Human Capital Development

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This paper has two main objectives. First, it assesses and measures the gaps in the stock of human capital across the world. It presents how effectively different regions are improving their stock of human capital, and how long it will take for developing countries to catch up with the current level of human capital in industrialized countries. Second, it revisits the contribution of human capital to economic growth, proposing a decomposition method to account for employment growth—which is also impacted on by human capital growth—in explaining growth in total output per worker. The proposed methodology introduces employment growth in the growth decomposition through the employment growth elasticity. It is conjectured that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive, resulting in higher economic growth. The proposed method points to the importance of the micro linkage between human capital and the labor market.

JEL classification: J24, O4, O15

I. INTRODUCTION

According to modern growth theory, the accumulation of human capital is an important contributor to economic growth. Numerous cross-country studies extensively explore whether educational attainment can contribute significantly to the production of overall output in an economy. Although macro studies have produced inconsistent and controversial results (Pritchett 1996), several micro studies that look into the same problem have shown a consistently positive relationship between the education of the workforce and their labor productivity and earnings (Trostel, Walker, and Woolley 2002; Psacharopoulos and Patrinos 2004a). The general finding is that individuals with more education tend to have better employment opportunities, greater earnings, and produce more output than those who are less educated. These findings provide a strong rationale for governments and households to invest substantial portions of their resources in education, with the expectation that higher benefits will accrue over time. In this context, education is deemed an investment, equipping individuals with

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knowledge and skills that improve their employability and productive capacities, thereby leading to higher earnings in the future.

This study has two main objectives. The first is to measure the gaps in human capital attainment across the world. The second is to explore the issues on how human capital affects labor productivity and earnings for the workforce. The paper is organized as follows. Section II discusses issues surrounding the definition and measurement of human capital. Section III measures the current level of human capital accumulation across the world. Section IV discusses how effectively different regions are improving their stock of human capital and how long it will take for developing countries to catch up with the current level of human capital in industrialized countries. Section V touches upon the role of human capital in determining economic growth. Sections VI and VII tackle the microeconomic aspects of human capital, with Section VI discussing micro-level empirical findings on returns to education, and Section VII dealing with the issue of labor market mismatch. Section VIII discusses the education policy debate between education for all versus education for highly skilled elite students, and Section IX concludes with some policy recommendations emerging from the findings of the paper.

II. WHAT IS HUMAN CAPITAL?

Human capital plays a critical role in economic growth and poverty reduction. From a macroeconomic perspective, the accumulation of human capital improves labor productivity; facilitates technological innovations; increases returns to capital; and makes growth more sustainable, which, in turn, supports poverty reduction. Thus, human capital is regarded at the macro level as a key factor of production in the economywide production function. From a microeconomic perspective, education increases the probability of being employed in the labor market and improves earnings capacity. Thus, at the micro level, human capital is considered the component of education that contributes to an individual's labor productivity and earnings while being an important component of firm production. In other words, human capital refers to the ability and efficiency of people to transform raw materials and capital into goods and services, and the consensus is that these skills can be learned through the educational system. That said, human capital development is important for development for its intrinsic value as a development goal in its own right, not only because of its instrumental value.

Although the conceptual definition of human capital is clear, its measurement is difficult because it is practically impossible to observe individual skill, and even harder to design a metric that is comparable across individuals and countries. Thus, various proxy measures of human capital have been proposed in the empirical literature, such as literacy rates (Azariadis and Drazen 1990); school enrollment rates (Barro 1991, Mankiw et al. 1992); years of schooling (Barro and Lee 1996, 2001, and 2010; Cohen and Soto 2007); and test scores (Hanushek and Kimko 2000, Hanushek and Woessmann 2009). While the literacy rate, which measures the proportion of the population who can read and write, is an important measure of well-being, it does not measure the educational attainment or skill level of the workforce. On the other hand, school enrollment rate is a relevant metric only for school-age children and has little relevance for the workforce. Although years of schooling can reasonably capture the human capital stock of the workforce, this only reflects the quantity of human capital; it does not give an indication of the skill level of the workforce. This brings us to test scores, an indicator of human capital suggested by Hanushek and Kimko (2000), which reflects the quality of education and is closely related to individual skill. However, a problem with test scores is that it is very difficult to get a measurement that can be reliably extrapolated for the entire workforce. In fact, the country-level measures of average cognitive skills in Hanushek and Kimko (2000), and later Hanushek and Woessmann (2009), are not based on a random selection of schools or students, and may therefore not be nationally representative of the skill level of students, much less of the workforce.

Thus, for this study, we adopt average years of schooling as the measure of human capital because (i) this can be measured for the entire workforce in most countries, (ii) it is fairly comparable across countries, and (iii) it is the most commonly used measure of human capital in the literature. Despite its limitations, average years of schooling is still the most consistent and comparable country-level measure of human capital. It should be noted, however, that an ideal measure would be to combine years of schooling with test scores (as a measure of skill and cognitive ability) and construct an index that reflects both quantity and quality of human capital. Nonetheless, as discussed earlier, this data is not available at this time.

III. THE STOCK OF HUMAN CAPITAL IN THE WORLD

This section measures the current stock of human capital in the world using internationally comparable data from Barro and Lee (2010) on average years of schooling among the population aged 15 years old and over. The data set covers 146 countries over 1950–2010.[1] Table 1 presents average years of schooling in

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[1] Industrialized countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. South Asia includes Afghanistan, Bangladesh, India, the Maldives, Nepal, Pakistan, and Sri Lanka. In addition, East Asia and the Pacific includes Brunei Darussalam; Cambodia; the People's Republic of China; the Fiji Islands; Hong Kong, China; Indonesia; the Republic of Korea; the Lao People's Democratic Republic; Macao, China; Malaysia; Mongolia; Myanmar; Papua New Guinea; the Philippines; Singapore; Taipei,China; Thailand; Tonga; and Viet Nam.

eight different regions and by gender. The gender disparity in the table is defined as the ratio of female and male average years of schooling. Thus, if this index is less than 1, then females are deemed to suffer deprivation due to the shortfall in their years of schooling relative to males.

