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Research Paper -Economics

Human Capital, Growth and Convergence - A Review of Literature

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A B S T R A C T

Human capital is increasingly believed to play an important role in the process of growth and convergence. This paper reviews the existing theoretical and empirical literature that links endogenous human capital, economic growth and convergence of the growth process. A broad conclusion that can be drawn from this review of literature analyzing the relation between human capital and growth is that quality of human capital also matters for growth along with the quantity of human capital.

JEL Classification: J11, J13

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1.Introduction

Human capital is an important determinant of technological progress and economic growth of a country. The contribution of human capital to economy-wide technological improvement through the twin channels of imitation and innovation, and consequently, its implications on economic growth has been a subject of much empirical and theoretical research. This paper reviews the existing theoretical and empirical literature that links endogenous human capital, economic growth and convergence of the growth process. The paper has been broadly divided into four sections. Section 2 reviews the earliest models explaining growth and convergence. Section 3 discusses the current linking human capital and growth. Section 4 reviews the empirical literature on the subject and Section 5 concludes.

2. Growth and Convergence - The Earliest Approaches

The earliest growth models explaining growth and convergence can be traced back to Solow-Swan (1956). Solow-Swan model is largely characterised by a production function that exhibits constant returns to scale and diminishing returns to each input (capital and labor) and a constant savings ratio. In the absence of technical change, the model predicts that due to diminishing returns to individual factors, there can be no long-run economic growth and the economy will reach a steady state in which there is zero growth of per capita income. Therefore, the main obstacle to sustained economic growth is diminishing returns. If exogenous technical progress is introduced in the basic model, then sustained economic growth is achieved, but this is linked to the (exogenous) rate of technical change. The technical progress overcomes diminishing returns as labor becomes increasingly productive and, therefore, economies exhibit positive rates of per capita income growth, which is linked to the rate of technical progress.

One shortcoming of the Solow-Swan model is that the savings rate is exogenous and constant. Cass-Koopmans-Ramsey (CKR) model (after the work of Ramsey (1928) that was refined by Cass (1965) and Koopmans (1965)) is an analytical framework in which saving rate is determined endogenously by optimizing infinitely-lived households and firms that interact in competitive markets.

Households choose their lifetime consumption (and savings) by maximizing their utility subject to a lifetime budget constraint. Firms, on the other hand, choose the levels of capital and labor they use in producing output in order to maximize profits. However, this specification of consumer-maximizing behavior does not lead to qualitatively different equilibrium conditions from the Solow-Swan model. The only difference between the two setups is that, in a CKR environment, the optimal level of per capita output in the long-run equilibrium may turn out to be lower than that in a Solow-Swan environment.

This happens because future consumption does not yield the same utility as present consumption due to the presence of a discount factor. This calls for less "sacrifice" in terms of foregone consumption and, consequently, fewer saving and a lower level of equilibrium level of per capita income and capital-labor ratio than in the Solow-Swan model with a constant savings rate. Akin to the Solow-Swan framework, their model too predicts that as long as there are diminishing returns, there will be no growth in per capita income, unless exogenous technological progress is introduced.

A key feature of the CKR model is that the representative household plans with an infinite horizon. This assumption of an infinitely-lived representative household is not realistic. In sharp contrast, the overlapping generations (OLG) models introduced and studied by Samuelson (1958) and Diamond (1965) captures the effects of finite horizons.

The OLG model assumes that individuals live for a fixed number of discrete periods such as childhood and adulthood. The period of adulthood for one generation overlaps with the period of childhood for the next generation. Individuals, by assumption, do not care about the welfare of the next generation. With logarithmic utility and Cobb-Douglas technology, predictions of the baseline OLG model are similar to Solow model. In the long-run, the per-capita income grows at the rate of exogenous technical progress. For more general specifications, however, the model may exhibits multiple equilibrium, which may be stable or unstable.

