ANALYSIS OF DETERMINANTS OF PUBLIC HOSPITALS
EFFICIENCY IN CAMEROON

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ABSTRACT

In Cameroon, the public health system is consisted of three sectors: public, private and traditional sectors. Quantitatively, the public sector is the dominant sector, in terms of its staff and equipment. The private sector is marginal. However, the national survey tracking public expenditures in the health sector shows that 65% of those surveyed prefer public hospitals and 34.7% prefer private hospitals. In the cities of Douala and Southwest, 55.6% and 56.6% of their population prefer private hospital services respectively. This result is paradoxical given that public hospitals usually have more structured technical support, higher budget allocations, increasing number of doctors and nurses and in addition practice relatively low charges. The objective of this study is to analyze the determinants of the efficiency of public hospitals in Cameroon. The methodology for measuring efficiency is the nonparametric approach (data envelopment analysis) and sources of inefficiency are analyzed using a censored Tobit model. We can retain that District health centres and integrated health centres, characterized mainly by low levels of available resources, are more efficient than district hospitals that have more resources. This result corroborates the fact that the fall in production of public hospitals in Cameroon is better explained by a lack of efficiency than by a lack of resources. Furthermore, the inefficiency of Cameroonian public hospitals is particularly explained by the occupation rate of hospital beds, corruption, the cost of health care and the degree of specialization.

KEYS WORDS: public hospitals, data envelopment analysis model, efficiency, Tobit censored

INTRODUCTION

The Cameroonian population is estimated at 19 406 100 inhabitants on January 1st, 2010 with a density of 39 inhabitants per km2 and considerable regional disparities. This population is essentially young: 43.6% are under 15 years old and more than half of the population is less than 18 years old. The structure by sex of the population shows a slight imbalance between the male and the female. Women represent approximately 51% of the population and the male 49%. The population growth in the urban areas is less than that in the rural areas. The annual demographic growth rate passed from 2.8% in 2005 to 2.6% at the end of 2009.

PRESENTATION OF THE PUBLIC HEALTH SYSTEM

The organization of public health system was defined in 1989 by the Ministry of Public Health by the N°89 / 011 decree. The participants in the domain of health work within a system structured in three levels: the central level which constitutes the Central Services of the Ministry of Public Health and
National hospitals; the intermediate level which constitutes the regional delegations of public health and regional and assimilated hospitals; and the peripheral level which includes the District hospitals and Health centers. Importantly, every level is made up of three sub-sectors, namely the public, the private and the traditional medicine sector.

**STAKEHOLDERS**

The stakeholders remain the State, the households and the communities, private centers, traditional doctors and international partners. The State intervenes in the sector as regulator, supplier of resources and the producer of health care. The households and the communities are called to play an important role in the definition of health policies and programs, the planning and the implementation of these latter as well as their follow-up and evaluation. The insufficiency of decentralization, the lack of training and supervision slow down the effective participation of the households and the communities in the management of health structures.

The private sector intervenes through the private sector with lucrative goals and the non-profit private sector. The private sector with lucrative goals has for each of the following professions: doctors, dental surgeons, pharmacists and male nurses an order and a labour union. The non-profit private sector includes confessional centres by the Roman Catholic Church, the Federation of Missions and Evangelic Churches of Cameroon (FEMEC), and the Muslims. The private sector with lucrative goals concentrates mostly in urban areas whereas the non-profit private sector is distributed across the whole territory.

The exercise of traditional medicine is non-regulated. However, in order to promote traditional medicine, the Ministry of Public Health has created a service in charge of traditional medicine and a Research centre on Healing plants and the traditional Medicine (CRPMT / IMPM)

Many international partners intervene actively in the health sector of Cameroon. Some support the Government in her efforts to develop the district health system and others in the development and implementation of priority programs. We have in particular UNICEF, WHO, World Bank and UNAIDS

**RESOURCES**

The country benefits from infrastructures and from human resources in excess of the average in Africa as the shown in table 1
Table 1: The workforce and the bed capacity of public health system in Cameroon with respect to the average in Africa

<table>
<thead>
<tr>
<th></th>
<th>Physicians</th>
<th>Nurses and midwives</th>
<th>Beds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Density per 10,000</td>
<td>Number</td>
</tr>
<tr>
<td>Public health in Cameroon</td>
<td>3124</td>
<td>2</td>
<td>26042</td>
</tr>
<tr>
<td>Regional average (Africa)</td>
<td>150708</td>
<td>2</td>
<td>792361</td>
</tr>
</tbody>
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The sanitary cover by health care establishments sharply improved, passing from 3,039 in 2007 to 3,370 in 2009. The Cameroonian health system has 04 general hospitals (1st category), 04 central hospitals (2nd category), 11 regional hospitals (3rd category), 164 district hospitals, 155 district health centres, and 1,888 integrated health centres among which 1,600 are functional. In addition, we have 93 private hospitals, 193 non-profit private health centres, 289 clinics and polyclinics and 384 surgery centres. It is also necessary to consider 12 approved laboratories of medical analyses with Centre Pasteur as the reference, 05 manufacturers of drugs, 14 wholesalers, 331 pharmacies (with 181 in Yaoundé and Douala), 01 National centre of drug and medicine provision.

