Influence The Education Levels on Income Worldwide: Empirical Evidence

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In this paper, I constructed a worldwide novel panel model to investigate the estimation returns of the education levels using the function of the aggregate production approach of education human capital growth using the Mincerian method to acquire an equation of a log-liner, considering the possibility of heterogeneity of the countries. We split the data samples based on the levels of schooling quality and develop the economy of the countries. Our estimation shows the effect of the differences or heterogeneity on the schooling levels among the countries which appear especially post-secondary or tertiary schooling level specified has more impact in developed countries with high quality of schooling learning than effect secondary and primary school levels, while vice versa is true in developing countries.

Key Words: Economic Development, Growth, Human Capital, Labour Productivity; Poverty, Health, Human Development

1. Introduction

Human capital accumulation improves labour productivity; increases returns to capital; facilitates technological innovations; and makes sustainable growth, which, in turn, poverty reduction supports. Human capital mainly refers to all worker characteristics that can potentially increase productivity and efficiency in the production process, human capital has been one of the most important elements of economic modelling. Labour economics is based on human capital theory, as the accumulation of human capital always improves productivity, innovation, poverty reduction and increases returns.

Much labour economic literature demonstrated that human capital has a positive effect on the earnings of an individual, while learning and studying are important elements to raising individual skills and boosting productivity, health, innovations and reducing poverty. Some are saying the returns to schooling may not necessarily reward the productive skills of the individuals, but rather it may reward the diplomas achieved. Another says the returns to education may be higher for individuals with higher abilities since they tend to attain more years of schooling as it is more convenient for them. I will not raise any argument about this in this paper, maybe I will in future.

Returns to education are predictable to vary across locations due to location-specific factors such as market potential, size and labour market structure, and access to amenities. In other words, workers with similar jobs and educational levels have different wage levels due to different location premiums (Hanushek, 1973; Farber and Newman, 1987; Asplund and Pereira, 1999; Black et al., 2009). Differences in returns to education can exist in a general equilibrium since firm and household amenities vary over space and therefore create differences in wage and rent compensation (Roback, 1982). The findings in this paper are those of a partial equilibrium since only wages are considered.

2. Literature Review

Park (1996) starts by examining the Kuznets Curve's inverse-U structure and bringing about a new interpretation of the curve. In this case, there will be more weight on education variables, particularly focusing on a level of education and income. Throughout the study conducted in this article, Park incorporates the Gini Index as well as income as a measure of the dependent variable run by its models. The education variables used to explain income were separated into four different categories: enrolments at different levels, mean/median years of schooling, rate of return at the different levels, and dispersion of educational attainment. An interesting finding from this paper was the negative effect education inequality and level of schooling have on income distribution when used in conjunction, as explanatory variables. For the regression to show a positive effect between the

Level of schooling and income distribution, the education inequality variable must be removed. The reasoning given for this phenomenon is the high correlation that is present between the level of schooling and the per capita income. Along with a high correlation, there is collinearity between the level of schooling and education inequality. The reason for this collinearity is due to the educational inequality variable already containing the level of schooling within it.

Judson (1998) examines the response of economic growth to the production of human capital through education. Primarily, this paper is concerned with the allocation of educational resources. Judson makes multiple assumptions before constructing his model. It is stated as a fact that years of education yield diminishing marginal returns; thus, investment in primary school has a larger economic return than investment in higher education does. However, this fact does not necessarily hold when returns from secondary education are compared to those from higher education. This claim is informative for our research. Another interesting technique used in Judson's paper was the allowance for the "revelation of talent". Individuals are not all equally talented, so the more talented ones should receive more education as they reveal themselves to be worthwhile investments. This strategy would defeat the aims of our research, as our goal is to reduce inequality, rather than to maximize absolute growth. By including this dimension, Judson creates a model that can be used to determine if a country's allocation of educational resources is efficient or not. After determining efficiency, Judson assesses the relevance of a country's efficiency score.

Since the availability of international educational attainment datasets (such as Barro and Lee (1993)), many empirical (growth) papers have used the educational variables measured by the (average) total years of schooling attained as a proxy for the human capital stock in a country. A common practice in these studies is to assess the impact of, among other factors, an additional year of schooling in the aggregate human capital stock on the aggregate income and/or growth. In this case, an implicit assumption is that an additional year of educational attainment increases the human capital stock by an equal amount without distinguishing whether that additional year corresponds to additional schooling attainment at the elementary or university levels.5 This assumption, in turn, might lead one to miss part of the picture regarding the heterogeneous impacts of educational attainment on the economic outcome of a country. Therefore, to judge the role of educational attainment more comprehensively, it is important to look at the impacts of the composition of education.

Furthermore, in an endogenous growth framework, where the economic growth is contingent on (the composition of) the human capital and the distance from the technological frontier, Aghion, Meghir, and Vandenbussche (2006) acknowledge the differing functions of the types of education in countries at different levels of development. Accordingly, lower lev- els of education stimulate adoption and imitation behaviour when the country is far from the technological frontier, while higher levels of education trigger innovation when the country is closer to the frontier.6 However, the estimations of Aghion, Meghir, and Vandenbussche (2006) are limited only to the OECD countries and leave out the quality dimension of schooling, an issue of great importance, to which we now turn.

Accordingly, recent (experimental) economic growth literature has been strongly motivated by the strong relationship between a country's economic performance and human capital in the form of formal education. In particular, at the beginning of the 1990s, the growth literature saw a rise in empirical studies based on the links between educational attainment and growth with the wide availability of data sets across countries. Durlauf, Johnson and Temple (2005) state that most of these empirical growth papers focus on the period after 1960, because it is mostly after this date when national accounts data began to become available for a large number of countries. Among the widely used data sets, various versions of the Penn World Table and Barro and Lee's (1993) educational attainment data were the main data sources that gave rise to many empirical growth papers in subsequent decades. This great wave of empirical studies across the country was one of the main motivations for our paper.

