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The Role of Human Capital in Economic Growth: A Comparative Study of Pakistan and India

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I. INTRODUCTION

Economic Growth has posed an intellectual challenge ever since the beginning of systematic economic analysis. Adam Smith claimed that growth was related to division of labour, but he did not link them in a clear way. After that Thomas Malthus developed a formal model of a dynamic economic growth process in which each country converge toward stationary per capita income. According to this model, death rates fall and fertility rises when income exceed the equilibrium, and opposite occur when incomes are less than that level. Despite the influence of the Malthusian model in nineteenth century economists, fertility feel rather than rose as income grew during the past 150 years in the west and other parts of the world.

The Neoclassical growth model of Solow (1956), which has been for the past thirty years the central framework to account for economic growth, focuses on exogenous technical population factors that determine output-input ratios, responded to the failure of Malthusian model.

Neither Malthus's nor the Neoclassicists approach to growth pays much attention to Human Capital. Yet the evidence is quite strong of close link between investments in human capital and economic growth. Since human capital embodied knowledge and skills, and economic development depends on advances in technological and scientific knowledge, development presumably depends on the accumulation of human capital. Investment in human capital has been a major source of economic growth in advanced countries. The negligible amount of human investments in underdeveloped countries has done a little to extend the capacity of people to meet the challenge of accelerated development. Schultz (1961) noted that the growth rate of output exceeded the growth rate of relevant input measures (employment and physical capital) suggesting that investment in human capital is

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probably the major explanation for this difference. Uzawa (1965) and Rosen (1976) also stress the importance of human capital in driving economic growth. Nelson and Phelps (1966) said that the ability of nation to adopt and implement new technology from abroad is function of its domestic human capital stock.

Recent models of economic growth such as Romer (1986) and Lucas (1998) emphasise that investment in human capital an important factor contribution to economic growth. These models generate persistent growth endogenously from the actions of the individuals in the economy. An additional role for human capital may as engine for attracting other factors such as physical investment, which also contribute measurably to per capita income growth. Recent experience with attempts to accumulate physical capital at a rapid rate in poor counties bears out the necessity of due attention to human capital because it has become evident that the effective use of physical capital itself dependent on human capital. If there is under-investment in human capital, the rate at which additional physical capital can be productively utilised is limited since technical, professional, and administrative people are needed for the effective use of physical capital. Lucas (1990) suggested that physical capital fail to flow to poor countries because of their relatively poor endowments of complementary human capital.

The large proportion of empirical evidence on the effect of human capital on growth are studies that use data on cross-section of countries and try to link some initial level of human capital with subsequent real output growth. In general, the results from the existing theoretical models suggest a positive impact of human capital on real growth. However, the individual empirical studies, though they provide numerous intriguing findings, differ substantially on their predictions, there is no consensus on the overall implications of the results.[1]

There are number of drawbacks to current implementation of cross-country analysis, as pointed by Ellis and Wang (1994). Levine and Renelt (1992) perform sensitivity analysis on the observed correlation between long run growth and policy variables in cross-country analysis. Their results suggest that regression that displays a positive relationship between human capital and economic growth are not robust to the inclusion of other relevant variables. They recommend a reasonable degree of skepticism about inferences from empirical studies linking human capital to growth.

Moreover, cross-country studies may fail to capture important country specific characteristics that may be crucial to their economic development.[2] So despite of the

[1]For example, Barro (1990) and Mankiw *et al*. (1992) investigates the impact of the human capital level on subsequent economic growth using cross-country analysis. Barro finds that primary school enrolment rates have significant explanatory power in the (per capita) output regression, but the same enrolment measures for 1950 or 1970 have no predictive value. Mankiw *et al.* find a significant role of human capital measured by the secondary school enrolment rates, but find production to exhibit diminishing returns to physical and human capital inputs.

[2]In the presence of multiple steady states and multiple convergence groups [see a discussion in Becker, Murphy, and Tamura (1990) and Tamura (1991)], cross-country analysis is generally subject to sample selection bias [see comment by Long (1989) on Baumal].

growing literature, the results of the existing cross-country studies present conflicting evidence so that the explicit effect on output growth from human capital remain inconclusive.

In fact, there are certain advantages of analysing growth in a comparative study framework. For example, (a) a more careful and in-depth examination of institutional and historical characteristics of a particular country, (b) the use of data set comprised of the most appropriate and highest quality measures unconstrained by the need for measurement consistency across countries, (c) a more detailed exposition of the dynamic evolution of the economy, (d) provide a comparative analysis.

Moreover, a lot of work has done for developed countries, a very little attention has been given to developing nations. Therefore, the present study adopts an alternative empirical strategy to investigate the importance of human capital on economic growth by focusing on two developing countries i.e., Pakistan, and India for a comparative analysis.

The main objectives of this study are to (1) estimate and analyse the effects of human capital as a flow variable on economic growth for five countries in the sample, (2) estimate and analyse the effects of human capital as a stock variable on economic for the selected countries, (3) estimate and analyse the effects of effective labour input on economic growth. (4) estimate and analyse human capital as an agent in attracting physical capital, and (5) finally, recommend some policy implications for each country in the sample.

The study is divided into seven section. In Section II, we discuss the main sources of data and its limitations. In Section III the framework of the study is explained. In Section IV of the study, empirical analysis is discussed. In Section V, empirical analysis II is presented. In Section VI, concluding remarks and policy implications are given. Finally, in Section VII of the study references are quoted.

