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ECONOMIC GROWTH AND EDUCATION REFORM IN DEVELOPING COUNTRIES

by

Merlym M. Ramirez

A research paper submitted in the partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Applied Economics

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2014

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ABSTRACT

ECONOMIC GROWTH AND EDUCATION REFORM IN DEVELOPING COUNTRIES

by

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Utah State University, 2014

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Department: Applied Economics

Developing countries have devoted to the implementation of education policies to improve the quality of education. The concern has originated from the fact that quality education produces the tools necessary to produce social mobility, reducing the inequality within a country and in turn increasing the economic growth. The attention on education quality has aroused conflicting opinions about whether to focus the educational policies in the lowest or in the highest achievers. Most policies focus on providing quality, basic education for all children, youth and adults arguing that basic education directly impacts all aspects of human development. On the other hand, some analysts suggest that the highest achievers deserve the same attention and concern.

This study applies a cross-country growth regression analysis to identify the relationship between the existence of lowest achievers and/or highest achievers, and economic growth in non-OECD countries. 5 percentage points increase in the share of basic performers in non-OECD countries is associated with 0.14 percentage points higher annual growth. While a 0.5 percentage points increase in the share of top performers in non-OECD countries is associated with 0.099 percentage points higher annual growth. Also, results suggest that non-OECD countries should focus on basic performers, given that their contribution to economic growth and the higher economic value of a reform focus on that group of 9.55 thousand dollars per person compared to a focus on top performers where the economic value is 6.59 thousand dollars per person.

PUBLIC ABSTRACT

ECONOMIC GROWTH AND EDUCATION REFORM IN DEVELOPING COUNTRIES

Merlym M. Ramirez

Developing countries have devoted to the implementation of education policies to improve the quality of education. The concern has originated from the fact that quality education produces the tools necessary to produce social mobility, reducing the inequality within a country and in turn increasing the economic growth. The attention on education quality has aroused conflicting opinions about whether to focus the educational policies in the lowest or in the highest achievers.

This study applies a cross-country growth regression analysis to identify the relationship between the existence of lowest achievers and/or highest achievers, and economic growth in non-OECD countries. Also a simulation is performed to evaluate the economic value of a possible educational reform focus on either basic or top performers in non-OECD countries. Results suggest that non-OECD countries should focus on basic performers, given their contribution to economic growth and the higher economic value of a reform focus on that group compared to top performers.

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CHAPTER 1

INTRODUCTION

1.1. Background

Investments in education have become a main focus of economic development policy (Hanushek and Woessmann, 2012), given that it can be considered an investment in human capital. It is believed that investments in human capital, like investments in physical capital produce a stream of future benefits. Hanushek and Woessmann (2010) point out the three mechanisms through which education may affect economic growth. First, education can increase the human capital (quality of labor) of the labor force, increasing labor productivity and thus transitional growth toward a higher equilibrium level of output (augmented neoclassical growth theories, e.g. Mankiw et al. (1992)). Second, education can increase the innovative capacity of the economy, which promotes economic growth (endogenous growth model, e.g., Lucas (1988), Romer (1990), Aghion and Howitt (1998)). Third, education can facilitate the diffusion and transmission of knowledge needed to understand and process new information, which again promotes economic growth, e.g., Nelson and Phelps (1966) and Benhabib and Spiegel (1994).

Most of previous studies have focused on two issues, i) relationship between education and economic growth and ii) measuring education. The relationship between education and economic growth has been a matter of discussion, given the mixed findings (Hanushek and Woessmann, 2010) in previous researches. Hanushek and Woessman (2010) argue that it is because schooling quantity, i.e., average years of schooling or education expenditure, had been used as measures of education in early studies. Hanushek and Kimko (2000) and Hanushek and Woessman (2010) show that quality of education, i.e., cognitive skills measured by international test scores, predominate over its association with years of schooling and raises the explanatory power of growth models substantially. Hanushek and Woessmann (2010) also show that the quality of education, measured by cognitive skills explains international differences well.

Even though many things enter into economic growth and development, the educational achievement of the population is extremely important for long-run growth. Moreover, in the presence of measures of educational achievement, school attainment does not even have a significant relationship with growth. This finding corroborates previous literature in that performance on years of schooling data is largely inconsistent with growth performance (Bils and Klenow, 2000; Easterly, 2001; Pritchett, 2001, 2006), suggesting that considering acquired skills rather than time in school provides an explanation for this inconsistency.

The role of school quality as a determinant of economic growth has entailed the commitment of international organizations to the improvement of the education systems, especially in developing countries. The attention to developing countries stem from the fact that quality education produce the tools necessary to produce social mobility, reducing the inequality within a country and in turn increasing the economic growth. To address this issue, the focus has been on education quality matters such as student performances, teacher quality, and enrollment rates.

