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Efficiency of public spending on primary education in developing countries: the case of resource-rich countries[1]

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Abstract

This paper examines the effect of natural resource endowment on the efficiency of public spending on primary education in resource-rich developing countries. The order-m non-parametric technique is used for this purpose on a sample of 138 developing countries covering the period 1995-2018. The results reveal that the endowment of natural resources and the low efficiency of a State reduce the efficiency of public spending on primary education.

Keywords: Education, public spending on primary education, fragility, efficiency, natural resources, non-parametric approach, resource-rich countries.

JEL Code: C14, H52, L70, O11

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1. Introduction

The rise in commodity prices since the early 2000s has reopened the debate on the performance of public spending in resource-rich developing countries (DCs). These countries, although they have considerable income from the exploitation of their natural resources, are at low levels of development compared to countries that do not. The situation is even more alarming in the education sector. Thus, in sub-Saharan Africa, despite the increase in income from natural resource exploitation, these countries continue to have high adult illiteracy rates and low enrolment and completion rates (Africa Progress Panel, 2013). This inverse link between the allocation of natural resources and this indicator of the performance of the education system is reviving the debate on the efficiency of public expenditure in developing countries, which has been the subject of intense work in recent years (Herrera and Ouedraogo 2018, Azar-Dufrechou 2018, Yogo 2015). Moreover, this work shows that education spending is not a priority in resource-rich countries. Cocx and Francken (2016) were among the last to study this theme and confirm this inverse link between the endowment of natural resources and public spending on education.

The contribution of this paper to the literature is twofold. Firstly, it improves the state of knowledge on the efficiency of public spending on education in primary education in developing countries by highlighting the impact of natural resource endowment. Secondly, this paper focuses on the use of the *order-m* non-parametric approach, which corrects the shortcomings inherent in non-parametric approaches such as the data development approach (DEA).

Emphasis is placed on the education sector because its importance in strengthening human capital has been proven in numerous studies. Barro (2001), Barro and Lee (1994), Cohen and Soto (2007), Hanushek and Woessmann (2007), Seetanah (2009) have shown at various levels that education is a vector of human capital which in turn is a major determinant of economic growth. In addition, there is a growing consensus on the importance of human capital formation for sustainable economic growth (Bassanini and Scarpetta, 2002).

This explains the increase in public spending on education in sub-Saharan Africa where governments spent an average of 16.9% of their total public spending on education compared to 11.8% in Europe and North America and 14.1% globally (AFD, 2018). Sub-Saharan Africa is thus one of the regions of the world where governments spend the largest share of their budget on their education system. This expenditure has even increased since 1999, when it averaged 14.8%. This priority to education is, however, less evident in resource-rich countries.

The paper is divided into five sections. The literature on the resource curse and the efficiency of public spending on education is discussed in section two. The methodological approach, data and empirical strategy are described in section three. The analysis of the results and their robustness are presented in section four while the last section discusses the main conclusions.

2. Literature review on the resource curse and efficiency of public spending on education

The extensive literature on the natural resource curse that followed the articles by Sachs and Warner (1995, 1997, 2001) focused on confirming or denying a negative relationship between the presence of natural resources and growth. As a result, the general idea that the abundance of natural resources is detrimental to economic and social development is inconclusive (Torvik, 2009) because it can have "winners" and "losers". Indeed, the curse and the blessing coexist in some cases and are distributed across social classes (Obeng-Odoom, 2013). Nigeria, a major oil exporter in Africa, is a typical example of the resource curse[3] (Sala-i-Martin & Subramanian, 2003). But countries such as Botswana, Equatorial Guinea[4] and others outside Africa such as Norway, Malaysia, Indonesia and Chile are examples of the blessing (Obeng-Odoom, 2013; Frankel, 2012; Gelb and Grasmann, 2010).

Following these debates, several other works by the authors (Frankel, 2012; Vander Ploeg 2011; Badeeb et al. 2017) show that the results can vary according to the quality of governance, the existence of a Dutch disease, the instability of prices or even according to the variables used to measure resource wealth or observation periods (Brunnsweiler and Bulte 2009; Gerelmaa, 2016). Some meta-analyses (Havranek, 2016) show above all the impossibility of definitively settling these debates. Indeed, out of 605 estimates made in 43 studies, the author notes negative links in 40%, no link in 40% and a positive effect in 20% of the studies conducted. Education is one of the most important vectors of long-term development and it is therefore expected that a resource-rich country will choose to devote a significant part of its resources to this sector. Moreover, in the context of low development sustainability (where different forms of capital are considered to be substitutable) Hartwick (1977) shows that to ensure a stable standard of living over time, non-renewable natural capital would need to be replaced by technical (industrial) or human capital. The latter is fundamental in any development process as discussed above. Even if current well-being can be improved through the financial flows generated by the exploitation of natural resources, the question of maintaining the current standard of living over time often remains and refers to the management of these wealth flows. For this reason, Hartwick (1977) states that maximizing welfare and maintaining it over time requires efficient conversion of oil revenues into reproducible capital (physical and human capital).

Since 2006, the World Bank has been publishing assessments of country wealth based on a wealth

[3] Nigeria's long-term economic performance has been poor due to wasted resources and corruption. GDP per capita was US$245 in 1965 and remained at US$245 35 years later.

[4] Equatorial Guinea is perhaps an example of a blessing of resources in Central Africa. The country's economic performance has improved. The average GDP growth rate over the period 1995-2013 is about 20 per cent (WDI, 2014). In addition, gross national income per capita (GNI) is the highest in the CEMAC space (US$ 14320 in 2013). But as Gelb and Grasmann remind it: “Equatorial Guinea has been cited as an extreme case where oil rents sustain a pathology of authoritarian rule, instability and underdevelopment, from which it is difficult to exit.” (Gelb and Grasmann (2010:18).

approach (World Bank, 2006, 2011; Lange et al. 2018)[5]. Human capital is considered as one of the components of the wealth of countries, which increases with the level of development of the countries[6]. Among the countries rich in extractive resources, those that are doing best are those that have managed to invest in other assets, such as Botswana and Chile. In Africa, for example, Ghana, which has invested in human capital, is doing better than Niger (Lange et al. 2018).

However, it is clear that human capital is rarely a priority in resource-rich countries; we shall also see that little work has been done specifically on the efficiency of education spending in these countries.

The link between the level of human capital and the presence of natural resources is subject to debate. Thus, the conclusions of Gylfasson (2001) and Birdsall et al (2001) which showed a negative link between human capital and the presence of natural resources are contested by Stijns (2006, 2009) due to the choice of inappropriate variables to account for natural resource wealth (because they include too disparate resources such as agricultural, forestry or mining resources). Yet, among recent studies, Cockx and Francken (2016) show that resource-dependent countries have lower education expenditure as a percentage of GDP. The fact that public revenues depend less on taxes paid by households than on those from the resource would reduce the sense of accountability of governments towards their populations. This weak state accountability in turn leads to changes in the level and structure of public expenditure. Indeed, more responsible regimes are associated with more public goods and greater well-being (Persson and Tabellini, 2004). Delavallade (2006), for her part, has highlighted that "the lack of freedom", which makes it possible to assess the low level of state responsibility, diverts public spending from the social sectors to sectors that generate high levels of income.

Countries in conflict also spend less on the education sector. However, some conflicts are linked to the presence of natural resources[7]. According to the World Bank (2001), conflicts linked mainly to political instability have been one of the main factors explaining the decline in growth in African countries since the 1970s. These conflicts have weakened institutions and discouraged investments of all kinds. Stijns (2006) found a positive relationship between resource abundance and human capital, although political instability and violence tend to reduce this effect. For oil-producing countries over the period 1970-2004, Behbudi et al. (2010) find an inverse relationship between resource abundance and public spending on the one hand and economic growth on the other and conclude that human capital is the main factor explaining the low growth of these countries.

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[5] Of the 52 countries classified as low-income countries by the World Bank in 1995, 28 have become middle-income countries by 2014, and 15 of these were considered resource-rich and have managed to diversify their assets (Lange et al. 2018: 52).

[6] It is estimated based on the expected income of the population (Lange et al 2018, chapter 6).

[7] Of the 12 low-income countries identified as resource-rich between 1995 and 2014 by the World Bank, eight are also fragile or conflict-affected states (2018: 55).

Much work has been done on the efficiency of spending on health or education through data availability, but unlike the work in this article, little of this work is specific to resource-rich countries.

