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Teacher's Characteristics and Performance in Education Service Delivery: Case of the Technical Efficiency of Primary Schools in Tanzania

Issofou Njifen[1,*]

[1]Dept. of Human Resources Management, University of Yaounde II, PO Box 1972, Yaounde, Cameroon

*Correspondence: Dept. of Human Resources Management, University of Yaounde II, PO Box 1972, Yaounde, Cameroon. Tel: 237-677-868-860. E-mail: njifenm@yahoo.fr

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Abstract

One of the basic questions on the educational system performance is how to improve school outcomes using a minimum of resources. Education production function theory highlights a relationship between education system performance and its main determinants. The purpose of this paper is to assess the influence of teacher characteristics on the technical efficiency of primary schools in Tanzania. To achieve this, micro data from the Service Delivery Indicator survey, collected in primary education system, are analyzed using two complementary methodological approaches: a non-parametric technique called Data Envelopment Analysis to estimate efficiency scores of primary school in a first-stage; then Tobit regression to identify the determinants of technical efficiency in a second-stage. The study findings show that there is a significant relationship between teachers' characteristics and efficiency of primary school. These results permitted to formulate some recommendations to policy makers in terms of education planning in Tanzania.

Keywords: Teacher characteristic, Efficiency, Primary school, Outcomes, Educational policy

1. Introduction

How teachers should be allocated to schools to achieve educational goals is one of important debates on the construction of performing school systems. Analyzing the efficiency of educational systems and organizations is today at the forefront of the policy and academic discussion (Fehintola, 2014; Agasisti & Zoido, 2015). Research on the school efficiency results in the "does money matter" controversy (Atkins & Moomaw, 2005)(Note 1); and one of the basic questions is how to provide an optimal output of education using a minimum of inputs. Indeed, various factors such as declining public spending in education and some facilities make efficiency more important than ever. Provision of quality education is therefore important in generating opportunities and benefits of social and economic development. Likewise, teacher quality is widely believed to be important for effective teaching and school efficiency. The teacher quality that is often associated with the teacher's characteristics is vital to student achievement (Waldo, 2002). It is crystal-clear that teachers are indispensable resources in educational system. The success of any educational system depends on the quality of these inputs into the system (Obadara, 2006).

On a pedagogical viewpoint, teachers play a key role because it is inside the classrooms where the educational production process takes place and innovation in teaching methods. The educational practices can improve educational quality (Cruickshank et al., 2009; Santin & Sicilia, 2014). Students will succeed in the classroom when they receive the support they need to be successful (Myers & Anderson, 2010). Teachers stand in the interface of the transmission of knowledge, values and skills in the learning process. A teacher is who plans and delivers lessons or instruction in such a way that objectives can be achieved (Lassa, 2000). In different contexts, authors concurred and opined that improving the quality of the teaching force in schools have an important influence on students' academic achievement (Ijaiya, 1998).

The influence of teachers' characteristics on the performance of school such as pupils' achievement has been analyzed rigorously during the last decades. A survey of the economic literature has permitted to conclude a clear relationship between teaching resource and student outcome (Thias & Carnory, 1972; Hanushek, 1996; Adeyemo, 2005). However, some studies demonstrate that teachers' observed characteristics don't show a consistent relationship with students' test scores (Rivkin et al., 2005; Hanushek & Rivkin, 2006). According to Rivkin et al. (2005), there has never been consensus on the teacher specific factors that influence students' academic achievement.

1.1 Problematic and Hypothesis of Study

Alike to Sabiran (2003) in the case of Indonesia, the inconsistency of Tanzania education quality can be caused by different operational funding allocation for each school. If bigger fund can make better education quality, the Education budget allocations for Tanzania education system shows that the share of education spending in total government expenditures for 2008-2016 decreases from 41% to about 20% at the glance to World Database information. The sustainability issue of the system and the increasing focus on results of the system have led to new ideas: the progressive devolution of powers from the

public sector to the schools and stressing the link between funding and performance. This situation gives the presumption on the efficiency problematic in management of schools. The relevant research questions addressed in this context are that: does Tanzania primary education system operate efficiently? In others terms, is it possible to reduce resources (spending) in primary school to achieve the same outcomes? If no what are the main determinants of primary school inefficiency in Tanzania? Do teachers' characteristics explain primary schools' efficiency?

The teacher characteristics in each school explain most of the variation in efficiency across primary schools in Tanzania. More specifically, this article seeks to test the following hypotheses:

i. The teacher background such age, gender and qualification affects significantly the efficiency score of primary schools ;

ii. The school head teacher or teacher leader(Note 2) background (gender, qualifications and experience) determines significantly the efficiency score of primary schools.

1.2. Objective and Research Relevance

The purpose of this paper is to analyze technical efficiency and its determinants in Tanzania primary education sector. More specifically, it aims to: *i)* estimate the technical efficiency score of Tanzania primary school; *ii)* identify the determinants of school efficiency score such as teachers' characteristics. In terms of policy relevance, the government of Tanzania injects a lot of money for free primary education. Despite these efforts put up to improve education in primary schools, outcomes of some schools always appear dismal. The results of this study will help stakeholders to identify areas of intervention to help increase the performance of primary schools in this context. On a scientific viewpoint, this study proceeds of observed shortcomings in the efficiency analysis of education system especially on primary education system in Tanzania. Few studies have been undertaken to assess the performance or the quality of primary education delivery in Tanzania context (Mbelle, 2008). Furthermore, others attempted to establish the relationship between teacher's characteristics and school output. Nevertheless, none of these studies, and to the best of our knowledge, has tried to tackle determinants of technical efficiency of Tanzania primary school; above all using micro data from the service delivery indicator survey.

The paper is organized as follows. Section 2 provides a dynamic analysis of performance in primary education in Tanzania. Section 3 highlights a theoretical view of organizational efficiency, including Leibenstein's theory of x-efficiency. Section 4 explains methods used in estimating technical efficiency and its determinants. Section 5 presents and discusses the empirical results. The last section proposes some recommendations to Tanzanian policy-makers.