The attention on education quality, however, has aroused conflicting opinions about whether to focus the educational policies in the lowest or in the highest achievers. Most policies focusing on providing basic education such as literacy for all children, youth and adults argue that basic education directly impacts all aspects of human development and is one of the most cost-effective ways to achieve long-term economic growth and sustainable development. On the other hand, Vandenbussche et al (2006) argue that skilled labor force is required for technological progress that will eventually lead to economic growth, especially in developed countries. This would suggest that the highest achievers deserve the same attention and concern, partly because a truly equitable system wants all students to be given opportunities to flourish and also because nations' prosperity and civic health will depend on them.

Given these diverse policy alternatives and the resource constraints, it is important to determine how the resources should be administered in order to achieve a higher economic growth: should a country focus on policies targeted to attain a basic education for all, or should it focus on recognizing and

encouraging the top-performers? It is critically important for developing countries like non-OECD countries where the resources are limited. This is the main theme of this research.

1.2. Research Objectives

This study applies cross-country growth regression analyses to identify the relationship between the existence of lowest achievers and/or highest achievers, and economic growth in non OECD countries. To better determine this relationship and its magnitude, I control for a group of other economic and educational variables that also affect the economic growth of the countries. In sum, four questions are addressed in this study:

- First, how do the shares of basic and top performers affect the economic growth of a country?
- Second, how does the share of basic and top performers work differently in contributing to the growth of OECD countries and non OECD countries?

  Third, should the focus of education policies be the basic or the top performers, that is

- What would be an optimal policy for a non OECD country in terms of education reform?
- Fourth, what is the economic value of the education reform?

1.3. Organization of the Research

This study is organized in the following way. Section two reviews previous literature about education and economic growth. Section three outlines the cross-country economic growth model and describes the data used for this analysis. Section four shows the regression results. Section five presents a simulation analysis and discusses the policy implications of the results obtained in section 4. Section six presents the conclusions and limitations of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Education and Economic Growth

In order to stand out and prosper in a global economy, countries have been devoted to the welfare of their inhabitants. Accordingly, their main focus has been the implementation of economic development policies. Even though economic development differs from economic growth, as Sen (1983) points out: "economic growth is one aspect of the process of economic development." Therefore, given its straightforwardness, the success of the implemented policies has been measured in terms of their contribution to the economic growth of the country. Economic development can be referred as concerted actions of policy makers and communities that promote the standard of living and economic health of a specific area. Such actions can involve multiple areas including development of human capital, critical infrastructure, regional competitiveness, environmental sustainability and other.

One of the most important macroeconomic goals is the achievement of economic growth, which is pursued by the government through the implementation of economic policies. Economic growth can be defined as the growth in the productive capacity of an economy, and so a growth of national income. Important contributions regarding economic growth literature were those of Solow and Swan (1956) who worked independently but coincide predicting conditional convergence. The convergence is conditional because the steady-state levels of capital and output per worker depend on characteristics that might vary across economies. To mitigate this, recent empirical studies indicate that it should be included additional sources of cross-country variation, especially differences in government policies and in initial stocks of human capital (Barro, and Sala-i-Martin; 2004).

Fisher (1906) defines capital as any asset that produces a flow of income over time. Human capital, like physical capital produces flow of income and Mincer (1981) points out, that it has acquired more relevance given its payoffs: (1) At the macroeconomic level, the social stock of human capital and

its growth are central to the process of economic growth. (2) At the microeconomic level, differences in individual human capital stocks and in their growth can explain much of the observed variation in the wage structure and in the personal distribution of income.

Analyzing the Solow economic growth model, Mankiw, Romer and Weil (1992) determine that human capital could be considered as an omitted variable that affects the coefficients on physical capital investment and population growth. To implement the model, Mankiw, Romer and Weil (1992) restrict their focus to human capital investment in the form of education and find the significance of this human capital measure entered the model. In sum their results suggest that the Solow model is consistent with the international evidence if both investments in human and physical capital are taken into account.

Investment in education has been the focus of attention by human capital analysts. Previous studies have addressed the relationship between education and economic growth. Hicks (1980) compares the growth rate of different countries in the 1960-1977 periods with each country's deviation from the 1960 expected literacy level. For all 63 developing countries, Hicks (1980) finds that on the average an increase in the literacy rate by 20 percentage points is associated with 0.6 percent higher growth rate.

Due to previous findings about the contribution of human capital (in the form of education) to economic growth, recent work has focused on the correct measure of human capital in order to quantify the real effect it has. Barro (2001) distinguishes the quantity of education, measured by years of school attainment, from the quality, as gauged by scores on internationally comparable examinations. His results suggest that the quality and quantity of schooling both matter for growth but that quality is much more important. Hanushek and Woessmann (2012), develop a new metric for the distribution of educational achievement across countries that can further track the cognitive skill distribution within countries and over time. They find that the fact of a very strong relationship between cognitive skills and growth does not address all concerns given that for policy advice, it is important to know whether the estimated relationship is causal or a mere association reflecting omitted variables, poor achievement measurement, or restricted models of growth.

Nevertheless, the use of cognitive skills captures variations in the knowledge and ability of the students, incorporating not only the skills acquired at the schools but also the skills obtained with the families. Besides, by allowing for differences in performance among students with differing quality of schooling (but possibly the same quantity of schooling), this is a good measure to identify the policies designed to affect the quality of education.