II. DATA SOURCES AND THEIR LIMITATIONS

The major sources of the data are the World Tables and World Development Reports published by the World Bank for different years. Moreover, UNESCO Yearbooks and United Nation Asia-Pacific yearbooks for different years have also been concerned. The data regarding employment and labour force has been obtained from the ILO Yearbooks of Labour Statistics published by the International Labour Organisation (ILO). Furthermore, the Statistical Yearbooks and Labour Force Surveys of the relevant countries have also been sorted out. The data are annual and over the period 1970–94.

Many theoretical models of economic growth have used the schooling enrolment rates (SERs) as proxy variables for human capital. We will also use the schooling enrolment rates. Schooling enrolment ratios have several deficiencies as measure of stock of human capital. First, the current enrolment ratios measures the

flows of schooling, the cumulation of these flows creates the future stocks of human capital. Because the educational process takes many years, the lag between flows and stock is very long.[3] If the approximate lag is considered, then the construction of human capital stocks still requires an estimate of initial stocks. Errors are introduced because of mortality and migration and because the net enrolment ratios are unavailable for developing countries. The gross enrolment ratio introduces errors related to repetition of grades and dropouts, phenomena that are typically high in developing countries.[4]

Another problem may be that the underlying data on schooling enrolment are doubtful quality for developing countries. Most information collected by UNESCO comes from annual surveys of educational institutions in each country. The typical practice is that the person responsible for administering each institution answers a number of questions about his or her institution. Chapman and Brothroyed (1988) note that in several countries headmasters have been observed to inflate the reported enrolment based on their experience that higher enrolment figures lead to more resource supplies, textbooks, and budget allocated to the school. Thus, in general, the reported enrolment may an upward bias.

An additional source of upward bias may be that the data refer to the registered number of students at the beginning of each school year. The actual number of children that attend the school during the year can be substantially lower. The error is particularly serious for developing countries in which government punishes parents that do not register their children at primary schools.

III. FRAMEWORK OF THE STUDY

The objective of the study is to estimate the role of human capital in economic growth, a comparative analysis of two developing countries i.e., Pakistan and India. For this purpose, our method of analysis is consisted of two parts.

Empirical Analysis I: Growth Accounting with Human Capital as a Factor of Production

We employ the standard growth accounting methodology with human capital specifies an aggregate production function in which Gross Domestic Product (GDP) Y_t is the dependent variable, three input factors i.e., employment L_t, physical capital K_t, and human capital H_t are the independent variables.

The growth model used in the study is

$$Y_t = A_t \; K_t^{\alpha} \; L_t^{\beta} \; H_t^{\gamma} \; e_t \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (1)$$

[3]See Psacharopoulos and Ariagada (1986), pp. 1-2, for discussion.

[4]For the total of developing countries in 1980, Fredriksen (1991) estimates that the average gross enrolment ratio at the primary level was 85 percent. The elimination of repeaters reduces the estimated value to 73 percent.

Where A_t = exogenous level of technology.
K_t = gross domestic investment (a proxy variable for physical capital).
L_t = employment.
e_t = error term.

Crucial to our analysis is the assumption that rates of return on investment in human capital rise rather than decline as stock of human capital increases, at least until the stock becomes large. So it is notable that there are constant return to scale in three reproducible (physical, labour and human) capital stocks (i.e., $\alpha + \beta + \gamma = 1$ or > 1), the model generate perpetual growth.

Taking log of (1), the relationship for growth can be expressed as

$$log\ Y_t = log\ A_t + \alpha\ log\ K_t + \beta\ log\ L_t + \gamma\ Log\ H_t + log\ e_t \quad \ldots \quad \ldots \quad (2)$$

$$log\ Y_t = a + \alpha\ log\ K_t + \beta\ log\ L_t + \gamma\ log\ H_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

Where $log\ A_t = a$, $log\ e_t = e_t$

Because of data constraints, we use proxy variables relevant to growth accounting by those, which are directly observable. For example, although physical capital are necessary to estimate the growth accounting equations, the literature has usually used gross investment rates as a proxy variable for physical capital accumulation [Barro (1991)]. So in our study we use gross domestic investment as a proxy variable for physical capital. In addition, human capital has been proxied in the literature by schooling enrolment rates. Therefore, in this part of the study we use schooling enrolment rates as proxies for human capital.

The three main proxies for human capital that we use are the values of schooling enrolment rates at the higher, secondary, and primary level. These schooling rates are obtained by the number of students enrolled in the designated grade levels relative to the total population of corresponding age groups i.e.

Gross Enrolment = total enrolment in the designated grade/total population of the corresponding age group.

Thus, alternatively, we estimate the following three equations for each country in the sample.

$$log\ Y_t = a + \alpha\ log\ K_t + \beta\ log\ L_t + \gamma\ log\ he_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

$$log\ Y_t = a + \alpha\ log\ K_t + \beta\ log\ L_t + \gamma\ log\ se_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

$$log\ Y_t = a + \alpha\ log\ K_t + \beta\ log\ L_t + \gamma\ log\ pe_t + e_t \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Where

he_t = schooling enrolment rate at higher level of education at t years (t = 1,2…25).

se_t = schooling enrolment rate at secondary level of education at t years (t = 1,2…25).

pe_t = schooling enrolment rate at primary level of education at t years (t = 1,2…25).

