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Public education expenditure and economic growth: the educational quality threshold effect

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Abstract - Using the threshold model (Hansen, 1996 and 2000), this paper analyses whether the growth effect of public education spending differs regarding the level of educational quality in each country. The results prove the existence of a threshold effect on the relationship between education expenditure and economic performance. Specifically, spending on education present a positive effect on growth if the quality of education is better otherwise the effect is negative. This result is robust to the use of different measures of education quality of the PISA scores and also of their average as a measure of the performance of the whole labor force.

JEL Classification
I22 ; I25 ; P46 ; O4 ; H52

Key Words
Education expenditure
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1. INTRODUCTION

The importance of human capital for growth has been stressed by the endogenous growth approach for which this factor is the engine of growth and responsible for the increasing returns to scale in the long term (Romer, 1986, 1990; Lucas, 1988). His principal component education is largely considered as a crucial driver of economic performance, for this reason many governments had made huge investments in this sector. Several theoretical studies have examined this relationship between education and growth (Glomm and Ravikumar, 1992; Eckstein and Zilcha, 1994; Zhang, 1996; Benabou, 1995 and 1996; Cardak, 1999; Pissarides, 2000, etc.). However, few amount of studies have empirically tested the correlation between the public education spending and economic growth using cross-country, time series and panel data (Sylwester, 2000 and 2002; Gylfason and Zoega, 2003, etc.)[1]. Though the theoretical literature provides a support of this positive relationship, the empirical works has failed to find a robust result. In fact, many studies confirm a positive effect of education expenditure on economic growth (Becker, Murphy and Tamura, 1990 and Goodspeed, 2000) where others present a negative relationship (Belgrave and Craigwell, 1995; Sylwester, 2000 and Nurudeen and Usman, 2010).

Many explanations had been advanced in order to elucidate this mixed result. For example, Sylwester (2000) had argued that the beneficial effect of educational expenditure cannot be observed immediately but after a certain time. Blankenau et al. (2007) prove that those empirical works do not take into consideration the negative effect of taxation. If the government decides to increase the taxes in order to finance the increasing expenditures, the private investment will be reduced because this policy competes away the private sector. Another important explanation is procured which is the existence of threshold effects. The effectiveness of education investment depends on other factors such as openness policies, institutional situation, labor market characteristics, etc. In reality, country that looks to improve its education policy is likely to improve also other economic policy as well in order to boost growth (Krueger and Lindahl, 2001).

In this paper, we will center our analysis on another essential explanation which is the low quality of education in a country. In fact, the quantity of education is largely related to its quality. It seems beyond doubt that a one year of schooling cannot procure the same amount of knowledge because it is strongly related to the efficiency of the education system, the quality of teaching, the infrastructure of education and also the curriculum. If the politicians increase expenditures by focusing on quantity rather than quality then such investments will only result in misallocation of resources which can impede growth (Lee and Lee, 1995; Hanushek and Kim, 1995; Bosworth and Collins, 2003 and Ciccone and Papaioannou, 2005). Our main objective is to find at which level of education quality the public expenditure starts affecting positively the economic growth. So this paper provides new evidence that sheds light on the role that education quality plays in mediating the influence of public education spending on economic growth. Specifically, we explore whether there exists a quality education threshold in the education expenditure-growth relationship. We seek to verify that high investment in education may not result in increased growth if the quality of education in a country is low. The findings of this paper may have important policy implications in the sense that policy makers

[1] See Benos and Zotou (2014) for more detail on the education-growth literature review and more precisely on the literature evocating the relationship between education expenditure and growth.

should recommend measures that enhance the quality of their public education[2] at the same time that they look to increase its quantity.