Given the potential role of human capital in economic development, in this paper, we are interested in examining the differences in the economic performance of countries (including underdeveloped, developing, and developed countries) with a special focus on (4 stages) of educational attainment. Located at different points in the development spectrum they have no uniform benefit by arbitrarily increasing educational attainment, besides the question that different stages of educational attainment may have different effects in different economic settings. Despite this aspect, it is very common in the literature to aggregate all levels of education across countries and see the effect on economic performance. In a way, such papers do not recognize a one-year difference in, for example, an increase in average years of primary school versus a one-year increase in average years of schooling in tertiary education on macroeconomic outcomes. In our opinion, not only do different stages of education per se have different effects on economic growth, but also these influences may have different effects in different contexts.

Regional variation in education returns to education on economic performance (e.g. on total income, growth rates, etc.) based on different theoretical tools and using different methods of economic measurements with different data sets. Many of these papers have not produced specifically findings regarding the role of education (e.g. Ben Habib and Spiegel (1994), Islam (1995), Temple (2001), etc.). For the majority of empirical growth papers, our approach is based on the Mincerian method for estimating education returns, which has been commonly used in micro-level work studies but is rarely applied across countries. Even among papers that have taken the Mincerian approach, the differential effects of different stages of education are not taken into account. To this end, we write a macro version of the income equation of the individual type at the individual level by modelling the different stages of education in a linear, multipart form. In the Standard Micro-Mincer Human Capital Earnings Function Approach, the coefficient in front of the education variable (i.e. years of study) gives the potential increase in earnings due to an additional year of study. Parallel to this approach, we apply the Mincerian function to countries and get the extended Macro-Mincer equation, which can give the effect of a one-year increase in the average years of a given level of education on per capita incomes across countries.

Another important issue we stress is the differences prevailing between countries, which makes it difficult to write models that place countries with different economic experiences, institutional structures, and levels of development in a single estimating equation. For example, in the specific context in which we are, the quality of education in a country, where education takes place, may play a major role in determining education returns. In this context, while many studies leave the quality dimension of education unchanged and act as if one year of study is uniformly the same across countries, we incorporate differences in this dimension of education into our analysis.

About the above issues about the differential role of stages of education, in this study, we carefully address the following questions: What are the effects of the different stages of education (primary, secondary and tertiary) on an individual's income? How does the answer to this question change when differences in the quality of education and the level of development in countries are taken into account? What types of education seem most important (ie higher returns) and for what types of countries? The results of our estimation of the entire group of countries (i.e. no distinction between developed or developing countries, etc.) essentially indicate that when education is broken down into levels, only tertiary education has the highest (and most significant) impact on per capita income, while estimates of primary and secondary education are not significant. . However, when we divide countries into subsamples based on level of development and quality of education, we get that, in general, more developed countries seem to benefit more from higher levels of education, while less developed countries seem to benefit more from early education stages. Moreover, there is some evidence to suggest that the effects of education on total income are influenced by the quality of education.

Plan the paper as follows: Section 2 details some important aspects of modelling the relationship between education and income. Section 3 describes the model and experimental specifications; Section 4 presents the data and estimation results; Section 5 concludes. Finally, the appendix offers more summary statistics about the data.

3 Model Methodology

We discuss why it is important to divide educational attainment into phases. We then highlight the importance of international differences in education quality. The additional year of education in the total human capital balance on gross income and/or growth. Elementary school or university level. This assumption, in turn, may lead to a loss of part of the picture regarding the heterogeneous effects of educational attainment on a country's economic outcome.

Therefore, to judge the role of educational attainment more comprehensively, it is important to consider the effects of education formation. Agion, Mugheer and Vandenbusch (2006) recognize the different functions of types of education in countries with different levels of development. Accordingly, lower levels of education stimulate the adoption and imitation of behaviour when the country is far from the technological frontier, while higher levels of education lead to innovation when the country is closer to the frontier. OECD countries ignore the qualitative dimension of education, an issue of great importance.

A common approach taken by the majority of papers in the empirical growth literature is that commonly used measures of human capital are almost always based on quantitative aspects of education (such as enrollment rates and years of schooling). Any difference in the quality of education is directly reflected in the difference in the labour force, which in turn affects the economic performance of the country. Hence, differences in education quality may generate heterogeneity across the country. In this context, Hanushek and Kimko (2000) and Hanushek and Wossmann (2007) argue that by ignoring quality differences in education, the empirical growth literature across countries implicitly assumed that a year of schooling in a poor and isolated country is the same as a year of schooling In a school in a developed country. To account for qualitative differences in education across countries, there were already many common and indirect measures of quality such as class size, pupil-teacher ratio, and share of education expenditures in GDP. At this point, one may come up with several objections regarding the direction of causation from quality towards growth. First, the quality of education may be rooted in the level of development of a country. In other words, a possible inverse causal relationship may exist from the level of development towards the quality of education, as richer countries may invest more in educational inputs and enhance students' test score performance. Hanushek and Kimko (2000) verify this possibility by performing additional regressions of test scores on per capita income levels and education inputs. Their results found no evidence of a reverse causal relationship, leading them to conclude that causal concerns for education quality and economic performance are not worrisome. Second, there may be some variables omitted, which can affect both test scores and economic performance, creating a spurious relationship. To deal with this point, Hanushek and Kimko (2000) look at immigrants living in the United States and attempt to correlate differences in their earnings with measures of quality. Accordingly, they find that immigrants who were educated in countries with higher scores on these tests have higher earnings in the United States, while there is no advantage in earnings for immigrants who receive part or all of their education in the United States.