Moreover, we combine a human capital measure and employment to create effective labour input. Because we know that human capital embodied labour performs better than traditional employment in estimating potential output growth. So aggregate production function of (1) can be written in the following form.

$$Y_t = A_t \; K_t^{\alpha} (L_t H_t)^{\beta} e_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Taking *log* of (7), we have

$$log\ Y_t = log\ A_t + \alpha\ log\ K_t + \beta\ (log\ L_t + log\ H_t) + log\ e_t \quad \ldots \quad \ldots \quad (8)$$

$$log\ Y_t = a + \alpha\ log\ K_t + \beta\ (log\ L_t + log\ H_t) + e_t \quad \ldots \quad \ldots \quad (9)$$

Equation (9) will be estimated at all educational levels i.e., primary, secondary, and higher for both countries in the sample.

Empirical Analysis II: Human Capital as a Determinant of Physical Capital

In this part of the study, we examine an alternative channel for human capital to contribute to economic growth: human capital may encourage accumulation of other factors necessary for growth, particularly physical investment. In endogenous growth models such as Rebelo (1990) and Barro (1990), per capita growth and investment ratio move together. For example, an exogenous improvement in productivity tends to raise the growth rate and investment ratio. In models that include human capital such as Romer (1990) and Becker, Murphy, and Tamura (1990), an increase in the initial stock of human capital tends to raise the ratio of physical investment to GDP.

In this case, we estimate the following equation for both countries in the sample by using all the proxies of human capital.

$$log\ GDINV_t = a + \alpha\ log\ GDP_t + \beta\ log\ L_t + \gamma\ log\ H_t + e_t \quad \ldots \quad \ldots \quad (10)$$

Finally in this part of analysis, we will use effective labour input as proxy variable for human capital, in which we have combined the simple schooling enrolment rates with employment. For this purpose, we will estimate the following equation for all the levels of education.

$$Log\ GDINV_t = a + \alpha\ logGDP_t + \beta\ (log\ L_t + \gamma\ log\ H_t) + e_t \quad \ldots \quad \ldots \quad (11)$$

Hypotheses of Study

In Empirical Analysis I i.e., the growth accounting with human as a factor of production, we will estimate the standard growth accounting model. In the literature

human capital is considered as the engine of growth. For example, Romer (1990) found that countries with greater initial stock of human capital experience a more rapid rate of introduction of goods and thereby to grow faster. Becker, Murphy, and Tamura (1990), assume that the rate of return on human capital increases over some range, an effect that could arise because of the spillover benefits from human capital that Lucas (1988) stresses. As an example, the return to kind of ability, such as talent in communications is higher if other people are more able. In this setting, increase in the quantity of human capital per person leads to higher rate of investment in human capital, and hence to higher per capita growth. Therefore, we hypothesise those proxies for human capital in Equations (4), (5), (6), and (9) will effect positively to the growth of the economies of the selected countries. In Empirical Analysis II (human capital as a determinant of physical capital), we have introduced and alternative channel for human capital to contribute to growth i.e., human capital may encourage to the growth other factors that are necessary for growth, especially physical investment. Lucas (1990) has suggested that one reason physical capital does not flow to poor countries may that these countries have little investment in human capital. In literature e.g. Benhabib and Spiegel (1994) found that human capital stock is positively correlated with the growth of physical capital. Therefore, we expect that measure of human capital used in Equations (10) and (11) will effect positively and significantly to the rate of growth of investment for both countries.

IV. EMPIRICAL ANALYSIS I: GROWTH ACCOUNTING WITH HUMAN CAPITAL AS A FACTOR OF PRODUCTION

The empirical estimates presented below provide insights into the relationship between measures of physical and human capital and growth. However, these regression should not be misinterpreted as causality tests: in particular, we acknowledge a substantial feedback effect from output toward the input, as emphasised in the endogenous growth literature. These estimates are not simple correlations because the input measures directly impact the production process so that the measures are related directly. Rather, we view the evidence as indicating whether our human capital proxies improve upon traditional growth measurement. Now we discuss the empirical result of empirical analysis I (that were explained in the framework of our study) in detail.

Effects of Human Capital on Economic Growth as Measured by School Enrolment Rates

In this section of the study, first of all Equation (4) has been estimated for the countries in the sample, in which schooling enrolment rate at primary level of education (SERP) is used as a proxy variable for human capital and the results are

reported in Table 1. It should be noted that regressions were estimated by using Ordinary Least Squares (OLS) method.

Table 1 reveals that the coefficient of logGDINV is positive and significant at 0.01 level of significance for both countries. When we look at the coefficient of employment, it is positive (i.e., 0.554) and significant at 0.01 level of significance for Pakistan but it is negative for India. These results indicate that employment effect positively to the growth of gross domestic product for Pakistan but not for India. The possible reason might be that since India is the second largest populated country in the world, so the level of unemployment is very high as compared to Pakistan. The comparison of the results for human capital proxy variable suggest that the coefficients of schooling enrolment at primary level is positive (i.e., 0.278) and significant at 0.01 level of significance for India but it is negative for Pakistan sample. It implies that for India human capital specially at primary level plays a crucial role for the growth of gross domestic product—consistent with the recent endogenous growth theory pioneered by Lucas (1988) that hypothesises that human capital as the main engine of growth. The coefficient is negative for Pakistan and the most important reason might be that in Pakistan the poverty level is very high and most parents allow their children to work rather than putting them in school. Moreover, the returns to primary education are very low especially in case of the urban formal sector of Pakistan.