Mainly we have 10 regional pharmaceutical centres, 03 public faculties of medicine in Yaoundé, Douala and Buea and 01 private faculty of medicine (Université de Montagnes) and 39 training centres of medical-sanitary staff. However, Cameroon has a good number of sanitary infrastructures unevenly distributed between regions, within regions and even between urban and rural zones. Thus, only 26 districts out of 172 have no District Hospital and 412 Health areas out of 1462 have no Integrated Health centre (Ministry of Public Health, 2009).

SOURCES OF FINANCING

The main financial sources for the health sector are: the national budget, the households through the costs covering and other direct payments and external financing. The local public authorities, NGO and private health insurance support marginally. Enormous disproportions exist between these financial sources. In 2009 for example, out of the total financing of the sector estimated at 2,301.1 billion FCFA, the contribution of households stood at 94.6% against 3.8% (that is 86,779,000,000 FCFA) by the State.
and 1.6% (37,425,080,000 FCFA) by foreign partners. It is necessary to note that this budget does not include the health resources assigned to other administrations (Loi des finances, 2009).

HEALTH STATUS INDICATORS

Although the country has human resources and equipments greater than or equal to the African average, the indicators of health globally degraded: the life expectancy at birth is passed from 56 years in 1990 to 52 years in 2007; the life expectancy corrected for invalidity is situated at 45 years, adults mortality rate passed from 295/1000 in 1990 to 384/1000 in 2000 before reaching 419/1000 in 2007; infant mortality passed from 85/1000 in 1990 to 88/1000 in 2000 before returning to 87/1000 in 2007 (WHO, 2009).

CAMEROONIAN PUBLIC HOSPITALS: A STATE OF DYSFUNCTIONS

The functioning of public hospitals is hindered by multiple difficulties. Among the most recurrent, (Balique, 2003; INS, 2005; Ministry of public health, 2006) consider five main elements:

- Difficulties of geographical accessibility: some regions - in particular those in the East, South and the North suffer these problems as a result of their demographic situation, long distances between villages and difficulties to circulate in these areas during the rainy seasons;

- Insufficient quality of care: lateness with emergency cases because of the inadequacy of payment mechanisms; the lack of quality training; the absence of standards norms; the absence of quality evaluation schemes; the insufficiencies in the consideration of patient and iniquity in the access to healthcare. This leads to the selection of health centres by patients following the social category. For instance, general hospitals are essentially reserved for the most favoured social categories and the poor categories of the population use the other health establishments. This contradicts totally the idea of public service;

- Non mastery of costs: charges are fixed irrespective of the cost of the corresponding services, because there are not known; pharmaceutical prescriptions done without specialist; shortages of stock obliging the patients to buy drugs prescribed at very high prices in private pharmacies; breakdowns of equipment, lack of reactive and unjustified absence of staff. Besides, low payments and lack of authority lead to the multiplication of illicit payments to obtain health-care and solicitude care;

- The inadequacy of the system of financing, the absence of an objective base in granting subsidies, the persistence of free accesses, which burden heavily the accounts of hospitals without insuring a significant access of the needy to hospitals. However, the institutionalization of direct payment by the patient remains inequitable in the context of poverty;

- Insufficiencies in human resources management: no mastery of human resources by hospital management, weak motivation of the staff, insufficient staff in some specialities and insufficient in-service training;
- Inefficiency in the management of material resources: public institutions of health are administered and not managed. We observe particularly the inadequacy of management tools: the absence of cost accounting, making it impossible to determine in a continuous manner the cost of the various services; lack of economic criterion in the process of decision (for example in the allocation of resources or in the creation of posts); absence of any depreciation allowance and the importance of unrecovered issues (needy, emergencies, unrecovered debts).

All the dysfunctions of public hospitals have pushed Cameroonian to prefer most often than not private hospitals as illustrated by the report of the survey on the follow-up of public spending and satisfaction of beneficiaries (PETS). According to the report of the PETS survey published in 2005, if hospitals are rather heterogeneous in terms of means and results, we will observe that public hospitals nevertheless better endowed in resources register low rates of attendance and satisfaction of patients compared to private health centres.

- 65.3% of patients frequent a structure of public health against 34.7% that opts for a private sanitary centre. In Douala and the Southwest, the population prefers private care: 55.6% and 53.6% respectively;

- The quality of reception seems more appreciated in the private health sector. 88% of patients met in public sanitary centres are satisfied or very satisfied with the reception that they received, compared 97% for those met in private sanitary centres.

- Consultations are better appreciated in private care than in public care. The proportion of patients who declare complete or good consultation in the private sanitary centre is 6 points more than that of the public sanitary centre. Besides, the number of patients consulted by a doctor is more in the private sanitary centre than in the public\(^1\). The proportion of patients consulted in the private sanitary centres by a doctor is 11 points more than that of the public sanitary centres. The more the number of patients consulted by a doctor, the more the quality is assured;

- however, the average consultation duration is 20 minutes in a health centre. In the private sanitary centre this duration seems slightly higher than that of the public health centres. It suggests that the first examination of patients seems better in the private health centres.

This report is paradoxical since public hospitals have generally a more developed technical support and practice relatively low prices. Indeed, if the purpose of public hospitals is to insure access to quality care, essential, relevant and affordable product costs to all on the national territory, Cameroonian public hospitals do not assure this mission to the satisfaction of their users (Médard, 2001; Okalla and Vigouroux, 2001; Balique, 2003; Olvera and al, 2008).