Gupta and Verhoeven (2001) use the Free Disposal Hull (FDH) technique to estimate the efficiency of education and health expenditures and conclude that African countries are less efficient than Asian and Western countries but that the productivity of expenditures is improving in African countries: Increased spending on health and education improves outcomes, but too much spending goes hand in hand with higher levels of inefficiency. These authors argue that efficiency should be improved before increasing spending. This result is consistent with Hauner and Kyobe (2010) whose sample includes 114 countries at all levels of development between 1980 and 2004. On the basis of a sample of 140 developing countries, Herrera and Pang (2005) estimated the efficiency of public expenditure on education using public expenditure as input and gross primary school enrolment and completion rates as output indicators. As in Gupta and Verhoeven (2001), they assessed the impact of the level of development on the efficiency of education expenditure by dividing the sample in two according to the level of GDP per capita. They found that the countries with the highest levels of public spending are in the least efficient groups. This may be explained by higher costs in the more developed countries compared to the developing country[8]. They also point out that the oil countries in the sample (Kuwait, Saudi Arabia) are among the least efficient. Moreover, they identified urbanization as a factor associated with high efficiency, while the level of public expenditure, the payroll as a percentage of total[9] expenditure and income inequality are negatively correlated with efficiency. Following the example of Gupta and Verhoeven (2001) and Herrera and Pang (2005), Grigoli (2014) considers that education spending is inefficient in many emerging and developing countries, particularly in Africa. This inefficiency would be due to the high rate of pupils per class and the percentage of the population in the rural sector. More recently, Yogo (2015) has highlighted the link between public spending in the health, education and infrastructure sectors and ethnic heterogeneity in 77 developing countries over the period 1996-2012. Two major conclusions emerge from his study: 12% of the countries in the sample can be considered efficient in the use of their public expenditure and ethnic diversity is positively correlated with high efficiency. As regards the education sector more specifically, African countries are among the least efficient. De Oliveira and Dieng (2016) used the order-m non-parametric method proposed by Cazals, Florenz and Simar (2002) to measure the efficiency of 2,522 schools in 12 Southern and Eastern African countries. Their work shows that inspections, as well as the location of schools in urban areas and the proximity of schools to pupils' homes, play an important and positive role in efficiency.

[8] Afonso et al (2005) point out that, even among developed countries, those with a lower weight of public expenditure in GDP have better efficiency scores. But this result does not specifically address the social sectors.

[9] This result may provide clues for understanding the low efficiency of public spending in a country such as Chad, whose operating expenses have increased significantly since the start of oil exploitation (Gab Leyba 2015).

In summary, the relationship between the abundance of natural resources and the level of human capital may not be completely clear-cut, although recent publications tend to confirm that the presence of natural resources reduces the sense of accountability of governments in developing countries. Most of the work on the efficiency of public expenditure in developing countries, particularly in the education sector, points to lower efficiency in African countries where the number of "fragile countries" is particularly high. The issue of governance and the quality of institutions, often presented as causes of the resource curse, are often among the factors explaining efficiency (Hauner, 2008, Grigoli 2014, Hauner and Kyobe, 2014).

The article by Hauner (2008) is interesting because it concerns an oil country. He uses public sector efficiency indicators and the DEA approach to compare Russia's efficiency scores with other countries and local governments' efficiency scores with each other. The results suggest that on average regions could achieve the same results using 64% of what they currently spend. A specific variable taking into account the share of the region's GDP coming from the oil sector does not show a lower efficiency of health and education spending. On the contrary, the richer regions seem to cope better with the problems of inequality and poverty.

3. Methodological approach

The first step is to calculate the efficiency of public spending on primary education. In a second step, regressions will make it possible to determine the variables and thus the socio-economic and political conditions that may have led to variations in the efficiency trajectory.

3.1 Measuring the efficiency of public spending

Two methods are mainly used in the literature to assess the efficiency of public spending. We have parametric methods, which are distinguished from non-parametric methods. These two methods differ mainly in the assumptions imposed by the data. Thus, there is a difference in terms of modelling, which will depend on the functional form of the method used. Secondly, they differ in terms of whether or not random errors are taken into account. Finally, these two methods differ in terms of taking into account random error and probability distribution.

The parametric Stochastic Frontier Approach (SFA) was developed independently by Aigner et al (1977) and Meeusen et al (1977). This approach decomposes the error term into two components: one part representing random effects beyond the control of the decision unit and the other part being a non-negative term that measures inefficiency. The functional form is usually a cost or profit function and incorporates a production relationship between inputs, outputs and environmental factors. It is also assumed that inefficiency observations as well as errors are orthogonal to inputs, outputs and environmental variables, i.e. there is independence between these variables and the error term.

Among the non-parametric methods, the Data Envelopment Analysis (DEA) initially developed by Charnes, Cooper and Rhodes (1978) is the most widely used. The latter introduced the model to measure the efficiency of Decision Making Units (DMUs) at constant returns to scale (CRS) where they operate at their optimal scale. Later, Banker, Charnes and Cooper (1984) introduced the variable returns to scale (VRS) model. The popularity of the DEA technique is explained by its qualities. Indeed, unlike parametric methods, non-parametric methods allow the simultaneous integration of multiple outputs and do not require assumptions about the functional form and production frontier. Despite these advantages, the DEA technique has several weaknesses that weaken the results obtained. It is sensitive to outliers and makes their detection and elimination from the sample studied indispensable, since the presence of highly efficient outliers could shift the production frontier and lead to an underestimation of public spending (Table 1).

The FDH method is a variant of the DEA technique. Both methods do not allow efficiency to vary over time. One of the main assumptions of these two non-parametric methods is the absence of random errors. Three implications can be identified for this assumption. First, it assumes that there is no measurement error in the construction of the boundary. Second, there would be no randomness that would allow a unit to have a better measure of efficiency in a specific year. Finally, it would imply that there are no inaccuracies associated with the use of the data. However, the use of this type of data leads to a deviation in the measurement of inputs and outputs. Consequently, the presence of errors for a single unit on the boundary may bias the efficiency measure for all the DMUs that are compared to that unit or the linear combinations that include that unit.

Table 1: Comparison of DEA and SFA methods

Data Envelopment Analysis	**Stochastic Frontier of Production**
Non-parametric method	Parametric method
Mathematical programming to determine the production boundary	Maximum likelihood estimation method
It is not necessary to specify a functional form	The functional form must be specified
Does not distinguish "white noise" which is considered part of efficiency	Distinguishes between noise and efficiency
Allows the association of many dependent and explanatory variables; the boundary is determined with respect to the extreme variables.	Multiple explanatory variables for one dependent variable

Source: Scippacercola and Ambra (2014)

On the basis of these weaknesses inherent in the DEA approach, Cazals et al (2002) and subsequently (Felder and Tauchmann (2013) developed the order-m method. This method is relatively more robust to outliers and sampling problems than the DEA or FDH methods. It also has the particularity of not integrating all observations so that the production frontier is not distorted by a few outliers. According to Daraio and Simar (2007), this implies that the efficiency of an observation may be higher than that of the reference group, and in this case its efficiency score will be higher than unity. Finally, it should be noted that this method makes it possible to distinguish between super-efficient (score greater than one), efficient (score equal to one) and non-efficient (score less than one) DMUs.

3.2. Presentation of the selected efficiency estimation model

The "order-m" production frontier estimation method proposed by Cazals et al. (2002) defines, for a certain level of inputs X, the maximum expected production level Y among a fixed number "m" of observations using a quantity of inputs less than X. Thus, formally, the estimator is written as follows:

$$\wp(\mathrm{m})^{\mathrm{x}} = \mathrm{E}\lfloor \max(\mathrm{y}^1, \dots, \mathrm{y}^{\mathrm{m}} \rfloor \mathrm{X} \leq \mathrm{x} \qquad (1)$$

$$\int_0^\infty \left\lfloor 1 - fF_C(\frac{x}{y})^m \right\rfloor \mathrm{dy} \qquad (2)$$

This maximum expected output function represents the maximum expected output within a fixed number of "m" observations, which use fewer X inputs. The estimator is therefore given by the following equation :

$$\wp(m)^x = \int_0^\infty \left\lfloor 1 - fF_C(\frac{x}{y})^m \right\rfloor \mathrm{dy} \qquad (3)$$

where F is the empirical distribution function.

3.3. Determinants of the efficiency score

The efficiency scores calculated in the first step are regressed to identify the impact of so-called "non-discretionary" or environmental variables that are not directly under the control of governments as input variables are. The impact of these variables is captured through a panel data regression model with the following general specification:

$$\hat{\delta}_{\mathrm{jt}} = \alpha + \mathrm{Z}_{\mathrm{jt}}\beta + \varepsilon_{\mathrm{jt}} \qquad (4)$$

where δ_{jt} is the efficiency score of the country (j) in year t, α is a constant, β is a vector of parameters evaluating the influence of non-discretionary variables or explanatory variables (Z_{jt}) on efficiency and $\varepsilon_{\mathrm{jt}}$is statistical noise.