It becomes apparent from the growth models discussed above that technical progress can overcome diminishing returns to factors, which otherwise pose an impediment to sustained economic growth. But technical progress in these models of neo-classical production function is generally assumed to be exogenous, which is a restrictive assumption as it does not give any economic explanation about how technical progress is happening. Another alternative way to get around diminishing returns is to directly assume a production function which is not subject to diminishing returns. AK model does the same by assuming that output is a linear function of capital, where A is the index of technology and K is defined in a broad sense to include different forms of capital stock such as human capital, physical capital, environmental capital etc.

An economy characterized by such a production function will accumulate capital continuously without experiencing diminishing returns to it and therefore, can experience sustained economic growth prospects. An alternative approach is to introduce additional inputs to the two basic inputs (capital and labor), which has been developed by Mankiw, Romer and Weil (1992). In their model, an additional form of capital, human capital, or the stock of knowledge is used in production. The introduction of this form of capital does not change the main findings of the Solow model. Human capital, however, can generate sustained economic growth. This subject has been discussed in detail later in the next section.

Another approach to overcome diminishing returns to factor is postulated by the learning by-doing and capital spillovers model introduced by Arrow (1962) and developed by Romer (1986). Learning-by-doing model functions on the assumption that the process of investing in physical capital by firms simultaneously increases their efficiency in production. This positive effect of experience on productivity is called learning by doing. Knowledge is considered to be a public good and therefore, investment in physical capital by a single firm has spillover benefits that raises productivity of all the firms in the economy.

A single firm's investment in physical capital increases aggregate physical capital stock and generates positive spillovers that eliminate the tendency for diminishing returns to capital. Thus, the learning-by-doing and spillover effects yield sustained economic growth in the economy. However, an implication of these models is that decentralized outcome is nonoptimal as individual firms do not internalize the positive spillovers generated by the process of physical capital accumulation and therefore, do not invest enough in physical capital stock.

Thus, there is scope for intervention by the government in the form of incentives to spur physical capital accumulation, that raises returns to physical capital and ensures that social optimum is reached in the decentralized economy. R. J. Barro (1990) postulates a model of public infrastructure in which provision of public services by the government eliminates the tendency for diminishing returns to capital accumulation. The purchases of goods and services by the government enters into the production function of a firm as a pure public good. The production function exhibits diminishing returns to private physical capital but constant returns to scale with respect to private capital stock and the flow of public services provided by the government. This constant returns to private physical capital and public services together generate sustained economic growth.

A second way to achieve sustained economic growth in the long-run is by improvement of production process through technological improvements. Technological improvements can happen through the development of new intermediate inputs that neither complement or substitute existing intermediate inputs as postulated by Romer (1990) in his product variety model. Alternatively, technical improvements can occur through quality improvement of existing inputs that render the older inputs obsolete as postulated by Aghion and Howitt (1992) in their quality ladders model. Both models generate sustained economic growth in the long-run.

One of the main questions that all these growth theories attempt to answer is whether poor countries are likely to catch up with rich countries. In other words, will the per capita income of poor economies converge to the per-capita income of rich economies? These initial growth theories explain convergence as a result of diminishing returns to inputs which are being used in production. As long as physical capital exhibits diminishing returns, the poor economies that have lower initial capital per worker have higher rates of return and therefore, higher growth rates as compared to rich economies that have higher initial capital per worker. As a result, poor economies will converge with rich economies to the same steady state without conditioning on any other characteristics (such as savings ratio, population growth) of economies. This process of convergence is referred to as absolute convergence. This is true when the economies are structurally similar. In comparison with this, the process of convergence is conditional when an economy with a lower initial per-capita capital stock grows at a faster rate and converges to its own steady-state depending upon the other characteristics of the economy. Since real economies tend to be structurally different, it is conditional convergence that has found much greater empirical support.