\(^{1}\) For this reason, patients generally prefer to consult in private health centres than in public health centres, even if the price is high.
The government aware of this has elaborated and adopted a sector-based strategy of health since 2001. Among the objectives of this sector-based health strategy, the government focused mainly on the means of an efficient management of resources in 90% of public hospitals (Balique, 2003; Ministry of public Health, 2006). This work thus contributes in the research of the determiners of public hospitals efficiency in Cameroon.

LITERATURE REVIEW

The question of the efficiency of health services becomes central for financing policies. It is the main message of the report on health in the world, published by the World Health Organization in 2000. Indeed, it is a question of better using the available resources to improve the efficiency of health services and better bind the implemented resources to the results. It is also a concern considering the tension which exists between financial needs and mobilisable resources to release resources, thanks to efficiency gains, in order to finance health needs in the future (Hensher, 2001; World Bank, 2004).

There is an extensive amount of literature examining the performance of the health care sector. Studies, which focus on efficiency and productivity using frontier techniques, have been undertaken in all areas of the health sector: from primary care to secondary care, tertiary care to nursing home care, as well as from the overall health system to health care providers, administrative bodies, and subgroups in health care providers such as departments and professionals. The review of efficiency studies in the health care sector has been undertaken in the studies of Hollingsworth and al. (1999) and Hollingsworth (2008).

Hollingsworth (2008), based on an analysis of 317 publications on the efficiency of health centres, concluded that «the public offer can be potentially more efficient than the private offer ».

METHODS OF EFFICIENCY MEASURE

Two methods of efficiency measure are available in the literature: the parametric methods and the non parametric methods.

In the parametric approach, we suppose the existence of a production function, that is the existence of a particular analytical expression representing the maximum output for a given level of inputs (or the minimum input necessary for the production of a given level of output.) this production function, which corresponds to an optimal physical allocation of production resources, defines a border which determines all the physically realizable productions of the considered activity sector.

The parametric models were applied in the analysis of efficiency of hospitals by many authors. We have for example Wagstaff, 1989; Zuckerman and al. 1994; Linna, 1998; Rosko, 2001. This approach is recommended when the nature of the production function of good or service is known. But the production function of health establishments is not a priori known and makes object of a debate (Jacobs and al, 2006).
Pioneer works of Charnes, Cooper and Rhodes (1978) introduced the notion of the Data Envelopment Analysis (DEA). They propose a linear program to measure the technical efficiency in a case of technology (multi-product and multi-factors). Their development resorts to no hypothesis (strong) on the nature of the production function. From these works, many authors have spread the measure of productive efficiency to non-tradable activity sectors and to the sector of health by means of non-parametric methods of estimation of production frontiers. The DEA method incorporates easily many outputs, thus, it is particularly more practical to measure health efficiency, which due to the nature of their activities use inevitably many inputs and produce several outputs. The DEA approach is more suited (compared to the stochastic frontier approach: SFA) in the estimation of the productive performances of non-profit services where, the prices are generally difficult to determine (Coelli and al, 1998). Among other relevant applications: (Audibert and al, 2007; Ray, 2008; Weng and al, 2009) resorted to the DEA approach in recent studies on productive efficiency of hospitals, in industrialized or developing countries. In the African context, the analysis of health establishments based on the DEA method is become popular, particularly in the Anglo-Saxon countries. The hospitals efficiency has been analyzed in Angola (Kirigia et al, 2008), Ghana (Osei, 2005), Kenya (Kirigia and 2002), Namibia (Zere et al, 2006), in South Africa (Kirigia et al, 2000; Zere and al,2001), Uganda (Yawe and Kavuma, 2008), Zambia (Masiye, 2007) and Benin (Kirigia et al, 2010).

LITERATURE ON THE EFFICIENCY OF PUBLIC HEALTH CENTRES IN CAMEROON

There are many studies on the public health sector in Cameroon. But no study focuses on the efficiency of hospitals generally and public hospitals in particular. Existing works focus on the financing (Amin, 1995; Ntangsi, 1998), the effects of direct payments of care by patients on the use of public hospitals (Litvack and Bodart, 1993), the impact of decentralization on human resources management in public hospitals (Médard, 2001), the distributive impact of public spending on the health sector (Kamgnia, 2005)

Amin (1995) states that as overall public spending decreased in the early 1990s, the improvement in health care services required shifting the financing to the individuals through the institution of user fees. Ntangsi (1998) quantifies the contributions of both the public and the private sectors in the supply of health services for the 1995/96 fiscal year. Litvack and Bodart (1993) observed that user fees and service quality led to increased utilization of health facilities, given that the travel and time costs involved in seeking alternative sources became too high. Kamgnia (2005) shows that public spending in integrated Health centres (IHC) benefit the poor than the rich; those of reference hospitals are unfavourable to the poor, and the marginal increase of spending renders IHC more attractive.

Our study of the efficiency of Cameroonian public hospitals is vital for three main reasons:

Firstly, it constitutes a contribution to the literature on the determiners of efficiency of public hospitals in Cameroon.
Secondly, in the health sector, the need to realize the Millennium Development Goals (MDG), the Cameroonian government has elaborated a Sector-based Strategy of Health. The objectives of this sector-based strategy of health are:

- to reduce by at least 1/3 the global morbid load and the mortality of the most vulnerable groups of the population;
- to set up, at an hour walking distance and for 90% of the population, a health centre delivering the minimum package of activities;
- to practice an efficient management of resources in about 90% of health centres.