Table 1

Estimated Results at Different Levels of Education—Dependent Variable LogGDP

Countries/Level of Education	Primary		Secondary		Higher	
Variables	Pakistan	India	Pakistan	India	Pakistan	India
Constant	0.322	3.768	–0.226	4.197	0.120	3.790
LogGDINV	0.453	0.949	0.425	0.877	0.440	1.119
	(8.425)*	(9.877)*	(7.579)*	(7.418)*	(7.499)*	(9.254)*
LogLAB	0.554	–0.231	0.526	–0.137	0.529	–0.111
	(10.287)*	(–2.800)*	(10.896)*		(10.396)*	
LogSERS	–0.024	0.278	0.061	0.258	0.042	–0.023
	(–1.801)***	(3.704)*	(2.213)**	(2.578)*	(1.632)***	
R^2	0.996	0.991	0.996	0.991	0.996	0.986
F	2165.808	944.740	2313.977	865.064	2113.896	573.418
S.E.	0.025	0.034	0.025	0.035	0.026	0.043

Notes: * Significant at 0.01 level of significance.
** Significant at 0.05 level of significance.
*** Significant at 0.1 level of significance.
Figures in the parenthesis are estimated *t*-value.

Regarding the assumption of the model, it is notable that for both countries i.e., Pakistan and India there are almost constant returns to scale (i.e., $\alpha+\beta+\gamma=1$) which imply that the model can generate perpetual growth.

Equation (5) has been estimated using schooling enrolment rate at secondary level of education as a proxy variable for human capital and the results are also reported in Table 1. It is clear from the table that gross domestic investment effect positively and significantly to the growth of gross domestic product for both countries.

When we compare the results of human capital proxy variable i.e., the schooling enrolment at secondary level, we found that SERS effect positively and significantly to the growth of the gross domestic product for both Pakistan and India. These results are analogous to cross-country studies such as Barro (1991); Mankiw and Weil (1992), in which a country's subsequent growth is positively related to the measures of human capital. It implies that if there is increase in human capital accumulation, it will lead to increase in economic growth of developing countries. As for as the assumption of the model is concerned, it is found that there are constant return to scale of production ($\alpha+\beta+\gamma=1$), so the model can generate perpetual growth for these countries.

Now Equation (6) has been estimated and the results are reported in the same table. It should be noted that in this equation we have used the schooling enrolment rate at a higher level of education (SERH) as a proxy variable for human capital. It is evident from the table that logGDINV has a positive and significant impact on the growth of gross domestic product for Pakistan and India.

The table, further reveals that the coefficient of logSERH is positive and effects significantly to GDP for Pakistan and negative for India. It implies that human capital proxied by SER at higher level of education has a significant contribution to economic growth for Pakistan. The coefficient of LogSERH for India is negative. The possible reason is that the facilities for higher education are inadequate in India and most of the people have no access to higher education. Moreover, in India, the policies are designed to promote primary education instead of higher education. Furthermore, the partial correlation between SERH and GDP is negative (i.e., –0.73 for India). It is interesting to note that there are constant returns to scale ($\alpha+\beta+\gamma=1$) for Pakistan and decreasing return to scale for India, so when we proxy human capital by higher education the model generates perpetual growth for Pakistan only.

Overall empirical evidence here supports the idea that human capital plays a crucial role in economic growth for these two developing countries. Moreover, treating human capital as a factor of production implies that in the growth accounting regressions, human capital effects positively and significantly especially at the secondary level of education to the growth of gross domestic product for the selected countries. Therefore, we can say that human capital has a positive impact on economic growth for developing countries.

Effects of Human Capital on Economic Growth as Proxied by Effective Labour

In this part of analysis, we have combined the human capital measures with employment in order to create effective labour input. As we know that human capital embodied labour performs better than raw labour. Furthermore, this measure is better as compared to simple schooling enrolment rates in estimating potential output growth. For this purpose Equation (9) has been estimated for all the selected countries by using different levels of education as a human capital measures and the results are presented in Table 2

The results in Table 2 reveals that in case of Pakistan, there is significant improvement in the share of effective labour for all the measures of human capital as compared to simple schooling enrolment rates. For example, for primary schooling enrolment rates, it improves from –0.024 to 0.123 and for secondary schooling enrolment, it improves from 0.061 to 0.388, which are both significant now and finally, for higher education from 0.042 to 0.090 but it is still insignificant. It implies that for Pakistan, human capital embodied labour performs better in estimating potential output growth as compared to simple schooling enrolment rates. It is also evident from the table that for Pakistan, $\alpha+\beta=1$ for all the levels of education which suggest that the above model generates perpetual growth for Pakistan's economy.

Table 2

Output Estimates and Education-enhanced Labour Input—Dependent Variable LogGDP

Countries	Levels of Education	Effective Labour					
		Constant	Lab*SERs	LogGDINV	R^2	S.E	F
PAKISTAN	Primary	0.537	0.123	0.889	0.983	0.054	709.305
			(2.688)*	(19.389)			
	Secondary	0.263	0.388	0.612	0.987	0.047	912.547
			(3.933)*	(6.201)*			
	Higher	1.811	0.090	0.904	0.978	0.061	558.451
				(10.518)			
INDIA	Primary	0.949	0.050	0.944	0.986	0.044	809.318
				(7.453)*			
	Secondary	–0.080	0.215	0.782	0.987	0.042	894.782
			(1.569)***	(5.716)*			
	Higher	2.197	–0.074	1.059	0.987	0.042	888.192
				(21.490)*			

Notes: *Significant at 0.01 level of significance.
***Significant at 0.10 level of significance.
Figures in the parenthesis are estimated *t*-values.

It is further evident from the table in case of India, this human capital measure has not performed well. The possible reason might be that India is the second most populous country and most of the population has no access to even the most basic education. Moreover, the informal sector is very strong and in that sector mostly people learn from training and experience during their work. The table further depicts that there are almost constant returns to scale in both reproducible (physical and human) capital for India's economy.