This study extends the literature in two ways. First, we use an innovative regression model found on the concept of the threshold effects developed by Hansen (1996, 1999 and 2000). Several studies are interested to the direct relationship between education expenditure and economic performance using linear model. Other works had used an interaction term in order to capture the nonlinear relationship. But as our knowledge, model that determine endogenously the threshold effect are inexistent. This econometric method (Hansen, 2000) has been used in many recent studies that analyze the relationship between economic growth and many topics as finance or financial development (Khoury and Savvides, 2006 and Law, et al., 2013), inflation (Drukker et al., 2005), know-ledge spillovers (Falvey et al., 2007), foreign direct investment (Azman-Saini, et al., 2010), institutional quality (Odawara, 2010). However, it is not yet used to explore the relationship between public education spending and economic performance. Our objective in this paper is to contribute in the determination of the likely reasons behind the failure of the empirical literature to construct a strong link between education expenditures and economic growth. Second, this paper analyzes the link between economic growth and education by considering his quantitative and qualitative aspect conjointly via the threshold level where many studies consider them separately. In fact, several works confirm that ignoring the differences in the quality of education between countries can explain the mixed empirical result of how educational and economic outcomes are related (Hanushek and Kimko, 2000; Barro, 2001; Woessmann, 2002 and 2003; Bosworth and Collins, 2003; Coulombe and Tremblay, 2006 and Jamison et al., 2007). Our study differs of these papers in the sense that we find out the threshold level of the educational quality above it the quantity seems to have a positive effect on growth where the others just include in their regression model the qualitative in addition to the quantitative measure and analyze separately their effect on the economic performance.

This paper is organized as follows: section 2 presents the data and the empirical model; section 3 contains the results of the regression analysis; and section 4 concludes.

2. EMPIRICAL MODEL AND DATA

Many studies have analyzed the relationship between the public education expenditure and the economic growth using the following linear cross-country growth analysis.

$$GROWTH_i = \alpha\, GEDU_i + \beta\, X_i + \varepsilon_i \qquad (1)$$

where $GROWTH_i$ is the average growth rate in a country i, $GEDU_i$ is the country level of public educational expenditure, X_i is a vector of controls variables such as initial income per capita, investment gross domestic product ratio, human capital, financial development, trade openness, etc. and ε_i is a noise term.

In order to test the non-linear relationship between economic growth and public educational expenditure, we use the threshold regression approach for cross-countries data (Hansen, 1996 and 2000). Our objective is to determine at which level of education quality the effect of public educational spending on economic

[2] This paper focuses on analyzing the impact of quantitative and qualitative aspects of education in the public system on growth. However, in a private system, parents require a better quality of education, which can explain the positive link between private spending and economic growth advanced by the theoretical study of Glomm and Ravikumar (1992).

growth becomes positive. The model based on the threshold regression presents the following form:

$$GROWTH_i = (\alpha_1 GEDU_i + \beta_1 X_i)\, I(EDUCATION\ QUALITY \leq \gamma) + (\alpha_2 GEDU_i + \beta_2 X_i)\, I(EDUCATION\ QUALITY \geq \gamma) + \varepsilon_I \quad (2)$$

where EDUCATION QUALITY is the threshold level variable that divides the sample into regimes or groups and γ is the unknown threshold parameter. The indicator function is I(.) which takes the value 1 if the argument is valid and 0 otherwise. In this function, the quality of education is considered as a threshold level. So the impact of the public education expenditure on the economic performance will be α_1 and α_2 respectively for countries with low and high quality of education. However, the model is considered linear if we obtain the equality between the estimated coefficients $\alpha_1 = \alpha_2$ and $\beta_1 = \beta_2$. At this situation, the regression will be reduced to the equation 1.

The first step of this non-linear analysis consists to test the null hypothesis of linearity against the threshold model (Equation 2) H_0: $\alpha_1 = \alpha_2$. The second step is to estimate the equation 2 and then an estimated level of γ is determined by minimized the residual sum of squares. In order to regress the equation 2 and then to find out the threshold level γ, we use a cross country dataset for the period 1980-2010[3] and the cross-section threshold approach with the OLS method. The panel data approach suggested by Hansen, 1999 for a non-dynamic specification is not pursued in this study for two reasons. First, because the lack of data which limit the number of observations and second because the model adopted in this study seems to be dynamic due to the lag of the dependant variable included as an explanatory variable and the endogeneity of the educational variables or the dynamic panel threshold has not been developed.

We use the scores of the international student achievement tests as a threshold level variable (EDUCATION QUALITY) which is considered by many works as the adequate measure of the educational quality (Hanushek and Woessmann, 2008 and 2009). These scores are collected from the database OECD Program for International Student Assessment (PISA)[4] on the mathematics, reading and science (MATH, READING and SCIENCE) and in order to study the robustness of our results, we consider a simple average of these scores (QUALITY) as a proxy for the average educational performance of the whole labor force (Hanushek and Woessmann, 2010).