The most well known initial empirical study of absolute convergence is by Baumol (1986). He finds no evidence of absolute convergence for a sample of 72 countries. Kormendi and Meguire (1985) and Grier and Tullock (1989) test for conditional convergence and their regression results provide evidence of conditional convergence. These initial convergence studies do not include human capital as an explanatory variable, which is a major drawback. R. J. Barro, Sala-i Martin, Blanchard, and Hall (1991) have proposed the concept of beta (â) convergence which is a popular methodology of investigating convergence empirically. â-convergence considers whether the growth rates of countries exhibit a negative correlation with the initial level of real GDP per worker.

If they are negatively correlated, this implies that countries with low real GDP per worker possess more potential for faster growth rates than countries with high real GDP per worker. To study convergence, R. J. Barro et al. (1991) includes the initial income variable in his regressions. He reports absence of absolute convergence in a broad sample of 98 countries. He finds that the coefficient of initial income turns negatively significant when the initial measures of human capital are included.

This leads R. J. Barro et al. (1991) to conclude that the data support conditional convergence. He also finds that the measures of human capital are positively and significantly related to income growth rates. Human capital has been extensively modeled in endogenous growth theories as an input that helps in countering the diminishing returns of neo-classical production function.The next section discusses in some detail the role of human capital in explaining growth and convergence.

3.Current Approach linking Human Capital and Growth

Two different approaches have been followed in the endogenous growth literature to model the relationship between human capital and economic growth. The first approach has been postulated by scholars like Lucas Jr (1988) and Rebelo (1991). Here, human capital is a direct factor of production, which is positively related to output growth just like other factors, such as physical capital and labor. Human capital accumulation implies acquisition and up-gradation of skills by the work force that increases the productivity of workforce, which ultimately culminates into higher economic growth rates.

Although, there exist diminishing returns to each factor individually, there are constant returns to physical and human capital together. This property of the production function prevents the marginal product from falling as human capital and physical capital are accumulated, and this gives the model the sustained growth property. Here, the rate of growth depends upon the rate of accumulation of human capital. Since they formulate an AK-type model structure in equilibrium, an implication of their model is that economies that differ in their initial conditions (different initial capital-labor ratio) will grow at different rates indefinitely and will never converge.

The second approach that has its origin in the contribution of Nelson and Phelps (1966) and Benhabib and Spiegel (1994) focusses on the relation between human capital and technological progress. Under this approach, human capital does not enter the production process directly but facilitates the adoption and development of technology (sometimes differentiated by imitation and innovation activity as two distinct routes for technological progress). This strand of literature de-emphasises the role of human capital accumulation and highlights the importance of technological progress. Within this framework, the economic growth rate is determined by the rate of innovation (and/or imitation) and therefore, subsequently, by the level of human capital and not by the rate of human capital accumulation. Romer (1990) formulates an endogenous growth model in which he makes explicit the role of human capital in promoting technological progress and, therefore, growth.

According to Romer (1990), new technologies are developed by inventing new intermediate product varieties. There are two distinct roles of human capital. One is for improving technology (that is, by developing new intermediate product varieties), and the other is for final production (that is, by increasing productivity). Aghion and Howitt (1992) have formulated a slightly different framework in which new technology is developed by improving the quality of existing intermediate inputs. Invention of a higher-quality intermediate good renders previous intermediate goods as obsolete.

These endogenous growth models predict a pattern of convergence across economies based on the diffusion of technology from leader to follower countries, instead of diminishing returns to capital as predicted by the neo-classical models. The researchers in leader countries expend effort in innovation. Innovation occurs either through the production of new intermediate varieties or through quality improvements. The follower country does not innovate but imitates and adapts the intermediate inputs produced in the leader country. The cost of imitation is less than the cost of innovation when only a small proportion of new ideas have been copied, but it increases as the pool of uncopied ideas contracts.

This cost structure implies a kind of diminishing returns to imitation and, thereby, generates a pattern of convergence. The follower country will have a higher growth rate than the leader until it has managed to emulate and adopt all the intermediate goods that have been developed by the leader. After that point, there will be simultaneous adoption of all intermediate goods that are developed and both the countries will grow at the same economic growth rate (R. Barro (1995) ch.8). Benhabib and Spiegel (1994) discuss the link between human capital and technology diffusion. Building on the formulation by Nelson and Phelps (1966), they develop a model in which a higher stock of human capital spurs technical progress in the long-run.