So overall, by applying this measure for human capital for the selected two countries during 1970–94 period suggest not only that there are important growth effects associated with human capital but also this measure out-performs the simple schooling enrolment rates except for Pakistan.

V. EMPIRICAL ANALYSIS II: HUMAN CAPITAL AS A DETERMINANT OF PHYSICAL CAPITAL INVESTMENT

Finally, in the last part of our analysis, we have examined an alternative channel for human capital to contribute to economic growth. Human capital may encourage accumulation of other factors necessary for growth, particularly physical capital investment. As Lucas (1990) has suggested, one reason why physical capital does not flow to poor countries may be that these countries are poorly endowed with factors complementary to physical capital. Therefore, the marginal product of physical capital in developing countries may not actually be that high, despite its apparent scarcity relative to developed countries. In this part of our analysis, we estimate the effect of human capital on physical capital, which will in turn effect economic growth by using different measures for human capital.

Effects of Human Capital on the Growth of Physical Capital as Proxied by Simple School Enrolment Rates

In the first stage, we use simple schooling enrolment rates as proxy variables for human capital for different levels of education. For this purpose, we have estimated Equation (10) for primary, secondary and higher schooling enrolment rates for both countries and the results are reported in Table 3.

Table 3 reveals that the coefficient of LogGDP is positive (1.705) and significant at 0.01 level of significance for Pakistan. This result implies that the gross domestic product (GDP) is the major determinant of gross domestic investment (GDINV) i.e., the proxy variable for physical capital. The coefficient of employment i.e., represented by LogLAB effect negatively to the growth of physical capital. This indicates that there is no correlation between employment and gross domestic investment for Pakistan. The possible reason might be that the unemployment rate is very high in Pakistan and in most of the industries highly advanced technology is used for the production of goods. In other words, we can say that capital-intensive

Table 3

Estimated Results for the Determination of Physical Capital at Different Levels of Education—Dependent Variable LogGDINV

Countries	Primary		Secondary		Higher	
Variables	Pakistan	India	Pakistan	India	Pakistan	India
Constant	–0.944	–6.086	–0.543	–6.614	–0.748	–7.563
LogGDP	1.705	0.867	1.721	0.825	1.654	0.718
	(8.425)*	(9.877)*	(7.579)*	(7.418)*	(7.499)*	(9.254)*
LogLAB	–0.722	0.299	–0.705	0.259	–0.664	0.312
		(4.581)*	(–3.562)*	(3.936)*	(–3.362)*	(3.097)*
LogSERS	0.020	–0.165	–0.037	–0.082	–0.008	–0.031
		(–1.937)**				
R^2	0.988	0.993	0.988	0.992	0.988	0.992
F	570.085	1034.563	566.635	909.311	517.274	897.952
S.E.	0.052	0.034	0.052	0.036	0.052	0.036

Notes: * Significant at 0.01 level of significance.
** Significant at 0.05 level of significance.
Figures in the parenthesis are estimated *t*-value.

mode of production is applied in Pakistan. Most importantly, human capital proxied here by primary schooling enrolment rates effects positively the growth of physical capital but not statistically significant. This implies that human capital proxied by primary education has a little correlation with physical capital. In case of India, the coefficient of LogGDP is positive i.e., 0.867 and significant at 0.01 level of significance.

Moreover, the coefficient of LogLAB is also positive and statistically significant at 0.01 level. The coefficient of LogSERP is negative and significant at 0.05 level of significance. It means for India, that gross domestic product and employment are the two main determinants of physical capital when human capital is proxied by schooling enrolment rates at primary level of education. From this result, we can say that human capital proxied by primary education has no relation with gross domestic product (physical capital).

Secondly, we have estimated the same equation i.e., 10 for schooling enrolment rates at secondary level of education and the results are presented in Table 3. It is evident from the table that the coefficients of LogSERS are negative for both countries in the sample. From these results, we found that human capital accumulation has no effect on the growth of physical capital i.e., the gross domestic investment, when we use secondary schooling enrolment rates as proxy variable for human capital. The possible reason might be that in case of developing countries either very low technology is used for which primary education is enough or in some cases a highly advance technology is applied for which higher education is required.

Therefore, we can say that human capital proxied by secondary education is not an important determinant of physical capital for developing countries particularly for these two countries.

Next, we have estimated the equation for higher education and the results are given in the same Table 3. It is evident from the table that the coefficient of LogSERH is negative for Pakistan. Further, it is also evident from the table that the coefficient of LogLAB is also negative and significant at 0.01 level of significance. It implies that human capital at higher level of education has no effect on physical capital for Pakistan. The only determinant of physical capital in this case is gross domestic product. As we have seen that in case of Pakistan only human capital proxied by primary schooling enrolment rates somehow effect positively to the growth physical capital.

In the case of India, the coefficient of LogSERH is negative and suggests a negative correlation between physical capital and human capital especially at higher level of education. For India, when we use higher education as a proxy variable, the important determinants of physical capital are the employment and gross domestic product (GDP). The reason for the negative effect of higher education may be the inadequate facilities in the countryside. Where most of the population is living.

Effects of Human Capital on the Growth of Physical Capital as Measured by Effective Labour

In the second stage of this part, we want to try another measure for human capital in order to find a better determinant of physical capital. For this purpose, we have used effective labour input as a proxy variable for human capital, in which, we have combined the employment with schooling enrolment rates for different levels of education. We can say that some countries, with lagging technological capacity, may be more able catch-up on 'best practice' technology than others if inter alia, they have larger stock of educated labour. By using this measure for human capital, we have estimated Equation (11) for different levels of education for both countries and the results are reported in Table 4. From the Table 4, it is evident that in case of Pakistan, there is a slight improvement in the results as compared to the simple schooling enrolment rates.