2.2 Education and Economic Growth in Non OECD Countries

As specified by the World Bank (2012), developing countries are defined according to the Gross National Income (GNI), which is mainly composed by the Gross Domestic Product (GDP). Therefore, in order to develop, these countries focus on their GDP growth. Thinking education could boost their economic well-being, many developing countries (and International organizations such as the World Bank and the United Nations) have devoted a substantial portion of their government funds towards education. Despite the huge sums of government funds allocated to education, these countries still struggle in keeping up with the OECD members (developed countries).

In 2000, the United Nations established the Millennium Development Goals (MDG). The second MDG goal was universal primary education, to be achieved by 2015 and consistent with Education for All (EFA). To be sure, both the MDG's and the EFA goals recognize that quality is an issue, and both suggest that quality should be monitored. But, the ease of measurement of school completion and the ability to assess progress toward the specific goals imply that qualitative issues of schooling receive considerably less attention. Over the past decade, developing countries have closed half of the gap of their enrollment rates compared to those in developed countries.

For the purpose of analyzing the relationship between education quality and economic growth in OECD countries, Hanushek and Woessmann (2010) develop a model with measures of both quantity and quality of schooling. They find that without taking into account the cognitive skills, the significant association between years of schooling and economic growth does not differ significantly between OECD and non-OECD countries. However, once cognitive skills are included, neither the OECD dummy nor its

interactions with cognitive skills are statistically significant, indicating that the OECD countries actually fit well within the rest of the world on this association

In terms of the dimension of education quality and its policy implication, Vandenbussche, Aghion, and Meghir (2006) and Aghion and Howitt (2006) argue that tertiary schooling is the key for developed countries. They develop a model where countries close to the world technology frontier should invest in colleges and universities in order to move the frontier out through innovation. Developing countries on the other hand, should invest in more basic education since they will grow by imitating the technologies of more developed countries. This conclusion, however, is based entirely on education measured by school attainment, which just take into account the years of schooling. A measure of school quality should be considered for policy advice purposes.

To examine the relationship between the different dimensions of education quality and economic growth in non-OECD countries, a cross-country growth regression model will be estimated. In addition, by controlling for other economic and education variables that affect economic growth, a more realistic relationship will be established in order to take into account for further analysis and policy implications. The cross-country growth regression model is described below.

CHAPTER 3

A CONCEPTUAL FRAMEWORK AND DATA

3.1. Cross-Country Growth Regression Models

Section 3.1 is heavily dependent upon section 2 in Hanushek and Woessmann (2012). The methodology used for this analysis is a simple growth model in which the growth rate of a country depends on human capital and other factors such that:

$$g = \alpha H + \beta X + \varepsilon \tag{1}$$

Equation (1) shows the simple regression model where g is the growth rate of real GDP per capita over an extended period, H is human capital, X is the other factors affecting GDP growth (i.e. initial level of income, economic institutions, etc.), and ε is a stochastic term where it is assumed that $E(H,X|\varepsilon)=0$. Typically, human capital, H, is measured by years of schooling (or school attainment) but given the differences in the growth of countries with the same amount of years of schooling, the human capital has been measured by other factors that contribute to the development of skills of the individuals:

$$H = \gamma_1(qS) + \gamma_2 F + \gamma_3 A + v \tag{2}$$

Equation (2) models human capital as a combination of years of schooling (S) and schooling quality (q) of schooling, family factors (F), and other attributes (A) including health, ability, and peer influences of the country's population. Even if years of schooling is a valid measure of human capital, the results might be misinterpreted given that a year of schooling doesn't necessarily produce the same increase in knowledge or skills in all education systems.

As suggested by Hanushek and Woessmann (2012), a better alternative is to focus directly on the cognitive skills component of human capital. This measure can be considered a more complete measure of human capital given that it incorporates skills from any source—families, schools, and ability. Also, by allowing for differences in performance among students with differing quality of schooling (but possibly

the same quantity of schooling), they open the investigation of the importance of different policies designed to affect the quality aspects of schools.

For this analysis, the human capital is measured by the dimensions of educational performance, i.e. share of basic performers and share of top performers. In order to account for the other factors[1] affecting the GDP growth (X in equation 1), the initial GDP per capita is used in this analysis. The inclusion of this variable is done based on the premise of conditional convergence, i.e. countries with higher initial income tend to grow slower, given the diminishing returns (particularly to capital) in poorer countries, which can replicate the production methods, technologies and institutions of developed countries.

3.2. Data

To analyze the relationship between economic growth and the dimensions of educational performance in non-OECD countries, a set of economic and educational variables are collected and used to identify the relationship. Six economic and social variables are compiled based on previous literature, e.g. Hanushek and Woessmann (2010, 2012) such as:

- GDP growth: Average annual percentage growth rate of GDP per capita between 1960-2000 at market prices based on constant local currency. Aggregates are based on 1996 U.S. dollars. GDP growth data is based on own calculations using data obtained from Penn World Tables (Heston et al. (2002)).[2]
- Initial GDP per capita: GDP divided by midyear population of 1960. Note that GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, based on 1996 U.S. dollars. 1960 GDP per capita was obtained from Penn World Tables (Heston et al. (2002)).[2]

[1] Hanushek and Kimko (2000) try a variety of other common measures of economies following Levine and Renelt (1992), e.g., the ratio of real government consumption expenditure net of spending on defense and education to real GDP, the ratio of private investment to GDP, and ratio of total trade to GDP. Hanushek and Kimo (2000) find that these variables are not significant statistically and do not change the overall results. Following their results, only the Initial GDP per capita is considered in this study.