Table 1. **Average Years of Schooling and Gender Disparity, 2010**

Region	**Male**	**Female**	**Total**	**Gender Disparity**
Central Asia	9.35	9.99	9.69	1.07
East Asia and the Pacific	8.47	8.01	8.24	0.95
Eastern Europe	10.24	9.95	10.09	0.97
Industrialized Countries	10.92	10.71	10.81	0.98
Latin America and the Caribbean	8.63	8.33	8.48	0.97
Middle East and North Africa	8.05	7.28	7.65	0.90
South Asia	6.41	4.79	5.62	0.75
Sub-Saharan Africa	5.98	4.89	5.43	0.82
World	8.41	7.84	8.12	0.93

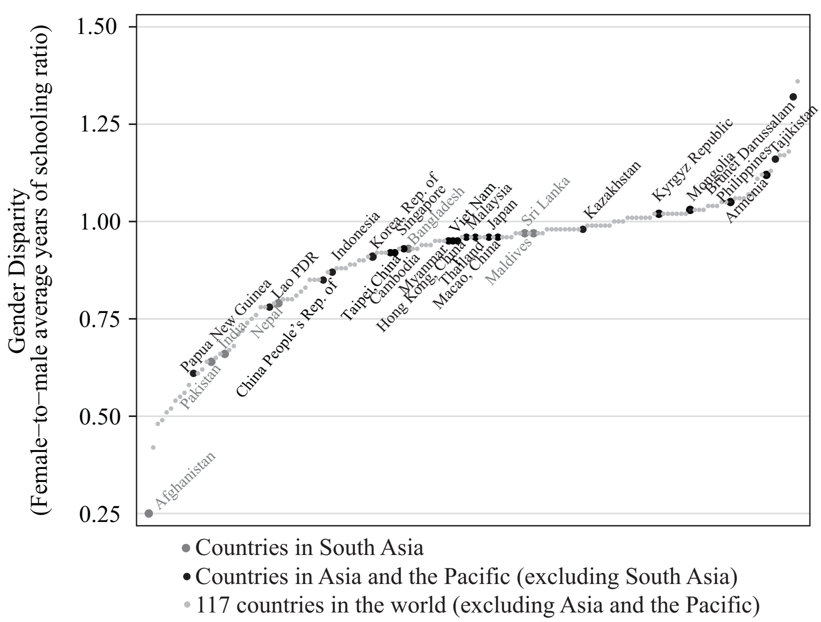
Source: Author's calculation based on Barro and Lee's (2010) data set.

The average number of years of schooling in the world is 8.12 years, with males having 8.41 years of schooling and females 7.84 years of schooling. A person in an industrialized country has the highest length of schooling at 10.81 years, while a person in sub-Saharan Africa has an average length of schooling equal to only 5.43 years. The situation in South Asia, with average years of schooling equal to 5.62, is not much better than in sub-Saharan Africa. Moreover, gender disparity is highest in South Asia (0.75) followed by sub-Saharan Africa (0.82). It is interesting to note that females have a slightly higher average number of years of schooling than males in Central Asia, although this difference may not be statistically significant. Figure 1 presents average years of schooling in individual countries. The countries have been arranged in ascending order in terms of gender disparity. Gender disparity is highest in Afghanistan, where females, on average, have only a quarter of the years of schooling of their male counterparts. Similarly, the gender disparity is high in most of South Asia, including Afghanistan, India, Nepal, and Pakistan. On the other hand, Sri Lanka performs far better than the other countries in South Asia on this front: the average years of education in Sri Lanka are 8.56 for males and 8.30 for females.

Gender disparities in South Asia have been repeatedly observed and documented. Das Gupta (1987) notes that South Asia is known to have higher mortality rates among females than males due to gender discrimination, and she documents persistent bias for sons and discrimination against daughters in Punjab despite the region's relative prosperity. Likewise, Filmer, King, and Pritchett (1998) report lower human capital outcomes for females in South Asia in various measures of human capital such as mortality rates, medical treatment, school enrollment, and literacy. The gender disparities may be caused by various intertwined reasons ranging from discrimination and cultural beliefs to biological differences and economic conditions, and this study will not attempt to disentangle these reasons. However, it could be argued that school systems and teachers in South Asia, by reflecting society's biases and prejudices, can aggravate inequities in human capital, making it very difficult for the region to achieve gender parity. In fact, even in a relatively progressive society such as Israel, teachers' gender biases can lead to measurable and significant differences in educational outcomes (Lavy 2008). On the other hand, well-ingrained notions of traditional gender roles can lead to the persistence of disparities in human capital investments and labor market participation even if socioeconomic conditions have changed, as observed by Vella (1994) in Australia.

Thus, a strong policy thrust is needed if discrimination and disparities in human capital are to be addressed within a reasonable amount of time. In fact, it is possible that the egalitarian educational policies of the former Soviet Union could have caused countries in Central and West Asia—such as Armenia, Kazakhstan, the Kyrgyz Republic, and Tajikistan—to show a high degree of gender parity in years of schooling. Likewise, it is useful to study the human capital policies implemented by Brunei Darussalam, which is the best performing country in terms of gender parity, with females having 2.1 more years of schooling than males on average.

Figure 1. **Gender Gap in Average Years of Schooling, 2010**

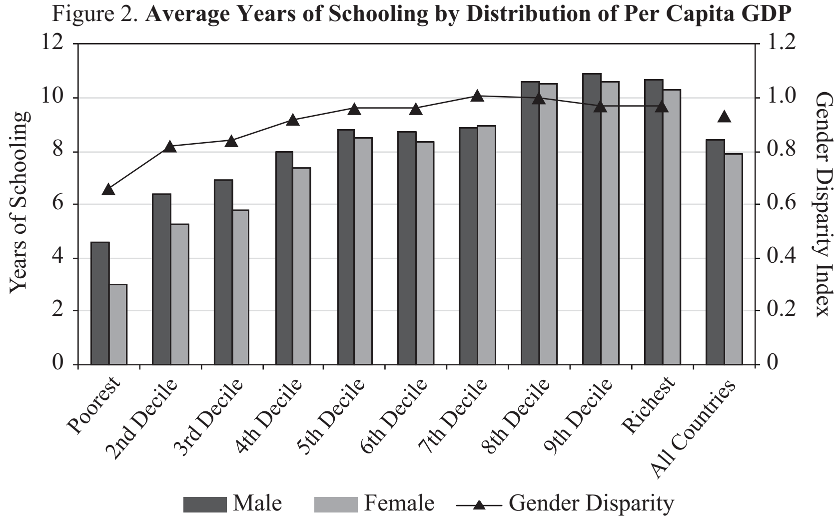


Source: Author's calculation based on Barro and Lee's (2010) data set.

The relationship between economic growth and human capital can be seen in Figure 2, which groups countries into deciles based on their per capita gross domestic product (GDP) and plots average years of schooling by decile. Figure 2 shows that gender disparity is worse in the lower deciles than in the higher deciles, indicating that gender equality in human capital is correlated with income. A similar finding was observed by Klasen (2002), who argues that gender disparity in education can slow down economic growth. He estimates that annual economic growth in South Asia could have been 0.49 percentage point higher in the 1970s and 0.45 point in the 1980s if its gender parity in education were the same as in East Asia and the Pacific.