As we have seen that when we use simple schooling enrolment rates, the coefficient of LogSERP was only positive but the coefficients for other levels of education were negative. Here, we found that the coefficient of effective labour with higher education is positive and other coefficients are negative. This shows that labour with higher education effect positively to the growth of physical capital and hence to economic growth.

In case of India, there is a significant improvement in the findings by using this measure as a proxy for human capital. As we seen that none of the coefficients was positive and significant. When we use simple schooling enrolment rates as proxy

Table 4

Estimated Results Using Effective Labour Input—Dependent Variable LogGDINV

Countries	Levels of Education	Constant	Effective Labour Lab*SERs	LogGDP	R^2	S.E	F
	Primary	–1.002	–0.086	1.063	0.982	0.062	591.517
				(19.389)*			
PAKISTAN	Secondary	–1.645	–0.048	1.039	0.980	0.065	533.410
				(6.201)*			
	Higher	–1.594	0.072	0.922	0.980	0.064	548.048
				(10.518)*			
	Primary	–4.975	0.241	0.758	0.990	0.042	1010.823
			(2.365)**	(7.453)*			
INDIA	Secondary	–3.281	0.232	0.764	0.988	0.044	915.575
			(1.738)***	(5.716)*			
	Higher	–2.320	0.107	0.902	0.990	0.041	1044.615
			(2.551)**	(21.496)*			

Notes: *Significant at 0.01 level of significance.
**Significant at 0.05 level of significance.
***Significant at 0.10 level of significance.
Figures in the parenthesis are estimated *t*-values.

variable for India. But know, we find that all the coefficients are not only positive but also highly statistically significant to the growth of physical capital i.e., the gross domestic investment which in turn effect positively to the growth of Indian's economy. For example, the coefficients are 0.241, 0.232 and 0.107 for primary, secondary and higher education respectively.

Therefore, we can say that human capital stocks are positively correlated with the growth of physical capital (gross domestic investment) and in most of cases are significant. This implies that the role of human capital as an agent in attracting physical capital investment is proved for these two developing countries. Furthermore, our evidence provides some support for Romer's (1990) model of endogenous growth that larger stocks of human capital may enable greater investment in physical capital, which in turn generates growth.

VI. CONCLUDING REMARKS AND POLICY IMPLICATIONS

In this paper, we made an attempt to determine empirically the role of human capital in economic growth, a comparative analysis of two developing countries. The neoclassical growth theory suggests that growth would be negatively related to initial stock of capital. Thus one would observe a convergence of the growth paths of countries. In the recent past, economists have come with a different analysis of the growth process, where growth is an endogenous process brought by human capital accumulation.

Barro (1991) tried to determine the impact of human capital and physical capital stocks on the growth rates of the countries for period from 1960 to 1985 in a sample of 98 countries. He found that while the initial stock of physical capital proxied by GDP in base year (GDP60) has a negative impact on growth rate, human capital measured by schooling enrolment rates in the base year (primary and secondary school enrolment in 1960) had a positive impact on growth rate. However, there are several drawbacks in trying to determine the effect of human capital so far back as 1960 on all future growth rates, which have been elaborated in the present thesis.

In our study, we have tried to determine the effect of human capital on economic growth of a more recent period namely 1970 to 1994 for the selected two developing countries. We have divided our study into two different parts by using different measures of human capital and ways to contribute in economic growth. The results of Empirical Analysis I i.e., growth accounting with human capital as a factor of production, of our analysis show that human capital represented by primary schooling enrolment rates has a positive impact on economic growth for India only. Human capital proxied by secondary schooling enrolment rates has a positive and significant impact on growth for both countries in the sample. But human capital measured by higher schooling enrolment rates has a positive impact on economic growth for Pakistan, while it effects negatively to growth for India. Moreover, in the same part of the analysis, we have tried another measure for human capital i.e., we have combined the human capital measures (schooling enrolment rates at different levels of education) with employment in order to create effective labour input. So by applying this measure for human capital, we found that there are not only important growth effects associated with human capital, but also this measure out-performs the simple schooling enrolment rates for Pakistan but not for India. Therefore, overall, empirical evidence in this part of the study supports the idea that human capital plays a crucial role in the growth of the economies for developing countries especially for these two countries. Moreover, treating human capital as a factor of production implies that in the growth accounting regressions, human capital effect the growth of gross domestic product for the selected countries.

Finally, in Empirical Analysis II of our study, we have examined an alternative channel for human capital to contribute to growth. For this purpose, we have estimated empirically the effect of human capital on physical capital (proxied by gross domestic investment), which in turn effects economic growth by using different measures for human capital. In the first stage, we have used simple schooling enrolment rates as the proxy variable for human capital and found that in case of Pakistan, only primary education has a positive impact, but it is only insignificantly different from zero. For India, none of the education levels effect positively to the physical capital that is proxied by gross domestic investment. But

in the same part of our analysis, we have tried another measure for human capital i.e., effective labour input. By using this measure, we found that this measure performs much better as compared to simple schooling enrolment rates in the determination of physical capital. Therefore, from this analysis, we can say that human capital stock is positively correlated with physical capital and in most of the cases are significant. This implies that the role of human capital as an agent in attracting physical capital is vindicated for these two developing countries. Furthermore, our empirical evidence provides some support for Romer's (1990) model of endogenous growth that larger stocks of human capital may enable greater investment in physical capital, which in turn generates growth. So we have shown that if the educational sector is intensive in physical capital, then a sudden increase in physical capital will always result in an accumulation of human capital.