We take years of schooling as a measure of human capital (stock). This allows us to obtain a linear logarithmic relationship between years of schooling and income, as will be explained in the empirical specification. However, as discussed in detail in the previous section, we believe that one year of study does not raise the human capital stock by an equal amount regardless of whether it is the first or fifteenth year of the individual. Therefore, we classify education into different stages (primary, secondary, and university) using the latest available data. Moreover, we argue that the effect of different stages of education on income (and thus on growth) may depend on the level of development and quality of education in a country. For example, lower levels of education may play a more important role for poor countries and/or education returns may be lower in countries where the quality of education is low. In this sense, Agion, Meijer and Vandenbusch (2006) also stress the importance of the heterogeneous effects of human capital on the economic performance of countries and say that "the possibility of human capital playing a different role at different stages." They are not often addressed in the empirical growth literature." Hence, while there are a few papers that have looked at the classified version of human capital variables, for the most part, these papers do not include the education quality dimension or do not constitute A model of human capital 'a la Mincer' (hence finding negatively signed significance and/or effects). Our contribution to the literature is that we integrate all of these aspects when we estimate the impact of education on the aggregate production function.

We measure the level of development with the average GDP per worker during the study period (1960-1990). Education quality is measured by internationally comparable test scores (mathematics and science) of students in different countries as provided by Hanushek and Kimko (2000) and Wossmann (2003). There are several reasons for choosing these two dimensions to rank countries. First, higher income levels do not entail higher quality education, although there may be some overlaps. Hence, it is worth distinguishing between the two. Second, given our context in seeing the effects of education on countries' incomes, it makes sense to include education quality as another dimension of integrating heterogeneity. Furthermore, as more data becomes available across countries over time, we choose to use panel data. In particular, we use the recently updated output, capital, and educational attainment data for the period 1960-1990.11 For papers that use cross-section data, our use of panel data certainly carries more information in the time dimension, which in turn helps improve the accuracy of the estimates. In addition, Aghion, Meghir, and Van-Denbussche (2006) advocate the use of dashboard techniques and hardware methods to deal with issues of heterogeneity and/or reversal of causation (that is, the possibility that higher income/growth may enhance educational attainment).

The Model

There has long been debate about the functional form of human capital that should be adopted in the empirical growth specification, Cohen and Soto (2007) assert that the Mincer-based measure of human capital has recently gained prominence in the aggregate growth literature. In his fundamental contribution, Mincer (1974) relates the logarithm of individual gains to educational attainment and experience with his square. Krueger and Lindahl (2001) suggest that a similar approach can be adapted at the macro level. First, we start with the following Cobb-Douglas aggregate production function by assuming technical progress to increase production:

$$Y_{it} = A_{it}\, K_{it}^{\alpha}\, H_{it}^{1-\alpha} \tag{1}$$

Where Y_{it} denotes the total output as a proxy for the aggregate income,

K_{it}^{α} is the aggregate physical capital,

H_{it} is the aggregate human capital.

As in the usual notation, i indexes country and t indexes time. The per-worker variables are denoted by small letters, i.e.

$y_{it} = A_{it}/\, L_{it}$, $k_{it} = K_{it}/\, L_{it}$ and $h_{it} = H_{it}/\, L_{it}$,

Where L_{it} denotes the labour force. Moreover, under the assumption of a competitive economy, where each input earns its marginal product, α and (1 − α) respectively denote the shares of physical and human capital in the national income. As we are interested in the productivity effect of the human capital input (i.e. education), we derive the output per worker by dividing both sides of Eqn. (1) by the total labour force:

$$A_{it}/\, L_{it} \;=\; A_{it}\,(\, A_{it}/\, L_{it}\,)^{\alpha}\,(\, A_{it}/\, L_{it}\,)^{1-\alpha} \tag{2}$$

$$y_{it} = A_{it}\, k_{it}^{\alpha}\, h_{it}^{1-\alpha} \tag{3}$$

The naturalised this algorithm yields:

$$ln\, y_{it} = lnA_{it} + \alpha\, ln\, k_{it}^{\alpha} + (1-\alpha)\, ln\, h_{it}^{1-\alpha} \tag{4}$$

This specification writes the natural logarithm of output per worker as a function of the natural logarithms of total factor productivity and physical and human capital per worker. Next, we assume that the natural logarithm of total factor productivity consists of a country-fixed effect η_i, a time effect (δ_t), and a random disturbance (ε_{it}) that varies over time:

$$lnA_{it} = \eta_i + \delta_t + \varepsilon_{it} \tag{5}$$

Note that with this formula, it is assumed that there is common technological progress for all countries. As suggested in the empirical labour economics literature, when modelling the relationship between educational attainment and income, one of the best fits to the data is given by the Mincerian earnings function method. To obtain a Mincerian log-linear relationship between per capita income and years of schooling from the aggregate production function, the input of human capital must be an exponential function of years of schooling. Thus, we model the total human capital as follows:

$$H_{it} = \exp(\Phi\ (S_{it})\ L_{it} \quad (6)$$

Where (S_{it}) is –for now– a composite of the average years of overall educational attainment, the implied human capital per worker is:

$$h_{it} = \exp(\Phi\ (S_{it}) \quad (6)$$

Then, we additively decompose education into its three stages, i.e:

$$\Phi\ (.) = \varphi_1(.) + \varphi_2(.) + \varphi_3(.) \quad (7)$$

$$h_{it} = \exp\left(\sum_{j=1}^{3} \phi_j\ (S_{jit})\right) \quad (8)$$

Where (S_{jit}) denotes the average total years of schooling of country i at t for the stage j = 1 (primary), 2 (secondary), and 3 (tertiary) of education. We assume linearity for the $\varphi_j(.)$ functions:

$$h_{it} = \exp\left(\sum_{j=1}^{3} \beta_j\ (S_{jit})\right) \quad (9)$$

Next, we plug in the total productivity and human capital formulations into Eqn. (4) to get:

$$lny_{it} = \alpha\ lnk_{it} + (1-\alpha)\left[\sum_{j=1}^{3} \beta_j\ S_{jit}\right] + \eta_i + \delta_t + \varepsilon_{it} \quad (10)$$