It can also be seen in Figure 2 that average years of schooling increases from 3.78 among the poorest 10% of countries to 10.50 among the richest 10% of countries, indicating a positive relationship between per capita GDP and years of schooling. However, it is unclear how the causality runs: it is plausible that human capital achievement can lead to higher economic growth by increasing productivity, but it is also plausible that high economic growth improves human capital by relaxing budget constraints and creating more opportunities to invest in human capital.

Figure 2. **Average Years of Schooling by Distribution of Per Capita GDP**



Source: Author's calculation based on Barro and Lee's (2010) data set.

IV. CAN DEVELOPING COUNTRIES CATCH UP WITH INDUSTRIALIZED COUNTRIES IN INCREASING HUMAN CAPITAL?

After observing that there is a wide gap between industrialized and developing countries in terms of years of schooling, we now consider whether we can expect to close this gap in the future. Data on average years of schooling are available in 5-year intervals from 1950 to 2010, thus the exponential trend method is used to calculate the yearly growth rate in average years of schooling for each of the 146 countries and eight regions. Table 2 shows that the average years of schooling in the world has been increasing at an annual rate of 1.69% during 1950–2010, with a higher growth rate for females at 1.88% versus 1.53% for males. This suggests that the gender disparity in schooling has been declining rapidly over the past 60 years. However, while gender disparity still exists in 2010, the gap is far smaller than that observed in 1950.

It can be noted from Table 2 that the world's poorer regions—such as sub-Saharan Africa and South Asia—which initially had very low human capital in 1950, have made remarkable progress in increasing average years of schooling over the last 6 decades, growing at an annual rate of 2.89% and 2.26%, respectively. Average years of schooling have been increasing at the fastest rate in the Middle East and North Africa, growing at an annual rate of 3.05%. On the other hand, the growth rate in human capital in industrialized countries is measured at 0.98%, which is the slowest growth rate among the eight regions. This suggests that further increases in years of schooling are harder for countries that have already achieved high levels of education because the quantity of human capital cannot go on increasing and thus, its growth has to eventually slow. Convergence in human capital can thus be expected because the time spent for schooling has an upper limit—people cannot study forever.

Table 2. **Annual Growth Rate in Years of Schooling, 1950–2010 (percent)**

Region	Male	Female	Total
Central Asia	1.24	1.67	1.46
East Asia and the Pacific	1.38	2.28	1.76
Eastern Europe	1.05	1.40	1.23
Industrialized Countries	0.90	1.06	0.98
Latin America and the Caribbean	1.64	1.81	1.72
Middle East and North Africa	2.66	3.72	3.05
South Asia	2.00	2.75	2.26
Sub-Saharan Africa	2.67	3.18	2.89
World	1.53	1.88	1.69

Source: Author's calculation based on Barro and Lee's (2010) data set.

Rich industrialized countries have much higher stocks of human capital than developing countries, so the next pertinent question is whether or not past performance in human capital accumulation indicates eventual convergence. The good news is that convergence in human capital has been observed in the past decades, as can already be gleaned from Table 2, in which developing countries have experienced faster growth rates. Many previous studies have observed that there is a trend toward eventual convergence in human capital, and this finding seems to be robust to methodology. Whether the research measures the coefficient of variation over time (Babini 1991); uses the perpetual inventory method (Ahuja and Filmer 1996); or performs a three-stage least square regression (Cohen 1996, Sab and Smith 2002), data over the past few decades point to eventual convergence in human capital. If convergence will happen, how many years will it take the developing countries to catch up with the current level of human capital of the industrialized countries?

To calculate time to convergence, it is assumed that countries will continue the human capital growth rates set over the past 6 decades. Note that this assumption may not always hold because the growth rate in human capital may slow when a country achieves a higher level of human capital, as illustrated by the slow growth rates in industrialized countries, as already discussed. As such, the estimated years for convergence in Table 3 may underestimate the required time and may be better interpreted as the lower limit for years for convergence.

Table 3 shows that it will take at least 3 decades for South Asia and almost a quarter century for sub-Saharan Africa to catch up with the current level (in 2010) of industrialized countries in average years of schooling. On the other hand, Central Asia and Eastern Europe will take less than 10 years to do so. It is also interesting that, in general, it will take fewer years for females (16.8 years) in developing countries to catch up with their counterparts in developed countries than males (17.2 years), mainly due to the higher growth rate in females' years of schooling in the past 60 years. This is especially true in Central Asia, where it will only take 4.2 years for females to catch up with the current level of education of their counterparts in industrialized countries, compared with 12.7 years for males in Central Asia to do the same. On the other hand, it will take longer for females than males in South Asia and sub-Saharan Africa to catch up with their counterparts in industrialized countries due to the high level of gender disparity in these regions.

Table 3. **Years to Catch Up with the Current Level of Industrialized Countries**

Region	Male	Female	Total
Central Asia	12.7	4.2	7.6
East Asia and the Pacific	18.6	12.9	15.6
Eastern Europe	6.2	5.3	5.6
Industrialized Countries	0.0	0.0	0.0
Latin America and the Caribbean	14.5	14.0	14.3
Middle East and North Africa	11.6	10.6	11.5
South Asia	26.9	29.7	29.3
Sub-Saharan Africa	22.8	25.1	24.2
World	17.2	16.8	17.0

Source: Author's calculation based on Barro and Lee's (2010) data set.

Table 4, on the other hand, presents figures on schooling for selected Asian countries. It can be seen that there is a wide variation in average schooling between Asian countries, ranging from 5.1 years in India to 9.0 years in the Philippines. Moreover, in most of these countries females have less schooling than males. The only exception to this observation is the Philippines, where females, on average, have half a year more schooling than males. Estudillo, Quisumbing, and Otsuka (2001) attribute this gender differential to the perceived comparative advantage of sons in farm activities and that of daughters in nonfarm activities, so parents in rural areas bequeath land to sons while daughters receive investments in education. On the other hand, females in South Asia generally receive less schooling than males, with the schooling differential being more than 2 years in India and Pakistan.

Over the past 60 years there has been a wide variation in schooling growth across countries, ranging from 1.2% annual growth in Sri Lanka to 3.5% in Bangladesh (Table 4). Thus, despite Bangladesh's low average schooling as of 2010 (5.8 years), if it can sustain its schooling growth it is estimated to converge with industrialized countries even faster than Sri Lanka. Furthermore, Table 4 shows that schooling for females in South Asia has been growing much faster than that for males over the last 60 years, with Bangladesh and Pakistan having the widest growth differential. Thus, females in Bangladesh, Pakistan, and Sri Lanka are estimated to converge with their counterparts in industrialized countries earlier than males, despite females having less schooling at present.