[2] GDP 1960 and GDP Growth 1960-2000 data retrieved from: https://pwt.sas.upenn.edu/php_site/pwt61_form.php

- Non-OECD countries: A dummy variable that takes the value 1 if the country is a non-OECD country and 0 otherwise.

To account for the determinants of school quality, the variables top performers, basic performers and years of schooling were used.

- Top performers: Share of top-performing students (based on average test scores in math and science, primary through end of secondary school, all years). Superior performance is defined as a performance of 600 points or one standard deviation above the OECD mean. Data was obtained from Hanushek and Woessmann (2012) database.
- Basic performers: Share of students reaching basic literacy (based on average test scores in math and science, primary through end of secondary school, all years). Performance of at least 400 test-score points or one standard deviation below the OECD mean is used as a threshold of basic literacy and numeracy. Data was obtained from Hanushek and Woessmann (2012) database.

The variables top performers and basic performers are derived from the aggregation of 12 different International Student achievement tests (ISATs) from the First International Mathematics Study (FIMS) to the latest Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA), from 1964 to 2003. To allow for comparisons Hanushek and Woessmann (2012) developed a common metric both for the level and for the variation of test performances.

- Years of schooling: population's shares of educational attainment by the appropriate length (in years) of each educational category (i.e. primary, secondary and higher education) in year 1960. The years of schooling are obtained from Cohen and Soto (2007) database.

Cross-sectional data for 48 countries are used, including 26 OECD members and 22 non-OECD countries. Table 1 contains descriptive statistics of the variables used in this analysis. Table 2 shows countries analyzed in this research.

Table 1. Descriptive Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Average annual growth rate in GDP per capita 1960–2000 (%)[1]	48	2.74	1.07	1.11	5.99
GDP per capita 1960 (1000 dollars)[2]	48	5.29	3.83	0.69	14.88
Share of students reaching basic literacy[3]	48	0.75	0.22	0.18	0.97
Share of top-performing students[4]	48	0.06	0.05	0.00	0.18
Years of schooling 1960 (in years)[5]	48	4.84	2.845	0.50	10.29

Sources:
[1,2]Penn World Tables (Heston et al. (2002), retrieved from: https://pwt.sas.upenn.edu/php_site/pwt61_form.php

[3, 4] Hanushek and Woessmann (2012) database.

[5] Cohen and Soto (2007) database.

Table 2. Countries Analyzed

OECD			NON OECD		
Australia	United Kingdom	Mexico	Argentina	India	Tunisia
Austria	Germany	Netherlands	Brazil	Iran	Uruguay
Belgium	Greece	Norway	Chile*	Jordan	South Africa
Canada	Hungary	New Zealand	China	Morocco	Zimbabwe
Switzerland	Ireland	Portugal	Colombia	Malaysia	
Denmark	Italy	Sweden	Cyprus	Peru	
Spain	Japan	Turkey	Egypt	Philippines	
Finland	Korea, Rep.	United States	Ghana	Romania	
France	Luxembourg		Indonesia	Thailand	

*Chile became OECD member country in 2010.

CHAPTER 4

APPLICATION OF CROSS-COUNTRY GROWTH REGRESSION

4.1. Regression Results

The basic growth model in equation (1) is estimated for 48 countries in Table 2 with data over the period 1960-2000. Table 3 reports the regression estimates for the relationship between education quality and economic growth. The first two columns, models 1 and 2, show the typical model of economic growth, with the years of schooling as the measure of quality of education (human capital). Coefficients for the initial GDP are negative and statistically significant, which implies the conditional convergence, i.e. developing countries grow faster. Years of schooling is not statistically significant both in models 1 and 2. Model 2 in column 2 shows that the economic growth in non-OECD is lower than that of the rest of the world.

As seen in models 3 to 8 in columns 3 through 8, both measures of the test scores are significantly related to economic growth. Both the basic-skill and the top-performing dimensions of educational performance appear separately important for growth. However, the point estimates for top performers are substantially higher than the point estimate for the basic skills. Nevertheless, the estimated coefficients don't show the actual effect of basic and top performers on economic growth. Section 4.3 analyzes the marginal effects of both basic and top performers on economic growth in non-OECD countries.

Considering the difference in the behavior of the variables between non-OECD and OECD countries, Table 3 shows that in both models, the impact of the basic and top performers on economic growth is lower in non-OECD than in OECD countries. Also, the higher the share of basic performers, the slower the economic growth in non-OECD countries compared to a faster growth in OECD economies. On the other hand, the share of top performers doesn't affect whether a non-OECD grows faster or slower than an OECD country.