Hence, we obtain a log-linear (or semi-log) relation between the aggregate income and years of schooling (rather than a log-log specification). In this case, the coefficient $(1-\alpha)\ \beta_j$ in front of years of schooling at stage j should be interpreted as the–possibly causal–effect (or return) of an additional year to the average years of schooling at stage j (or simply the effect of schooling at stage j) on GDP per worker and ultimately on growth. We note that the coefficient $\beta_j$by itself is just the effect of an additional year of schooling attainment at stage j on the human capital per worker in Eqn. (9).

Due to the Cobb-Douglas specification, the Eqn. (10) imposes the coefficients α and $1-\alpha$ in front of the input variables of the production. However, we can rewrite the Eqn. (10) in an unconstrained form as:

$$lny_{it} = \pi_k\ lnk_{it} + \pi_s\left[\sum_{j=1}^{3} \beta_j\ S_{jit}\right] + \eta_i + \delta_t + \varepsilon_{it}$$

$$lny_{it} = \pi_k\ lnk_{it} + \pi_{1s}\ S_{1it} + \pi_{2s}\ S_{2it} + \pi_{3s}\ S_{3it} + \eta_i + \delta_t + \varepsilon_{it} \quad (11)$$

Where π_k and π_{js}'s (with $\pi_{js} = \pi_s \cdot \beta_j$, main parameters of interest) are the effects of the physical capital and educational attainment by levels of output per worker, respectively.

Our estimation procedure is based on several methods. To estimate Eqn. (11), we start with ordinary least squares (OLS) and fixed effects methods. However, we recognize that these methods do not correct potential biases in the estimates that may arise from measurement errors and internal homogeneity of explanatory variables. In this context, Bond, Hoeffler, and Temple (2001) assert that “the possibility of obtaining consistent estimates of parameters even in the presence of measurement error and right-side internal variables is a great strength of GMM (Generalized Momentary Method) in the context of experimental growth research.” Therefore, we continue, our estimates using the most involved panel data estimation methods, such as Arellano-Bond and System Generalized Method of Moments (System GMM). Regarding the latter methods, about the classic Arellano-Bond method, an additional advantage of the GMM system is that the equation in the first differences is estimated simultaneously with the equation of levels and therefore additional tools can be used using the equation of levels such as in the following system:

$$lny_{it} = \pi_k \, lnk_{it} + \pi_{1s} \, S_{1it} + \pi_{2s} \, S_{2it} + \pi_{3s} \, S_{3it} + \eta_i + \delta_t + \varepsilon_{it}$$

$$\Delta lny_{it} = \pi_k \Delta \, lnk_{it} + \pi_{1s} \, \Delta S_{1it} + \pi_{2s} \, \Delta S_{2it} + \pi_{3s} \, \Delta S_{3it} + \Delta\delta_t + \Delta\varepsilon_{it} \quad (12)$$

The procedure in both methods is the instrument of the endogenous variables with properly selected delays of the explanatory variables and the delay of their first differences. More precisely, while the Arellano-Bond method estimates the equivalence of the first variances by measuring them with the levels of two or more lagging explanatory variables, the System GMM method also estimates the equivalence of the levels by treating it with the first lags of the explanatory variables. Moreover, as is known, the consistency of the GMM estimation depends on the validity of the tools and the lack of sequence correlation at the residues, both of which can be tested. To test the first condition, we use Sargan's test for over-determining moment constraints.

For the second version, we use the Arellano-Bond test for serial correlation in error terms. The p-values for these tests are included at the bottom of the grading tables. We report the estimation results in Section 5.

4 Data

Our estimates are based on the education, production, and capital dataset provided by Cohen and Soto (2007). Cohen and Soto's educational attainment data (referred to as CS, hereafter) covers 94 countries and is described in more detail in Cohen and Soto (2007) discussing in detail the optimization of measurement error problems with respect to many other data sets. Meanwhile, although their education data covers the period 1960–2010 (with projections for 2010), their estimates are based on the period 1960–1990 for comparison with the majority of papers in the empirical growth literature. The data is available at the following link: http://soto.iae-csic.org/Data.htm

Essentially, CS data provide information on the percentage of the population aged 15 and over and the population aged 25 and over without education, with primary (complete and/or incomplete), and secondary (complete and/or incomplete) education and higher education (complete and/or incomplete). CS data also provides cross-country census information regarding the duration of years of schooling by educational level. Using this data allows us to calculate the years of schooling achieved by the educational levels of each country between 1960 and 1990 (Table 1). Output data is a cross-country panel based on version 5.6 of the Penn World Table (Penn World Table) covering the same period. Physical capital data for Cohen and Soto (2007) was originally from Easterly and Levine (2001). Since the computer science education data is based on 10-year intervals (hence, T = 4), the output and physical capital data are reported at 10-year intervals. In general, the final sample (we call it the CS sample) is an unbalanced panel consisting of 376 pairs over the course of a year.

Finally, education quality (time constant) data were provided by Hanushek and Kimko (2000) and Wossmann (2003), with the latter author reporting the observed and calculated values of the Education Quality Index for a much larger group of countries (using quality index data from Hanushek and Kimko (2000) for 65 countries, Wossmann (2003) takes the mean of the respective regional average). The former quality data covers 65 countries, while the latter covers much more than the countries in the CS sample (excluding Cuba). Therefore, our headline estimates use the latest quality index to cover a larger group of countries.