Table 4. **Years of Schooling for Selected Asian Countries**

Country	Average Years of Schooling in 2010			Annual Growth Rate in Years of Schooling, 1950–2010			Years Needed for Convergence		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
China, People's Rep. of	7.6	8.7	8.2	3.5	2.2	2.7	9.9	10.3	10.5
Indonesia	5.6	6.6	6.1	3.6	2.3	2.8	18.2	22.1	20.7
Philippines	9.2	8.7	9.0	2.0	1.5	1.8	7.6	14.8	10.6
Thailand	7.3	7.7	7.5	1.7	1.0	1.3	22.5	37.1	28.7
Viet Nam	6.3	6.6	6.4	1.9	0.9	1.3	28.3	55.2	38.9
Bangladesh	5.6	6.0	5.8	6.0	2.6	3.5	11.2	23.3	18.2
India	4.1	6.1	5.1	4.3	2.6	3.1	23.1	22.3	24.6
Pakistan	4.3	6.7	5.6	5.1	1.9	2.9	18.4	25.5	23.4
Sri Lanka	8.3	8.6	8.4	1.7	0.9	1.2	14.9	27.3	20.3
Industrialized Countries	10.7	10.9	10.8	1.1	0.9	1.0	0	0	0

Source: Author's calculations based on Barro and Lee's (2010) data set.

However, while years of schooling has an upper limit and can be expected to converge, the quality of human capital may not have such an upper limit, and in the future, vast inequalities in quality of education may be seen, rather than in years of schooling. It would be interesting to study whether or not convergence is happening with regard to quality of schooling, and if this has any implications for the impact of human capital on economic growth, and whether or not per capita incomes will eventually converge.

V. HUMAN CAPITAL AND ECONOMIC GROWTH

Education has been considered a key determinant of economic growth since the introduction of Solow's (1956) growth model. Although Solow did not explicitly factor in education in his growth theory, the central role of technology in his model provided the impetus for the focus on education; after all, an educated population was necessary for technological innovation. Nelson and Phelps (1966) made the link explicit in what they termed "investment in humans": workers needed education in order to utilize new technologies (the development of which is considered exogenous), thereby increasing total factor productivity and spurring economic growth. A few decades later, the endogenous growth models played the central role of human capital in technological development and economic growth. According to these new growth theories—such as Lucas (1988); Romer (1990); Mankiw, Romer, and Weil (1992); Barro and Sala-i-Martin (1997)—the accumulation of human capital through education and on-the-job training fosters economic growth by improving labor productivity, promoting technological innovation and adaptation, and reducing fertility.

Numerous cross-country empirical studies have established the positive correlation between human capital and economic growth. Azariadis and Drazen (1990) find that a country's literacy rate in 1960 is a significant determinant of per capita GDP growth for 1960–1980, and literacy rates and initial per capita GDP in 1960 together account for 38% of the variation in economic performance in the 20-year period. On the other hand, using school enrollment as the measure of human capital, Barro (1991) finds that primary and secondary school enrollment rates are positively linked with economic growth and investments while being negatively linked with fertility rates.

Similarly, Mankiw, Romer, and Weil (1992) find that the elasticity of per capita GDP to enrollment rate is 0.66 for non-oil exporting countries and 0.76 in OECD countries; moreover, they show that differences in enrollment rates can explain nonconvergence in incomes during 1960–1985. On the other hand, applying the Mincerian specification, Barro and Lee (2010) estimate that increasing average years of schooling by 1 year increases per capita GDP by 1.7% to 12.1%, depending on specification (i.e., random vs. fixed effects regressions); while Cohen and Soto (2007) calculate returns to years of schooling at 12.3% to 22.1%. Testing the impacts of schooling quality on growth, Hanushek and Woessmann (2009) find that a unit increase in a country's average cognitive test scores increases its per capita GDP growth rate by 1.2–2.0 percentage points. Moreover, increasing average math and science scores by one unit increases per capita GDP growth rates by 2.0 points, and by 2.3 points for low-income countries. Overall, these studies find that education is significantly and positively correlated with economic growth and argue that causation runs from education to growth in line with human capital growth models.

However, as pointed out by Bils and Klenow (2000) and Krueger and Lindahl (2001), the causation can run in the reverse—i.e., economic growth increases returns to education and thus causes people to attain more education—and they argue that the data seem to be stronger in this direction. Bils and Klenow (2000) show that the schooling-to-growth effect accounts for less than one third of the observed correlation between schooling and growth, arguing that the findings in previous studies are mainly due to omitted variable bias. Likewise, Krueger and Lindahl (2001) argue that, compared with micro-level studies, cross-country macro-level studies suffer more from reverse causation (i.e., it is difficult to find valid instrumental variables in cross-country data) and omitted variable bias (such as policies that are nonstationary and which country dummy variables will not resolve). As such, micro-level analysis, where these problems can be plausibly resolved, might be more appropriate in studying the economic impacts of education. Krueger and Lindahl mention that natural experiments such as the different education policies of states in the United States or twins can more accurately measure the rates of return on education.

Another issue regarding studies on the relationship between education and economic growth is the lack of consistency between human capital theory and empirical testing. While the Solow and Nelson-Phelps models defined the basis of human capital theory, testing them in practice has been a problem. Mincer (1974) tested this relationship by measuring human capital as years of schooling, and derived a log-linear specification for output and schooling, respectively. This has been the traditional way returns to education have been measured, as can be seen in the papers earlier mentioned. However, Hanushek and Kimko (2000) argue out that cognitive ability, as measured by achievement test scores, is a more relevant measure of human capital, since cognitive ability directly relates to the ability of a worker to implement technology, as required by the Nelson-Phelps model. They also point out that length of schooling is not comparable across countries because a year of schooling in, say, Japan is not comparable with a year of schooling in, say, Bangladesh. On the other hand, Schady (2003) argues that the log-linear specification—i.e., the assumed Mincerian model of human capital—may be flawed, showing that returns to years of education features significant convexities and sheepskin effects.

An alternative way to derive the contribution of human capital to economic growth is through the growth accounting method, which assigns the contribution of various inputs such as labor, physical capital, and factor productivity toward outputs. An advantage of this approach is that it avoids the ambiguities of measuring human capital and is internally consistent (Stevens and Weale 2004). Recently, Bosworth and Collins (2003) proposed a growth accounting method that is an exact decomposition quantifying the contribution of growth in factors—including human capital, physical capital, and factor productivity—to growth in labor factor productivity. In this study, this growth accounting methodology is modified to explain growth in output per worker in terms of growth in four contributors, namely, employment, physical capital, human capital, and factor productivity (see Appendix for a discussion of the methodology).