Table 3. Basic Education for All or Top Performers

	Years of schooling		Basic Education			Top Performers		
	(1)	(2)[1]	(3)[2]	(4)[3]	(5)	(6)	(7)	(8)
Share of students reaching basic literacy			3.677***	2.958***	3.836***			
			(0.811)	(0.870)	(0.663)			
Share of top-performing students						18.778***	15.189***	18.862***
						(3.493)	(4.021)	(3.556)
Initial GDP per Capita	-1.139**	-0.219**	-0.142	-0.187*	-0.192***	-0.150***	-0.185***	-0.153***
	(0.066)	(0.111)	(0.100)	(0.098)	(0.053)	(0.052)	(0.055)	(0.054)
Years of schooling 1960	0.108	0.020	-0.055	-0.073	-0.093	-0.090	-0.092	-0.091
	(0.089)	(0.157)	(0.141)	(0.141)	(0.074)	(0.079)	(0.077)	(0.080)
Non OECD countries		-1.455***		-0.816*			-0.671*	
		(0.532)		(0.481)			(0.395)	
Basic X Non OECD					-1.171**			
					(0.464)			
Top X Non OECD								-1.433
								(7.218)
Constant	2.954***	4.472***	0.998**	2.233***	1.647***	2.901***	3.611***	2.928***
	(0.299)	(0.717)	(0.430)	(0.855)	(0.490)	(0.235)	(0.477)	(0.274)
No. of Countries	48	48	48	48	48	48	48	48
R^2	0.100	0.322	0.447	0.504	0.519	0.457	0.491	0.4573
F-statistics	2.50	3.91	8.05	8.13	11.58	12.34	10.37	9.06
Breusch-Pagan Heteroskedasticity test statistics	2.79	5.82	6.61	4.2	3.53	0.00	0.24	0.00
P-value	0.09	0.02	0.01	0.04	0.06	0.99	0.63	1.00

Standard Errors in Parenthesis
[123]Robust standard errors are used to fix heteroskedasticity.
*** indicates that a coefficient is significantly different from zero at 1% significance level.
**indicates that a coefficient is significantly different from zero at 5% significance level.
*indicates that a coefficient is significantly different from zero at 10% significance level.

4.2. Marginal Effects

As indicated in Table 4, from the estimates in Model 5 and Model 8 in Table 3, a 5 percentage points (0.25 standard deviations improvement[3] of the share of basic performers) increase in the share of basic performers in non-OECD countries is associated with 0.14 percentage points higher annual growth over the long run, compared to a lower increase in the annual growth in OECD countries of just 0.109 percentage points. While a 0.5 percentage points (0.25 of standard deviations of the share of top performers) increase in the share of top performers in non-OECD countries is associated with 0.099 percentage points higher annual growth, compared to a higher increase in the annual growth in OECD countries of 0.180 percentage points.

Marginal effects for basic education, i.e. 0.140, and top performers, i.e. 0.099, are different statistically (t-value is 4.47 and P-value is 0.000) and variances of marginal effects are not different statistically at 5% significance level (F-value is 1.15 and P-value is 0.323). It may be more feasible for non-OECD countries to increase the share of basic performers than to increase the share of top performers by the same amount, as indicated by the fact that the standard deviations of these two variables are 0.77 and 7.66 respectively, in non-OECD countries.

Table 4. Marginal Effect in Non-OECD Countries

	Basic Education		Top Performers	
	OECD	Non-OECD	OECD	Non-OECD
Estimated regression slope	3.836	2.664	18.862	17.429
Standard Error	0.663	0.773	3.557	7.661
t-value	5.78	3.45	5.30	2.27
Marginal effect[1]	0.109	0.140	0.180	0.099
Standard Error	0.020	0.041	0.034	0.044
95% conf. interval	[0.071, 0.149]	[0.058, 0.223]	[0.011, 0.248]	[0.011, 0.187]

[1] When basic education and top performer increase by a 25% of its standard deviation, i.e., 5 percentage points increases in the share of basic performers and 0.5 percentage points increases in the share of top performers.

[3] Roughly a 25 point increase on Programme on International Student Assessment (PISA) test scores.

Marginal effects for basic education, i.e., 0.109 for OECD countries and 0.140 for non-OECD countries are different statistically (t-value is 4.456 and P-value is 0.000). Marginal effects for top performers, i.e., 0.180 for OECD countries and 0.099 are different statistically (t-value is 9.552 and P-value is 0.000).

CHAPTER 5

SIMULATION OF EDUCATION REFORM

5. 1. Introduction

The results obtained in the cross-country regression model (Tables 3 and 4) suggest that the educational achievement affect positively the economic growth. However, they do not show how much should be achieve in terms of outcome, to have a desired effect in the economic growth of the country. Also, these results don't show the economic value of the education reform required to achieve that economic growth.

In this section I perform simulation analyses following Hanushek and Woessmann (2010) that use the estimates from the previous section to project what the results mean for the economic impact of an education reform and compare simulation results for focusing on basic or on top performers in non-OECD countries. The projections assume that the estimated impacts of both the basic and top performers on growth are causal, meaning that a change in the dimension of achievement of a country's population will lead to improved growth.