The use of truncation models builds on the work of Simar and Wilson (2007), who show that the Tobit estimators that have been used to date are biased by the existence of a serial correlation of the error term and a potential correlation between Z variables and the error term. This results from the fact that the explanatory and non-discretionary variables can be correlated with the inputs and outputs selected in the first step. This can lead to the invalidation of standard approaches to inference. This is why, in order to obtain unbiased β coefficients and valid confidence intervals, we use the double boostrap procedure recommended by Simar and Wilson (2007) for our estimates.

3.4 Presentation of data

The calculation of the efficiency scores is based on a panel of 138 countries including Low Income Countries (LICs), Lower Middle Income Countries (LMICs) and Upper Middle Income Countries (UMICs). The data cover the period from 1995 to 2017, i.e. 22 years.[10]The data used in this paper come from the *World* Bank's World *Development Indicator* (WDI) database and the *Center for Systemic Peace'*s State Fragility Index Matrix.

Determining the efficiency of a decision-making unit consists of maximizing its level of production from a given set of inputs (Farrell, 1957). From this perspective, the net primary school enrolment rate (*prim_enr_rate)* and the primary completion rate (*prim_comp_rate*) are used as output variables. Despite the finding that recent papers tend to use Barro and Lee's years of schooling (Azar-Dufrechou, 2016 and Yogo, 2015), we choose these variables because on the one hand the data is relatively better informed for the LICs that make up the majority of our sample and on the other hand the primary completion rate is one of the indicators for measuring progress towards UN SDG 4.

The net enrolment ratio is the ratio of children of official school age enrolled in school to the population of the corresponding official school age, while the primary completion rate measures the performance of the primary cycle. Indeed, the latter output, by omitting repeaters, contributes to evaluating the quality of education in this cycle[11].
Public expenditure on primary education as a percentage of GDP (*Pub_exp_prim_educ_gdp)* and as a percentage of total public expenditure (*Pub_exp_prim_educ_tot_exp)* are the two input variables used in this paper. Yogo (2015) and Azar-Dufrechou (2016) used public education expenditure as a percentage of GDP to estimate the effort made by the States in their education sectors.

The choice of the variable public expenditure on primary education as a percentage of total public expenditure makes it possible to assess the effort made by governments in the education sector and this relative to other priorities in developing countries. Despite the generally accepted idea that developing countries do not finance their education systems sufficiently, recent results show that, expressed as a percentage of total public expenditure, it is relatively high in sub-Saharan Africa compared to other regions of the world. Thus, for the year 2015, they are 16.9% as against 11.8% in Europe and North

[10] We limited our sample to the period 1995-2016 based on the availability of data for the *State Fragility Index* (SFI) variable available only for the period 1995-2016. Annexes 1 and 4 present respectively the variables used in the first and second stage and the list of countries in our sample.
[11] In the primary cycle, the basic skills taught to children are reading, writing, mathematics and a basic understanding of subjects such as history, geography, natural sciences, social sciences, art and music.

America, and 14.1% at the world level (AFD, 2018). This is in line with the commitments made by these States within the framework of the *Education for All* initiative where these countries had decided to devote 15 to 20% of their national budgets to the education sector (UNESCO, 2015). Summary statistics of the variables used in the first stage are given in Table 2 below.

Table 2: Variables used in the first step

Variable	Comments	Average	Standard deviation	Minimum	Maximum
Prim_enr_rate	1793	84.67	15.33	21.95	100.00
prim_comp_rate	1919	82.21	22.71	13.45	134.54
Pub_exp_prim_educ_tot_exp	978	40.89	12.02	0.71	98.67
Pub_exp_prim_educ_gdp	919	13.89	7.64	0.26	65.10

Source: WDI of the World Bank

In order to explain the efficiency scores determined in the first step, eight variables were identified. Among these, two make it possible to assess the effect of rent on the efficiency of public spending on education. These are the rent from the extraction of natural resources as a percentage of GDP and exports of manufactured goods as a percentage of GDP.

The rent in relation to GDP makes it possible to assess the effect of the exploitation of natural resources[12] on public spending in the education sector (Cockx and Francken, 2016; World Bank, 2011 and Gylfason, 2001). The ultimate objective is to evaluate the efficiency of this category of expenditure in countries with high rents. The estimation of this variable is based on the work of Lange et al (2018). A positive sign of the coefficients would indicate that the importance of the rent goes hand in hand with a lower efficiency of education spending in the primary sector.

Among the factors explaining the decline in economic growth, one of the manifestations of Dutch disease is the reduction of the manufacturing sector in the economy relative to the service sector (Gerelmaa and Kotani, 2001; Sachs and Warner, 2001). For this reason, in this paper we use exports of manufactured goods as a percentage of total exports to test for the presence of Dutch disease and in particular the impact of the presence of natural resources on export competitiveness.

The quality of governance, a determining factor in resource-rich countries, is assessed through the two components of the State Fragility Index from the *Center for Systemic Peace* database. These are effectiveness and legitimacy,[13] which are themselves subdivided into four components (political, economic and social security)[14]. The choice of this indicator is motivated by the fact that “A country’s

[12] The natural resources concerned are mainly oil, natural gas, minerals and forests.
[13] The earliest year for this index is 1995.
[14] The *State Fragility Index* (SFI) is calculated for 167 countries in the world with more than 500,000 inhabitants in 2016.

fragility is closely associated with its state capacity to manage conflict, make and implement public policy, and deliver essential services, and its systemic resilience in maintaining system coherence, cohesion, and quality of life, responding effectively to challenges and crises, and sustaining progressive development." (Marshall and Elsinga-Marshall, 2017:51). The maximum value is set at 13 points for the "effectiveness" sub-index, while the maximum value for the "legitimacy" variable is set at 12 points. Positive coefficients of the efficiency and legitimacy coefficients mean that they contribute to the inefficiency of public spending on primary education[15].

Two variables are used to assess the effect of population structure on changes in efficiency scores. The urban population expressed as a percentage of the total population (Yogo, 2015 and Azar-Dufrechou, 2016) and the population under 15 as a percentage of the total population (Azar-Dufrechou, 2016). Urbanization is expected to improve the efficiency of public spending on primary education because of the population density in urban areas where the number of children per class may be higher than in rural areas (Hauner and Kyobe 2010; Herrera and Pang 2005). In the latter, housing is more dispersed and therefore access to school is more difficult. A significant proportion of young people can be expected to reduce efficiency as public spending would have to be higher to achieve the same level of output (Hauner and Kyobe 2010).

Government expenditure as a percentage of GDP is used to assess the size of governments. These data come from the national accounts compiled by the IMF and the OECD. It is expected that a high level of public expenditure relative to a country's GDP should have a negative impact on the efficiency of public spending on education (Afonso et al., 2010).

GDP per capita and the economic growth rate are used to assess the impacts of the level of development of the country and the size of public expenditure, respectively. For Hauner and Kyobe (2010), the effect of per capita income can go in both directions: on the one hand, education costs may be higher in high-income countries and thus have a negative effect on efficiency; on the other hand, a high level of income often coincides with good health and education outcomes (Afonso et al., 2010). The literature shows that a high level of public spending is rather associated with lower efficiency in public spending on education (Gupta and Verhoeven 2001). Azar-Dufrechou (2016) emphasizes the volatility of the GDP growth rate. Indeed, it goes hand in hand with a pro-cyclical policy frequently observed in resource-rich countries. The author has shown that high volatility reduces the efficiency of education spending and that the level of development tends to improve the efficiency of education spending while high volatility calculated from the GDP growth rate reduces it.

[15] In the 2017 report ranking countries for the year 2016, the three most fragile countries are the Democratic Republic of Congo (first with 24 points), the Central African Republic (second with 23) and Southern Sudan (third with 22 points) while the most stable countries are the United Kingdom (first), Taiwan (second) and Sweden (third) with zero scores.

Table 3: Variables used in the second stage

Variable	Comments	Average	Standard deviation	Minimum	Maximum
model_9	680	0.46	0.55	0.14	13.68
Rent	3025	8.95	12.08	-	86.45
l_eff	2741	1.67	0.65	-	2.56
l_legit	2684	1.66	0.56	-	2.48
Pub_exp	1495	21.87	9.47	0.00	84.97
Pop_under_15	3161	35.22	9.19	13.41	50.46
Urb_pop	3281	47.20	20.47	7.21	100.00
Exp_man	234	36.65	29.28	0.00	373.23
log_GDP	314	23.33	2.18	16.97	30.01

Source: WDI, World Bank

3.5 Empirical strategy

On the basis of the methodological approach presented above, we adopt a strategy that consists in first calculating the efficiency of public spending on primary education. In the first step, efficiency scores are calculated from the input and output variables. In total, four models are estimated. The value of *m* has been set at 90 which corresponds roughly to the value of the formula $m= N^{(2/3)}$ which represents the ceiling as specified by Simar and Wilson (2007) and Tauchmann, (2012). N represents the total number of observations.