Economic growth takes place due mainly to two factors: labor productivity growth and employment growth. In the method proposed by Bosworth and Collins, growth in employment is assumed to be exogenous, but in the proposed method in this paper, growth in employment is endogenous. Using this proposed decomposition, we are able to quantify the direct impact of growth in human capital on the growth rate of total output. However, it should be noted that growth in human capital indirectly affects growth in both productivity and employment, apart from its direct impacts on growth. Although previous studies have measured the impact of human capital on productivity growth, relatively fewer studies have analyzed the impact of human capital on employment growth. This study attempts to fill the gap.

Another interesting idea behind the proposed decomposition method is that human capital affects growth in output per worker through the employment growth elasticity, which measures how much employment is generated by growth in output. Our conjecture is that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive and resulting in higher economic growth. The proposed method is applied to Bosworth and Collins's dataset, and the empirical results are presented in Tables 5–7.

As can be seen in Table 5, world output grew at an average annual rate of 3.8% during 1960–2003. Using our proposed decomposition method, in which growth in output is explained by four components, our results show that almost 40% of growth in global output is explained by growth in employment. Table 5 also shows that growth in physical capital per worker contributes to growth in world output by 26.3%; growth in factor productivity is the third largest source contributing to world output by 23.7%; and growth in human capital makes only a 7.9% contribution to world output growth. These results are consistent with previous empirical studies—such as Bosworth and Collins (2003) and Collins (2007)—pointing to a weak correlation between growth in human capital and economic growth. It should be pointed out that the small magnitude for the contribution of human capital relative to the other three factors does not suggest that human capital is insignificant for output growth. The figures for the contribution of human capital in Table 5 only capture its direct impact on growth through labor productivity, and do not reflect its indirect impact through changes in the employment rate. Once we take this indirect channel into consideration, human capital, indeed, plays a major role in explaining growth in output per worker.

Table 5. **Sources of Growth in the World, 1960–2003**

Region	Annual Growth Rate	Percentage Contribution of			
		Employment	Physical Capital	Human Capital	Factor Productivity
Industrialized Countries	3.4	35.3	29.4	8.8	29.4
East Asia	6.5	41.5	33.8	7.7	15.4
Latin America	3.7	73.0	13.5	10.8	2.7
South Asia	4.6	45.7	23.9	6.5	23.9
Sub-Saharan Africa	3.2	81.3	12.5	9.4	−3.1
Middle East	4.6	58.7	21.7	10.9	8.7
World	3.8	39.5	26.3	7.9	23.7

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

Growth in total output has been quite impressive in East Asia as a whole; however, growth in human capital has not played a major role in explaining its output growth. Indeed, Table 5 suggests that the contribution of human capital growth to output growth has been around 5% to 10% for 4 decades. Rather, it is the growth in physical capital that has been the main contributor to rapid growth in East Asia.

The Philippines, however, presents an interesting case. As can be seen in Table 6, more than 75% of output growth stems from employment growth, suggesting that its pattern of growth is highly labor-intensive. This finding is consistent with the structure of the Philippine economy where the service sector accounts for almost 53% of its GDP and employs as much as 48% of the labor force during 2000–2008. On the other hand, the contribution of growth in physical capital is the lowest in the region (21%), which hinders improvements in factor productivity. This can be seen from the fact that growth in factor productivity has been negative. Unlike its neighboring economies, the direct contribution of human capital to output growth is rather large for the Philippines, accounting for as high as 10% of growth. In contrast, the Republic of Korea's pattern of growth is more balanced, with employment and physical capital each contributing about 36% to its total output growth.

Table 6. **Sources of Growth in East Asia, 1960–2003**

Economies	**Annual Growth Rate**	**Percentage Contribution of**			
		Employment	**Physical Capital**	**Human Capital**	**Factor Productivity**
China, People's Rep. of	6.9	28.1	26.9	5.2	38.8
Indonesia	5.5	47.1	32.0	8.9	11.6
Republic of Korea	7.4	36.5	36.6	9.5	16.6
Malaysia	6.6	49.6	31.0	8.2	10.8
Philippines	3.9	75.3	20.8	10.0	−6.4
Singapore	7.9	42.6	36.3	5.8	14.6
Thailand	6.7	37.1	35.0	5.7	21.6
Taipei,China	8.4	31.7	36.1	6.4	24.6

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

Compared to East Asia, growth rates of countries in South Asia are generally far lower, although employment remains the main source of total output growth (Table 7). Growth in Bangladesh is the most labor-intensive in the region, with almost two-thirds of total output growth contributed by employment growth. However, its growth in physical capital is the lowest of all the countries in the region, suggesting that this could be a binding constraint to achieving higher growth for Bangladesh. In all of South Asia, the contribution of human capital accounts for around 7%, with the exception of Pakistan where it is merely 6%.

Table 7. **Sources of Growth in South Asia, 1960–2003**

Countries	Annual Growth Rate	Percentage Contribution of			
		Employment	Physical Capital	Human Capital	Factor Productivity
Bangladesh	3.4	66.5	15.5	7.0	10.8
India	4.6	43.9	25.3	7.4	25.8
Sri Lanka	4.5	48.9	26.7	7.2	16.8
Pakistan	5.4	51.6	25.9	6.1	16.2

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

These findings are similar to the earlier findings of Collins (2007). Calculating the contribution of human capital to growth in output per worker for 84 countries over 1960–2003, she finds that although human capital is a significant contributor to growth in per capita outputs, this contribution is still much less compared with physical capital and total factor productivity. These results suggest that despite the positive contributions of human capital, investment levels and overall efficiency in the economy are mainly attributable to growth in output per worker. It is also worth noting from Collins (2007) that over 1960–2003, the contribution of human capital to labor productivity growth has changed little, despite the fact that educational attainment has nearly doubled during the period, particularly for developing countries. This is true when one looks at regional averages or individual country experiences in East Asia and South Asia.

The empirical studies show that the difference in growth across countries is not primarily due to educational attainment or growth in human capital. Rather, cross-country differences in growth in output per worker are largely attributable to changes in physical capital and total factor productivity over time. These findings suggest that while human capital matters for output growth or productivity at the aggregate level, future research at the micro level is needed to explore the link between the education of working individuals and their labor productivity and earnings. Households make important decisions on schooling and employment; as such, it is most logical to use a micro-level approach to look into the relationship between education, labor productivity, and earnings. It is at the micro level—the individuals, households, and firms—and the labor market where the skills learned through education are translated into outputs, and it is thus necessary to study these micro linkages if one is to make sense of macro observations.