2 The Dynamic Analysis of Performance in Primary Education System

The United Republic of Tanzania (hereafter, Tanzania) has a long history of trying to reduce

illiteracy. In order to do a meaningful analysis of the current situation in Tanzania primary education sector it was necessary to reminisce key events occurred in the past 50 years. Comprehensive policies and strategies have been well articulated. The rationale of these reforms has been to improve efficiency and cost effectiveness in resource allocation and utilization. Implementation, however, has not been free from some problems (Mbelle, 2008). Figure 1 provides a longitudinal overview of primary education between 1970 and 2014.

In the 1960s and 1970s, independence of Tanzania attained en 1961 involved huge popular pressure for access to primary schools because education was generally glanced in this period as a gateway to social mobility. Accordingly, enormous effort was made to transform an insignificant educational sector characterized by low enrolment rates and poor infrastructure to a national provider of Universal Primary Education (hereafter, UPE). Following the most of authors, the goal was to make primary education available, compulsory and provided free of cost to all society members (Carnoy & Samoff, 1990). Other important measures were elimination of certain examination procedures and abolition of primary school fees in 1973. Consequently Tanzania launched an UPE-policy based on huge increases in the numbers of primary schools and teachers through campaign-style programs with the help of donor financing. Given the poor prerequisites, Närman (2001) opines that the result of the first two decades was impressive. The common apprehension is that Tanzania was close to UPE around 1980, at least in terms of gross enrollment ratio and primary completion rate.

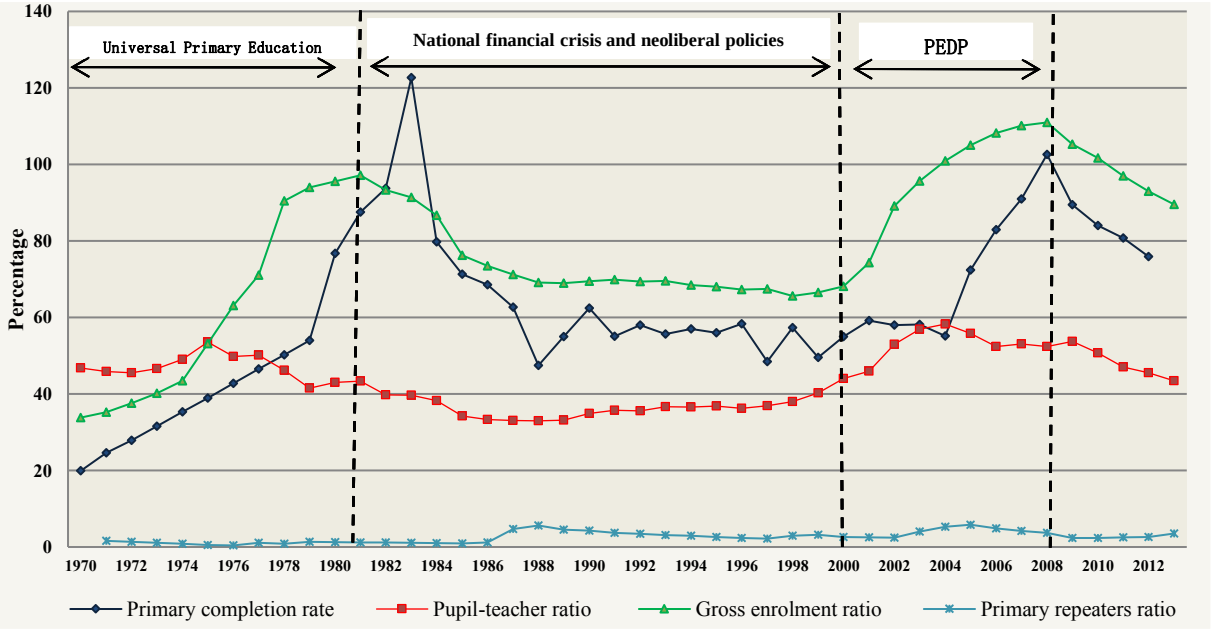

Figure 1. Primary School Situation in Tanzania 1970 – 2014

In the 1980s in the wake of neo-liberal policies imposed on Tanzania by the Bretton woods institutions through Structural Adjustment Programs (hereafter, SAP), the approach to education changed. Alike to some African countries, SAPs resulted in a substantial reduction of public educational service in Tanzania (Ewald et al., 2001). Moreover, through the

introduction of school fees large segments of the population especially the poorest were excluded from education. Thus in the mid 1980s – at the glance to figure 1 - the positive quantitative expansion both of primary school enrolment and primary school completion from independence was reversed. Educational service was partly erroneous and that Tanzania had difficulties in financing its educational sector before SAP was introduced. However, education services delivery are not only a function of financial interventions. There are a number of other issues at play, such as governance, cultural issues, etc., which also need to receive adequate attention.

In 2002, the Government of Tanzania launched the Primary Education Development Plan (hereafter, PEDP), first stage. This program being ambitious, it aimed to enhance enrollment and strived to improve educational quality. This reform plan, which aims to materialize Tanzania's commitment towards the international Education For All (hereafter, EFA)(Note 3) is a five year plan with four strategic priorities: enrolment expansion, quality improvement, capacity building and optimizing human, material and financial resource utilization. Once school fees were eliminated, remarkable increases in the primary school enrollment were recorded. Both survey and administrative data sources show how enrollment rates increased significantly between 2001 and 2008 (figure 1). The efforts to expand access to primary education led to an unprecedented increase. However, new concerns surfaced.

As stated by the literature, the PEDP reform plan did not choose between increasing enrollment and enhancing quality. There is a strong relationship between a fast quantitative expansion of education system and inability to uphold quality (Närman, 2001). From a qualitative standpoint, Tanzania education system had severe difficulties to keep pace with the fast expansion of enrolment. Moreover, the education sector was struggling with severe quality deficiencies(Note 4) (Närman, 2004). Main problems were shortage of qualified teachers, lack of relevant teaching material, inadequate school buildings and poor pedagogy, and allocated considerable funds to improving teaching quality and learning (BEDC, 2001). The share of education budget devoted to teacher training, declined from 2,6% in 1997/1998 to less than 1% in 2007/2008. The number of trainee teachers fell from 27700 in 2003 to 19084 in 2006 and 18754 in 2007.