In the second stage, the scores of the non-efficient DMUs from the first stage are regressed on socio-economic and political variables (Table 3). They make it possible to check whether socio-economic and political conditions may have led to variations in the efficiency trajectory. The basic model used then takes the following form :

$$\hat{\delta}_{jt} = \alpha + \beta_1 \mathrm{Rent}_{jt} + \beta_2 \mathrm{Log\_Effic}_{jt} + \beta_3 \mathrm{Log8egit}_{jt} + \beta_4 \mathrm{Log\_GDPhabts.}_{jt} + \prod \mathrm{Z}_{jt} + \varepsilon_{jt}$$
(5)

Where δ_{jt} represents the efficiency score of the country (j) in year (t), Rent_{jt} is the natural resource rent expressed as a percentage of GDP, Effic_{jt}, the sub-index of State effectiveness, which measures the capacity to implement public policies, Legit_{jt} allows us to understand the fragility of states, Log $(\mathrm{PIB}_{habts})_{jt}$ the logarithm of GDP per capita expressed in constant 2005 dollars, Z_{jt}, a set of variables that allows to affect the variation of the efficiency score (*Pop_under_, Urb_pop, exp_man,…)* and finally ε_{jt} the term error. This equation is first estimated for all four efficiency scores.

In order to test the robustness of our results, we estimate equation (6) derived from equation (5) which takes the following form:

$$\hat{\delta}_{jt} = \alpha + \beta_1 \mathrm{Rent}_{jt} + \beta_2 \mathrm{Log\_Effic}_{jt} + \beta_3 \mathrm{Log\_\ Legit}_{jt} + \beta_4 \mathrm{Log\_PIB\ habts.}_{jt} + \prod Z_{jt} + \mathrm{LICs}_j + \mathrm{LMICs}_j + \mathrm{UMICs}_j + \varepsilon_{jt} \qquad (6)$$

where $\mathrm{LIC_j}$ is a dichotomous variable designed to capture any possible variation in the score due to a characteristic specific to countries with a given income level. It is equal to 1 for LICs and 0 otherwise. The same applies to the other two dichotomous variables. $\mathrm{LMICs_j}$ and $+\mathrm{UMICs_j}$.

Finally, equation (7) is estimated to capture any variation in the efficiency score resulting from a specific regional characteristic. It takes the following form:

$$\hat{\delta}_{jt} = \alpha + \beta_1 \mathrm{Rent}_{jt} + \beta_2 \mathrm{Effic}_{jt} + \beta_3 \mathrm{Legit}_{jt} + \beta_4 \mathrm{Log(GDP\ per\ capita.}_{jt}) + \prod Z_{jt} + \mathrm{SSA_J} + \mathrm{MENA_J} + \mathrm{SA_J} + \mathrm{ECA_J} + \mathrm{EAP_J} + \mathrm{LAC_J} + \varepsilon_{jt} \qquad (7)$$

where $\mathrm{SSA_J}$ is equal to 1 for sub-Saharan African countries and 0 otherwise. The same principle is used for the other variables[16].

4. Analysis and robustness of results

4.1 Analysis of efficiency scores

Comparison of the input and output variables reveals important results across regions and countries classified by income level. Figure 1 shows a positive correlation between the primary completion rate and the income level as measured by GDP per capita. Despite the presence of some outliers, countries with high per capita incomes tend to have relatively high completion rates. Public spending on education tends to be lower in countries with natural resource endowments (Figure 2). This is consistent with the findings of Cockx and Franken (2016).

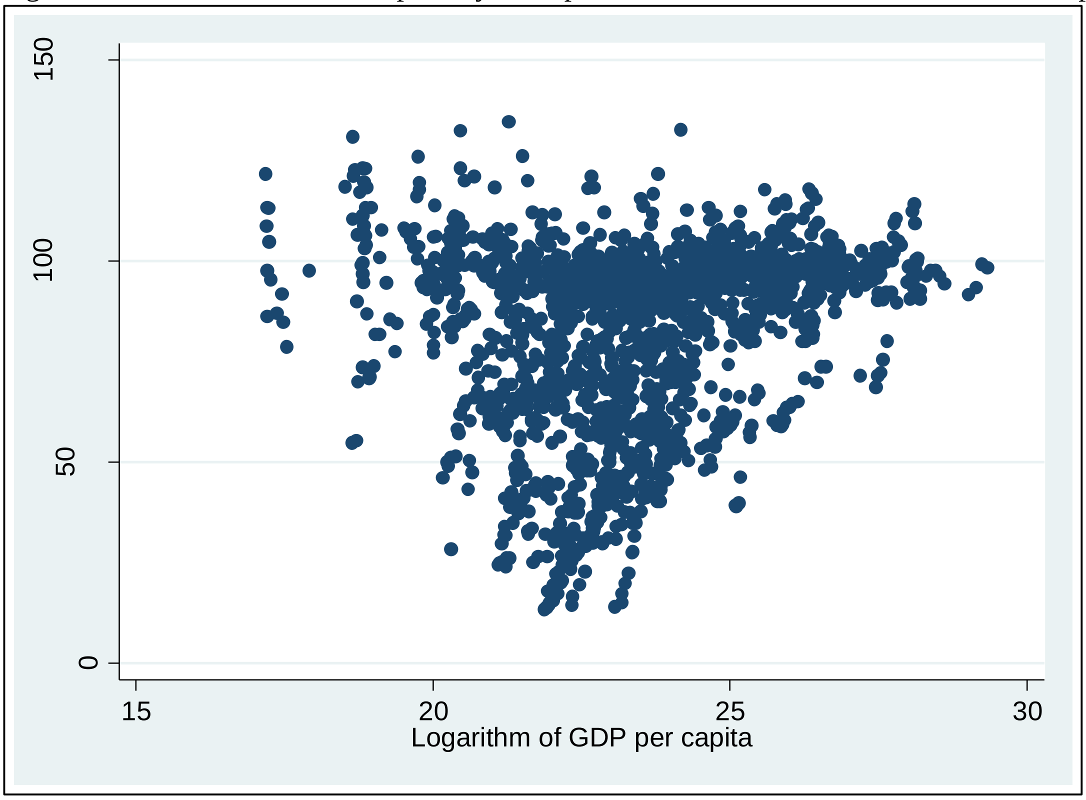
There is also an inverse relationship between the efficiency score and public spending on primary education as a percentage of GDP per capita (Figure 3). The results show that countries that tend to allocate a relatively large share of their budgets to education sectors are less efficient than countries that allocate a relatively small share (Herrera and Pang, 2005; Gupta and Verhoeven, 2001). In particular, Gupta and Verhoeven (2001) attribute this result to the fact that increasing educational attainment and health indicators requires improving efficiency more than increasing budget allocations.

The efficiency discussed in this paper results from the comparison of countries on the basis of the same types of public expenditure on primary education (inputs) and completion rates or net enrolment ratios (outputs). The DMUs or countries considered as efficient are those with the best ratios of completion or

[16] MENA : Middle East and North Africa ; SA : South Asia ; ECA : Europe and Central Asia ; EAP : Eastern Asia and Pacific ; LAC : Latin American Countries.

enrolment [17]rates/public expenditure, i.e. those that correspond to the best practices observed. The efficiency of each country is therefore evaluated by a score calculated as the gap between the country observed (outside the frontier) and the benchmark located on the frontier (Dieng, 2016).