Research on the determinants of public hospital efficiency answers a current concern of the Cameroonian government. Thirdly, as a public service, the public health centres have to insure access of the whole population to health care, quality emergency care, affordable product cost. This requirement of public service is particularly incompatible with the observation that approximately 20% of Cameroonians are still excluded from the public health services (Médard, 2001), and that they continue to finance approximately 74% of their health expenses (Olvera, Flat and Pochet, 2008).

OBJECTIVES OF THE STUDY

This proposal has as main objective to identify the determinants of efficiency of public health centres in Cameroon. Specifically the study

1) evaluates the efficiency scores of public hospitals; and
2) identifies the sources of inefficiency of public hospitals in Cameroon.

METHODOLOGY

MODELS OF STUDY

The non parametric method is used to determine the level of efficiency of public health centres in Cameroon. In fact, the non parametric approach has the advantage of not imposing any specification of the production technique or the efficiency distribution law (Hollingsworth and al, 1999). The choice of a non parametric technique in the assessment of efficiency in the health domain has the advantage of taking into consideration the specificities of health sectors, such as; (i) the complexity of multiproduct/multifactor technology, (ii) the absence of both inputs and outputs prices, (iii) the uncertainty related to the behaviour and objectives of actors engaged in the health sector (Leleu and Dervaux, 1997).
Amongst the non parametric approach, the DEA method (Data Envelopment Analysis) is the most currently used to measure efficiency both in the health sector or in other sectors of the economy (Hollingsworth, 2008). In addition, as indicated by Osei and al. (2005) in their study of efficiency in Ghana hospitals and Valdmanis and al. (2004) in their study of efficiency in Thai hospitals, the application of DEA is likely to be suitable in low income countries. They showed that DEA analysis is useful when working with insufficient health sector information, and particularly when the price data is missing. The DEA method was initially developed by Charnes and al. (1978). They were inspired by the works of Farell (1957). Without knowledge on the net global cost necessary for the functioning of health centres and the inputs prices, our study focuses on technical efficiency (Guisset and D’Hoore, 1998; Leleu and Derveau,1997; Byrnes and Valdmanis, 1994; Audibert and al, 2007).

COMPUTATION OF EFFICIENCY SCORES OF PUBLIC MEDICAL CARE UNITS IN CAMEROON

a) Specification of DEA model

According to Coelli (1998) the best way to introduce the DEA method is by using ratio form. Hence for each decision making unit in our sample, we would like to obtain a measure of the ratio of all outputs over all inputs, such as:

\[ \frac{\sum_{k=1}^{K} y_{jk} \nu_k}{\sum_{i=1}^{I} x_{ij} \lambda_i} \]  

(1)

Let us consider J hospitals (j=1,…,J) which could be evaluated, each hospital use different quantities, \( x_{ij} \), of inputs \( i = 1,\ldots, I = 5 \), in order to produce many quantities of outputs, \( y_{jk} \), of different outputs \( k = 1,\ldots, K = 3 \). Let us equally define \( u_{jk} \) and \( v_i \), as been the weights attributed respectively to different levels of outputs \( K = 1,\ldots, K = 3 \) and to the different levels of inputs. To select optimal weights, we specify the mathematical programming problem . It is represented as follow:

\[ \text{Max} \quad \frac{\sum_{k=1}^{K} y_{jk} u_{jk} \nu_k}{\sum_{i=1}^{I} x_{ij} \lambda_i v_i} \]

(2)

\[ \text{s/t} \quad \frac{\sum_{k=1}^{K} y_{jk} u_{jk} \nu_k}{\sum_{i=1}^{I} x_{ij} \lambda_i v_i} \leq 1 \]

\[ u_{jk}, v_i \geq 0 \]

\[ j=1,2,\ldots,J \]

2 Others non parametric methods exist: For example, the MCDM (Multiple Criteria Decision Making) models; the MOLP (Multiple Objective Linear Programming) models and the FDH (Free Disposal Hull) models. The FDH method remain relatively near the DEA method and had equally used in the health center. DEA, MOLP and MCDM methods are complementaries models, non by substitute, since the first is considered has been an evaluation tool of ex post performance, meanwhile MOLP and MCDM models are generally considered has been planification tool ex ante (Joro and al,1998)
The program is interpreted as follows: the efficiency of a medical care unit is obtained as ratio between outputs and inputs under the condition that this ratio should be less than or equal 1 for the entire production unit. This implies the determination of the values of $K_k$ and $V_l$ in such a manner that the measurement of the $j$ production unit should be maximal under the constraint that any measures of efficiency should be less than or equal to 1. The problem with this formulation in terms of ratio is that it contains an infinite number of solutions (Coelli and al, 1998). In avoid this, the numerator or denominator of the ratio should be equal to 1 ($V^lX = L$). Hence, the problem becomes a problem of maximization of output under the constraint of inputs (or minimization of inputs under the constraint of outputs). We can re-write the program as a multiplier program or primal program as follows (3):

$$\begin{align*}
\text{Max}_{\mu, \nu} \quad & (\mu \nu) \\
\text{s/t} \quad & v^lX_l = 1 \\
& \mu \nu - v^lX_l \leq 0 \quad \mu, \nu \geq 0 ; \ i = 1 \ldots I
\end{align*}$$