Overall, as consequence of these reforms and several programs, the primary education sector registered significant improvements during the 1970s in child literacy and vocationalization of primary education. However, these achievements could not be sustained during 1980s decade due to economic crises experienced in the early 1980s. There has been a rapid deterioration in the delivery of primary education services leading to current low levels of academic achievement and declining gross enrollment rate or completion rate for primary school pupils. The general conclusion ought to be that the post-independence educational policy of Tanzania compromised quality for quantity.

3. Theoretical View of Organizational Efficiency

This section deals with the theoretical view of organization efficiency, including

Leibenstein's (1966) theory of x-efficiency. Efficiency involves the relationship between inputs and outputs in a production process. The simplicity of this statement, however, obscures a variety of complexities that arise when the concept is actually applied. In education, efficiency is never a given (Hanushek, 2015). First, education is generally publicly provided. Governmental organizations, which do not face the same incentives as private firms, cannot be expected to move toward efficient production. In particular, few school personnel are rewarded or punished based on the outcomes students obtain, making the incentives for performance minimal or nonexistent. Second, it is difficult to find information on school efficiency. With complete information, parents might be expected to pressure schools to use resources – either through local political processes or through moving to districts that did better (Tiebout, 1956). Because student performance is influenced by factors schools cannot control – i.e., input from family and friends – simply observing student achievement does not accurately reflect school contribution. Thus, parental and voter pressures on schools are lessened by imperfect information.

According to Taylor and Taylor (2003), the x-efficiency is the deviation from the optimum because it does not assume all resources and individuals to work at a maximum level and with maximum utilization. The familiar expression of technical efficiency refers to a very fuzzy concept. Standard microeconomic theory of production does not even consider the possibility that firm behavior may be inefficient, at least from a production or technical point of view. This is due to the constraints the profit maximization assumption that places on firm behavior. Thus, the very concept of technical efficiency cannot be rationalized with the tools of the neoclassical theory of the firm(Note 5). The neoclassical theory assumes that managers and employees act completely rational and have all information to maximize the owner's profits (Chandler, 1992). This means that costs should be minimized and organizations work as efficient as they could. If this would be the case, no x-inefficiency would exist but in reality and practice costs are not minimized and firms are not that efficient as they can be, so that there is always a certain kind of x-inefficiency in organizations. The very notion of inefficiency violates central assumptions of economics. Within this theoretical framework, real observed output should always match potential output. Leibenstein (1966) suggested that in general organizations do not minimize production costs and they do not consequently work at their optimal level.

The x-efficiency means the difference between the optimal efficient behavior of business in theory and the observed behavior in practice. This theoretical framework has some different underlying assumptions (Huil, 2014). First, low productivity can occur because of agency problem, which is the possibility of interest conflict between the shareholders and management of a firm (Levacic, 2009; Hillier and *al*., 2011). Second, individuals have a great influence on organization performance either in a negative way as well as in a positive way and the overall performance of an organization is dependent on the performance of the individuals working for the organization(Note 6). The third assumption is the motivational efficiency (Tomekovic, 1962; Zelenyuk & Zheka, 2006). In his point of view, Leibenstein (1966) coined the term x-inefficiency to refer to the amount of forgone output that occurs as a consequence of motivation deficiencies along the firm's hierarchy. There exist several reasons

why the giving inputs do not result in calculated output. These can be summarized as follows (Leibenstein, 1975): 1) Labor contracts are incomplete. This implies that an unavoidable degree of effort discretion will be present in the behavior of workers and managers; 2) all factors of production are not marketed; 3) and the production function is not completely specified or known. According to Vos and Schiele (2014), Leibenstein's Theory is in the Progression-Stage(Note 7) and the main variables of x-efficiency explain his emergence.

The one and more important of main variables are employees and individuals. According to literature, employees and individuals mostly do not work as hard and effectively as they could. This makes employees and individuals to one of the main variables (Leibenstein, 1966). Variables need to be measured and Taylor and Taylor (2003) report that the x-efficiency theory has the potential to make performance indicators more understandable, practical and useful. Within the x-efficiency theory, individuals are never supposed to be fully rational. They are rational but selective rational. Sometimes they show rational behavior, but sometimes they show up non-rational behavior. This is conforming to Harbison's (1956) assertion that human beings are motivated by drives, hopes, desires, fears and frustrations. Furthermore, it is evident that if some (efficient) firms do better than others (inefficient) it simply happens because they are different. This difference is what some authors are commonly calling technical inefficiency. Therefore, it is possible to interpret current technical efficiency scores as indicators of firm heterogeneity. More precisely, observed technical inefficiency arises from heterogeneity in stock resources and essential capabilities that are included as inputs in the efficiency model (Majumdar, 1998).

The x-efficiency can be applied in different areas such as education industry. Two characteristics make it a prime candidate for a study of efficiency (Levin, 1976): size and rising cost. Of course, education represents one of the largest industries in all nations and the one possible explanation for rising costs is quantitative increases in student's enrollment or qualitative increases in education outcomes. Production models have three parts: desired outcomes, inputs and the process that transforms parts are linked together by a production function. According to Prichett and Filmer (1999), resources are allocated to maximize educational output and the educational "production function" is determined by an underlying pedagogical process. However, the relationship between school output and inputs is not behavioral relationship like as technical relationship in classical function production. Prichett and Filmer (1997) argue that a behavioral theory is necessary to understand the results of estimating a production function. For these authors, reasons are very simple: the increment to output from additional inputs is not constant; the second algebra book per student will likely help less than the first, and the tenth much less. They develop a positive theory of educational expenditures allocation. About this theory, inputs, which provide direct benefits to educators (like teacher wages), are vastly over-used relative to inputs that contribute directly to educational output.

The presence of x-efficiency in schools may mean that more efficient school management could lead to substantially better outcomes without increasing spending (Levin, 1997). The x-efficient schools would have a clear, objective function with measurable outcomes, incentives linked to success, efficient access to information, adaptability and use of the most

productive. The x-inefficiency' factors can result in poor management and staff motivation in schools.