In terms of country classification, our working hypothesis is that given the potential variation between countries, judging the impact of education on income across countries may not see part of the picture if it does not also take into account the different (and differing) potential impacts of education stages) in different types (in terms of the level of development, quality of education provided, etc.) In this context, we suggest classifying the country based on the level of development and/or quality of education in the country.

Table 1: Descriptive Statistics: Yeas of Educational Attainment by Levels

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	376	1.787911	1.07757	0.032743	5.50228
Secondary education (15+)	376	2.459899	2.273109	0.0057603	9.431778
Tertiary education (15+)	376	0.6474553	0.8215172	0	5.081615
Total years of education (15+)	376	4.895265	3.216765	0.0545301	12.32269
Primary education (25+)	376	1.789238	1.196409	0.0293006	5.425602
Secondary education (25+)	376	1.893248	2.065935	0	9.100007
Tertiary education (25+)	376	0.7221706	0.9210138	0	5.588048
Total years of education (25+)	376	4.404656	3.229513	0.0523398	12.44395

Notes: The total years of schooling achieved at each level of education is calculated using the percentage of the population with a particular level of education and census information showing the duration in years for each level of education in each country. All data are from Cohen and Soto (2007). The sum of the years of education is the sum of the years of the three levels of education attained.

This is closely in line with the multiple (growth) systems approaches across countries proposed by Durlauf and Johnson (1995) and Durlauf, Johnson and Temple (2005). Intuitively, this approach indicates different patterns or systems of return that may exist between education and total per capita income across countries.

More precisely, we measure the level of development by the average (logarithm) output per factor (approximate to per capita income) during the period 1960-1990. The Education Quality Index is from Wossmann (2003), based on tests conducted internationally for students. After analyzing the distribution of per capita average output and education quality index across countries (see Table 2), we choose the relevant cut-off points for these two indicators. As a simple illustration, let y ∗ and q be the cut-off points chosen for average production per worker and education quality index, respectively. One example of classification could be assigned a country i to category 1 if $y_{it} > y^*$ and $q_i > q^*$ and to category 3 if $y_{it} > y^*$ and $q_i > q^*$. The remaining countries (if any) are assigned to category 2. We also try simpler ratings based only on the education quality index, which is closely related to the level of development. In this case, we choose q^* one (it can be median, median, etc. for the time-constant q distribution) and then specify that countries above q^* are in category 1 and vice versa.

Table 2: Descriptive Statistics: Schooling Quality and Mean Output

	No. of Countries	Mean	Median	Stand.Dev.	Min	Max
q	94	0.9309255	0.892	0.2461947	0.39	1.542
$\ln y^{-}$	83	8.788214	8.89294	0.9774275	6.434523	10.32463

Notes: q denotes the schooling quality index from Wossmann (2003), which is originally based on Hanushek and Kimko (2000). $\ln y^{-}$ is the logarithm of the average output per worker (in 1985$) in the CS sample over 1960-1990.

In general, our estimates include several classifications depending on the cut points chosen. In the estimation results, the cut-off points are noted at the bottom of each table. Furthermore, to avoid results being driven by ad hoc rankings, we experimented with several cut-point sets for mean income and/or quality index (as long as sample sizes are reasonable across the different groups; otherwise, the smaller group is added to the next); In almost all cases, our results remain fairly robust.

5 Result

Complete Set of Countries' Data

Initially, we estimate the equation of levels in Eqn. (12) by least squares and fixed effects methods for the entire group of countries, without classification of any kind and without correcting for homogeneity problems. We see that an additional year to the average years of higher education has on average, a significant effect of between 6.1% to 6.8% on total income per capita for a whole group of countries. While primary and secondary education is small and negatively located, with slight effects. However, we know that many country-specific effects are not considered with the OLS method. To this end, we report estimates of fixed effects in columns (2) and (4).

Table 3: OLS and Fixed Effects Estimations

	(1) OLS	(2) Fixed Effects	(3) OLS	(4) Fixed Effects
Primary educ. (15+)	-0.0630	0.0643**		
	(0.0461)	(0.0274)		
Secondary educ. (15+)	-0.0057	0.0488**		
	(0.0215)	(0.0225)		
Tertiary educ. (15+)	0.0684*	0.1328**		
	(0.0352)	(0.0382)		
Primary educ. (25+)			-0.0444	-0.0338
			(0.0438)	(0.0290)
Secondary educ. (25+)			0.0008	0.0809**
			(0.0209)	(0.0245)
Tertiary educ. (25+)			0.0611*	0.1120**
			(0.0320)	(0.0282)
N	313	313	313	313
$R2$	0.8940	0.8136	0.8925	0.8196

Notes: All estimations are based on the CS Sample and control for the year effects. Robust standard errors are reported in parentheses. * denotes the significance of at least 10%, while ** denotes the significance of at least 5%.

The estimates of fixed effects produce significant and positively signed effects for each level of education on the output for each factor. By controlling for primary and secondary education, tertiary education again appears to be the most influential type of education, with a significant impact on the total income per capita in the range of 11.2% to 13.2%. Moreover, in columns (2) and (4), among the three types of education, secondary education appears to have the least effect, resulting in a slight V-type pattern of education effects.

We then estimate the same model by the most involved panel data methods considering possible smoothing problems and measurement errors. Specifically, we estimate the effects of different levels of educational attainment on output for each factor using the Arellano-Bond and System GMM methods, as briefly described in Section 3. The results are presented in Table 4. Similar to the fixed-effect estimates, the GMM system estimates yield only significant effects for higher education. In particular, estimates from columns (2) and (4) indicate that an extra year of average years of higher educational attainment in a country would mean a 7.3-10.9% increase in output per worker. Arellano-Bond estimates for the same type of education give a 10-11% effect on production. However, the estimates are not statistically significant, albeit economically significant.