They postulate that the level of human capital affects the total factor productivity through two channels. Firstly, human capital directly influences productivity by enabling a country to innovate new technological capabilities suited to domestic production. Secondly, they assume that the ability of a country to adopt and adapt new foreign technologies (that is, the catch-up effect) depends upon its domestic human capital stock. Here the economies converge to world technology frontier, and eventually, also in terms of economic growth rates. The follower, which is at a distance from the world technology frontier, will have a higher growth rate than the leader due to the catch-up effect.

Once the follower gets closer to the world technology frontier, the catch-up effect vanishes and the leader and follower will grow at the same rate at the world technology frontier. The role of human capital is crucial as it is the human capital stock that determines the strength of the catch-up effect. A follower with a higher human capital stock adopts new technology and converges to the technology frontier at a faster pace as compared to a follower country with a lower human capital stock.

Using cross-country data from 78 countries over the period of 1965 to 1985, Benhabib and Spiegel (1994) estimate a positive relation between human capital stock and economic growth. Similarly, Pritchett (2001) finds a positive relation between human capital and economic growth. However, the findings of Benhabib and Spiegel (1994) and Pritchett (2001) have been criticized by other researchers citing reasons of misspecification of model and measurement errors (see, for instance, Topel (1999); Temple (1999). In another influential study, Krueger and Lindahl (2001) observe that human capital enhances growth only for the countries with the lowest level of education. That is, education matters only for catching up but not for innovation at the frontier. Also, they find evidence in support of conditional convergence.

In an attempt to resolve this Krueger-Lindahl puzzle, Vandenbussche, Aghion, and Meghir (2006) argue that human capital does not affect innovation and imitation uniformly. They develop an endogenous growth model, where innovation makes relatively more intensive use of skilled labor and imitative activities make relatively intensive use of unskilled labor. Thus, in their model, human capital is skill differentiated. They show that human capital affects the rate of technical progress via a level effect and a composition efffect. Holding the composition of human capital constant, an increase in the stock of human capital is always growth-enhancing.

However, holding its level constant, the growth-enhancing properties of human capital depend on both its composition and the distance to the technological frontier. The growth-enhancing impact of skilled labor increases with a country's proximity to the world technology frontier, where proximity is measured by the ratio between the total factor productivity in the country and the corresponding variable for a frontier economy such as the US. Conversely, the growth-enhancing impact of unskilled labor decreases with the proximity to the world technology frontier.

Their theoretical results state that tertiary education should become increasingly important and primary and secondary education less important for growth as a country moves closer to the technology frontier. Using a panel dataset covering 19 OECD countries for period 1960-2000, they find evidence in support of their theoretical findings. Ang, Madsen, and Islam (2011) empirically investigate the predictions of the theoretical model of Vandenbussche et al. (2006) for developing countries. In particular, they investigate whether the contribution of human capital to productivity growth depends on the composition of human capital and proximity to the technology frontier in a panel of 87 sample countries over the period from 1970 to 2004.

Their results show that the growth enhancing effects of tertiary education attainment or skilled human capital increase when high and medium income countries move closer to the technology frontier. Human capital is not contributing to growth in low income countries, suggesting that they neither innovate nor imitate. Also, they find evidence of technology convergence independent of human capital in low income countries, implying that being far from the frontier allows one to experience faster TFP growth. Income convergence is the joint outcome of the twin processes of capital deepening and technological catch-up. Since TFP is the closest measure of technology, researchers have investigated whether countries have come closer in terms of TFP levels.

This has given rise to the concept of TFP-convergence. Income convergence across countries gets either accelerated or thwarted depending on whether initial TFP-differences narrow or widen over time (N. Islam, 2003). The main drawback of the study by Vandenbussche et al. (2006) is that they assume that there exists an exogenously given composition of skilled-unskilled human capital. They consider only the benefit of skilled labor and ignore the fact that skill acquisition is not cost less.