4. Data and Data Analysis

In this section, we specify the data sources and data analysis tools. It outlines the basic concept of Data Envelopment Analysis (thereafter DEA) and the Tobit model specification adopted in order to assess the determinants of technical efficiency of primary schools.

4.1 Database Description

In order to test our hypothesis we use data survey, which were collected in 2014 by a Tanzania local think tank, namely Research for Poverty Alleviation (REPOA), under African Economic Research Consortium's Institutions (AERC) and World Bank Service Delivery Research Program auspices. These data organized in six modules provide more information respectively about:

1. School information (school type, facilities, school governance, students numbers, etc.);
2. Teacher roster (list of all school teachers, absence rates and teachers characteristics);
3. School finances;
4. Classroom observation (teaching activities and classroom conditions);
5. Pupil assessment (scores in mathematics and languages);
6. Teacher assessment (mathematic and language subjects knowledge and teaching skills).

The sample covers 400 primary schools in Tanzania mainland, about 3257 teachers assessed and 3978 pupils evaluated which 2784 in mathematics and 1194 in language. This representative sample provides possibilities to analyze the relationship between teacher's characteristics and technical efficiency in the primary schools.

4.2 Econometrical Strategy

The econometric strategy refers to quantitative data analysis. We implement it in two steps: estimate the efficiency scores and identification the determinants of school inefficiency.

4.2.1 Estimation Method of Efficiency Scores: Data Development Analysis

Two approaches are generally used to measure efficiency of a Decision Making Unit: (*i*) the method of productive efficiency based on the principal/agent relationship, (*ii*) and the method of productive efficiency based on the production frontiers (Kobou et al., 2009). Regarding the second approach, two main methods namely the parametric method (Aigner and Chu, 1968; Aigner et al., 1977; Meeusen & Van Den Broeck, 1977) and the non-parametric method (Charnes et al., 1978; Banker et al., 1989) are currently used to appreciate the organizational

efficiency.

The parametric method requires the specification of production function. Otherwise, this approach necessitates acknowledge of the form of education production function (Cohn and Cooper, 1997). This study considers primary schools as unit of analysis and analyses how schools can be organized or resourced in order to improve educational outputs. However, the primary schools deliver education services. It is not straightforward to express a priori the production function of education in this sector. For these reasons, the non-parametric method is useful to detect differences in terms of efficiency across schools. The non-parametric method estimates the efficiency scores of a school from the distance function (Kirjavainen & Loikkanen, 1998), which establishes the relationship between actual output and optimal production (Shephard, 1970). The production frontier is elaborated by solving primal and dual problems of linear programming once defined inputs and school outputs. This method evaluates the relative efficiency of comparable schools and generates efficiency levels using information on inputs and outputs. One of current used methods is the DEA. It is a method specially designed for analyze efficiency in context that organizations use multiple inputs in order to produce multiple outputs.

DEA mathematical formulation can deal with both Constant Returns to Scale (CRS) and Variable Returns of Scale (VRS). In the purpose of generate the technical efficiency (TE) under the variable returns to scale, this study used, the model suggested by Charnes and *al.* (1978) and assuming variable returns to scale (VRS), one applied model of Banker and *al.* (1989). When assuming constant returns to scale, total technical efficiency is estimated, but total technical efficiency can be further decomposed into pure technical efficiency and scale efficiency (SE). To calculate pure technical efficiency, the production technology is assumed to display variable returns to scale. Scale efficiency is then the residual between total and pure technical efficiency. Calculation of SE itself assumes the calculation of TE measures under both CRS and VRS. If there is a difference between technical efficiency scores under CRS and VRS for a certain school, the difference indicates that a school is scale-inefficient. Scale efficiency measure can be calculated by dividing the total technical efficiency by pure technical efficiency:

$$SE = \frac{TE_{CRS}}{TE_{VRS}} \quad (1)$$

Scale efficiency can be interpreted as follows: if SE = 1, then a school is scale-efficient, its combination of inputs and outputs is efficient both under CRS and VRS; if SE < 1, then the combination of inputs and outputs is not scale-efficient. In addition, the results permit to identify whether a school operates under increasing returns to scale (IRS) or decreasing returns to scale (DRS) by using the DEA model under the non-increasing returns to scale (NIRS).

There are two different specifications of a DEA model: input-oriented and output oriented. In this study, an output-oriented model is employed, to consider that resources invested in education for a single school is basically given, and the objective of the educational system is to maximize its achievement score. According to Agasisti (2011) a well-known shortcoming

of DEA is that the method is deterministic; so all the deviance from the frontier is attributed to inefficiency without considering the possibility of random noise. This is obviously a very strong assumption. Some methodological advancement allowed solving this problem by defining a procedure to derive statistically robust efficiency scores through the bootstrap DEA (Simar & Wilson, 2000).

Given information on inputs and outputs available in the Tanzania Service Delivery Indicator dataset, the output of primary school (Y) is a function of effort (e), ability (θ) and inputs vector (x): $Y = f(e, \theta, x)$. The score of primary schools will be generated through the DEAP software. The DEA framework can be made as follows:

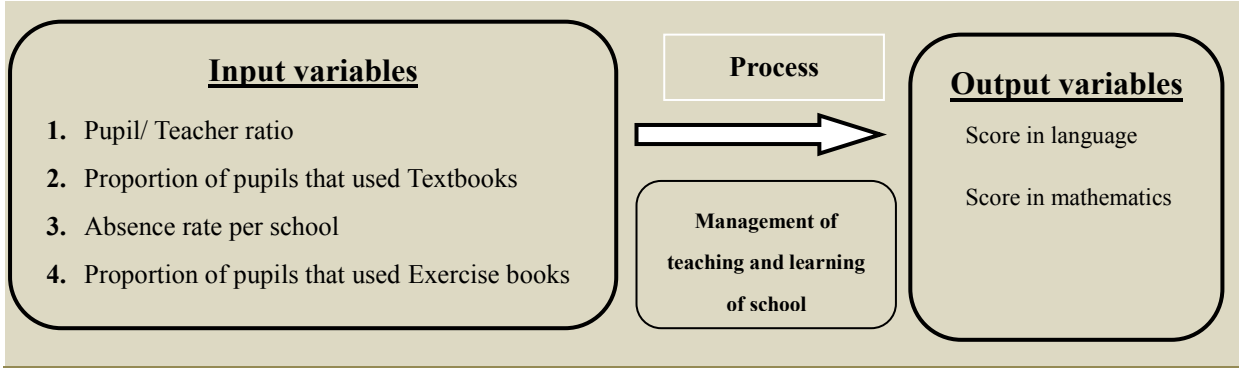

Figure 2. Data Envelopment Analysis Framework

All studies on the efficiency analysis agree that the choice of inputs and outputs is important. However, any input that has an impact on output measure should be taken into account when determining the efficiency scores, *i.e.* in the first stage (DEA model) and must not be introduced among the determinants of school efficiency, *i.e.* in the second stage. Appendix 1 presents the summary statistics on input and output variables.