With the help of a dual linear program we can obtain the equivalence of program (3) in an envelope form (dual$^3$):

$$\begin{align*}
\text{Min}_{\theta, \lambda} \quad & \theta \\
\text{s/t} \quad & -y_l + X\lambda \geq 0 \\
& \theta X_l - X\lambda \geq 0 \\
& \lambda \geq 0
\end{align*}$$

Where $X_l$ et $Y_l$ represent vectors of inputs and outputs of each medical care unit $I$; $X$ and $Y$ are matrix of inputs and outputs representing data for all the $I$ medical care unites; $\theta$ is a scalar ; $\lambda$ is a constant vector with size $N \times 1$. The problem is resolved $N$ times, for each health care establishment in the sample to generates $N$ optimal values of $\theta$ and $\lambda$. The value of $\theta$ obtained is the efficiency score for a health establishment $i$ and is less than 1; 1 indicating the point on the reference frontier and revealing the position of the technically efficiency production unit according to Farrell.

All the long, we have considered the hypothesis of constant return to scale in conformity to the model proposed in Charnes and al. (1978). The hypothesis of constant returns to scale is appropriate

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$^3$The advantage of this transformation is that is requires a reduced number of constraints (Coelli et al. 1996).
when all decisions units operate at an optimal scale. However, financial and regulatory constraints or of market can lead a unit not to realize an optimal production. This observation pused Banker and al. (1984) to extend the efficiency measure to variable return to scale, introducing an additional convexity constraint. This way, CCR model can be modified by taking in to account the variable returns to scale hypothesis. The additional constraint implies that an inefficient health establishment can only be compared with another operating on a similar scale. Adding a convexity constraint \( N^\prime \lambda = 1 \) in program (4), we obtain:

\[
\begin{align*}
& \min_{\theta, \lambda} \theta_0 \\
\text{s} & / t \\
-\theta x_1 + H \lambda & \geq 0 \\
\theta x_1 - X \lambda & \geq 0 \\
N^\prime \lambda & = 1 \\
\lambda & \geq 0
\end{align*}
\]

Where \( N_1 \) is a vector of \( N \times 1 \) dimension composed of 1

b) **Specification of the variables used to calculate efficiency scores**

To generate the level of efficiency of health centres, we first specify the inputs and outputs of health units.

**Outputs and Inputs**

Concerning outputs, the specification commonly used to study the technical efficiency of hospitals in the non-parametric approach considers as outputs the number of consultations, adding the number of emergencies, for external consultations (Audibert and al, 2007; Afonso and Fernandes, 2008). Concerning hospitalizations, we consider the number of admissions, the number of days, weighted by the severity of the cases (Linna 1998; Dervaux and al. 1997), or the number of outlets by service (intensive surgery, surgery of emergency, maternity), preferred length of stay, to avoid endogeneity problems (or confusion between efficiency and occupancy) and bypass the need for an index of severity (Byrnes and Valdmanis 1994). Where possible, the model incorporates the quality of care that the disparity between hospitals or services may have an impact on technical efficiency by affecting the mobilization of resources and costs (Carey and Burgess, 1999; Pouvoirville and Minvielle, 2002).

The classical inputs are labour (staffs) and capital (beds). Labour can be classified into many categories. Some authors consider only two categories: doctors and other staffs (Eakin, 1991) or nurses and non nurses (Folland and Hofler, 2001). Others consider three categories: academic staff, staff nurses
and administrative staff (Steinmann and Zweifel, 2003; Yu and Ruolz, 2008). Another group considers four categories: the medical staff, nurses, other health workers and administrative staff (Scuffham and al, 1996) or administrative staff, non-medical staff, technicians and support staff (Vita, 1990). Outside of work and capital equipment used in the clinic is also a category of input (Eakin, 1991; Scuffham and al, 1996). Capital is not easily measurable in contrast to the work that is measured by physical quantities (number of workers, hours of work). To measure capital, the number of beds is commonly used as a measure of capital stock (Wagstaff, 1989; Rosko, 2001). Some authors add the expenses, but this inclusion can be criticized in that technical efficiency involves the unique ability to combine the quantities of inputs and not the ability to also use inputs at the best price (Audibert and 2007).

In Africa, Osei et al (2005) used DEA to estimate the technical efficiency of public district hospitals and health centers in Ghana. The hospital DEA model had a total 7 variables, including 3 outputs and 4 inputs. The outputs included number of maternal and child care, number of child deliveries, and number of patients discharged. The inputs included number of medical officers, number of technical officers, number of supporting or subordinate staff, and number of hospital beds. On the other hand, the health center DEA model was estimated with a total of 6 variables, including 4 outputs and 2 inputs. The outputs included number of child deliveries, number of fully immunized children under the age of 5 years, number of other maternal and childcare visit, and number of outpatient curative visits. The inputs included the number of technical staff and number of supporting or subordinate staff. Kirigia et al. (2002) studied the technical efficiency of 54 district level public hospitals in Kenya using DEA. The inputs concern: medical officers, pharmacists, dentists; clinic officers; nurses; administrative staff; technicians, technologists; other staff; subordinate staff; pharmaceuticals; non pharmaceuticals supplies; maintenance of equipment, vehicles, and building; and food and rations. The outputs are: outpatient department casualty visits; special clinic visits; dental care visits; general medical admissions; pediatric admissions; maternity admissions; and amenity ward admissions. In another study Kirigia et al. (2004) investigated the technical efficiency of 32 public health center in Kenya. The six inputs they used were: clinical officers, and nurses; physiotherapists, occupational therapists, public health officers, dental technologist; laboratory technician, laboratory technologist; administrative staff; non-wage expenditures; and number of beds. The four outputs were: diarrhea, malaria, urinary tract infections, intestinal worms, respiratory disease visits; antenatal, family planning visits; immunizations; and other general outpatient visits.