Table 4: Arellano-Bond and System GMM Estimations

	(1) Arellano-Bond	(2) Sys. GMM	(3) Arellano-Bond	(4) Sys. GMM
Primary educ. (15+)	-0.0012	-0.0152		
	(0.0617)	(0.0274)		
Secondary educ. (15+)	0.0066	-0.0063		
	(0.0400)	(0.0225)		
Tertiary educ. (15+)	0.1116	0.1328**		
	(0.0848)	(0.0338)		
Primary educ. (25+)			0.0444	0.0944**
			(0.0561)	(0.0291)
Secondary educ. (25+)			0.0589	0.0190
			(0.0505)	(0.0245)
Tertiary educ. (25+)			0.1058	0.0734**
			(0.0752)	(0.0314)
N	147	230	147	230
Serial Corr. (p-values)	0.1579	0.4709	0.1602	0.5630
Sargan (p-values)	0.2149	0.0984	0.2973	0.1513

Notes: All estimates are based on CS sample and year effects control. Strong standard errors are reported in parentheses. ** Indicate a significance of not less than 5%. The first line of p-values comes from testing the null hypothesis that the items are not sequentially related. Sargan p values come from the plug-in (over-specified) viability test.

As a result, regarding the role of education in total per capita income, our baseline results remain promising in the sense that we get both positive and significant returns from (higher) education concerning non-specific and/or negative outcomes of education. Achievement in the experimental growth literature. This further convinces us that the Mincerian specification greatly improves the results. However, our estimates yield almost no significant impact of primary and secondary education on income, which may play a role in less developed countries—particularly considering the leader-state argument proposed by Agion, Meijer, and Vandenbusch (2006) as briefly described in section 2. Moreover, placing 94 countries with different levels of development, institutional structure and quality of education in the same evaluating equation may lead to results that are not representative of all of them. Therefore, we turn to estimates with country rankings to see if other types of education have a significant and positive impact on output for each factor across different groups of countries.

Classification Set of Countries' Data

Our estimates of the effect of stages of education on total income mainly yielded relatively higher and often only significant values for tertiary education (both for the educational attainment variable for the population aged 15 years and above and 25 years and above) ranging from 6–13%. However, when considering the role of other types of educational attainment, it may seem surprising that they do not affect output. Here is where we think, country rankings may be particularly useful to help us diagnose returns to education patterns across countries.

Table 5: Fixed Effects Estimations

	(1) Class 1	(2) Class 2
Primary educ. (15+)	0.0929	0.0762
	(0.0729)	(0.0838)
Secondary educ. (15+)	0.0728	0.0615
	(0.0668)	(0.0414)
Tertiary educ. (15+)	0.1193*	0.1193*
	(0.0613)	(0.1154)
N	137	176
$R2$	0.8022	0.6088

Notes: The estimations control for year effects and use the educational attainment variable of the population aged 25 and over. The robust standard errors are reported in parentheses. * denotes significance at least at 10%. A country i is allocated to Class 1 if $q_i > 0.95$ and Class 2 if $q_i < 0.95$.

In Table 5, we initially report fixed-effect estimates of the effects of education levels on output for each factor in two categories of countries, where countries that are relatively similar (in terms of education quality) are allocated to the same category. In other words, Category 1 contains countries with higher education quality concerning Grade 2. By reading the output table, we get that tertiary education has the largest and most significant (11.9%) impact in Category 1 countries, while primary education has the highest effect (7.6%).) in Category 2 countries. In general, despite some statistically insignificant estimates of fixed effects, different relative magnitudes and indications between levels of education across different groups of countries appear to indicate divergent patterns of returns to education levels. Another interesting observation (so far, neither a standardized nor a general result) in Table 5 is that from columns (1) and (2) we see that estimates, especially for higher education, in Tier 1 countries are always higher than those in countries Category 2. Next, given the fact that countries are ranked according to their education quality, one way to explain this difference in magnitude is that the effects of education levels seem to decrease when the quality of education is relatively lower.

Then, in Table 6, we report fixed-effect estimates with a different classification that divides countries into three groups, Category 1, Category 2, and Category 3, where, in parallel to the first rating, countries are relatively similar (this time in terms of average output per factor and education quality) for the same groups. In this table, Category 1 consists of countries with a high average production per worker from 1960-1990 and quality of education, while Category 3 consists of countries with a relatively low average production per worker and quality of education. Category 2 contains all remaining countries located in between. From column (1) of Table 6, we see that tertiary education has a significant and highest impact (13.5%) on production in Category 1 countries. On the contrary, primary and secondary educational attainment have relatively higher effects, with secondary education significantly estimated at 11.7% for countries in Category 3. Finally, for countries in Category 2, our estimates produce effects of around 7% for all levels of education.

Regarding the magnitude of the effect of a given level of education on output for each factor across seasons in Table 6 we see that for tertiary education, the highest estimated parameter values belong to category 1 countries. For primary and secondary education, on the other hand, the highest estimated parameter values belong to countries Category 3. One possible explanation for this result may be that differences in quality in education are more significant at higher levels of education (e.g. tertiary education) than at earlier levels (e.g. primary), possibly because the earlier stage of education involves the accumulation of more complex knowledge than the second. However, since we do not have a quality scale for the different stages of education, but we do have a composite index that summarizes everything, we cannot say much about this issue. Overall, even with this different classification of countries, our results indicate similar patterns regarding the heterogeneous effects of educational attainment by levels between countries.