4.2.2 Identification Method of Determinants of Schools' Efficiency: Tobit Model

Some studies went further and tried to relate efficiency to some teachers' characteristics among others variables by using several approaches in a second stage analysis (Bradley and *al*., 2001). Kirjavainen and Loikkanen (1998) apply Tobit model (Tobin, 1958) to explain efficiency by school characteristics, teachers and environment characteristics in Finnish senior secondary schools. Likewise, Waldo (2002) uses Tobit regression model to investigate the teacher characteristics effects on efficiency in public and private school in Sweden. In a similar manner, Bradley et al. (2001) use Tobit model to explain the secondary schools efficiency in England. In another study, Noulas and Ketkar (1998) use Ordinary Least Square to relate efficiency to local characteristics in public schools in New Jersey State (USA). From these empirical studies, we expect to use Tobit model in order to establish the relationship between teachers' characteristics and primary school efficiency in Tanzania.

The efficiency scores have an upper bound of one. Consequently, standard regression

techniques (ordinary least square, logit or probit) with these data come to biased or fallacious estimates. According to Maddala (1983) or Greene (2008), Tobit model estimation gives the robust coefficients. Nevertheless, the censored Tobit model is not appropriated when dependent variable does not include zero values. To overcome these difficulties, the literature strives rather to explain inefficiency scores (*i.e.* one minus efficiency score) by using the censored Tobit model because the inefficiency scores belong into interval [0 1[. The censored Tobit model used to analyze the explicative factors of inefficiency is specified as follows.

If Y_i represents the inefficiency score of any school i, the model can be written:

$$\begin{cases} Y_i = \beta X_i + v_i \\ with \begin{cases} Y_i = Y_i^* \ if \ 0 \leq Y_i^* \leq 1 \\ Y_i = 0 \quad if \ no \end{cases} \end{cases} \tag{2}$$

In this equation, Y_i^* depends on a number of explicative variables X_i. These variables did not include as inputs in the DEA framework. The effects are compiled in β vector. Y_i^* is the combination of predicted value by the deterministic component model βX_i and a residue v_i whose value changes randomly for each school. However, it is assumed that the variable Y_i^* is not observable directly but rather the variable Y_i continuous and limited between zero and one. Assuming errors are normally distributed, the Tobit estimator permits to maximize the log likelihood below:

$$LogL = \sum_{i=1}^{n} Log \left[1 - \Phi {X_i}^{\beta}/_{\delta}\right] + \sum_{i=1}^{n} Log \left(\frac{1}{\sqrt{2\pi\delta}}\right) - \frac{\sum_{i=1}^{n}(Y_i X_i \beta)^2}{2\delta^2} \tag{3}$$

Where n is the number of observation and δ, the standard deviation. The application of this model requires an appropriate choice of explicative variables presumed to be determinants of school inefficiency. Appendix 2 and 3 provide respectively the description of variables taken in account in DEA (first-step) and the list of variables selected for a Tobit model (second-stage).

5. Results

This section presents the major findings in two stages: first, the statistical analysis of efficiency score; second, the identification of factors determinant the school's efficiency scores.

5.1 Statistical Analysis of Efficiency Score

At the glance to the figure 3 showing the distribution of technical efficiency in Tanzania Primary School, it is important to remark that some primary schools (about 14% in the sample) are efficient (efficiency score equal one) and schools located in urban area are more efficient than those of rural area. In addition, the mean total technical efficiency equals 56,9% and the standard deviation is 0,2857. This output means that in average under CRS

hypothesis schools could increase their output by 43,1% keeping constant level of inputs if they had adopted most effective technology. This means that the large gaps exist in resources management from a global viewpoint compared to existing technology. However, the CRS hypothesis is valid only if total of schools in the sample operate at an optimal scale level (Coelli and *al*., 1998). Factors such as imperfection of competition or several of financial constraints could ensure that a school does not effectively operate. Regarding the pure technical efficiency scores about 25,75 per cent of primary schools sample are identified as technically efficient and operating at the best practice. The average VRS measure of technical efficiency is 64,7 per cent. This means that primary schools could increase their output approximately of 35,3% for an unchanged quantity inputs.