In the case of Cameroon, the outputs and inputs are inspired from the previous DEA health care studies and availability of data.

The outputs retained are:
- number of maternal and child care;
- number of medical tests;
- number of consultations;
admissions number;
- the number of cumulated hospitalization days

The inputs retained are
- number of beds;
- the medical staff, that is all physicians; the number of physicians represents physical quantities, that is, the total number of permanent and non-permanent physicians in the health establishment during the period of investigation;
- the paramedical personnel which represent the group of nurses and the assimilated; the number of nurses also represents physical quantities, that is, the total number of permanent and non-permanent nurses present in the health establishment during the period of study;
- the technical personnel which is constituted by laboratory technicians;
- the administrative personnel which is composed of a group of individual which provides the financial and the administrative management of the hospital.

The DEAP software (Coelli, 1996) version 2.1 is used to calculate technical efficiency. The model adopted is a model under the assumption of variable returns to scale-oriented output (output maximization). The model is estimated together for three groups of public health centres: District Hospitals, District Health Centres and Integrated Health Centres. We are interested only in public health centres in this study for at least two reasons: firstly, it is important to know whether public resources allocated to public health establishments for the treatment of Cameroonians are used efficiently and secondly, the availability of data on these institutions. The public health hospitals studied are District hospitals, District health centres and integrated health centres. The other categories of public health institutions such as general, regional and central hospitals are excluded from the study due to their particular statutes. Mission, private and traditional health establishments do not interest us because of the fact that they function following the principle of economic rationality due to the private nature of resources contrary to public health establishments where the problem of wastage of resources is permanent. Also, it should be noted that these institutions suffer from the lack of data. Considering traditional health institutions, it is important to note that these structures function mostly in the informal sector despite the setting up of a legal framework by the Cameroonian government. We can particularly

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4 General, regional and central hospitals don’t depend directly on the Ministry of Public Health. They are structures having financial and administrative autonomy as they function with a board of administrators. This status explains their exclusion from the database. Only District hospitals, District health centres and integrated health centres depend totally on the budget of the Ministry of Public Health. The database considered only the last three categories so as to apprehend how public resources are managed.
note that most traditional health establishments operate illegally. This makes it difficult to acquire information necessary for the study of their healthcare activities.

4.1.2 - Identification of technical efficiency determinants of public hospitals in Cameroon

a) Specification of the model

The analysis of determinants of public hospital efficiency is done using the following equation:

\[ E_j = \sum_{i=1}^{N} B_i X_{i,j} + \sum_{m=1}^{M} b Y_{m,j} + \sum_{h=1}^{H} \psi_{h,j} + e_j \]  

(6)

Where:

- \( E_j \): the efficiency level of hospital \( j \);
- \( B \): three vectors representing the coefficients to be estimated;
- \( X_i \): internal environment variables of the hospital not included in the DEA;
- \( Y_m \): environmental variables of the community served by hospital \( j \);
- \( e_j \): the error term;
- \( N \): number of internal environment variables of the hospital not included in the DEA;
- \( M \): the number of environmental variables of the community served by the hospital;
- \( \psi_{h,j} \): Dummy variable \( h \) characterizing hospital \( j \);
- \( H \): number of dummy variables.

The dependent variable in this equation takes values in the interval \([0, 1]\), we cannot estimate the OLS, but censored models estimation such as the generalized Poisson and censored or censored Tobit model can be used. Indeed, the censored regression models are recommended when the data are censored, in other words, the values of the endogenous variable are defined in a specific interval. The Poisson model is often recommended when the values of the dependent variable are natural. Contrarily, the Tobit model is used when the following two conditions are fulfilled:

- the dependent variable is continuous in an interval;
- the probability that the dependent variable take zero values is positive.

Concerning the determinants of the efficiency of public hospitals, the dependent variable "level of efficiency" is continuous in the interval \([0, 1]\). The censored Tobit model and the generalized Poisson model cannot be used because:

- values of the dependent variable are not natural numbers, the use of the Poisson model is not recommended;
- the dependent variable does not have null values. Thus, the censored Tobit model is inappropriate (Maddala, 1983, Greene, 1993).
To overcome this difficulty, we can explain the inefficiency of health, as the level of inefficiency of health facilities which takes null and positive values and is continuous in the interval $[0,1]$. A censored Tobit model can be used to explain the inefficiency of health facilities. Thus, if $Y_i$ is the level of inefficiency (1 - efficiency) of health facility $i$.