Table 6: Fixed Effects Estimations

	(1) Class 1	(2) Class 2	(3) Class 2
Primary educ.	0.0783	0.0782	0.1224
	(0.0491)	(0.0533)	(0.0854)
Secondary educ.	0.0453	0.0704	0.1170**
	(0.0375)	(0.0502)	(0.0573)
Tertiary educ.	0.1352**	0.0740	0.0414
	(0.0520)	(0.0449)	(0.1231)
N	89	122	102
$R2$	0.9342	0.8420	0.6413

Notes: The estimations control for year effects and use the educational attainment variable of the population aged 25 and over. The robust standard errors are reported in parentheses. ** denotes significance at least at 5%. A country i is assigned to Class 1 if $q_i > 1.1$ and ln $y_i > 9.4$; Class 3 if $q_i < 0.8$ and ln $y_i < 8.5$; and Class 2 otherwise.

Finally, we turn to estimates using Arellano-Bond and System GMM methods with country rankings. In Table 7, we report model estimates based on the Arellano-Bond methods and System GMM with the same two-part classification of countries as used in Table 5. As shown in columns (1) and (3), both Arellano-GMM methods The Bond gives the highest and most significant ratings for higher education in Category 1 countries (9.4% and 4.04%, respectively). Estimates of other types of educational attainment are rather small and not significant for countries in category 1. On the contrary, as shown in columns (2) and (4), the Arellano-Bond and System GMM methods give relatively higher estimates of primary education In Category 2 countries, 5.1% and 12.62%, respectively, with the latter estimate being significant at 5%. Regarding the effects of other levels of education on production in Category 2 countries, neither the Arellano-Bond methods nor System GMM presents a large and clear pattern of returns. As a result, these recent estimation methods also suggest heterogeneous effects of education levels across countries when differences in education quality are taken into account.

Table 7: Arellano-Bond and System GMM Estimations

	(1) Arellano-Bond Class 1	(2) Arellano-Bond Class 2	(3) Sys. GMM Class 1	(4) Sys. GMM Class 2
Primary education	0.0061	0.0510	-0.0088	0.1262**
	(0.0454)	(0.0621)	(0.0181)	(0.0311)
Secondary education	0.0250	0.0404	-0.0298**	0.0035
	(0.0360)	(0.0486)	(0.0075)	(0.0185)
Tertiary education	0.0940**	-0.0672	0.0404**	0.0542
	(0.0391)	(0.0921)	(0.0093)	(0.0479)
N	67	80	102	128
Serial Corr. (p-values)	0.8482	0.0775	0.3846	0.0949
Sargan (p-values)	0.0918	0.4918	0.2549	0.5153

Notes: All estimations are based on the CS Sample, control for the year effects, and use the educational attainment variable of the population aged 15 and above. The robust standard errors are reported in parentheses. ** denotes significance at least at 5%. The first line of p-values comes from testing the null hypothesis that the residuals are serious-correlated. The Sargan p-values come from testing the null hypothesis that the additional instruments are valid. A country i is allocated to Class 1 if $q_i > 0.95$ and Class 2 if $q_i < 0.95$.

6 Conclusion

In this paper, we provide cross-country estimates of the effects of education by its levels of output per worker. Our empirical specifications are based on the macro-chopper equation with the total production function. To account for heterogeneity between countries, we categorized countries into relatively homogeneous subsamples based on a criterion such as education quality. Overall, our results suggest heterogeneous effects of education levels on total income across countries. In particular, estimates from different panel data methods indicate that higher education appears to have a more significant impact on total income in countries with higher levels of development and education quality, while primary and/or secondary education appears to have a more significant impact on overall income. Total. Income in less developed and/or developing countries with low quality of education. Thus, although many papers from the empirical aggregate growth literature do not indicate a clear estimate of the effect of education levels on total income, Sirian's method and classification approach with the use of updated human capital stock data yield promising results.

In addition, in several contributions to returns to education literature, the Psacharopoulos (1981, 1994) and Psacharopoulos and Patrinos (2004) surveys have drawn attention to the importance of different educational levels, providing extensive surveys of individual-level estimates of the rate of returns to education for a large group of countries. Although our estimates are not directly comparable to such studies for many reasons (for example, our paper provides estimates at the macro level, while it uses micro-level estimates for countries), our results do not necessarily support the proposed general pattern of such as primary education yielding the highest return. in all countries. Moreover, their conclusion that returns to education are higher in relatively poor countries (with potentially lower quality of education) may not necessarily hold if the quality dimension is taken into account, since the latter dimension may increase returns to educational attainment.

As a final analysis, by suggesting areas of focus in educational attainment, we believe that our findings provide essential policy implications for increasing the well-being of society through investment, among other things, in education. For example, as reported in Aghion, Meghir, and Vandenbussche (2006), Sapir et al. (2003) suggest that for European countries to reduce the productivity growth gap to the United States, the former countries should increase educational investments in higher education level. Moreover, in the least developed and developing countries, in addition to paying attention to the types of educational attainment that can enhance total income, another possible strategy for promoting growth is to improve the quality of education provided through investment in teachers. Finally, our estimates stimulate further understanding of the mechanism related to the effect of education on economic growth considering the heterogeneous role of its levels along with the quality dimension. In this sense, the theoretical contribution of Agion, Meijer, and Vandenbusch (2006) with the argument type of the leader and follower type is rather attractive.

Appendix

In this section, we provide additional descriptive statistics for countries by categories. We begin by reporting on the countries belonging to the relevant group based on the Human Capital Quality Index and the average per capita rankings used in Tables 5-7. The following tables show the average years of educational attainment by country levels for the classification used in Tables 5-7. As before, the total years of schooling at each level of education is calculated using the percentage of the population with a given level of education and census information showing the duration in years for each level of education in each country. Data are from Cohen and Soto (2007).