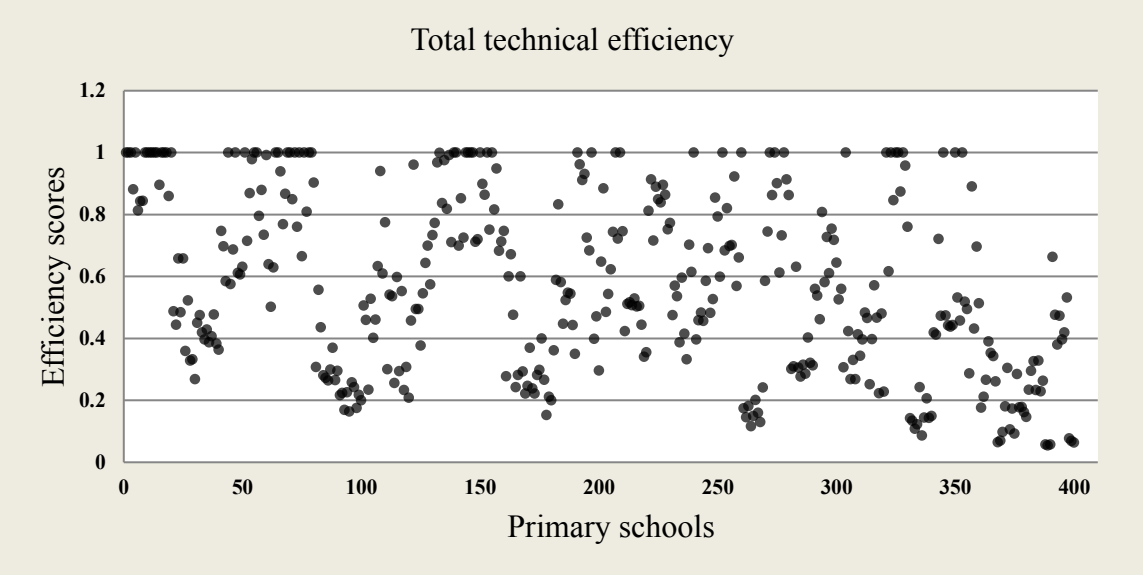

Figure 3. Efficiency Scores of Primary Schools over the Frontier

The difference between CRS and VRS technical efficiency index for the same school appears as a good measure of efficiency scale that represents the case of a school perfectly competitive and operating to an appropriate scale i.e. that its marginal cost equals to market price. To show a best visibility of this situation, the mean efficiency scores are presented in figure 4 below.

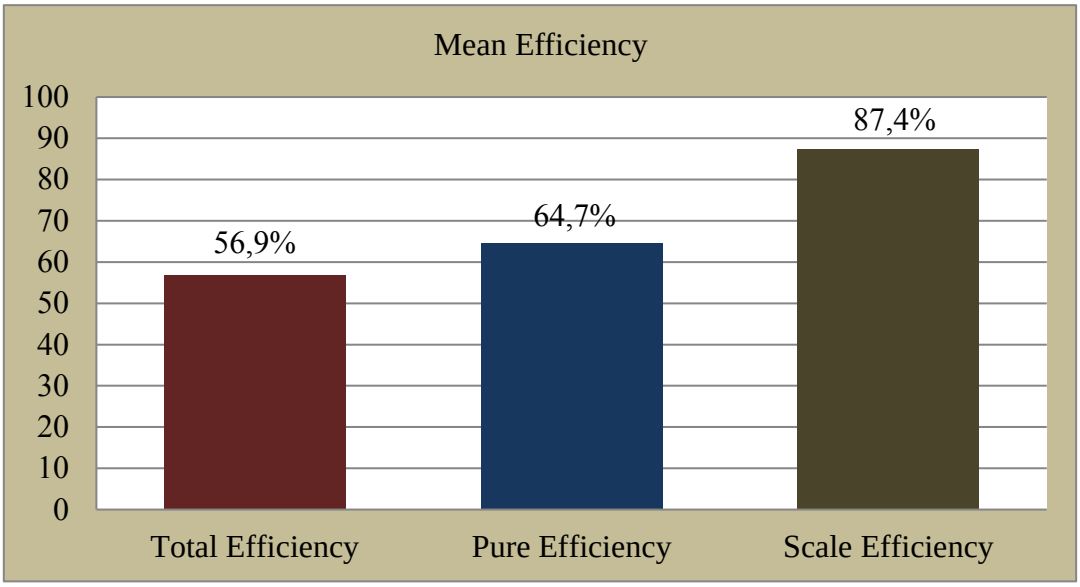

Figure 4. Technical Efficiency Average under Different Patterns of Scale Returns

As seen earlier, efficiency scale can be measured by CRS/VRS ratio. The ratio of unity indicates that the school is operating at optimal scale. About 17,25 per cent of schools in the sample are operating at their optimal scale. Thus, 82,75 per cent are above their optimal scale and hence could increase their technical efficiency by decreasing their size (number of pupils). In average, scale efficiency is about 87,4 per cent, the standard deviation is 0.1253. In fact, if primary schools adapted to their optimal size (scale efficiency), it would be possible to earn in order of 12,6 per cent. As seen above, the existence of sub-optimal or supra optimal scale is identified by equality or inequality of variable returns to scale and the non-increasing returns to scale input measures of technical efficiency. The results show that about 11,25 per cent are operating below their optimal scale (IRS). They also indicate that 71,5 per cent of schools are above their optimal scale (DRS).

5.2 Teachers' Characteristics as Determinants of Primary Schools Inefficiency

The school inefficiency is not only explained by mismanagement allotted to executives or non-adapted school organization but can also be influenced by the own structural environment of each school. This is why some authors like Ray (1988) propose to identify the sources of productive inefficiency through econometric regression of efficiency scores. It is intuitive to know if teachers' characteristics influence the primary schools performance. The econometric estimation results obtained in Stata sofware (table 3) show in terms of robustness that the model is overall significant (Prob. = 0.0009 < 0.01).

At first glance, results indicate that variables linked to school organization have a statistically significant impact on technical efficiency of primary schools. When school operates in one-shift its inefficiency score increases about 15 per cent than school that has two teaching shifts. In addition, primary school located in urban area perform 11,19 per cent in terms of technical efficiency score below school which takes place in rural zone. The negative and

statistically significant coefficient of -0,11649 on the dummy variable controlling for whether schools have at least one teaching award indicates that the teaching award improve technically the primary school efficiency of about 11,64 per cent. This finding is not surprising at the glance to empirical literature. In other contexts such as Chile, Contreras et al. (2003) who examined the teacher productivity bonuses effects on school performance indicated that the introduction of this incentive, which diversifies the income structure of teachers, increases the scores obtained in the standardized exams between 5 and 18 points.