The model can be written:

$$
\begin{align*}
Y_i^* &= X_i \beta + u_i \\
\text{with} & \quad Y_i = Y_i^* \text{ if } Y_i^* > 0 \\
& \quad Y_i = 0 \text{ if } Y_i^* \leq 0
\end{align*}
$$

In equation (7), $X_i$ is a vector of variables representing the internal environment variables (not included in the DEA) from hospital $i$ and the community served; $\beta$: a vector representing the parameters to be estimated; $Y_i^*$ is a latent variable observed in an interval.

b) The determinants of hospital efficiency

Economic literature shows that the level of hospital efficiency depends largely on factors of the internal and external environment of hospitals (Sloan, 2000; Preker and Harding, 2003)

Determinants of hospital efficiency associated with the external environment

We considered four external factors as explanatory variables: geographic location, competition, subsidy and corruption. In some cases, empirical studies show that the geographical location (either the distance covered by the patient) is an explicative factor of the hospital efficiency level (Worthington, 2004). We define a competition variable: Herfindahl–Hirschman index of all public and private hospitals. Many studies (Burgess et Wilson, 1998; Puenpatom et Rosenman, 2008) use the market concentration index of Herfindahl-Hirschman in order to measure the impact of competition on the efficiency of sanitary establishments or health establishments. Three conclusions emerge from these studies: competition can favour and reinforce the efficiency of sanitary establishments; competition can have an inverse relationship with efficiency; competition has no significant link on sanitary establishments. Subsidies contribute to efficiency when the amount is used to balance the budget of the health centre (Balique, 2003; Audibert and al, 2007). However, the link between subsidies and efficiency of health facilities appears to be low in many developing countries. Multiple reasons can justify this result:

- A high concentration of public resources in secondary and tertiary hospital facilities and personnel, despite low rates of bed occupancy;

- Subsidies are often allocated to health facilities in urban areas whereas they could certainly provide better results if they were more focused on areas where the marginal benefits are likely to be higher, as in rural areas (WHO, 2008).
A social climate characterized by corruption also reduces the efficiency of hospitals. One of the most important constraints to the performance of health facilities in developing countries probably lies in the mismanagement of the public health sector, especially at district and municipal levels (Mills and al, 2006). An estimated 10 to 25% of public health spending related to the supply of medicines, equipment and infrastructure are lost each year due to corrupt practices (WHO, 2010).

Determinants of hospital efficiency related to the internal environment

Internal factors that influence the efficiency of health care facilities are represented by elements such governance, beds occupancy ratio, degree of specialization and the user fees. Governance concerns particularly the management of human and technical resources, supply and drug use, size and range of activities of the institution. The inefficiencies of health facilities due to inefficient management of the workforce are important. In Tanzania, for example, Kurowski and al, (2003) reported that unexplained absences and time spent at rest, social contacts reduce efficiency levels by 26%. Purchases and unnecessary use of equipment may also generate inefficiencies in health facilities. It is estimated that 50% of medical equipment of health facilities in developing countries is partly usable or totally unusable (Issakov, 1994). In Sub-Saharan Africa, up to 70% of medical equipment is not used. Studies explain this kind of systemic problem through mismanagement of technology procurement process, lack of user training and lack of technical assistance (WHO, 2010). The supply of branded drugs rather than generic formulations may also be the source of inefficiency. A recent study of 18 drugs in 17 countries, mostly middle-income countries shows that patient costs could be reduced by 60% on average passing from original brand to cheaper generic equivalents (Cameron, 2010). In addition, counterfeit or expired drugs, regardless of their prices are a supplementary source of wasted resources (WHO, 2010).

Another source of inefficiency is the inappropriate size of some institutions and the range of services they offer. Studies conducted primarily in the United States and the United Kingdom indicate that inefficiency starts at less than 200 beds and over 600 beds approximately (Posnett, 2002). A good indicator of the efficiency of a hospital facility is the use of installations by hospitalized patients, measured by the ability level. At the same amount of hospital output, hospitals that maximize their bed uses or having fewer empty beds could be able to improve efficiency (Puenpatom and Rosenman, 2008). A study by the World Health Organization in eighteen countries of low and middle income showed that in district hospitals only 55% of beds were occupied on average, well below the recommended level of 80 to 90% (Chisholm and Evans, 2010).

The positive relationship between user fees and hospital efficiency is expected. Bamako initiative (1987) indicates that as health reform is focused on changes in the financing mechanism of public hospitals, public hospitals cannot receive funds from the government to break even. As a result, in order to become financially independent, each hospital has to reduce its operating costs by improving its efficiency. Furthermore, the fee levels or payment rates approved by the Ministry of Health are often set
below the actual costs of health services, resulting in the increase of financial pressures on hospitals. As mentioned by Rosko (1998), in such a case the user fee share of revenues will be inversely associated with inefficiency.

Chillingerian (1993) presented evidence that health providers that are more specialized have been associated with a less efficient use of input resources. However, this evidence was not conclusive, since there was no significant relationship between the level of specialization and the level of technical efficiency (Worthington, 2004).