The dependent variable is the average growth rate (GY) during the period 1980-2010. The independent variables[5] are: the initial real GDP per capita (US$ 2000 constant prices) (GDP_{80}) recurred in order to confirm the convergence hypothesis of Solow; the human capital (HK) measured by the average years of schooling and reflects the quantitative aspect of education; the public education expenditure as a ratio of GDP (GEDU) which is a proxy of the educational infrastructure; the openness of the economy in the international trade obtained by the sum of export and import as a ratio of GDP (TRADE). This variable is considered as a common and powerful measure of the institutional framework of the economy

[3] The analysis period is limited to 1980-2010 because the human capital data is not available for subsequent years.

[4] We adopt only the data of the PISA test because for the TIMSS scores we do not have a sufficient number of observations. It is also interesting to indicate that this test is reserved to students from the public and the private systems.

[5] All these variables are considered as an average during the period 1980-2010 except the initial GDP which is relative to 1980.

and which is largely considered in the literature as a fundamental determinant of the economic growth[6]; the investment (as a percentage of GDP) (IY) and finally, with respect to the financial development, we focus on the liquid liabilities (LL) as a ratio of the GDP[7].

The human capital data (HK) is gathered from the Barro and Lee Dataset (2013). The liquid liabilities variable (LL) is taken from the Financial Structure Database of the World Bank. The variables of education quality (MATH, READING and SCIENCE) are from Education Statistics of the World Bank. The rest of data are obtained from the World Development Indicators of the World Bank.

Table 1: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GY	71	2.2563	1.6717	-3.5052	8.5010
GDP80	52	9.0175	1.2896	5.3967	11.3119
KH	66	2.1584	0.2137	1.6224	2.5266
GEDU	70	1.4195	0.3379	0.1038	2.0075
TRADE	70	4.3190	0.5700	3.0269	5.8731
IY	70	3.1373	0.1598	2.7061	3.5237
LL	69	3.9694	0.6250	2.6186	5.6151
READING	71	454.042	57.013	299.363	555.828
MATH	70	458.928	63.914	320.869	600.076
SCIENCE	71	462.730	57.200	325.788	574.617

Table 2: Correlations

	GY	GDP80	KH	GEDU	TRADE	IY	LL	READING	MATH	SCIENCE
GY	1.0000									
GDP80	-0.4390	1.0000								
KH	-0.2343	0.7100	1.0000							
GEDU	-0.4653	0.5360	0.4845	1.0000						
TRADE	0.2234	0.0314	0.1021	0.1931	1.0000					
IY	0.6015	-0.1946	-0.0656	-0.0895	0.2434	1.0000				
LL	0.3148	0.3130	0.3178	0.0803	0.4594	0.4352	1.0000			
READING	0.2762	0.5984	0.5387	0.2090	0.0643	0.3294	0.4659	1.0000		
MATH	0.3204	0.5503	0.5382	0.1665	0.1544	0.4013	0.5556	0.9713	1.0000	
SCIENCE	0.2939	0.5559	0.5443	0.1841	0.1066	0.3894	0.5491	0.9837	0.9866	1.0000

Notes: GY = economic growth; GDP80 = initial GDP; KH = human capital; GEDU = education expenditure (a percentage of GDP); TRADE = economic openness (a percentage of GDP); IY = investment (a percentage of GDP); LL = liquid liabilities (a percentage of GDP); READING = PISA international test score on reading; MATH = PISA international test score on mathematics; SCIENCE = PISA international test score on reading.

The descriptive statistics and the correlation matrix of all the variables are presented in Table 1 and 2. The results prove that the public education expenditure is negatively related to the economic growth which is similar to the finding of several studies (Sylwester, 2000 and 2002) where a larger government size overgrown by education expenditure leads to his use inefficiently but controversial to the theoretical literature that rather suggest a positive link (Glomm and Ravikumar, 1992). However, the quality of education is positively related to the economic perfor-

[6] This trade measure is preferred by many works both from a theoretical as well as an empirical point of view because it avoids a potential bias due to simultaneous changes of both the nominator (volume of exports and imports) and the denominator (total GDP) (Romer and Frankel, 1999; Noguer and Siscart, 2005; Feyrer, 2009 and Squalli and Wilson, 2011). See also Busse and Koniger (2012) for several measures of the openness trade.