VI. SOCIAL AND PRIVATE RETURNS TO EDUCATION

One of the primary benefits of education is increasing a person's chances of employment and being paid wages—other things being equal, a firm will hire the job applicant with more education. Moreover, workers with more education are able to command a higher wage. While this seems straightforward enough, the underlying mechanism behind this phenomenon is subject to much debate. A central question is whether or not education actually improves the productivity of workers. On one hand, the human capital theorists (e.g., Becker 1962, Schultz 1963) argue that education increases productivity by imparting skills—such as the 3Rs and problem-solving skills—needed for the workplace, resulting in higher employability and wages. On the other hand, the market signaling theorists pioneered by Spence (1973) argue that education may not actually increase worker productivity, but rather reflect it, with innately high-ability workers using education to separate themselves from low-ability workers. While the debate may seem academic, understanding the mechanism between wages and education has serious policy implications. If education does improve productivity, then it makes economic sense to promote basic education for all. If, on the other hand, sheepskin effects dominate, then the educational system should be calibrated such that there will be more efficient matching of skills in the classroom and in the workplace.

Most of the empirical literature on the private benefits of education are grounded on the human capital school, estimating the returns from educational attainment through regressions on wages and schooling. Despite wide variations in data sources, locations, and methodologies, Psacharopoulos and Patrinos (2004a) find that pre-2000 estimates of rates of return to an additional year of education in 73 countries revolved around 10%, with rates of return falling between 5% and 15% for 62 of these countries. This is still true even for the following studies after 2000:

(i) developed countries such as the United Kingdom (Harmon, Oosterbeek, and Walker 2003), Germany (Ammermueller and Weber 2005), the United States (Turner et al. 2007), and various countries in the European Union (Strauss and de la Maisonneuve 2007);
(ii) developing countries like India (Duraisamy 2002), the People's Republic of China (Li et al. 2005, Zhang et al. 2005), and Bangladesh (Asadullah 2006); and
(iii) various African countries (Schultz 2004).

On the other hand, Trostel, Walker, and Woolley (2002) estimate the overall return to education at 5% for a panel of 28 countries during 1985–1995, with country estimates ranging from 2.4% in Norway to 16.0% in Northern

Ireland. In general, these findings are fairly consistent with the rates of return calculated from cross-country studies.

Whether one looks at micro or macro data, the correlation between human capital and productivity is clear: more education is better than less education. However, there seems to be a discrepancy between the findings of micro-level studies and macro-level studies on returns to education by level of schooling. While cross-country macro studies show increasing rates of return from higher levels of education (for example, Lange and Topel 2006, Barro and Lee 2010), micro-level studies show decreasing social returns and U-shaped private returns as one goes from primary to tertiary education (Table 8). This discrepancy can be reconciled when one considers the different methodologies in calculating returns to education at the micro and macro levels. In cross-country studies, one only looks at the contribution of additional education to output or growth; macro-level regression analysis does not take into account the costs that go into producing education services. On the other hand, micro-level analysis takes into account the private and social costs of education, illustrating that at the tertiary level the private benefits of education outweigh the social benefits. These two approaches can have very different policy prescriptions: while macro-level studies will advocate the accumulation of human capital up to the tertiary level, micro-level studies will argue that public spending on education must stop at secondary school.

Table 8. **Returns to Investment in Education by Level (percent)**

	Social Returns			**Private Returns**		
	Primary	**Secondary**	**Higher**	**Primary**	**Secondary**	**Higher**
Per Capita Income Group						
Low income	21.3	15.7	11.2	25.8	19.9	26.0
Middle income	18.8	12.9	11.3	27.4	18.0	19.3
High income	13.4	10.3	9.5	25.6	12.2	12.4
Region						
Asia	16.2	11.1	11.0	20.0	15.8	18.2
Europe/Middle East and North Africa	15.6	9.7	9.9	13.8	13.6	18.8
Latin America and the Caribbean	17.4	12.9	12.3	26.6	17.0	19.5
Industrialized Countries	8.5	9.4	8.5	13.4	11.3	11.6
Sub-Saharan Africa	25.4	18.4	11.3	37.6	24.6	27.8
World	18.9	13.1	10.8	26.6	17.0	19.0

Note: Industrialized countries include Japan and exclude the Republic of Korea.
Source: Psacharopoulos and Patrinos (2004b).

Psacharopoulos and Patrinos (2004a) also observe that in 1992–2004, while average years of schooling increased, the average returns to schooling declined by 0.6%, which indicates decreasing marginal returns to education—an observation predicted by human capital models. Trostel, Walker, and Woolley (2002) find a similar phenomenon in their data, with average rates of return in 28 countries falling between 1985 and 1995, although trends vary widely across countries. In Cambodia, Sakellariou (2008) finds that the supply of more educated workers exceeds demand in the labor market, leading to a decline in the returns to tertiary education. A similar phenomenon is observed by Son (2009) in the Philippines: between 1997 and 2003 returns decreased for all levels of education from primary to tertiary. However, she attributes this to something different—the decrease in returns from education is due to poor job creation and low investment. This lack of job opportunities forces educated workers to take low-skill jobs, decreasing the returns from their education, and depressing overall labor productivity in the economy.

In other words, the expansion of education in recent decades does not always lead to higher productivity and economic growth as predicted in neoclassical growth models. As Pritchett (1996) observes, all the expansion in education since the 1960s has not resulted in the expected expansion in economic growth, especially for developing countries. Pritchett thus argues that a study of human capital will also have to consider educational quality and institutions: staying in school will not build human capital if the quality of education is very low, while bad institutions can lead to a situation where human capital is used for counterproductive rent-seeking activities. And this is where micro-level analysis can make an important contribution. While macro-level studies can only see average correlations between education and economic growth, micro-level studies will be able to see what is happening in the educational system and the labor market as well as how human capital is used and who actually benefits from education. If investments in human capital are to bear fruit, one also needs to consider the supply and demand conditions in the labor market.

VII. HUMAN CAPITAL AND THE LABOR MARKET

The link between education and economic development is realized through the labor market. Skills learned in the educational system should be used by firms in the production of goods and services so that workers will be paid wages commensurate with their productivity. Without this link, however, even educated workers will not realize the returns from their education reflected in their wages, and the economy will not reap investments in education through higher productivity. This unfortunate situation is observed by Son (2009) in the Philippines during 1997–2003. Looking at the educational attainment of the working age population at the household level, she finds that the proportion of employed household members with secondary and tertiary education increased, while the proportion of those employed with only primary education decreased.

This indicates that attaining secondary or tertiary education is an important factor for employability; however, this also means that the opportunities for those with low educational attainment have been diminishing.

There are two possible reasons for this observation: the Philippine labor market is demanding more workers with high educational attainment; or workers with secondary or tertiary education are crowding out less-educated workers in getting low-productivity jobs. If the latter is true, then one should observe that the productivity of educated workers is on the decline. Son (2008) observes a structural shift in employment from agriculture to the service sector especially among female workers. The service sector, however, includes low-productivity jobs like housemaids and drivers as well as high-productivity jobs like lawyers and financial advisers. Son (2009) then calculates that real labor productivity declined by 4.76% in 1997–2000 and by 1.42% in 2000–2003. In terms of returns to education, this results in a 23.5% decline in the real returns from secondary education (from P6.75 per hour in 1997 to P5.16 per hour in 2003), and a 16.3% decline in returns from tertiary education (from P19.80 per hour in 1997 to P16.57 per hour in 2003). Therefore, workers with secondary or tertiary education are increasingly accepting low-productivity jobs, resulting in lower productivity and rates of return to education.