5. 2. Simulation of Education Reform in Non-OECD Countries

The projection of the total value of the education reform requires several steps. First, a time path of the annual growth rate inflicted by the education reform that goes from the current performance to the new level the student reaches. Second, based on the estimations from the cross-country regressions the GDP with and without education reform is modeled. Third, based on these projections, the total value of the reform is calculated by aggregating the discounted values of the annual differences between the GDP with reform and the GDP without reform.

The annual growth rate increases in different phases. The starting point of the projection is a scenario where the non-OECD country implements an education reform in 2015 that takes 20 years to be fully implemented, i.e., all labor force reach the new achievement level. The economic value of the

reform is then traced across an 80-year period (which represents the expected lifetime of somebody born in 2015). The phases work as follows:

a) Phase 1 (2015-2035): The path of increased achievement during this phase is taken as linear. The additional growth in GDP per capita in year t due to the reform is given by:

$$\Delta^{t} = \text{Effect(Basic or Top)} * \frac{1}{\text{Working Life}} * \frac{t - 2015}{20} + \Delta^{t-1} \quad (3)$$

where Δ^{t} is the additional economic growth rate due to the better human capital induced by the education reform, the Effect of basic or top is the regression slope coefficient for non-OECD countries obtained in section 4.1 times 0.25 standard deviations of basic and top performers, i.e., marginal effects in Table 4. The working life term indicates that each cohort of new, higher achieving students is only a fraction of the total labor force. The number 20 in equation (3) means that educational reform program is assumed to take 20 years to be fully implemented.

b) Phase 2 (2031-2050): During this phase, the education reform is fully implemented. The additional growth in GDP per capita in year *t* due to the reform is given by:

$$\Delta^{t} = \text{Effect(Basic or Top)} * \frac{1}{\text{Working Life}} + \Delta^{t-1} \quad (4)$$

c) Phase 3 (2056-2075): During this phase, the first 20 labor-market cohorts – which only partially profited from the education reform – are replaced by cohorts that profited from the fully enacted education reform:

$$\Delta^{t} = \text{Effect(Basic or Top)} * \frac{1}{\text{Working Life}} - (\Delta^{t-40} - \Delta^{t-41}) + \Delta^{t-1} \quad (5)$$

d) Phase 4 (After 2070): Finally, the whole workforce has gone through the reformed education system. The annual growth rate is now increased by the constant long-run growth effect Δ:

$$\Delta^{t} = \Delta^{t-1} \quad (6)$$

After we calculate the annual growth rate in every phase, we can obtain the growth of the economy both with and without the educational reform. Without the reform, I assume that the economy grows at the constant growth rate at 2.19% which is the average of non-OECD countries from the past data. On the other hand, with the reform, the annual growth rate is additionally increased by the growth effect. Finally the total value of any reform is given by the sum of the discounted values of the annual differences between the GDP with reform and the GDP without reform.

5. 3. Projection Results

The starting point is the economic impact of 0.25 standard deviation improvement in the share of basic performers in non-OECD countries. The reform policy begins in 2015 and while there is no impact initially, until improved labor-force (due to the reform) start becoming more significant in the labor market. By 2055 when the phase III starts, GDP growth rate is 0.11 percentage points higher than what was expected without the education reform. By the end of 2100, GDP growth rate will be 0.14 percentage points higher than the baseline. The economic impact of a 0.25 standard deviation increased in the share of top performers in non-OECD countries. Due to this educational reform, by 2055, GDP is 0.08 percentage points higher than what was expected without the reform. By the end of 2100, GDP growth rate will be 0.10 percentage points higher than without the reform. Table 5 presents summary of the projection.

Table 5. Summary of Projection of Education Reform[1]