Besides this strand of literature linking human capital, technical progress and economic growth, there exists another line of literature that describes the process of human capital formation as a source of demographic transition from a Mathusian economy to a Modern economy. The genesis of this strand of literature can be traced back to the seminal work of Becker (1960) where he mentioned the concept of "child quantity-quality trade-off" for the first time. Becker defines child quality as the expenditure incurred on a child. So, higher the expenditure incurred on a child, higher is the skill-set of a child. Parents maximize their utility which depends on child bearing and own consumption subject to a budget constraint to determine the optimal quantity and quality level of children. In this particular setting, Becker proposes that parents experience a trade-off between the quantity and the quality of their children as per capita income rises. Parents start spending more on children's education and bear a lower number of children, which leads to a decline in fertility.

The literature linking human capital formation and demographic transition of an economy highlights the process of human capital accumulation as a trigger for the child quantity-quality trade-off, which leads to the transition of an economy from a primitive economy having high fertility and low economic growth to a modern economy with low fertility and higher economic growth. The central idea behind theories belonging to this line of literature is that technical progress leads to better utilization of resources, which in turn, leads to higher wages.

However, higher technical progress requires skilled labor. Therefore, altruistic parents who care about their children focus on increasing the human capital investment in their children. This triggers a child quality-quantity trade-off wherein parents prefer having fewer but higher quality/ more educated children. As a result, economic growth is accompanied by a fertility transition from high to low fertility. Becker, Murphy, and Tamura (1990) formulate a theoretical model with endogenous fertility to characterise Malthusian economies and modern economies. They assume that rate of return on human capital rises as the stock of human capital increases. The reason behind this assumption is that human capital is largely defined by knowledge embodied in individuals. The benefit of imparting additional knowledge to an individual depends positively on the knowledge he/she has already gained. Becker et al. (1990) explain this rationale by citing an example that learning of complicated mathematical concepts is easier when there is conceptual clarity of basic mathematical concepts. Therefore, when human capital stock is abundant, families have lesser children and invest more in their offspring as rate of return on human capital is high. On the other hand, individuals have larger families and invest little in children when human capital stock is limited. This assumption generates two steady states in the model. One is the Malthusian steady state with high fertility, lower stock of human capital and lower return on human capital and therefore, lower per capita income. The other one is the developed steady state with low fertility and higher human capital stock which yields higher returns on human capital investment and higher per capita income. They also show that an economy may switch from a Malthusian trap to modern economic growth after a threshold value of human capital accumulation.

A pioneering work in this field is the "Unified Growth Theory" postulated by Galor and Weil (2000)."Unified Growth Theory" is a comprehensive endogenous growth model of technology, fertility and human capital which explains the entire evolution process of mankind starting from a Malthusian economy through a Post-Malthusian regime, to a demographic transition and eventually the period of sustained economic growth. It explores the interlinkages among technical progress, per capita income and human capital formation process. The impact of technical progress on per capita income and the child quantity-quality trade-off determines the entire process of economic growth. Galor and Weil (2000) postulate a technical progress function that depends on population size and education. In the Mathusian regime, the economy is in a Malthusian trap with low per capita income. The technological progress occurs at a slow pace such that the rise in income per capita is always offset by popluation growth. In the intermediate stage of Post-Malthusian regime, the economy takes off due to higher rate of technical progress caused by the increase in the size of population during the Malthusian regime. A higher rate of technical progress increases the relative return to human capital. This triggers a child quantity-quality trade-off where parents start spending on their offsprings' education and have lesser number of children. This induces a demographic transition in which fertility rates decline. This eventually the paves way to the period of sustained economic growth. Galor and Moav (2002) extend Galor and Weil (2000) by introducing heterogeneous preferences of individuals about quantity and quality of children.