[7] In our study, we use only the liquid liabilities as a proxy of the financial development, but the abundant literature on this topic use other banking sector development indicators such as private sector credit and the commercial bank assets.

mance but the entire scores test (READING, MATH and SCIENCE) are highly correlated between them for this reason they are introduced separately in the regression equation. The initial GDP corroborates the convergence hypothesis of Solow with a negative correlation with the economic growth. Human capital presents also a negative sign which confirms the finding of several empirical studies that suggest the evidence of the weakness of this relationship (Sala-i-Martin, 2002). The others determinants of growth (investment, commercial openness and financial development) elucidate the positive sign largely advanced by the theoretical literature.

3. EMPIRICAL RESULTS

Table 3 presents the results of estimating Equation 2 considering the three international PISA test scores and the average of performance as threshold variables. The P-Value calculated by the Bootstrap method with 2000 replications and 15% trimming percentage leads to evaluate the statistical significance of the threshold estimate. This P-value indicates that the test of the no-threshold effect is rejected which implies that the sample can be divided in two regimes. The countries under the threshold level present low educational quality while those with greater values are considered with high quality.

Table 3: Threshold estimate of the educational quality (PISA scores)

	MATH	SCIENCE	READING	QUALITY
LM test for no threshold	17.407	17.232	18.156	18.388
Bootstrap P-Value	0.006	0.0115	0.0065	0.0045
Threshold estimates	423.838	431.240	424.159	428.288
95% confidence interval	[397.4920; 484.4084]	[427.9366; 437.3219]	[420.4731; 424.1599]	[423.7588; 428.288]

Note: H_0 = no-threshold effect.

Table 4 is reserved to the estimated results with the average of performance where Table 5, 6 and 7[8] concern respectively sciences, reading and mathematics scores as quality of education threshold level. In these tables, we present the results of two models: the linear model (Equation 1) which consider the heterogeneous sample that integrates all the countries and the non linear model (Equation 2) where the threshold level of the education quality divide the sample on two homogenous groups of countries (regime 1 and regime 2).

The regression of the linear model without the threshold effect considering the OLS method implies that the coefficient of the public education expenditures as percentage of GDP (GEDU) is insignificant for the table 4, 5 and 6 and it becomes with negative sign and significant in the table 7. The result reveals the ambiguous sign of this variable as proved by many empirical studies mentioned above. However, when we consider the nonlinear model in order to study the effect of educational quality on the relationship between public education spending and economic growth, we obtain a negative and statistically significant link if the country presents a low quality of education and it becomes positive and significant above the educational quality threshold level (table 4, 5 and 6). This finding indicates that the educational quality can replicate nonlinear relationship between the public spending on education and economic growth which means that public expenditure on schooling enhances the economic performance only if the quality of education is high. According to this threshold level, it is remarkable that all the countries above

[8] See Appendix.

it are developed or emerged[9] where the level of human capital is important (9.42 years), the initial GDP per capita (22133$ in average) is relatively high which let them to invest in education (4.65 in percentage of the GDP) also their quality of education is extremely high (501.74 in average). In reality, all these countries present the favorable environment and factors that can stimulate their investment in education and generate a positive impact on their economic performance. Nevertheless, it is difficult for countries below the threshold level[10], characterized by low level of GDP (3086$) and human capital (7.42 years) in addition to the low level of education quality (400 in average), to stimulate growth while the large part of GDP addressed to education (4.1 percent of GDP) which is closed to the part of the developed countries (4.6 percent of GDP). For example, Tunisia and Moldova spend a lot for education which exceed largely the average expenditure of their category of countries (6.04 and 7.03 percent) but regarding their quality of education which is the lowest (380.5 and 399.4), this effort seems without a benefic effect on their economic growth (2.48 and -1.08 percent). In fact, this negative result on the economic growth can be explained by the inefficiency and non immediate productivity of this spending in the sense that a high investment of education will be realized in the detriment of the other investment (infrastructure, health, etc.) and also it needs a high taxation which can oust the private investment and affect it negatively (Blankenau et al., 2007). Moreover, the effectiveness of this investment is related to many others factors that can boost the growth such as the openness of the economy, the institutional quality, etc. or these developing countries are less performing which contrary inhibit their growth. This finding reveals the endogenous character of this relationship where the level of development can affect the intensity of the education quality impact on the links between the economic performance and the public spending on schooling.