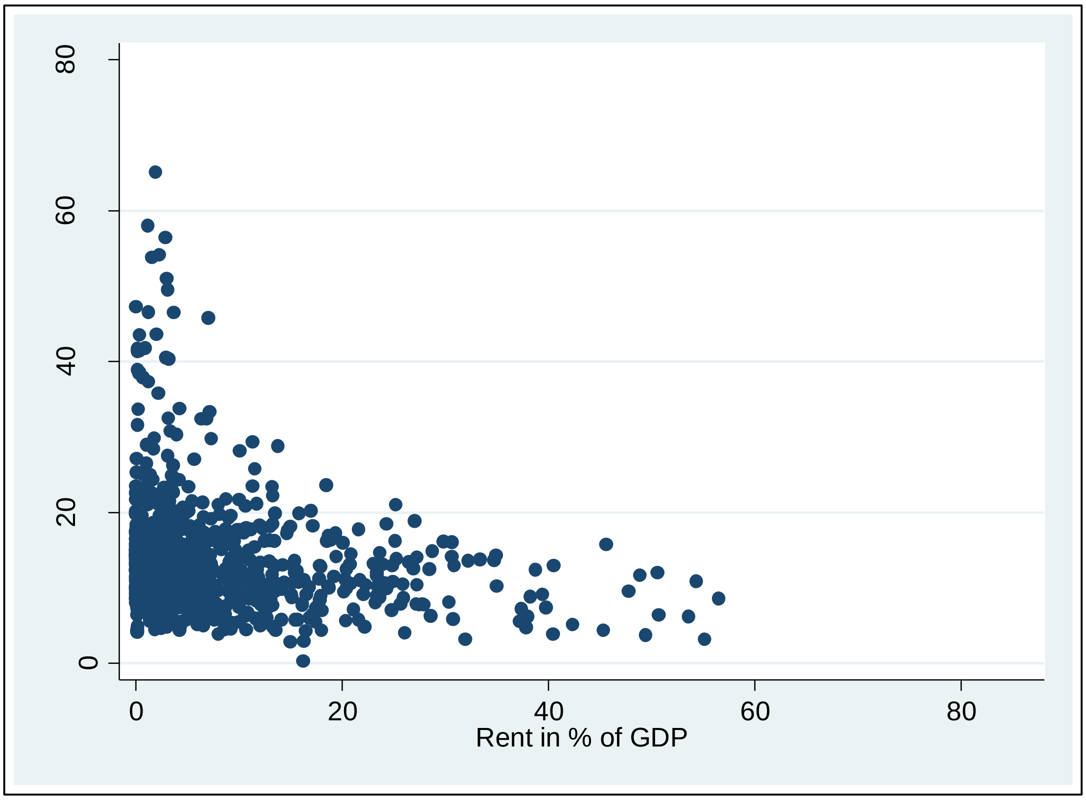
Figure 1: Evolution of the primary completion rate as a function of GDP per capita



Source: WDI, World Bank

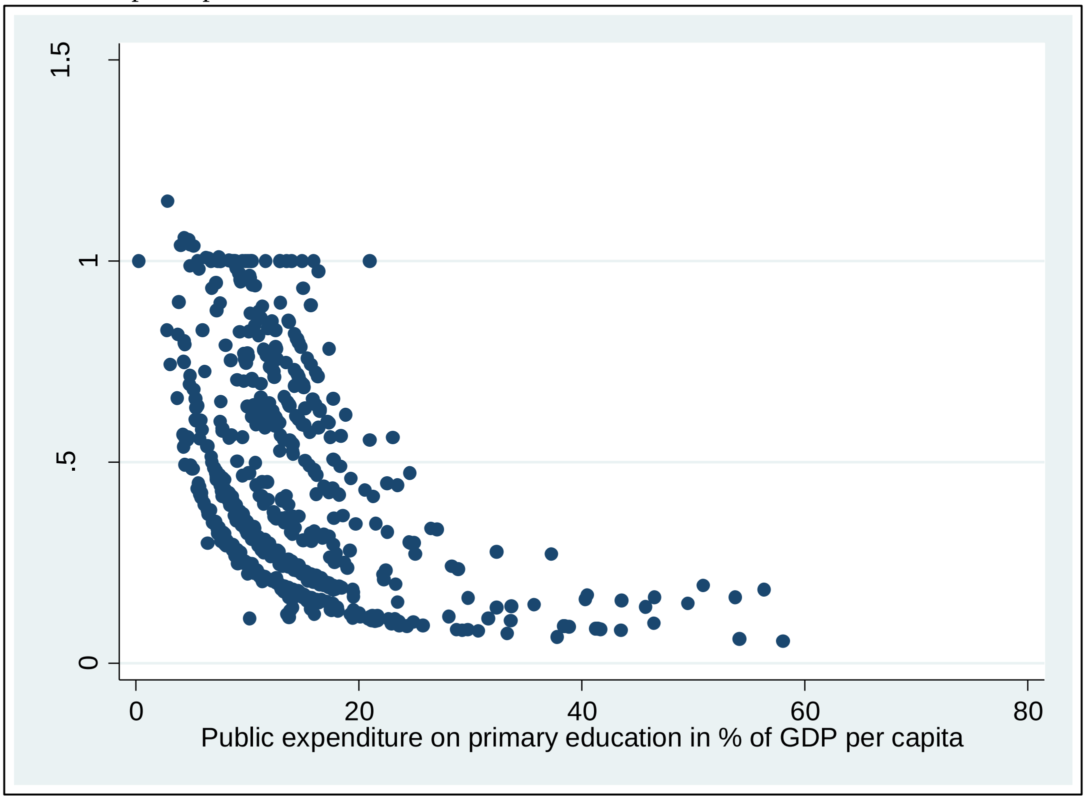
[17] or net enrolment ratio.

Figure 2: Evolution of public expenditure on education in % GDP according to the weight of the rent in the GDP



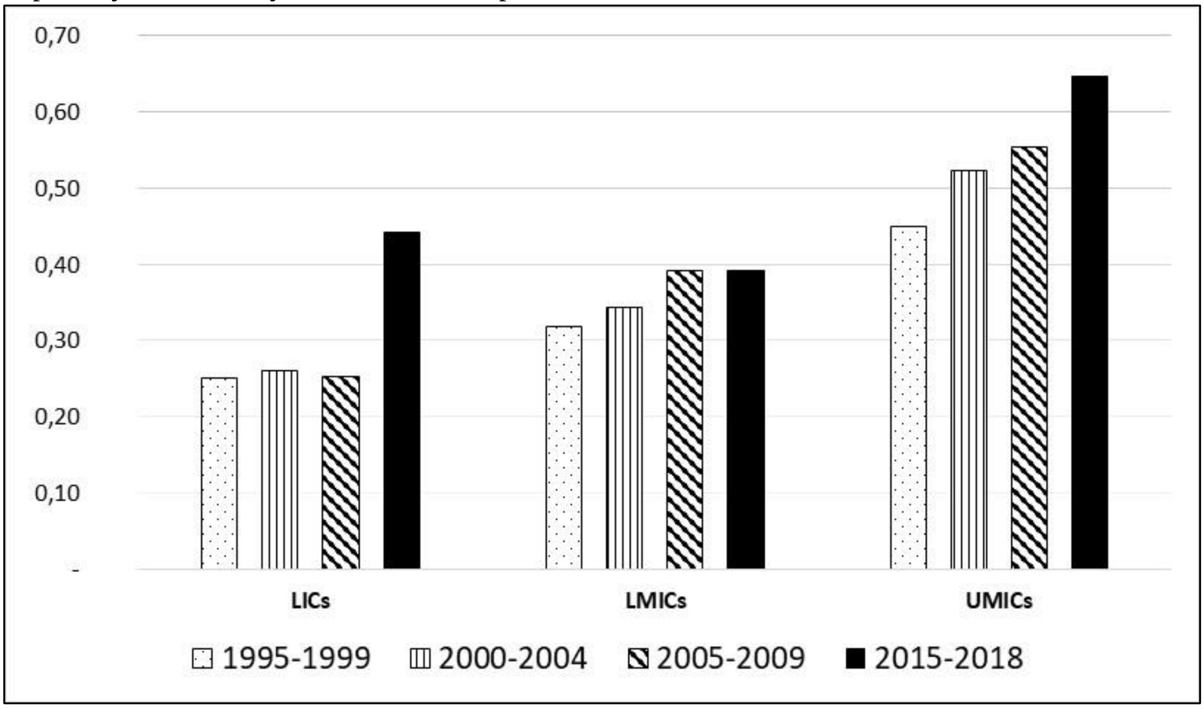
Source: WDI of the World Bank

Figure 3: Distribution of efficiency score as a function of public expenditure on primary education as a % of GDP per capita