Countries in tales 5 and 7

Class 1: Argentina, Australia, Austria, Belgium, Bulgaria, Canada, China, Costa Rica, Cyprus, Denmark, Fiji, Finland, France, Germany, Greece, Guyana, Hungary, Ireland, Italy, Jamaica, Japan, Korea, Malaysia, Mauritius, Netherlands, New Zealand, Norway, Panama, Romania, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Trinidad and Tobago, United Kingdom, United States, Uruguay.

Class 2: Algeria, Angola, Bangladesh, Benin, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Central African Republic, Chile, Colombia, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Haiti, Honduras India, Indonesia, Iran, Iraq, Jordan, Kenya, Madagascar, Malawi, Mali, Mexico, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Paraguay, Peru, Philippines, Portugal, Senegal, Sierra Leone, Sudan, Syria, Tanzania, Tunisia, Turkey, Uganda, Venezuela, Zambia, Zimbabwe.

Descriptive Statistics for Countries in Tables 5 and 7

Table 8: Years of Educational Attainment by Levels for Class 1 Countries

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	156	2.334278	1.083744	0.318334	5.50228
Secondary education (15+)	156	4.272049	2.285101	0.258205	9.431778
Tertiary education (15+)	156	1.139072	0.9897321	0	5.081615
Total years of education (15+)	156	7.745399	2.357525	2.321623	12.32269
Primary education (25+)	156	2.54592	1.170039	0.3809392	5.425602
Secondary education (25+)	156	3.481304	2.259672	0.1314224	9.100007
Tertiary education (25+)	156	1.258744	1.105146	0	5.588048
Total years of education (25+)	156	7.285968	2.541385	1.978461	12.44395

Table 9: Years of Educational Attainment by Levels for Class 2 Countries

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	220	1.400487	0.8908363	0.032743	3.722054
Secondary education (15+)	220	1.17492	1.074249	0.0057603	5.821728
Tertiary education (15+)	220	0.2988546	0.4099925	0	3.202738
Total years of education (15+)	220	2.874261	1.97363	0.0545301	9.069577
Primary education (25+)	220	1.252681	0.8860209	0.0293006	3.882302
Secondary education (25+)	220	0.7671715	0.7900454	0	4.764664
Tertiary education (25+)	220	0.3416912	0.4874161	0	4.221591
Total years of education (25+)	220	2.361544	1.783505	0.0523398	8.424913

Countries in tale 6

Class 1: Australia, Austria, Belgium, Canada, China, Denmark, Fiji, Finland, France, Guyana, Hungary, Japan, Korea, Malaysia, Mauritius, Netherlands, New Zealand, Nor- way, Singapore, Spain, Sweden, Switzerland, United Kingdom, Uruguay.

Class 2: Angola, Argentina, Bangladesh, Bulgaria, Cameroon, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Dominican Republic, Ecuador, Gabon, Germany, Greece, Guate- mala, Honduras, Indonesia, Ireland, Italy, Jamaica, Jordan, Myanmar, Nepal, Nige- ria, Panama, Paraguay, Peru, Portugal, Romania, Senegal, South Africa, Thailand, Trinidad and Tobago, Tunisia, Turkey, United States, Venezuela, Zimbabwe.

Class 3: Algeria, Benin, Bolivia, Brazil, Burkina Faso, Burundi, Central African Re- public, Chile, Egypt, El Salvador, Ethiopia, Ghana, Haiti, India, Iran, Iraq, Kenya, Madagascar, Malawi, Mali, Mexico, Morocco, Mozambique, Nicaragua, Niger, Philip- pines, Sierra Leone, Sudan, Syria, Tanzania, Uganda, Zambia.

Descriptive Statistics for Countries in Table 6

Table 10: Years of Educational Attainment by Levels for Class 1 Countries

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	96	2.155932	1.064551	0.318334	4.731682
Secondary education (15+)	96	4.726842	2.337	0.258205	9.431778
Tertiary education (15+)	96	1.268079	1.009797	0.0641069	5.081615
Total years of education (15+)	96	8.150853	2.402838	2.321623	12.32269
Primary education (25+)	96	2.414116	1.167494	0.3809392	5.261272
Secondary education (25+)	96	3.841493	2.39178	0.1314224	9.100007
Tertiary education (25+)	96	1.403274	1.125305	0.0855791	5.588048
Total years of education (25+)	96	7.658884	2.668446	1.978461	12.44395

Table 11: Years of Educational Attainment by Levels for Class 2 Countries

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	152	1.985473	1.058444	0.0348266	5.50228
Secondary education (15+)	152	2.206529	1.834738	0.0219743	9.16422
Tertiary education (15+)	152	0.6121178	0.7483985	0	4.737205
Total years of education (15+)	152	4.80412	2.744041	0.1120054	12.25059
Primary education (25+)	152	1.94551	1.167292	0.0323371	5.425602
Secondary education (25+)	152	1.680353	1.64507	0.0130539	8.727866
Tertiary education (25+)	152	0.6847209	0.8528265	0	5.207569
Total years of education (25+)	152	4.310584	2.745485	0.1113263	12.30352

Table 12: Years of Educational Attainment by Levels for Class 3 Countries

	No. of Obs.	Mean	Stand.Dev.	Min	Max
Primary education (15+)	128	1.277291	0.9148768	0.032743	3.722054
Secondary education (15+)	128	1.060568	1.110913	0.0057603	5.821728
Tertiary education (15+)	128	0.223951	0.3011026	0	1.400801
Total years of education (15+)	128	2.561809	1.942351	0.0545301	8.90608
Primary education (25+)	128	1.135005	0.9116557	0.0293006	3.882302
Secondary education (25+)	128	0.6848759	0.8430163	0	4.764664
Tertiary education (25+)	128	0.2558142	0.3481071	0	1.583966
Total years of education (25+)	128	2.075695	1.739408	0.0523398	8.424913

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