For the initial GDP per capita (GDP80), the estimated coefficients in the linear model are negative and significant (Table 4, 5 and 7) which is consistent with theory and confirms the convergence hypothesis of Solow. However, considering the nonlinear model, this variable still with a negative sign and significant only for the group of countries above the threshold level (regime 2) (Table 4, 5, 6 and 7) which implies that the initial GDP presents a negative effect on the economic growth only for the developed countries. In fact, these countries are in general characterized by a high level of income per capita, high economic growth but also high performing economic indicators[11] which let them to grow faster than the developing countries.

[9] The list of countries above the threshold level of the quality: Australia; Austria; Belgium; Canada; China; Denmark; Finland; France; Germany; Greece; Hong Kong; Iceland; Ireland; Italy; Israel; Japan; Korea Rep.; Luxembourg; Malta; Netherlands; New Zealand; Norway; Portugal; Singapore; Spain; Sweden; Switzerland; Turkey; United Arab Emirates; United Kingdom; United States.

[10] The list of countries below the threshold level of the quality: Albania; Argentina; Brazil; Bulgaria; Chile; Colombia; Costa Rica; Indonesia; Jordan; Malaysia; Mauritius; Mexico; Moldova; Panama; Peru; Thailand; Trinidad and Tobago; Tunisia; Uruguay.

[11] Such as a developed financial sector (in our sample the average of the liquid liabilities for this category of countries during the period of study is about 88.93 percent and the private credit as percentage of GDP is about 83.72), high commercial openness (the average of the sum of export and import as percentage of GDP is about 90.55 percent), high investment (23.72 percent), high institutional quality (according to the data of Kaufman et al., the index of corruption is 1.49; government effectiveness is 1.48; political stability is 0.78; regulatory is 1.32; voice and accountability is 1.03 and rule and law is 1.36), etc. However, for the developing countries (regime 1) these indicators are less important and are respectively 49.14 percent and 39.29 percent for the liquid liabilities and the private credit, 77.45 percent for

This result is also confirmed by Dowrick and Nguyen (1989) and Mankiw et al. (1992)[12] who argue that there is no tendency for poor countries to increase their income more than rich countries and this negative relation between initial GDP and growth is only significant for OECD countries.

The use of the nonlinear model improves the result of the human capital (HK) compared to the linear model. This variable considered no significant in the global model becomes with a negative effect for the countries below the educational quality threshold level but it turns into a positive effect if the countries exceed this threshold level. In fact, developing countries with low quality of education present also low level of human capital and unless their financial effort in order to increase it they cannot beneficiate of his positive effect. This means that human capital with a weak quality cannot contribute positively to the economic growth. In addition, the production process in these countries does not require a high level of human capital which in general leads to his less employment or his mismatching. This finding joins the literature that present a mixed result of the relationship between human capital and growth (Mankiw et al., 1992; Islam, 1995; Sachs and Warner, 1997; Temple, 1999 and 2001 and Barro, 2001). Many of these studies attribute this ambiguity to the existence of a nonlinear link where the effect on growth is negative if the level of human capital is weak and it became positive at middle levels (Azariades and Drazen, 1990 and Kalaitzidakis et al., 2001).

The estimated coefficients of the investment as a percentage of GDP (IY) still with a positive sign and are statistically significant for the linear and the nonlinear model[13]. This result is in line with the theory that confirms the positive effect and the strong correlation between physical capital investment and economic performance independently of the level of development of each country (Barro, 1990; Sachs and Warner, 1995; Bosworth and Collins, 2003; Le and Suruga, 2005, etc.). However, the relationship between commercial openness (TRADE) and growth is no significant for the global model but it becomes positive and statistically significant in promoting growth whether below or above the educational quality threshold[14]. This finding is confirmed by the economic theory where trade is largely considered helpful for growth (Krugman, 1979). In fact, it is proved that countries with fewer trade restrictions experience faster growth than countries with heavily restrictions. In reality, the openness to trade leads to the possibility of an international product cycle, in the sense that the production of certain products previously generated by developed countries migrates to developing countries. This process of product migration contributes to increase the trade volumes of these less developed countries and to expand their available technology due to the diffusion of more production technologies. However, empirical studies do not predict a simple link between trade and growth which can explain the mixed results especially for cross-countries analysis (Rodríguez and Rodrik, 2001 and Rodríguez, 2007). The emerging consensus is that the effect of trade on growth is subject on various economic, social, institutional and political factors. Recently, many studies evoke the conditional relationship and test the existence of a threshold level (Foster, 2008 and Dufrenot et al., 2009). The financial development (LL) presents positive impact on growth for the linear model[15] but for the nonlinear model the coefficient