They assume that these preferences about child quantity-quality are hereditary implying that if an individual prefers quality over quantity of children, his future generations will share same preferences. Thus, the population is segregated into different groups according to their choices between child quantity-quality. Their model postulates that population composition is reshaped due to changing technological and economic conditions such that people with quality-biased preferences survive. As a result, human capital accumulates leading to faster technical progress which leads to the transition from the Malthusian era to a demographic transition and eventually, paves the way to sustained economic growth.

In a similar vein, Moav (2005) develops a theory of fertility and child educational choice to explain the persistence of poverty across countries. He assumes that the cost of education is in terms of the wages foregone on account of the time spent on educating the children. Further, he assumes that individuals' productivity in educating children increases with their own human capital whereas the child rearing costs are equal across all individuals. A lower level of parents' education (lower human capital) implies that the parents' time is cheaper, and therefore, it is cheaper to have children. As a result, parents have more children and incur lesser investment in human capital of their children, which leads to lower per capita income. The high fertility rates further dilute the accumulation of per capita physical capital which reinforces the impact of child quality choice on economic development.

Thus, households in poor economies choose higher fertility rates with lower investment in their offspring's education and lower levels of capital transfers; and therefore, poverty persists. In contrast, families in the richer countries choose lower fertility rates with higher investment in education and higher levels of capital transfers, and therefore, high income persists in such economies. Thus, the model offers explanation for cross-country output differences and for the phenomenon of club convergence.

Club convergence is a weaker form of convergence in which countries having the same structural characteristics and similar initial conditions converge to similar levels of per capita income; that is, poor countries and rich countries converge to low and high income levels respectively. Countries in the club of the rich converge to a high income-per-capita steady state, whereas countries in the club of the poor converge to a low-income level. The poor countries fail to catch up with the rich because of insufficient progress in education, which is due to high fertility rates.

From the theoretical and empirical studies reviewed so far, it can be concluded that education has far-reaching impact on the growth prospects of a country. However, as pointed out by empirical studies like Benhabib and Spiegel (1994), Pritchett (2001), schooling per se does not necessarily lead to higher growth. Quality of schooling also matters for economic growth. One of the reason for divergent growth trajectories of developing countries vis-´a-vis developed countries is the significant qualitative differences in their education systems. The next section discusses the empirical literature on the linkages between human capital, economic growth and convergence.

4. Human Capital, Growth and Convergence - Empirical Literature

In the existing empirical literature on human capital, growth and convergence, human capital stock is largely measured using various measures of schooling such as mean years of schooling attained, net enrolment ratios. These are imperfect measures of human capital stock as they measure only the quantity of schooling, not the quality. The quality of schooling varies substantially across countries. Presently, in practice, there are two approaches followed for measuring the quality of human capital. The first includes measures of schooling inputs, such as expenditures per student, pupil-teacher ratio, and teachers' salaries etc.

The second refers to the direct measures of cognitive skills such as science, mathematics and reading scores on internationally standardized tests of cognitive skills. Lee and Barro (2001) have compiled test scores on examinations in science, mathematics and reading tests for students of various age groups in different years for 58 countries. Using this dataset, they investigate the determinants of quality of human capital. Their regression results show that family factors (such as income and quantity of schooling) and school inputs (pupil-teacher ratio, average teacher salary and length of school year) are closely related to school outcomes, as measured by internationally comparable test scores, repetition rates and dropout rates. Their study concludes that school inputs and family factors play a major role in improving school quality.

R. J. Barro (2001) analyzes the determinants of growth in an unbalanced panel of about 100 countries for the period of 1965-1995. He finds evidence in support of conditional convergence. The growth rate of per capita GDP is inversely related to the initial level of per capita GDP, keeping the influence of measures of government policies, institutions and character of national population constant. Growth is positively related to the initial level of average years of adult-male educational attainment at secondary and higher levels. He also analyzes the relationship between quality of human capital and growth for a smaller unbalanced panel of 43 countries. He uses data on three test scores (science, mathematics, and reading) as indicators of quality of human capital along with a measure of quantity of human capital . (male post-secondary schooling) in the growth regression. He finds that science scores have a positive and significant effect on growth and, in terms of magnitude, its effect is more important than educational quantity. Mathematics scores are also a significant determinant of growth and the magnitude of this effect has been found to be larger than that of the science scores. Finally, reading scores turn out to be an insignificant determinant. The overall result is that the quality of schooling is far more important for growth than the years of schooling.