What is the effect of characteristics of teacher leader on schools performance? The purpose of this paragraph is to establish the relationship between head teachers and primary school inefficiency. The findings reveal that school inefficiency depends significantly of some variables such as head teacher skills and experience. Compared to primary level diploma, the teacher leaders who have a secondary level diploma (Ordinary or Advanced-level) get the best practices and their school performs more. This finding is consistent with the views of Sotonwa (2003) and Olaleye (2011) which identified the qualities related to teaching skills such as content knowledge, clarity of expression, attitude and teaching skills. Mushra and *al*. (2007) also asserted that teachers' verbal or intellectual aptitude always correlates with better students' academic performance. However, the teacher leaders detaining an university diploma are overeducated and provide less effort because unsatisfied. Consequently, their school inefficiency score increases significantly. Obviously, a worker is said to be overeducated if he/she has acquired more education than is required to perform his/her job (Freeman, 1976). Numerous studies higherlight the overeducation effects on job satisfaction and health (Rumberger, 1981; Tsang & Levin, 1985; Hersch, 1991). In general, authors confirm the hypothesis that overeducation negatively affects workers' behavior and thus presents a severe risk for organizations (Vroom, 1964; Quinn & Mandilovitch, 1975).

Regarding the head teachers experience, the estimation results show a negative and significant relationship between teachers' years of experience and school inefficiency. When the teacher leader earn one year in terms of length of teaching service, inefficiency score decreases of 0,83 per cent. This finding confirms Darling Hammond (2000), Abraham and Keith (2006) or Owolabi (2007) who agree that teachers' experience is important in school performance. Experienced teachers have a richer background of experience to draw from and can contribute insight and ideas to the course of teaching and learning, are open to correction and are less dictatorial in classroom. Teachers' experience and student achievement was that students taught by more experienced teachers achieve at a higher level, because their teachers have mastered the content and acquired classroom management skills to deal with different types of classroom problems (Gibbons et al., 1997). Furthermore, more experienced teachers are considered to be more able to concentrate on the most appropriate way to teach particular topics to students who differ in their abilities, prior knowledge and backgrounds (Stringfield & Teddlie, 1991). From the positive relationship between number of years of teaching (experience) and performance, it is clear that as the age of head teacher progresses, the level of school inefficiency significantly decreases about 3,9 per cent.

Table 3. Determinants of Inefficiency in the Tanzanian Primary Education System

Independent variables	Dependent variable: inefficiency scores			
	Coefficients	Standard Error	T-student	P-value
School's characteristics				
Work in shifts (*Ref.: two shift*)	0,15055**	0,05869	2,56	0,011
School location (*Ref.: rural*)	- 0.11197**	0.04952	- 2.26	0.024
Teaching award in school (*Ref.: none*)	- 0,11649*	0,03559	- 3,27	0,001
Characteristics of Teacher leader in school				
Sex of teacher leader (*Ref.: female)*	0,01111	0,039385	0,28	0,778
Experience of teacher leader index	-0,00834*	0,00288	-2,89	0,004
Higher diploma of head teacher (*Ref.: Primary complete*)				
Secondary (o level or A level)	-0.00803	0.05947	-0.14	0.893
Diploma and postgraduate diploma	0.01292	0.08266	0.16	0.876
University (bachelor or master)	0.08863**	0.07350	2.16	0.034
Head teacher's grade (*Ref. Postgraduate degree)*				
Undergraduate degree in education	0.00339	0.05448	0.06	0.951
Diploma (grade V)	-0.10522**	0.07539	-1.98	0.047
Grade A	-0.14037	0.11698	-1.20	0.231
Age of head teacher	-0,03936***	0,02576	-1,76	0,071
Teacher's characteristics				
Gender composition in school (*Ref. More mistresses*)	-0,04401***	0,03255	-1,84	0,061
Mean level of school's professional experience	-0.00766*	0.00284	-2.69	0.004
Mean age of teachers in each school	0,02372	0,02099	1,03	0,303
Classroom management				
Teacher in class-teaching	- 0,06301**	0,00266	- 2,36	0,019
Teacher in class-not teaching	0,00715***	0,00420	1,70	0,089
Teacher not in class-learning activity ongoing	0,01379**	0,00587	2,35	0,019
Constant	0,33598	0,17396	1,93	0,054
Sigma	0,30497	0,01058		-----
Observations number: 400	Prob. > chi2 :		0,0009	
Left-censored observations: 56	LR Chi2 (18):		43,33	
Uncensored observations: 344	Pseudo R2 :		0,1353	

Sources: Own calculations

In concerning the gender effect on school performance, at the glance to table 3, having a male head teacher as opposed to a female increases inefficiency score by about 1,1 per cent but this effect does not significant. According to governance theory, women contribute to a company's success and the diversity in management teams is a competitive advantage. Kanter (1977) suggests that the women appointment to top management positions has symbolic value that may influence performance. Regarding the influence of the participation of women in top management positions on firm performance, the gender effect of head teacher in Tanzania is in accordance with previous findings that led to the expectation of a positive gender diversity-performance relationship (Joecks et al., 2012).

Overall and independently to the methodology adopted, teachers' characteristics have a

positive influence on school performance. More specifically, Akinsolu (2010), through the inferential statistics, shows a positive and significant relationship among quantity and quality of teachers and students' academic performance in the Nigerian secondary schools. Fehintola (2014) adopting a descriptive research design of correlational type discovered that about eight selected characteristics of teacher appear to be potent factors to academic performance of secondary school students in Saki-west local government area. Likewise, Olaleye (2011) investigates the perceptions of students on teachers' characteristics in relation to students' academic performance. Through Data analyzed by a simple percentage, Pearson Product Moment Correlation and chi-square, findings showed that there was a significant relationship between teachers' characteristics on students' academic performance. Kosgei (2013) establishes the relationship between teacher characteristics and students' academic achievement in Biology subject in selected secondary school in Kenya. Using the descriptive and inferential statistical techniques, he reveals that teacher experience had significant relationship with student academic achievement in Biology. In the Kenyan context, Kathuri (1986) established that there was relationship between teachers' characteristics and pupils' performance in Core Primary Education; when Kimani and *al*. (2013) by using linear regression and one-way Analysis of Variance found that teachers' job group had significant and positive relationship with students' achievement.

Interestingly, the professional diversity appears to be significant in explanation of the primary school efficiency. Schools that dispose more masters than mistresses in teacher staff are technically efficiency. This manner of gender composition permits to school to decrease about 4,4 per cent of its inefficiency score. Similarly, when the mean year of teachers' experience in a school increases, the inefficiency score decreases significantly of about 0,7 per cent. This is in accordance to Thias and Carnory (1972) or to some recent studies (Rockoff, 2004; Sanders et al., 2005; Clotfelter et al., 2006; Goldhaber & Anthony, 2007) which already observed that teacher's experience had significant effects on school performance.