the economic openness, 22.21 percent for the investment and -0.01; 0.1; -0.16; 0.27; 0.15 and -0.03 for the institutional quality.

[12] Mankiw et al. (1992) found that there is no significant tendency toward convergence for no-oil and intermediate countries.

[13] Except for countries below the threshold of the mathematics scores.

[14] Except for reading scores threshold relative to regime 1.

[15] The coefficient is no significant for the mathematics scores (MATH).

remain positive and statistically significant only for countries that have exceeded the threshold level of the reading scores test. This result is in line with the finding of Deidda and Fattouh (2002) and Rioja and Valev (2004) who suggest that there is no significant relationship between financial development and growth in low-income countries and significant in high-income countries. In fact, it is clear that more financial development can boost economic growth (King and Levine, 1993a and 1993b; Rahaman, 2011; Kendall, 2012, etc.) but the existence evidence demonstrates that this relationship seems to be nonlinear.

Table 4: Threshold estimates of the average education quality (QUALITY)

	Linear Model	Threshold Model	
	OLS without threshold	Regime 1 QUALITY < 428.288	Regime 2 QUALITY > 428.288
GDP80	-0.844**	0.409	-1.672***
	(0.304)	(0.402)	(0.135)
KH	1.549	-2.473**	1.244
	(0.994)	(0.952)	(0.785)
GEDU	0.109	-2.955***	1.494***
	(0.891)	(0.673)	(0.316)
TRADE	-0.134	0.809**	0.512***
	(0.367)	(0.347)	(0.145)
IY	3.213**	2.819**	6.658***
	(1.241)	(1.304)	(0.963)
LL	0.833*	0.537	0.383
	(0.487)	(0.682)	(0.311)
R-sq.	0.5392	0.7150	0.9127
Heteroskedasticity test P-Value	0.1737	-	-
No. Observations	50	19	31

*Notes: standard errors in parentheses (White corrected for heteroskedasticity). ***, ** and * indicate respectively significance at 1%, 5% and 10%. All the variables are in Log.*

4. CONCLUSION

In this study, we examine the existence of a quality education threshold effect on the relationship between economic growth and public education expenditure by using a data from 50 countries covering the period 1980-2010 and the PISA test scores as a measure of the quality. The major contribution of this paper is to determine endogenously this threshold level considering the regression model of Hansen (2000). The empirical results indicate that there is a significant education quality threshold. In fact, countries below this threshold level find that their effort in education investment did not boost growth contrary to countries above it. These findings imply that expenditure on education promotes growth after education quality exceeds a certain threshold level. This result is robust for all the measures of the PISA international test scores (reading, mathematics and science) and for their average considering as a measure of the performance at whole.

The results of this paper suggest that the quality of education is also as important as the quantity of education and it matters for economic development. In fact, to invest a lot on education in a country where the quality of education is low tends to distort the capability of this investment in generating benefits in terms of economic performance. For these reasons, policy makers should improve the level of education quality specifically in developing countries where it is relatively low in order to explore the benefits of education expenditures in promoting economic growth. Otherwise their effort seems to be without any positive result.

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APPENDIX

List of 50 countries

Albania; Argentina; Australia; Austria; Belgium; Brazil; Bulgaria; Canada; Chile; China; Colombia; Costa Rica; Denmark; Finland; France; Germany; Greece; Hong Kong; Iceland; Indonesia; Ireland; Italy; Israel; Japan; Jordan; Korea Rep.; Luxembourg; Malaysia; Malta; Mauritius; Mexico; Moldova; Netherlands; New Zealand; Norway; Panama; Peru; Portugal; Singapore; Spain; Sweden; Switzerland; Thailand; Trinidad and Tobago; Tunisia; Turkey; United Arab Emirates; United Kingdom; United States; Uruguay.