Hanushek and Kimko (2000) provide an extensive discussion of how scores from cognitive skill tests can be used to measure the quality of human capital and its effects on economic growth. They use data from six voluntary international tests of mathematics and science over the period 1964-1991 to build a measure of quality of education. Four of these tests are organized by the International Association for the Evaluation of Educational Assessment (IEA) and two tests were organized by the International Assessment of Educational Progress (IAEP). Hanushek and Kimko (2000) find that adding educational quality to a base specification, including only initial income and educational quantity, increases the explanatory power of the model from 33 to 73 percent. The effect of years of schooling is greatly reduced by including quality, leaving it mostly insignificant. At the same time, adding the other factors leaves the effects of quality basically unchanged. The hypothesis of conditional convergence is supported by their results as the coefficient of initial income is negative in all the specifications. Several studies have since found very similar results. Extensions of the measure of Hanushek and Kimko (2000) have been used in the cross-country growth regressions by Bosworth and Collins (2003) and in the cross-country industry-level analysis by Ciccone and Papaioannou (2009). Both of these also find that educational quality strongly dominates any effect of educational quantity on growth. Hanushek and Woessmann (2012a) extend previous measures of Hanushek and Kimko (2000) to improve direct comparisons of student knowledge over time, across tests, and across age groups. The new data comprises 77 countries, and observations are updated up to 2003. They have repeated the cross-country growth regressions of Hanushek and Kimko (2000) for the expanded set of countries. Their estimate of human capital quality was found to be positively significant signifying that a one standard-deviation increase in test-scores would increase the long-run growth rate by two percentage points.

Hanushek and Woessmann (2012a) look at the distribution of scores by defining two variables that measure the proportion of students that meet a threshold level of achievement. The first was a score of 400 or above on the transformed international scale, that is, one standard deviation below the mean test scores for OECD countries (meant to capture basic literacy) and the other 600 or above (to capture high achievement). The estimates for the two threshold levels were highly significant indicating that both basic and high achievement are important determinants of growth, with the coefficient on high achievement substantially greater than the coefficient on basic skills. The effect of the basic-literacy share does not vary significantly with the initial level of development, but the effect of the high achieving share of students is significantly larger in countries that have more scope to catch up to the most technologically advanced countries. These results appear consistent with a mixture of the basic models of human capital and growth mentioned earlier. The accumulation of skills as a standard production factor, emphasized by augmented neoclassical growth models (e.g., Mankiw, Romer, and Weil (1992)), is probably best captured by the basic-literacy term, which has positive effects that are similar in size across all countries. But, the larger growth effect of high-level cognitive skills in countries farther from the technological frontier is most consistent with technological diffusion models (e.g., Nelson and Phelps (1966)). Their results give consistent support for the hypothesis that quality-adjusted human capital and its interaction with the technology gap are essential for growth.

5. Conclusion

A broad conclusion that can be drawn from this review of literature analyzing the relation between human capital and growth is that quality of human capital also matters for growth along with the quantity of human capital. As the existing growth literature reveals that human capital is a major driver of economic growth, therefore, investment in human capital has been a primary focus of development policy worldwide. While there has been a significant progress in expanding access to education but it has not led to a concomitant improvement in learning outcomes among children in many countries. Studies assessing learning outcomes among school children across low- and middle-income countries have consistently found that effective learning in schools in these countries is abysmally low (Pritchett, 2013; Snilstveit et al., 2015). As P. Glewwe (2013) point out, school enrolment is not the sole objective of education policy but instead, the actual intent is to prepare the present generation for a better future by honing their basic and advanced skills. Therefore, there is a need to reconsider the role of schooling in the process of economic growth by focussing on the qualitative aspects of schooling and its consequent impact on economic growth of a country.

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