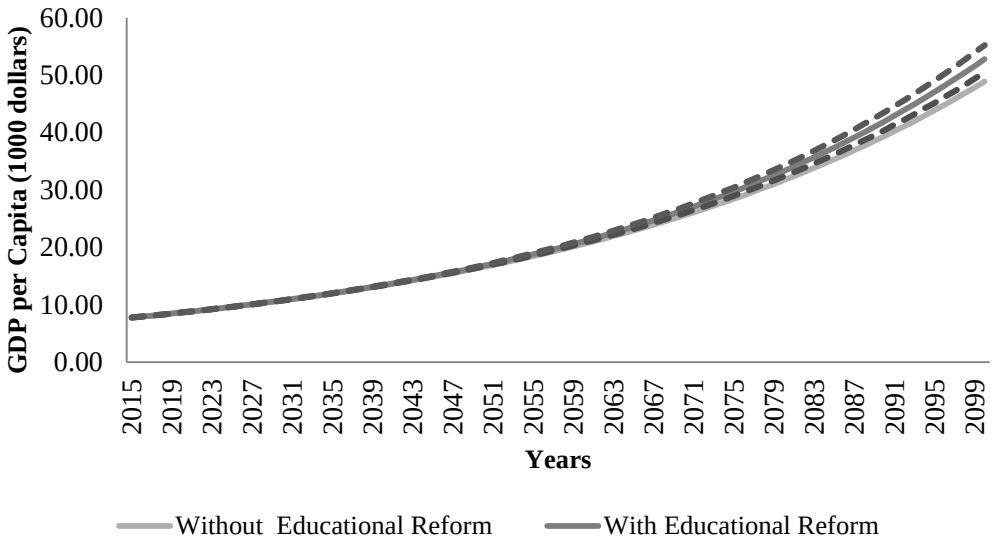
	Baseline		Basic Education		Top Performers	
	GDP growth (%)	GDP per capita[2] (000 $)	GDP growth (%)	GDP per capita (000 $)	GDP growth (%)	GDP per capita (000 $)
2025	2.19	9.65	2.21	9.66	2.20	9.65
2035	2.19	11.98	2.26	12.01	2.21	12.00
2045	2.19	14.88	2.33	15.00	2.24	14.96
2055	2.19	18.47	2.40	18.79	2.26	18.70
2065	2.19	22.93	2.46	23.61	2.28	23.41
2075	2.19	28.47	2.47	29.71	2.29	29.34
2085	2.19	35.35	2.47	37.40	2.29	36.78
2095	2.19	43.89	2.47	47.08	2.29	46.12

[1] When basic education and top performer increase by a 25% of its standard deviation, i.e., 5 percentage points increases in the share of basic performers and 0.5 percentage points increases in the share of top performers.

[2] GDP per capita is constant dollars in 1996.

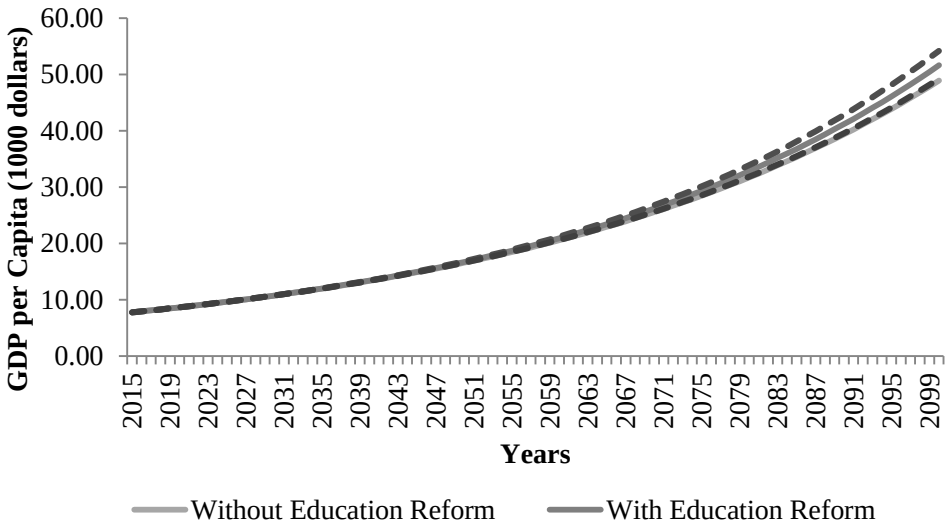
Figures 1 and 2 present the time path of GDP per capital with and without the educational reform with 95% confidence bands to visualize Table 5. As shown in Table 5 and Figures 3 and 4, in 2015, the average GDP per capital in non-OECD countries is $5,618. In 2055, GDP per capita rises to $18,471 without the educational reform while it becomes $18,789 with the improvement in the share of basic performers and $18,695 with the increases in top performers, respectively. In 2100, GDP per capita rises to $48,910 without the educational reform while it becomes $52,820 with the improvement in the share of basic performers and $54,634 with the increases in top performers, respectively.

These results would suggest that the implementation of educational reform focus basic performers in non-OECD countries will lead to a higher GDP per capita than the reforms targeting top performers. To evaluate the economic value of the educational reform the present value of the difference in the GDP per capita with and without the education reform in Section 5.4.



*Dotted lines are 95% confidence intervals

Figure 1. GDP per Capita Projection Targeting Basic Performers



*Dotted lines are 95% confidence intervals

Figure 2. GDP per Capita Projection Targeting Top Performers

5.4. Value of Education Reform

The value of the education reform is calculated by adding the discounted values of the differences in GDP per capita with and without the education reform:

$$\text{Value} = \sum_{t=2015}^{2100} \frac{\text{GDP}_t^{\text{R}} - \text{GPD}_t^{\text{base}}}{(1+\text{r})^{t-2015}} \tag{7}$$

where GDP_t^{R} is the GDP per capital in year t with the educational reform and $\text{GDP}_t^{\text{base}}$ is the GDP per capita in year t without the educatinal reform in non-OECD countries, and r is the discount rate.

Table 6 presents the results for the present value of the education reform targeted to basic and top performers, discounted at 3 plausible discount rates. The total value of the reform applied to basic performers in non-OECD countries, calculated from the initial year of implementation to the end of the expected life and discounted at a 3% rate is of about $9,554 per person. On the other hand, the total value of the reform applied to top performers in non-OECD, calculated for the same period is of about $6,686 per person. Statistical tests show that values of the education reform targeting basic and top performers are different statistically. Two sample t-test statistics is 15.4 and P-value is given by 0.000.