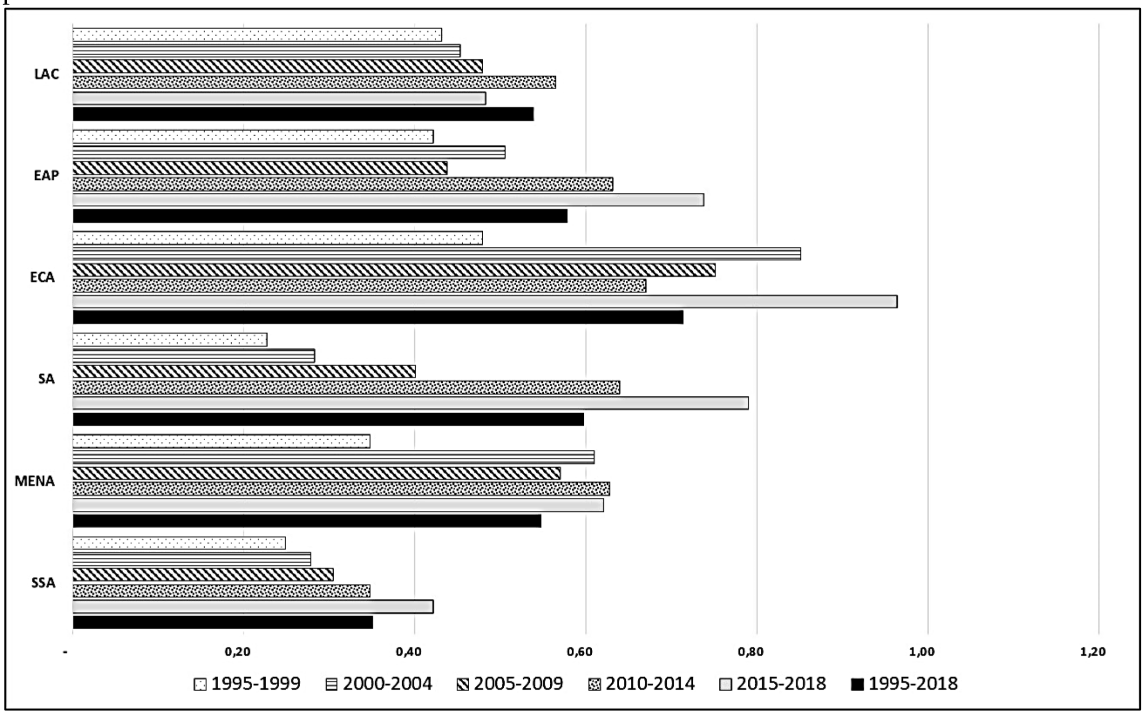
Source: WDI, World Bank

Figure 4: Distribution of the efficiency score for public expenditure on education of primary education by income level and period



Source: Authors' calculations based on the World Bank's WDI.
UMIC: upper-middle-income countries; LMICs: lower-middle-income countries; LICs: low-income countries

Figure 5: Distribution of the efficiency score of public spending on primary education by region and period



Source: Authors' calculations based on the World Bank's WDI.
MENA : Middle East and North Africa ; SA : South Asia ; ECA : Europe and Central Asia ; EAP : Eastern Asia and Pacific ; LAC : Latin American Countries.

The classification of countries' efficiency scores by income level and region (figure 5 and annex 2) corroborates the results of (Yogo, 2015), with countries in Europe and Central Asia also clearly distinguishing themselves from other groups of countries. With regard to income levels, the results obtained are in line with those of Afonso et al. (2010), with efficiency improving with the level of GDP per capita (figure 4 and annex 2). While on average public spending on primary education is inefficient (0.46), the score is lower in LICs (0.27). On the other hand, this average increases in LMICs (0.39) and is highest in UMICs (0.60). These results are almost similar when comparing efficiency scores by region. The average score for SSA countries (which includes most LICs[18]) is the lowest (0.30). The highest score is recorded by countries in Europe and Central Asia (0.96), while countries in the Middle East and North Africa have a lower score (0.57). Countries in South Asia and Latin America and the Caribbean score slightly higher than those in sub-Saharan Africa (0.48 and 0.47 respectively). These results are in line with those of Yogo (2015).

Observation of the evolution of efficiency scores over time shows that they are improving regardless of region or income group (Figures 4 and 5). Indeed, in all the countries in our sample, the average score increases from 0.36 over the 1995-1999 period to 0.62 over the 2015-2018 period. The results for the regions are consistent with those obtained by Yogo (2015) and Gupta and Verhoeven (2001). The latter observe the lowest efficiency scores in Africa, compared to Western and then Asian countries, due to higher education expenditure as a percentage of GDP.

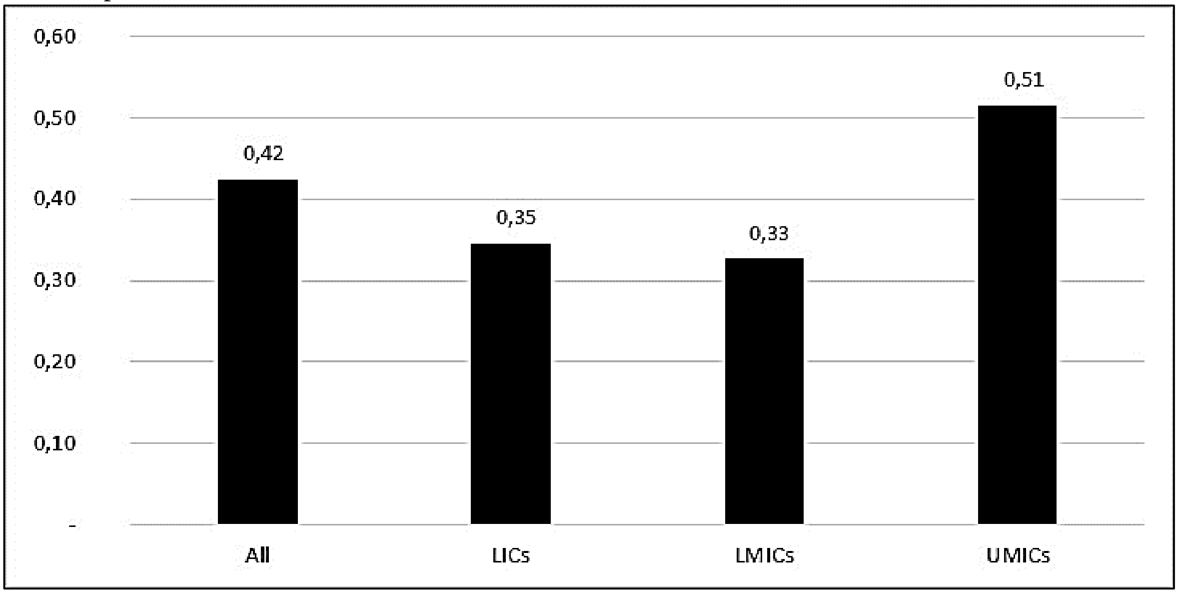
Given the wide variance of results across sub-periods, countries classified by income level and region, the interpretation of the efficiency score over time must be made with caution. This wide variance is explained by the lack of data for some periods and countries.

4.2 Regression results

The following section of the paper presents the results of the truncated panel regressions on the efficiency score. A positive (negative) sign in the regression coefficient indicates that an increase (reduction) in the independent variable reduces (increases) efficiency. Appendix 5 presents the correlations between the dependent and independent variables. The sample sizes for the different models range from 265 (Model 1) to 318 (Model 4). This difference is explained by missing data for some input and output variables.

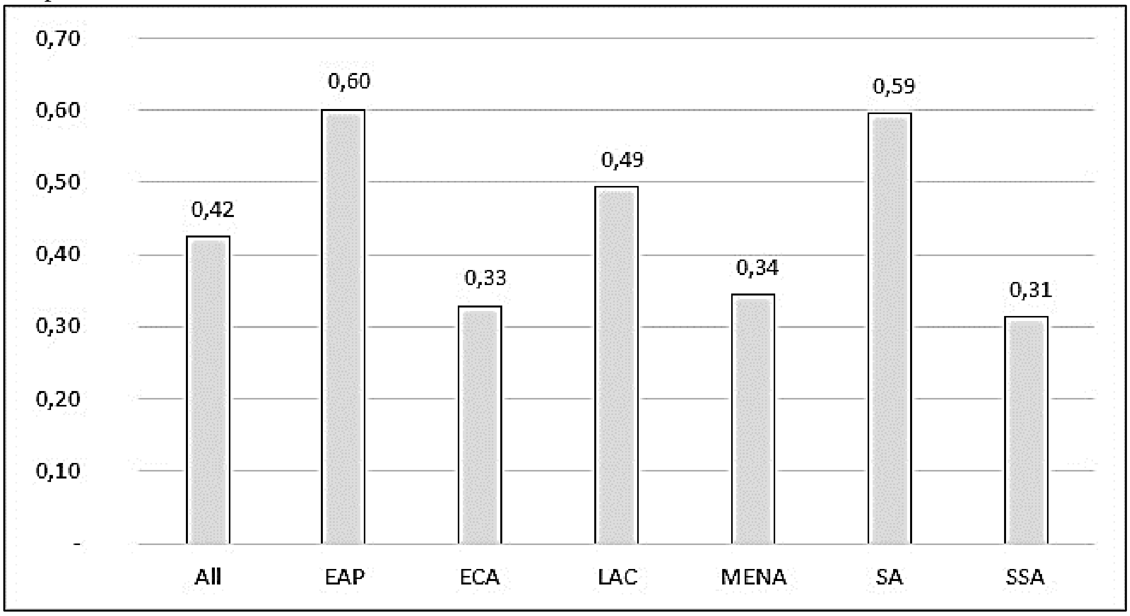
[18] With the exception of Afghanistan, Haiti, North Korea, Nepal, Syria and Yemen.

