used to perform sensitivity analysis of the study.

$$\text{Log } YL_t = \log A_t + \alpha \log K_t + \beta \log L_t + \gamma \log EH_t + \theta \log Z_t \quad \ldots\ldots III$$

Where $\log Z_t$ represents a sub set of variables, which are already identified as potentially important explanatory variables. Different combinations of $\text{Log } Z_t$ can be included in the model to check their impact on the focus variable $\text{Log } EH_t$. If the inclusion of these variables does not affect the sign and the significance of the focus variable $\text{Log } EH_t$, the findings of the initial model would be more consistent, reliable and robust. In case if the inclusion of the other related variables affect the sign and the significance coefficient of $\text{Log } EH_t$, the initial findings would be less reliable and the results which are based on that finding would be "fragile". Moreover, if the coefficient of the focus variable falls within a

narrow interval, this indicates that the initial findings provide consistent information pertaining to the coefficient of the focus variable.

The other variables used for the analysis are log E that represents the log of exports as a percentage of GDP, log F that represents the log of Foreign Direct Investment as a percentage of GDP and log R that represents the log of Remittances as a percentage of GDP. As a pre condition, the Stationarity of all these three variables are checked through Augmented Dickey-Fuller and Philips-Perron test and reported below in the table 4.

Table 4: Test for Stationarity

	ADF Test				**Philips-Perron Test**			
	Level		First difference		Level		First difference	
Variables	C	C & T	C	C & T	C	C & T	C	C & T
F	1.454	0.078	-3.882	-4.312	1.454	-0.169	-3.882	-4.312
R	-1.174	-1.627	-5.320	-5.243	-1.150	-1.772	-5.320	-5.243
E	-2.879	-2.804	-7.124	-5.758	2.838	-2.816	-7.290	-7.226

Note: Critical Values for these tests with intercept (C), Intercept and trend (C&T) on level at 5% are -2.967 and -3.574 respectively. Critical Values for intercept (C), Intercept and trend (C&T) on first difference at 5% are -2.971 and -3.580 respectively. Lag length in all cases is 0 as per AIC.
Source: Authors' estimation.

All the variables are stationary of the order one hence qualified to be used in the sensitivity analysis. The results of the analysis are presented in the table 5 below.

Table 5: Results of Sensitivity Analysis

	Basic Model	Model II	Model III	Model IV	Model V	Model VI
		Log F	Log R	Log E	Log R Log F	Log R Log E
Coefficient of Focus variable	0.26	0.21	0.22	0.21	0.18	0.17
t-stat (prob)	6.14(0.00)	5.01(0.00)	5.14(0.00)	4.17(0.00)	4.46(0.00)	3.62(0.00)
Coefficient of the other variable/s	---	0.07	-0.06	0.15	-0.05 0.05	-0.06 0.13
t-stat (prob)	---	2.67(0.01)	-2.59(0.01)	0.15(0.10)	-2.28(0.03) 2.36(0.02)	-2.55(0.01) 1.68(0.10)
Adjusted R^2	0.94	0.95	0.95	0.94	0.96	0.96
Durban Watson Stat	0.74	0.77	0.83	0.92	0.81	0.94
F- Statistics	163.02	152.94	150.99	131.79	144.04	130.17

Source: Authors' estimation.

The findings from all the six models, as reported, show that the sign and significance of the core variable is unchanged which indicates that the results obtained through the basic model are robust or invariant of the other related variables. However, the magnitude of the focus variable varies slightly, as we incorporate the other variables in the model, which indicates that the other variables have less effect on the variability of the coefficient of the focus variable.

5. Conclusion and Policy implications

Spending on health and the education sectors historically remains on a lower side in Pakistan as compared with the other countries in the region. The findings of this study support the finding that human capital is positively related with economic growth in Pakistan in the long run. The proxy of human capital in this study was health adjusted education indicator that was found significant which necessitates a special focus on the health and education sectors of the economy simultaneously.

The sensitivity analysis confirms the robustness of the initial findings about the direction and significance of the effect of human capital on economic growth. The results from this study are broadly in line with the results of other studies and moreover our study confirms that the results are robust despite the inclusion of the other associated variables.

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