Table 6. Present Value of Education Reform (1000 dollars per person)

	Discount rate		
	1%	3%	5%
Basic performers	37.95 [15.51, 61.09]	9.55 [3.91, 15.35]	2.72 [1.12, 4.36]
Top performers	26.54 [2.96, 50.89]	6.69 [0.75, 12.80]	1.91 [0.21, 3.64]

Numbers in brackets are 95% confidence interval

Discounted at a lower discount rate of 1%, the value of the education reform focusing on basic performers in non-OECD countries is $37,952 per person; while when focusing on top performers in non-OECD countries, the value of the reform is calculated to be $26,535 per person. At a higher discount rate of 5%, the value of the reform focusing on basic performers is $2,720 per person and on top performers is $1,906 per person.

As seen in Table 6, regardless of the discount rate used, the education reform focusing on basic performers has a higher economic value per person in non-OECD countries. These results would suggest that non-OECD countries focus on investing their educational resources to basic performers in order to achieve a higher GDP per capita. Along with population growth, the education reform provides non-OECD countries substantial economic growth.

CHAPTER 6

CONCLUSION

Most of the policies in developing countries are motivated by the possibility of achieving the economic growth necessary to increase the level of income of its inhabitants and provide them with a better quality of life. To do so, the main tool has been the implementation of policies, focused on the improvement of the education of the individuals. These educational policies focus both in the quantitative and qualitative measurement of schooling.

Due to the scarcity of resources, a focus on quality (which takes more time to show results) complicates decision making. It appears to be generally easier to understand how to expand access than to improve quality. Nevertheless, given the importance of quality policymakers have been interested in targeted policies for basic performers by providing quality, basic education for all children, youth and adults. Others argue that the highest achievers should be given opportunities because nations' prosperity and civic health will depend on them.

This study applies a cross-country growth regression analysis to identify the relationship between the existence of lowest achievers and/or highest achievers, and economic growth in non-OECD countries. 5 percentage points increase in the share of basic performers in non-OECD countries is associated with 0.14 percentage points higher annual growth. While a 0.5 percentage points increase in the share of top performers in non-OECD countries is associated with 0.099 percentage points higher annual growth. Also, results suggest that non-OECD countries should focus on basic performers, given that their contribution to economic growth and the higher economic value of a reform of 9.55 thousand dollars per person compared to top performers where the economic value is 6.69 thousand dollars per person.

Given the results obtained in this analysis, it will be convenient for policy makers in non-OECD countries to focus on the implementation of education reforms whose target is the achievement of basic education for all. These policies should target issues such as universal access to education, to ensure that all people have the ability of receiving at least basic education regardless of their social class, background

or physical or mental disabilities. This issue can be addressed by the construction of schools near poverty areas or the provision of transportation to those areas where school access is limited. Also, the construction of facilities and the implementation of educational programs accessible to the disabled, for them to have the same access to education as everyone else.

Another reform in the education system that will increase the amount of basic performers in non-OECD countries is the improvement of the teachers' quality. By assessing the teachers to determine the flaws in the teaching techniques, it will be possible to improve their ability to pass on their knowledge to the students and empower them with the tools necessary to provide a quality education. With this, policy makers will make sure that all students receive a quality basic education. By improving the teacher quality and thus, the quality of the knowledge received by the students and by ensuring that all people in non-OECD countries have access to that quality education, policy makers will be able to increase the share of basic performers in their countries.

Even though these policies are targeted to the increase of basic performers in non-OECD countries, they benefit both basic and top performers. Therefore, in order to incorporate policies more targeted to basic performers, by increasing the secondary education for all, the students will be able to continue to improve the knowledge they have acquired in primary school.

Also, another policy that fits well in non-OECD countries, for the increase of basic performers is the increasing of enrollment rates. This policy is very important given that in developing countries, a lot of children don't attend school because it is more profitable for them and their families if they work, which has short run returns, rather than going to school which will show the benefits in the long run. In order to improve the enrollment rates, which will also increase the share of basic performers, a successful policy will be the incentives to families to send their children to school. These incentives can be done in the form of conditional cash transfers.

The contribution of these policies is twofold: First, it increases the quality of education of the people of non-OECD countries, ensuring a more skilled labor force. Second, this more skilled labor force contributes to the economic growth of the country and the increase in the well-being of its inhabitants.

Nevertheless, one thing to take into account regarding these results is the endogeneity issue between economic growth and education quality, which is one of the limitations of this study. To address this problem, the use of instrumental variables in the model would be a plausible solution as suggested by Hanushek and Woessmann (2012). The instrumental variables that can be used could be variables regarding the institutional structure of the school systems, such as share of privately operated schools, teacher's salary and educational spending levels. Also, years of schooling could be added as an instrumental variable to help explain the differences in cognitive skills, as suggested by Hanushek and Woessmann (2012).

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