Figure 6: Distribution by income level of the efficiency score of public spending on primary education over the period 2015-2018



Source: Authors' calculations based on the World Bank's WDI.

Figure 7: Distribution by region of the efficiency score of public spending on primary education over the period 2015-2018



Source: Authors' calculations based on World Bank WDI.

Table 4: Determinants of the efficiency of public spending on primary education

	Model 1	Model 2	Model 3	Model 4
hand				
rent	0.00862***	0.00572*	0.00527***	0.00500***
	(4.05)	(2.28)	(3.52)	(3.90)
log_GDP	-0.00564	0.0219	-0.00415	-0.00178
	(-0.61)	(1.90)	(-0.55)	(-0.29)
dep_pub	-0.0120***	-0.0259***	-0.00457*	-0.00295
	(-4.74)	(-7.20)	(-2.28)	(-1.82)
Pop_under_15	-0.0259***	-0.0173***	-0.0246***	-0.0215***
	(-9.54)	(-4.96)	(-12.66)	(-13.38)
Urb_pop	0.00357***	0.00653***	0.00149	0.000418
	(3.74)	(4.72)	(1.96)	(0.65)
exp_man	0.000611	0.000227	0.000441	0.000435
	(1.15)	(0.37)	(0.99)	(1.12)
l_eff	0.0659*	0.0828*	-0.000700	-0.0116
	(2.21)	(2.17)	(-0.03)	(-0.58)
l_legit	0.0216	-0.0108	0.0355	-0.000763
	(0.66)	(-0.26)	(1.29)	(-0.03)
_cons	1.464***	0.404	1.240***	1.197***
	(5.58)	(1.24)	(5.94)	(7.11)
sigma				
_cons	0.160***	0.219***	0.147***	0.140***
	(17.41)	(15.54)	(18.58)	(23.54)
N	237	294	265	318

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Rent variable is significant in all models with a positive sign of the coefficient. This means that all other things being equal, an increase in the share of rent resulting from the extraction of natural resources reduces the efficiency of public spending on primary education. This result could come from an increase of education expenditure (inputs) while primary completion rates or enrolment rates (outputs) do not improve or improve less quickly. Yet many studies show the lack of priority given to education by resource-rich countries (Cockx and Francken 2016). Graph 2 also shows the inverse relationship between public spending on education and the weight of rent in GDP, despite the fact that education is a factor contributing to sustainable economic growth. Thus, on the one hand, there is an insufficient priority given to education, which is reflected in the lower level of public expenditure in GDP in resource-rich countries and, on the other hand, the low efficiency scores in these same countries. The primary explanation for the scores probably lies in the inefficient management of education expenditure, the lack of monitoring of education expenditure which would not allow better results to be achieved. In addition, the *Transparency International* report (2013) shows the different sectors where corruption occurs and explains why it is particularly prevalent in the education sector. Delavallade (2006) had also shown that corruption distorts public spending to the detriment of social sectors. This result would tend to show the importance of first improving efficiency before focusing on increasing spending, as also argued by other authors (Hauner and Kyobe, 2010).

Of the two governance variables, only the *Efficiency* variable is significant in two of the models with a positive sign. This means that all else being equal, any deterioration in the effectiveness of the government in a country results in a reduction in the efficiency of public spending on primary education.

With regard to demographic factors, the variable relating to the proportion of the population under 15 years of age is significant in all four models with a negative sign, which is contrary to the expected effect (see section 3). It can be assumed that high population growth in developing countries would generate economies of scale with some effects on the cost of primary schooling. This could be the source of efficiency in public spending on primary education. In other words, the enrolment rate would increase but expenditure would not evolve at the same pace. This explanation would then raise the question of the quality of education, which is not reflected in the available output variables. The measurement of the quality of education is the subject of recent studies based on the PASEC (Programme d'Analyse des Systèmes Educatifs) surveys for the French-speaking African countries and SACMEQ (*The Southern and Eastern Africa Consortium for Monitoring Educational Quality)* for the English-speaking African countries, but the indicators only concern around thirty countries in 2014 (Altinok, 2015).

The coefficient of the urban population variable is significant in the first two models with a positive sign, which is also contrary to the expected effect. This result reveals that greater urbanization has a negative effect on the efficiency of public spending on education. A plausible explanation would be that developing countries have large inequalities in the distribution of spending on infrastructure and human resources in the education sector with a concentration in urban areas. However, given the low efficiency of public expenditure due to weak governance, this expenditure does not necessarily translate into physical achievements (poor quality of infrastructure and high teacher absenteeism, ...) as shown by the expenditure tracking surveys conducted in the education and health sectors (Gauthier and Wane, 2005). This leads to poor performance indicators of the education system.

The variable relating to public expenditure expressed as a percentage of GDP is significant with a negative sign in the first three models. This means that all other things being equal, an increase in the share of public spending in a country improves the efficiency of public spending on primary education. This implies that the countries that have a greater weight of the State in the economy are also those with the best results in the primary education sector. This result does not correspond to those obtained by Afonso et al. (2010), which focuses on European countries.

On the other hand, the variables relating to GDP per capita and manufactured exports as a percentage of merchandise exports are not significant in all four models.

4.3 Robustness of results

The robustness of the previously estimated results is assessed through several tests. They ensure that measurement error problems and other methodological limitations do not hamper the quality of the estimates. First, the Spearman correlation coefficient is used to test the robustness of the four models (Table 5). This test is based on the calculation of correlation coefficients between the ranks of the efficiency scores, without this relationship being of the affine type. The results of this test show that the correlation coefficients between the models are relatively significant (above 0.45). This means that the efficiency scores for public spending on primary education are relatively similar between the models.

Table 5: Spearman correlation coefficient between models

	model 1	model 2	model 3	model 4
model 1	1,00			
model 2	0,77	1,00		
model 3	0,87	0,52	1,00	
model 4	0,84	0,46	0,97	1,00

Source: Author's calculation

In order to ensure that the estimation results are stable across samples and to highlight possible specific effects by region and income level, we estimated the four models by first including the dichotomous variables of income level (Appendix 5) and then by region groups (Appendix 6). To avoid multi-colinearity and over-determination in our estimates, we omitted one of the variables in each of the groups of estimates. In the estimation using countries classified by income level, we have omitted the variable UMICs, while in those where these countries are classified by region, the variable SA for South Asian countries is omitted[19].

The dichotomous variables LICs and LMICs are significant in three of the four models. This demonstrates the existence of specific effects specific to a country's level of development (Annex 5). Despite the presence of these specific effects, our variables of interest still remain significant. We also note the significance of specific regional effects with significant variables of interest across the four estimated models (Annex 6).

[19] In interpreting the results, the omitted variable becomes de facto the reference variable from which the other variables are compared.

5. Conclusion

In recent years, empirical work has highlighted the determinants of the level of public expenditure on education in developing countries. However, very few studies have attempted to highlight the role of the rent generated by the exploitation of natural resources. Some have highlighted an inverse relationship between the endowment of natural resources and the reduction of public expenditure on education (Gylfason, 2001 and Cocx and Francken, 2016). Others have looked at education or human capital indicators in resource-rich countries, some showing that they tend to be worse in resource-rich countries (Perez and Claveria, 2020), others that they tend to be better, especially in countries that also have high incomes, low corruption and more democracy (Kim and Lin, 2017). There are even fewer studies looking at the efficiency of public spending on education in relation to natural resource wealth.

This paper addresses this shortcoming by highlighting the impact of natural resource endowment on the efficiency of public spending on primary education. For this purpose, data from the World Bank's WDI database and the *Center for Systemic Peace's* State Fragility Index covering the period 1995-2018 were compiled. Initially, the *order-m* non-parametric method was used to determine the efficiency scores. In a second step, a truncation model with 1000 replications is estimated to highlight the determinants of these efficiency scores. The results show that the endowment of natural resources and the low efficiency of States reduce the efficiency of public spending on primary education. On the other hand, a larger share of the population under 15 years of age and a large share of public expenditure in a country's GDP contribute to improving the efficiency of public expenditure on primary education. These results are stable whatever the income level of the country and the region considered. As mentioned above, the analysis of efficiency for our country sample faces statistical limitations with respect to the quality of education and especially with respect to the effects of corruption on the efficiency of spending in the primary education sector in many developing countries.