Our analysis shows that: (1) the carrier of human capital is human beings who are characterised as both productive and consumptive; (2) human capital is a multi-dimensional concept which consists of different particular human capital factors; (3) there is an overall positive relationship between human capital investment and economic growth; (4) most of human capital is also subordinate to physical capital rather than an independent variable in the process of growth.

The above analysis has the following policy implications for each of the country in the sample.

Pakistan

- Greater attention should be given to the areas where the facilities of education, especially primary education, are inadequate.
- There is positive relationship between human capital measures especially at secondary and higher levels of education and economic growth. It means that if there is increase in human capital investment at these levels of education, it helps to increase economic growth. Therefore, the policy alternative should be to increase the investment in human capital for secondary and higher levels of education.
- Human capital embodied labour effects positively and significantly to economic growth, so the policy alternative should be that government has to increase investment in training programmes for labour and technical education.
- The annual budget allocation for education in Pakistan is very low, so there is a need to allocate a significant amount of funds to education sector.
- There may be hindrances to the free choice of profession. Racial discrimination and religious discrimination are still widespread in Pakistan. Such hindrances keep the investment in this form of human capital investment substantially below its optimum. The policy alternative should be to reduce such kind of hindrances in the process of growth.

India

- For India, there is positive relationship between the human capital proxy variables for primary and secondary education and economic growth, so India should strengthen its investments in these levels of education to make human capital more productive factor of production.
- Since higher education as a measure for human capital has no significant impact on economic growth, the policy alternative should be to pay more attention to the areas where the facilities of higher education are inadequate.
- There is a lack of technical education in India, so there is need to increase investment in this activity. This is because of that skilled labour is more productive as compare raw labour.
- India is the second highest populous country in the world and most of the population is living in rural areas where education facilities are inadequate, so there is need to provide education facilities to the neglected areas.
- Human capital deteriorates when it is idle because unemployment impairs the skills that workers have acquired. Losses in earnings can be cushioned by appropriate payments but do not keep idleness from taking its toll from human capital. Since in India, the unemployment is very high and effects negatively to GDP growth, so the policy alternative should be to reduce the level of unemployment in the economy.

Some Common Policy Implications

- It is indeed to stress the greater imperfections of the capital market in providing funds for investment in human beings than for physical goods. Much could be done to reduce these imperfections by reforms in tax and banking loans and by changes in banking practices. Long term private and public loans to students are warranted.
- In most of the development countries investment in human beings is likely to be underrated and neglected. But truly, the distinctive feature of our economic system should be the growth of human capital, without it there would be only hard, manual work and poverty, except for those who have income from property.
- A significant amount of public funds in developing countries should be allocated to education and health (for human capital formations) and research (for the production of intellectual capital).
- Education must be regarded as an important and indispensable pre-requisite for sustained scientific and technological progress.
- The relatively large human capital formation must be viewed as an important cause of the more equal distribution of income.

- The community may benefit from increased investment in human capital because it improves the general "character" of society and the "quality" of economic and social decisions.
- All of these countries have large growing populations. Greater attention should be given to women's health education, sex education, and birth control.
- Investment in human capital is important for the developing countries. Because of that, the economies with high ratios of physical to human capital will always decumulate physical capital and economies with low ratios of physical to human capital will always increase their holdings of physical capital. This places human capital as a key factor for growth.

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Comments

The author has touched upon a topic of extreme importance. The paper is an attempt to empirically test, for the two neighbouring countries of South Asia, the now commonly-accepted hypothesis that human capital, formation is an important, if not the most important, determinant of economic growth. In other words, human resources are, in fact, a country's wealth. It is the people, not machines, infrastructure or money, that lead to sustainable economic growth, though other factors i.e., quantity and quality of capital and infrastructure, may also determine the pace of economic growth in the short-run. A long-standing commitment to education and health is now regarded as the best strategy for long-term economic growth and development. Developing countries like Pakistan need to make big strides in developing its social sector to enter the league of fast-growing economies.

A review of development history reveals that at any level of economic development, education remains the key determinant of economic growth. Dynamic growth environment requires that workers should be able to perform complex and multiple skills. But as the precise links between particular types of education and specific levels or forms of industrialisation are not always easy to understand, governments, especially in developing countries are caught in a dilemma of how much of scarce resources should be allocated towards development of human capital vis-à-vis other investments and current consumption. As a result, most developing countries tend to under-invest in their people. They do not realise that education, by enhancing labour productivity through increased receptivity to knowledge and higher capacity to learn generally pays for itself in the long-run.

Various studies display that the time required for major changes in the quality of life has been shortened steadily over the centuries. This is mainly because growth of knowledge and technological innovation quickened this pace of progress, and has allowed late starters to catch up with the forerunners. Education has played a major role in this rapid dissemination of knowledge.

In Asia, Japan's rise as a major economic power has been attributed, in part, to its highly educated and education-conscious population [Morishima (1982)]. By 1868, Japan's literacy was only 15 percent, but by 1872 a universal and compulsory system of primary education had been introduced and the foundations for secondary education had been laid. Primary school attendance grew from less than 30 percent in 1873 to more than 90 percent. In 1907 and by 1930s, Japan was already starting to exert itself as an emerging economic power.