The above observations clearly show that the labor market in the Philippines is not able to effectively utilize the country's increasingly educated workforce. Despite having a greater proportion of workers with secondary or tertiary education, the average productivity of workers is on the decline. This means that the labor market is not generating enough quality jobs for the educated workers, so they end up taking up low-productivity jobs. Alternatively, this also indicates that the educational system is not teaching the skills needed by the labor market, either because of a mismatch between skills supplied and demanded, or because of poor quality of education. Either way, this suggests that educational attainment is not leading to high productivity, and therefore economic growth remains slow.

For human capital theorists, overeducation in the labor market implies market inefficiencies—either the economy is not generating enough quality jobs for workers or there is overinvestment in education. However, proponents of job market signaling would see it a different way: overeducation is natural and should be expected to persist. As argued by Sicherman (1991), overeducation in the market can be explained by the trade-off between schooling and experience (so young workers use education to compensate for lack of experience), and the labor market mobility that overeducation eventually allows. However, from a policy perspective, overeducation implies a misallocation of already strained resources. Thus, for developing countries, going beyond universal coverage in education is imperative because economic development requires an expansion of the supply of the right kind of skills. Unfortunately, the reality is that labor market mismatches remain a challenge faced by many other developing countries, including Cambodia (Sakellariou 2008); the People's Republic of China (Li, Morgan and Ding 2008); Mongolia (Pastore 2009); and Taipei,China (Hung 2008).

Governments in developing Asia need to address these mismatches in order to accelerate and sustain economic growth. Given their limited resources for providing education, a pertinent policy question is whether the education policy of a country ought to be geared toward the lowest or highest achievers, which is discussed in the next question.

VIII. EDUCATION POLICY: BASIC SKILLS VERSUS HIGHLY SKILLED LABOR

Indeed, an important policy consideration is whether to concentrate education resources toward gifted students or to spread resources to achieve universal basic education. On one hand, allocating more resources toward developing the skills of high-aptitude students can provide an economy with a pool of highly skilled managers and scientists and increase the likelihood of generating technological innovations. However, this will mean a greater proportion of the workforce is poorly educated and unskilled, making them unlikely to utilize technology into production. On the other hand, spreading resources equally in basic education will ensure a workforce with at least basic skills that can implement existing technologies, but this will lessen the likelihood of growth-spurring technological innovations. In other words, should a country devote significant resources to developing an elite group of "rocket scientists", or should these resources instead be used to teach basic skills to all students?

To answer this question, Hanushek and Woessman (2009) test how the share of high-aptitude students—those with cognitive test scores of 600 or higher—and the share of students with basic literacy skills—those with cognitive test scores of 400 or higher—affect a country's growth path. They find that both "rocket scientists" and "basic-skills students" contribute positively to growth; but "rocket scientists" have a much stronger impact on economic growth. Increasing the share of students who are "rocket scientists" by 10 percentage points will lead to 1.3 percentage points higher annual economic growth, while increasing the share of "basic-skills students" by the same amount will raise annual growth by just 0.3 percentage point. Moreover, the impact of the share of "rocket scientists" is significantly stronger for countries that have a long way to catch up with developed countries. Thus, developing countries with a high share of "rocket scientists" but with low initial GDP per capita are able to converge faster on industrialized countries, as can be seen in the experiences of the Republic of Korea; Singapore; and Taipei,China.

On the other hand, Hanushek and Woessman also find that the interaction variable for shares of "rocket scientists" and "basic-skills students" has the strongest correlation with economic growth —its coefficient is more than four times higher than the coefficient for the share of "rocket scientists" alone. This means that a country needs to have both an elite pool of "rocket scientists" to generate technological innovation as well as a workforce with basic literacy skills that can use this technology in production. Moreover, teaching basic literacy skills to all students may be a prerequisite to finding those few "rocket scientists" in the population.

IX. SUMMARY AND POLICY RECOMMENDATIONS

Human capital, as the name suggests, represents the productive capacity of the people. Just like land or machinery, workers are an essential requirement for production. As such, human capital denotes the skill of the labor force, how well and efficiently workers can transform raw materials and capital into goods and services. These skills—such as literacy, numeracy, cognitive, and analytical skills—can be learned and honed through education; thus, any discussion of human capital has to touch upon education.

Various proxy measures of human capital have been proposed, such as literacy rates, enrollment rates, and test scores, but so far the most available, comparable, and consistent measure of human capital is years of schooling. Analyzing data for 146 countries over 60 years (1950–2010), we have seen that there is still a wide gap in human capital accumulation between industrialized and developing countries, with the average working-age adult in industrialized countries having 11 years of schooling compared with less than 6 years in South Asia and sub-Saharan Africa. The good news is that human capital has been converging over the past 60 years, with human capital accumulation being faster in developing countries than in industrialized countries.

However, estimates of time to convergence indicate that it may take decades for poor countries to catch up with the 2010 levels of human capital of rich countries. In South Asia, it will take almost 30 years for the region to catch up with the 2010 levels of human capital in industrialized countries, based on its historical performance during 1950–2010. Moreover, it will take longer for females than males in South Asia to catch up with their counterparts in industrialized countries due to the persistence of gender disparity in the region. Note, however, that regional averages can hide significant variations across countries. For example, higher growth rates in schooling for females in Bangladesh and Sri Lanka over the past 60 years mean that females are estimated to converge with the schooling of their counterparts in industrialized countries more than 12 years before males do. Likewise, despite females in Pakistan currently having 2.4 years less schooling than males, convergence for females is estimated to come more than 7 years before that for males.

Although the findings on convergence may be reassuring, this is mainly due to there being a natural upper limit on the amount of schooling—an average individual cannot be expected to accumulate schooling endlessly. Thus, growth rates in countries with high levels of schooling will slow down and convergence will occur. On the other hand, there is no natural limit on the quality of education: teachers can receive more training, equipment can be upgraded, and classroom conditions can be improved. Thus, while we can expect convergence between industrialized and developing countries in terms of years of schooling, the gap in their quality of education may still widen in the future.

This study has also proposed a decomposition method to account for the role of human capital in explaining growth in total output per worker. In addition to growth in human capital, physical capital, and factor productivity, the proposed methodology attempts to explain growth in total output per worker in terms of employment growth. This methodology introduces the contribution of employment growth to output growth through the employment growth elasticity. Unlike the conventional method, employment growth is endogenous in explaining growth in output in this methodology.