Table 5: Threshold estimates of education quality (SCIENCE)

	Linear Model	Threshold Model	
	OLS without threshold	Regime 1 SCIENCE < 431.240	Regime 2 SCIENCE > 431.240
GDP80	-0.844**	0.490	-1.440***
	(0.304)	(0.304)	(0.185)
KH	1.549	-3.547***	0.537**
	(0.994)	(0.659)	(0.983)
GEDU	0.109	-2.727***	1.639***
	(0.891)	(0.479)	(0.390)
TRADE	-0.143	0.765**	0.387***
	(0.367)	(0.336)	(0.178)
IY	3.213**	2.599**	3.654***
	(1.241)	(0.963)	(1.116)
LL	0.833*	0.683	0.551
	(0.487)	(0.606)	(0.332)
R-sq.	0.5392	0.8382	0.8678
Heteroskedasticity test P-Value	0.4178	-	-
No. Observations	50	17	33

*Notes: standard errors in parentheses (White corrected for heteroskedasticity). ***, ** and * indicate respectively significance at 1%, 5% and 10%. All the variables are in Log.*

Table 6: Threshold estimates of education quality (READING)

	Linear Model	Threshold Model	
	OLS without threshold	Regime 1 READING < 424.159	Regime 2 READING > 424.159
GDP80	-0.844**	0.260	-1.526***
	(0.304)	(0.287)	(0.137)
KH	1.549	-2.697*	1.359*
	(0.994)	(0.816)	(0.798)
GEDU	0.109	-2.634***	1.418***
	(0.891)	(0.521)	(0.348)
TRADE	-0.134	0.526	0.412**
	(0.367)	(0.348)	(0.166)
IY	3.213**	2.124**	3.566***
	(1.241)	(0.997)	(1.037)
LL	0.833*	1.011	0.584***
	(0.487)	(0.657)	(0.320)
R-sq.	0.5392	0.8059	0.883
Heteroskedasticity test P-Value	0.3696	-	-
No. Observations	50	17	33

Notes: standard errors in parentheses (White corrected for heteroskedasticity).***, ** and * indicate respectively significance at 1%, 5% and 10%. All the variables are in Log.

Table 7: Threshold estimates of education quality (MATH)

	Linear Model	Threshold Model	
	OLS without thresh-old	Regime 1 MATH < 423.838	Regime 2 MATH > 423.838
GDP80	-0.353	0.317	-1.432***
	(0.268)	(0.390)	(0.164)
KH	0.762	-2.469**	1.401**
	(0.865)	(0.886)	(0.669)
GEDU	-1.633***	-3.084***	0.585
	(0.711)	(0.666)	(0.462)
TRADE	0.246	0.720*	0.566***
	(0.249)	(0.388)	(0.134)
IY	3.693***	1.639	2.77***
	(0.991)	(1.825)	(0.629)
LL	0.427	0.893	0.219
	(0.368)	(0.834)	(0.274)
R-sq.	0.6015	0.7231	0.8905
Heteroskedasticity test P-Value	0.3221	-	-
No. Observations	49	18	31

*Notes: standard errors in parentheses (White corrected for heteroskedasticity).***, ** and * indicate respectively significance at 1%, 5% and 10%. All the variables are in Log.*

Dépenses publiques en éducation et croissance économique : l'effet de seuil de la qualité éducative

Résumé **-** En utilisant le modèle à effet de seuil de Hansen (1996 and 2000), cet article analyse comment l'effet sur la croissance économique des dépenses publiques en éducation diffère en fonction du niveau de la qualité éducative des pays. Les résultats montrent l'existence d'un effet de seuil. Plus précisément, les dépenses éducatives présentent un effet positif sur la croissance si la qualité d'éducation est relativement élevée, dans le cas inverse l'effet est négatif. Ce résultat paraît robuste quels que soient les scores des tests internationaux PISA utilisés, de même qu'en considérant leur moyenne, prise comme une mesure de la performance globale de la force de travail.

Mots-clés

Dépenses éducatives
Qualité de l'éducation
Croissance économique
Effet de seuil