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Annexes

Appendix 1

Variable name	Definition		Source
Net primary school enrolment ratio	This rate is the ratio of children of official school age enrolled in school to the population of the corresponding official school age.	%	UNESCO Institute for Statistics
Primary completion rate	This rate is the number of new entrants (enrolments less repeaters) to the last grade of primary education, regardless of age, as a proportion of the population at the entry age for the last grade of primary education.	%	UNESCO Institute for Statistics
Public expenditure on primary education as % of GDP	It is the average general government expenditure (current expenditure, own funds and transfers) per pupil for a given level of education, expressed as a percentage of GDP per capita.	of GDP per capita	UNESCO Institute for Statistics
Public expenditure on primary education as % of total public expenditure on education	Expenditure on primary education is expressed as a percentage of total government expenditure on education. The term general government generally refers to local, regional and central governments.	%	UNESCO Institute for Statistics
Log of GDP per capita	GDP per capita is the gross domestic product divided by the population of the corresponding year. Data are in constant 2010 U.S. dollars.	Log (GDP per capita)	World Bank and OECD
Resource rent as % of GDP	The natural resource rent is the sum of the rent from oil, gas, mining, coal from minerals and forestry. It is the difference between the selling price and the cost of production (Lange 2018).	% of GDP	World Bank estimates based on the methodology described in Lange et al (2018).
Efficiency	It is an index to measure a country's ability to implement the measures in its security, political, economic and social dimensions.	Level[20]	Center for Systemic Peace
Legitimacy	It is an index that measures a country's legitimacy through four components: security, political, economic and social.	Level[21]	Center for Systemic Peace
Government expenditure as % of GDP	They relate to expenditure on goods and services, wages, transfers and subsidies and investment. They also relate to the payment of interest on the public debt.	% of GDP	IMF, World Bank and OECD estimates
Population 0-14 as % of total population	Population between the ages 0 to 14 as a percentage of the total population. Population is based on the de facto definition of population.	%	United Nations Population Division.
Urban population as % of total population	This ratio refers to the number of people living in urban areas out of the total population of the country.	%	United Nations Population Division.
Manufactured exports (% of merchandise exports)	It is the sum of manufactured exports (chemicals, commodities, machinery and transport equipment, miscellaneous manufactured products excluding non-ferrous metals) over total merchandise exports.	of total merchandise exports	World Bank estimates from the UN Statistics Division's Comtrade database.

[20] The maximum level of the efficiency component of the WEI is set at 13.

[21] The maximum level of the legitimacy component of the WEI is set at 12.

Appendix 2: Average Efficiency Score by Income Level and Region, 1995-2018

Period	Average efficiency score									
	LICs	LMICs	UMICs	SSA	MENA	SA	ECA	EAP	LAC	Ensemble
1995-1999	0.25	0.32	0.45	0.25	0.35	0.23	0.5	0.42	0.43	0.36
2000-2004	0.26	0.34	0.52	0.28	0.61	0.28	0.85	0.51	0.45	0.43
2005-2009	0.25	0.39	0.55	0.30	0.57	0.40	0.75	0.44	0.48	0.44
2010-2014	0.34	0.45	0.65	0.35	0.63	0.64	0.67	0.63	0.56	0.51
2015-2018	0.44	0.39	0.65	0.42	0.62	0.79	0.96	0.74	0.48	0.56
1995-2018	0.34	0.41	0.61	0.35	0.55	0.60	0.71	0.58	0.54	0.50

Appendix 3: model specifications

Variables	Model 1	Model 2	Model 3	Model 4
Outputs				
Net enrolment ratio	X	X	X	X
Primary completion rate	X	X	X	
Inputs				
Public expenditure on primary education as % of GDP	X	X		
Public expenditure on primary education as % of total public expenditure	X		X	X

Source: the authors

Appendix 4: Linear correlation coefficients between the dependent variable and the independent variables in the second step (Model 4)

	Efficiency Score	Rente ress. Nat.% GDP	Export prod. Manu	Log (Efficiency)	Log(Legitimacy)	Population <15% of total	Urb. population % of total	Government expenditure % of GDP	Log (GDP per capita)
Efficiency Score	1.00								
Rente ress. Nat.% GDP	0.05	1.00							
Export prod. Manu	0.01	-0.36	1.00						
Log (Efficiency)	-0.17	0.13	-0.17	1.00					
Log(Legitimacy)	-0.05	0.34	-0.30	0.53	1.00				
Population <15% of total	-0.24	0.28	-0.31	0.65	0.42	1.00			
Urb. population % of total	0.10	-0.03	-0.09	-0.66	-0.30	-0.38	1.00		
Government expenditure % of GDP	0.12	-0.18	0.18	-0.51	-0.39	-0.66	0.35	1.00	
Log (GDP per capita)	0.12	-0.06	0.31	-0.40	0.05	-0.36	0.46	0.06	1.00

Source: our calculations under STATA

Appendix 5: Estimation with dichotomous income level variables

	Model 1	Model 2	Model 3	Model 4
rent	0.00884***	0.00741**	0.00504***	0.00483***
	(3.94)	(2.93)	(3.39)	(3.75)
log_GDP	-0.00590	0.0187	-0.00132	-0.000273
	(-0.61)	(1.66)	(-0.18)	(-0.04)
Pub_exp	-0.0116***	-0.0233***	-0.00397*	-0.00248
	(-4.57)	(-7.09)	(-2.00)	(-1.52)
pop_under_15	-0.0264***	-0.0180***	-0.0261***	-0.0232***
	(-9.47)	(-5.26)	(-13.08)	(-13.69)
Urb_pop	0.00351***	0.00511***	0.00184*	0.00106
	(3.56)	(3.82)	(2.38)	(1.57)
exp_man	0.000643	0.000236	0.000648	0.000652
	(1.22)	(0.41)	(1.48)	(1.71)
l_eff	0.0805*	0.151***	0.0172	0.00317
	(2.37)	(3.71)	(0.70)	(0.15)
l_legit	0.0146	-0.0567	0.0198	-0.00793
	(0.44)	(-1.42)	(0.72)	(-0.31)
LICs	-0.00539	-0.103	0.100*	0.103**
	(-0.10)	(-1.46)	(2.08)	(2.67)
LMICs	-0.0291	-0.180***	-0.0268	-0.0149
	(-0.83)	(-4.11)	(-0.98)	(-0.61)
_cons	1.479***	0.573	1.178***	1.141***
	(5.38)	(1.80)	(5.66)	(6.80)
sigma				
_cons	0.160***	0.210***	0.144***	0.137***
	(17.53)	(16.26)	(18.79)	(23.62)
N	237	294	265	318

t statistics in parentheses
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Appendix 6

	Model 1	Model 2	Model 3	Model 4
rent	0.00725**	0.00541*	0.00460**	0.00461**
	(3.25)	(2.18)	(2.88)	(3.27)
log_GDP	-0.00594	0.00373	0.00162	0.00415
	(-0.63)	(0.34)	(0.21)	(0.66)
Pub_Exp	-0.00999***	-0.0162***	-0.00729**	-0.00362*
	(-3.47)	(-4.63)	(-3.16)	(-2.01)
pop_under_15	-0.0230***	-0.0177***	-0.0235***	-0.0158***
	(-5.40)	(-3.64)	(-7.75)	(-5.96)
Urb_pop	0.00507***	0.00712***	0.00287**	0.00260***
	(4.53)	(4.75)	(3.01)	(3.34)
exp_man	0.000164	0.000346	0.000343	0.0000919
	(0.27)	(0.56)	(0.69)	(0.21)
l_eff	0.0521	0.125***	-0.0157	-0.0288
	(1.69)	(3.37)	(-0.65)	(-1.39)
l_legit	0.0360	-0.00887	0.0295	-0.00816
	(1.10)	(-0.23)	(1.08)	(-0.34)
EAP	-0.0585	0.0452	-0.103*	-0.157***
	(-1.01)	(0.59)	(-2.13)	(-3.95)
ECA	-0.145*	-0.243**	-0.0215	-0.0300
	(-2.14)	(-2.85)	(-0.39)	(-0.66)
LAC	-0.181**	-0.0479	-0.137*	-0.214***
	(-2.85)	(-0.59)	(-2.40)	(-4.53)
MENA	-0.176*	-0.274**	-0.0597	-0.138**
	(-2.56)	(-3.07)	(-0.99)	(-2.71)
SSA	-0.136	-0.120	-0.0284	-0.140**
	(-1.93)	(-1.35)	(-0.50)	(-2.90)
_cons	1.411***	0.672*	1.156***	0.953***
	(4.88)	(1.99)	(5.08)	(5.00)
sigma				
_cons	0.155***	0.202***	0.143***	0.134***
	(17.75)	(16.68)	(18.75)	(23.84)
N	237	294	265	318

t statistics in parentheses
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.