The responsibility of teachers in the use of classroom management strategies is related to multiple learning goals for students. Classroom teachers are known as classroom managers because of their roles in managing learning activities, instructional procedures, the prevailing attitudes, feeling and atmosphere in the classroom (Osakwe, 2014). At the glance to previous studies such as Evertson and Weinstein (2006) or Korpershoek et al. (2014), this study retains three strategies: teacher in class and teaching, teacher in class but not teaching, teacher does not in class but learning activity ongoing. On the empirical view, the fact that teacher in classroom and teaching improves significantly the school efficiency scores. This behaviour involves a decrease of technical inefficiency of about 6,3 per cent. However, when teacher is in class but not teaching and when teacher does not in class but learning activity ongoing, the school does not perform effectively. The inefficiency score increases about 0,7 and 1,3 per cent respectively. Consequently, the success of any educational system is a function of the teachers' behavior of classroom.

6 Conclusion and Recommendations

In developing countries such as Tanzania, resources are often scarce to finance the free educational policy. In this context, policy makers are increasingly concerned with measuring efficiency. The efficiency scores offer ideas and opportunities to improve the ability of primary school in cost usage and allocation. In addition, efficiency analysis gains in relevance because schools, which are more efficient, tend to be more inclusive. The aim of this study was to investigate the influence of teachers' characteristics on technical efficiency in Tanzania primary school system. To achieve this goal, analysis is focused on two complementary methodological approaches: a non-parametric technique called Data Envelopment Analysis and Tobit regression. Beyond the school location and incentives, findings reveal that the head teacher's characteristics and the composition in school of teachers' characteristics influence significantly the technical efficiency of school. More specifically, the findings reveal that school efficiency depends significantly and positively to head teacher skills, head teachers' years of experience, age of head teacher and head teacher gender. In accordance to composition effects of teachers' characteristics, the professional diversity, the mean year of teachers' experience in a school and the gender composition appear to be significant in primary school efficiency explanation. Overall, this analysis highlighted more evidence on efficient/less-efficient schools and reasons why some perform better than other does. This led to rejection of null hypothesis that there was no significant relationship between teachers' characteristics and schools' technical efficiency. About implications for practice, the good governance is recommended to ministry of education in school budget management or resources allocation and monitoring systems. Furthermore, the government must pay attention on the evaluation of teachers' characteristics before appointment and affectation into Tanzanian primary school system.

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Notes

Note 1. The consensus appears to be that providing more resources–money–to schools may improve outcomes, but that there is no guarantee.

Note 2. School head or teacher leader is an educator that works with fellow colleagues for the purpose of improving teaching and learning, whether in a formal or an informal capacity.

Note 3. The PEDP targets such as articulated in Jomtien and Dakar.

Note 4. More over some studies from Uganda and Malawi also conclude that hasty enrolment expansion tends to erode quality (Bruns et al. 2003).

Note 5. The x-efficiency theory is a theory, which differentiates itself from other theories like the neoclassical view because it takes other variables into consideration. One of the other variables is the motivation of the employees or individuals (Huil, 2014).

Note 6. This assumption is that Leibenstein views individuals as the basic unit of analysis (Taylor and Taylor, 2003).

Note 7. Despite its apparent realism, the theory of x-inefficiency has been strongly criticized by some authors (Parish and Yew-Kwang, 1972; Stigler, 1976).

Appendix

Appendix 1. Summary statistics on input and output variables

Output variables					
Variables	**Observation**	**Mean**	**Standard Deviation**	**Min.**	**Max.**
Mathematics score tests	400	49.4	2.8	25.9	54.8
Language score tests	400	26.5	6.3	21.3	34.6
Input variables					
Pupils /teachers ratio	400	46.06	17.1166	14	121
Absence rate per school	400	40.327	21.33267	3.39	96.1
Proportion of pupils that used Textbooks	400	92.758	21.11171	0	100
Proportion of pupils that used Exercise-books	400	92.758	21.11	0	100
Proportion of pupils that wrote on the blackboard	400	4.092	7.8639	0	53.33
Proportion of pupils did the teacher go to individually	400	16.739	24.665	0	100

Sources: Own calculations

Appendix 2. Description of explicative variables of efficiency

Definition of variables	Explanations
Teacher Characteristics	
• *Age*	*Number*
• *Gender*	*Dummy variable: 1 = if school have more teacher male than female and 0 = if no.*
• *job experience*	*Number*
• *qualification or training*	*Highest level of teacher training completed*
Teacher leader characteristics	
• *Age*	*Number*
• *Gender*	*Dummy variable: 1 = male and 0 = female.*
• *job experience*	*Number*
• *professional qualification in education*	*Highest level of professional education completed*
• *qualification or training*	*Highest level of teacher training completed*
School characteristics	
School Shifts	*Dummy variable: 1 = one shift and 0 = two shifts*
School location	*Dummy variable: 1 = urban and 0 = rural*
Teaching Award School	*Dummy variable: 1 = yes and 0 = no*

Sources: author

Appendix 3. Summary statistics on explicative variables

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
Teacher Characteristics					
Mean Age of teachers per school	400	37.84	8.89237	19	47
Gender diversity per school	400	0.5325	0.499567	0	1
job experience	400	12. 5	6.93.363	2	30
qualification or training	400	1.99	0.539097	0	1
Teacher leader characteristics					
Age	400	36.16	8.192814	30	54
Gender	400	0.67	0.470801	0	1
job experience	400	0.4725	0.6206503	0	2
professional qualification in education	400	0.4725	0.620650	1	3
qualification or core training	400	2.08	0.5140629	1	4
School characteristics					
School Shifts	400	0.885	0.3194215	0	1
School location	400	0.9025	0.2970089	0	1
Teaching award in School	400	0.68	0.4670603	0	1
Classroom management					
Teacher in class-teaching	400	26.6	7.6246	0	30
Teacher in class-not teaching	400	2.49	3.8984	0	22
Teacher not in class-learning activity	400	1.33	2.3906	0	14

Sources: Own calculations