Applying our proposed method, our empirical results suggest that the direct contribution of human capital to output growth per worker varies between 5% and 10%. However, this does not suggest that human capital is unimportant for growth. Of the many potential reasons for the relatively small contribution of human capital, two are worth pointing out. First, the measure of human capital in this study—i.e., years of schooling—may not be able to capture its direct contribution to output growth in an economy. As pointed out in Section II, a better measure of human capital that reflects both quantity and quality of human capital may be needed to be able to quantify its precise effect on economic growth. Second, our estimates do not account for the indirect contribution of human capital in increasing output growth per worker through the generation of employment. This brings us to the next point pertaining to the micro linkage between human capital and the labor market.

Human capital impacts economic growth only if it is utilized in the labor market: those who have attained schooling need to be employed so that their skills can be used to produce goods and services. However, there may be a mismatch between the skills taught by the educational system and the skills needed by the labor market, so highly educated workers may end up doing low-productivity jobs. Thus, despite a country's achievements in accumulating human capital through the education system, this achievement may not lead to economic growth and poverty reduction if the labor market is not considered.

This is where education policy becomes very important. While each country's needs and conditions are different, a general recommendation arising from this study is that education policy must be closely tied with labor and economic policy. The educational system must not exist in a vacuum; rather, decisions on priorities, curricula, and budget allocation need to be made in line with medium- and long-term development plans. If the country seeks to develop its information technology sector, then the quality of math and science education will need to be improved. Likewise, if a country needs to improve governance and institutions, then civics and history cannot be eliminated from the curriculum. Likewise, development institutions will need to hone education sector strategies to the needs and situation of individual countries rather than propose sweeping one-size-fits-all strategies.

Country-specific micro-level studies are needed if one wants to make sensible and relevant policy recommendations. Although the generalizations afforded by macro-level cross-country studies are interesting, they can seldom be applied to specific countries because policy recommendations need to deal with the within-country variations rather than the smoothed aggregates. A comprehensive study of human capital and economic development will need to consider the skills taught in the educational system, the dynamics of the labor market, and the institutions governing the means of production.

APPENDIX: GROWTH ACCOUNTING METHODOLOGY

Growth accounting measures the contribution of human capital to economic growth by assigning the contribution of various inputs towards outputs. As has been discussed in the study, human capital has direct and indirect impacts on total output growth. For this section, we first discuss one of the ways by which human capital affects the employment growth elasticity. We show that higher levels of human capital leads to more capital-intensive (and hence less labor-intensive) growth in output, and thus a lower employment growth elasticity. This is followed by an exposition of the growth accounting methodology, which applies the concept of employment growth elasticity, used in Section V of the study.

Human Capital and Employment Growth Elasticity

To begin the discussion, let us define the following identities:
$y = \Delta \ln(Y)$ is the growth rate of output, where Y is total output

$p = \Delta \ln\left(\frac{Y}{E}\right)$ is the growth rate of output per worker, i.e., the growth rate of labor productivity where E is total employment

$e = \Delta \ln(E)$ is the growth rate of employment

$\varepsilon = \frac{e}{y}$ is the employment growth elasticity

Using the above definitions, we can rewrite the growth rate of output as;

$$y = \frac{p}{(1-\varepsilon)} \qquad \text{(A1)}$$

which shows that economic growth is a function of productivity growth and employment growth elasticity. The employment growth elasticity measures the extent to which a growth process is labor-intensive; the larger its value, the greater the degree of labor intensiveness. The growth process in developing countries is generally highly labor-intensive, suggesting that the value of employment growth elasticity is closer to 1; while the elasticity in industrialized countries, where growth is highly capital-intensive, is likely to be less than 0.5.

As can be seen in equation (A1), growth in human capital affects both productivity growth and the employment growth elasticity. The impact of human capital growth on the growth rate of labor productivity (p) can be traced through the production function. While many studies have attempted to measure the impact of human capital on labor productivity (e.g., Trostel, Walker, and Woolley 2002; Psacharopoulos and Patrinos 2004a), few studies have tried to capture the impact of human capital on employment growth elasticity. Our conjecture is that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive and resulting in higher economic growth.

Employment growth elasticity tells us how much employment will be generated by growth in economic output. Jobless growth, which rapidly increases total output without generating enough jobs, increases the income of those who are employed at the cost of those who are unable to find work, thereby being bypassed by economic growth. Thus, employment growth elasticity is clearly an important indicator of economic development because it has implications for both inequality and poverty in a country.

Measuring the Direct Impact of Human Capital on Economic Growth

We can measure the impact of human capital on growth through the growth accounting model. For simplicity, let us assume a constant returns to scale production function:

$$Y = AK^{\alpha}\left[EH\right]^{1-\alpha} \tag{A2}$$

where H is a measure of educational attainment, K is physical capital stock, and A is the level of technology. In addition, we can define the following growth rates:
$k = \Delta \ln\left(K/E\right)$ is the growth rate of physical capital per worker
$h = \Delta \ln\left(H\right)$ is the growth rate of human capital
$a = \Delta \ln\left(A\right)$ is the growth rate of total factor productivity due to technological advancement

From the production function in equation (A2), we can obtain:

$$p = \alpha k + \left(1-\alpha\right)h + a \tag{A3}$$

Using equations (A1) and (A3), we can derive $y = \varepsilon y + \alpha k + \left(1-\alpha\right)h + a$, which on dividing by y gives the four sources of economic growth:

$$1 = \varepsilon + \frac{\alpha k}{y} + \frac{\left(1-\alpha\right)h}{y} + \frac{a}{y} \tag{A4}$$

Therefore, the total growth in output can be explained by four factors:

(i) ε measures the contribution of employment to growth: the larger its value, the more labor-intensive the pattern of growth is

(ii) $\frac{\alpha k}{y}$ measures the contribution of physical capital per worker

(iii) $\frac{\left(1-\alpha\right)h}{y}$ measures the contribution of human capital

(iv) $\frac{a}{y}$ measures the contribution to growth due a change in total factor productivity

Using this proposed decomposition, we are able to quantify only the direct impact of growth in human capital on the growth rate of total output. Indirectly, human capital can impact the employment growth elasticity, but this decomposition is unable to capture this indirect impact. Our conjecture is that growth in human capital will reduce the magnitude of employment growth elasticity. This suggests that the net contribution of human capital to growth in total output will be less than the direct contribution of human capital as measured by the third term of equation (A4). It is also very likely that human capital will impact growth in total factor productivity, which occurs due to technological diffusion. An economy endowed with a highly skilled workforce is likely to have larger growth in total factor productivity. This is another indirect impact of human capital to growth that has not been researched in the literature.

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