Korea's accumulation of human capital started during the period 1910-45, with substantial on-the-job training and foreign technical assistance. Important education programmes focussing on universal primary education and adult literacy were launched during the late 1940s and 1950s. In the 1960s, higher education was also greatly expanded, and many students were sent overseas for technical and advanced training. This relatively strong base of human capital was the key to its rapid growth in industrial production since 1960s [Pack and Westphal (1986)].

Taiwan is another good example of a strong economy based on an educated and highly skilled labour force. As in Japan and Korea, government policy focused first on universalising primary and secondary education for the rapidly growing population in the two decades after the war. Education up to class nine was made free and compulsory in 1968, and literacy rose to 68 percent in 1952 to more than 92 percent in 1987.

Besides this historical evidence across countries, other empirical work confirms the positive relationship between education and economic growth. Research for the World Bank's 1991 World Development Report suggests that increasing the average amount of education of the labour force by one year, when this average is three years or less, raises aggregate real output by 9 percent. More recent works [Barro (1991) and Dollar (1991)] suggest that, at least in the medium term, primary and secondary education are more important for economic growth than post-secondary education.

Now, focussing on the paper: this research is indeed a very welcome contribution to the existing body of literature and as such my purpose is not to criticise the paper. I would, however, like to identify a few technical weaknesses, which I hope could be easily removed, to significantly improve the quality of this paper.

(1) The paper utilises a Cobb-Douglas production function, with human capital (measured by school enrolment rates) as an independent factor of production. Nevertheless, the author kept on using the production equation as a growth equation. In other words there is considerable confusion about what, in empirical terms, is the hypothesis of the paper. To put it simply, it is not made clear whether it is production (real income) or the growth in production which is determined by level of education. The set of equations presented in the paper indicate it is the former (which imply that equation in its first difference would define growth), however, the explanations given in the text suggests the latter. I personally would have preferred a growth, rather than a production, equation. Not only do I feel that education is expected to have a direct impact on growth, but also the specification in first difference would have resolved the possible multicollinearity problem, which I suspect is the biggest reason for some

non-plausible results derived in the paper. For example, negative coefficient of labour variable in Indian and of primary education variable in the Pakistani equation.

(2) The paper has used education as the sole proxy for human capital formation and that, too, being measured by three separate independent indices, i.e. enrolment rates in primary, secondary and higher education, defining various stages of human capital formation. Was there a special reason for not including them all together in the equation? One feels that both for analytical and policy purposes it would have been better to include all three variables in the equation as it would have determined the relative influence of each of them (with other two being held constant).

(3) Is human capital formation only based on education? Undoubtedly, education is the most important determinant but one would have liked to see some index of health and nutrition in the equations as well. This is important as international evidence indicates that there are several ways by which good health and nutrition affect economic growth. Perhaps the most obvious one is through improvements in the physical strength and endurance of workers. For example, in Sierra Leone, a 10 percent increase in the caloric intake of farm workers consuming 1,500 calories a day raised output by 5 percent [Strauss (1986)]. Similar results have been found among Kenyan road construction workers with a daily intake of 2,000 calories. A second route from health to growth is through reductions in number of days ill and days absent from work due to sickness. Household survey data suggest that the economic effects of adult illness may be due to absenteeism from work [King *et al.* (1991)]. The potential income loss due to illness in eight developing countries averages between 2.1 to 6.5 percent of yearly earnings of workers. In addition, good health raises lifetime earnings by increasing the number of years that adults work without the illnesses generally associated with old age.

(4) While the author does mention various studies highlighting the importance of "lags" by which education would affect output or growth, surprisingly no attempt is made to incorporate "lag" values in estimation. The way the estimable equation is specified in the paper indicate an immediate impact of enrolment rates on output, which gives me an uneasy feeling. The studies quoted in the paper, as well as those mentioned above, have specified equations which consider the lagged effect of education.

(5) I personally believe that the type of equations specified in the paper may not be the right way to compare the effect of human capital formation between different countries as this discriminates against the country with low levels of education. This is because the same change in enrolment rate would lead to a larger proportionate change, and hence smaller coefficient for the same change in output, in the country with lower levels if education.

(6) I have to confess that I was unable to understand the reasons given for negative coefficients of labour variable in the India equation, and the primary education variable in the Pakistan equation. For India, a larger population and correspondingly larger unemployed labour to me should not be any reason for negative output elasticity of labour. Similarly, I would find it hard to believe that poverty and low returns to primary education would make the coefficient of education variable negative in Pakistan and not in India. As mentioned above, a possible explanation may be that in a time-series model, enrolment rates and labour variables are perhaps correlated and as such one variable is capturing the effect of the other.

(7) I was thoroughly confused by the econometrics used in the paper beyond the first set of equations. Take for instance Equation (9) which is used to define "effective labour" and this composite variable is used in estimation of the production equation. I can see the logic of Equation (9), but only if both variables are in same units (usually taken as indices, i.e., they are made unit free). However, in the paper, labour variable is (presumably) measured in number, while education variable is measured as (enrolment) rates, and hence can not be added even in their log values. I would very much like to be corrected on that.

(8) Similarly, I was unable to understand the specification and estimation of physical capital equations. The way these equations are specified, the second (i.e. the investment equation) is nothing but a rearrangement of the first set of equations (i.e. production functions); and therefore add no new information. The reason for somewhat different coefficient values is perhaps due the small sample (24 observations). In larger samples (i.e. in probability limits), the two set of equations would have yielded "identical" estimates i.e., one could be easily derived from the other.

Finally, I would very much like to encourage the author to incorporate some of these suggestions in improving this paper or perhaps in extending the research as the topic chosen is not only interesting but extremely important for Pakistan.

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