In Cameroon, the debate of the efficiency of public health establishments calls for the consideration of variables such as:

- **The source of financing:** this is mainly government subsidy and the contributions of households. Considering government subsidy, its effect on the efficiency of public health establishments is questioned given the financial constraints of the country. In fact, since 2005, the budget allocated by the government of Cameroon to the health sector has a positive trend, moving from 85.6 to 113.3 billions. The beneficial effects of these budget increases are still to be ascertained. Concerning households, their contribution is mainly on the cost of treatment. For the year 2009, the contribution of households amounted to 94.6% against 3.8% for the government and 1.6% for foreign partners (PETS Report, 2010). Households, better informed, wish therefore to be aware if the amount of money paid for the cost of treatment increases or decreases efficiency in the provision of health services;

- **Geographical location:** this is measured by the distance between the public health establishments and the patient. Some regions in Cameroon, notably those of East, South and North Regions, suffer from the problem of geographical remoteness due to the weakness of their demographic situation, long distances that separate different localities and circulation difficulties during periods of rain;

- **Staff motivation:** the low motivation of staff is considered as a cause of the low efficiency of public health establishments. With the aim of increasing the motivation of health staff, the government of Cameroon undertook to implement a reform that consist of paying 30% of returns generated by lucrative services\(^5\) as bonuses to the entire health staff of the establishment\(^6\). It is therefore important to investigate the effect of this bonus on the efficiency of public health establishments;

---

5 This concerns external consultations, laboratory analyses and tests, surgical interventions, medico sanitary services, radiological services, housing and restoration services and post-mortem services (Decree n° 94/303/PM of 14 June 1994)

6 Decree n° 94/303/PM of 14 June1994 fixing the modalities of allocation of quotas on the returns on lucrative services to certain medical and Para-medical staffs working in public health establishments in Cameroon.
- competition: according to Balique (2003), public health establishments in Cameroon are administered and not managed. Administrative logic, inherited from colonization, thus prevails over managerial logic. We notably observe the absence of economic criteria in decision processes concerning for example the allocation of resources or the creation of a position. A growing opinion holds that competition can improve on the efficiency of public hospitals in Cameroon. In becomes therefore important to study the effective importance of competition on the efficiency of public health establishments in Cameroon so as to inform policy makers;

- the occupation rate of hospital beds: public health establishments in Cameroon are usually blamed for presenting a high level of beds that remain unoccupied during a year. Meanwhile, theoretically, the higher the occupation rate of beds, the higher the efficiency of the health establishment. Testing the effect of occupation rate of hospital beds on the efficiency of public health establishments is therefore interesting especially when we consider the fact these hospitals are usually equipped with these beds based on administrative and political decisions, not taking into consideration economic analysis;

- the degree of specialization: the level of specialization is often considered as a cause to the low activity level of public establishments in Cameroon. The absence of certain departments in certain public establishments obliges patients to turn to other type of health establishments such as mission and traditional hospitals. It is therefore important to study the effect of degree of specialization on the efficiency of public health establishments;

- corruption: this is captured in public hospitals in Cameroon by the extra amount paid by the patient apart from those provided for by the government. The cost of treatment in public health establishments are fixed by Decree n°87/529 of 21 April 1987. According to this decree, the prices of the services of public health establishments are fixed by the government and are posted in these institutions so as to facilitate the information of patients and to avoid corruption. Meanwhile, the last survey on the follow-up on customer satisfaction shows that for 43% of patients surveyed, the prices of services are not posted and that patients pay prices that are above the ones displayed. Corruption is an important variable in this study as the low level of production in public health establishments could be explained by the refusal of patients to pay prices higher than those displayed. It is therefore interesting to analyze the effect of extra cost paid by patients on the efficiency of public hospitals. The variables that might explain the inefficiency of public health facilities in Cameroon are summarized in Table 2

| Table 2: Explanation of variables used to explain the inefficiency of public hospitals |

- competition: according to Balique (2003), public health establishments in Cameroon are administered and not managed. Administrative logic, inherited from colonization, thus prevails over managerial logic. We notably observe the absence of economic criteria in decision processes concerning for example the allocation of resources or the creation of a position. A growing opinion holds that competition can improve on the efficiency of public hospitals in Cameroon. In becomes therefore important to study the effective importance of competition on the efficiency of public health establishments in Cameroon so as to inform policy makers;

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Thus, the Tobit model estimated is as follows:

\[
\text{INEFF} = \alpha_0 + \alpha_1 \text{SUBP}_i + \alpha_2 \text{QPP}_i + \alpha_3 \text{CO}_i + \alpha_4 \text{HHI}_i + \alpha_5 \text{OC}_i + \alpha_6 \text{DIST}_i + \alpha_7 \text{CS}_i + \alpha_8 \text{DS}_i + \varepsilon_i
\]

**SUBP**: Public subsidy;

**QPP**: Quote-part given to personnel;

**CO**: The level of corruption

**HHI**: Herfindahl–Hirschman index

**OC**: Beds occupancy rate of a hospital

**DIST**: distance

**CS**: user fees

**DS**: degree of specialization

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public subsidy</td>
<td>Public subsidy amount</td>
</tr>
<tr>
<td>User fees</td>
<td>Cost of care</td>
</tr>
<tr>
<td>Geographical location</td>
<td>The distance in kilometers covered by the patient</td>
</tr>
<tr>
<td>Quota given to the staff as bonuses</td>
<td>The quote-part given to personnel (Q.P.P) gives the proportion of income of curatives act redistributed statutory to personnel of public sanitary centre.</td>
</tr>
<tr>
<td>Herfindahl–Hirschman index of all public and private hospitals (HI)</td>
<td>HI is defined as the sum of the squares of the market shares of each individual hospital where the market share is calculated by the ratio of number of beds of hospital ( i ) to the total number of beds in each region(^7). Higher HI values reflect less competitive pressure.</td>
</tr>
<tr>
<td>Bed occupancy ratio(^9)</td>
<td>the bed occupancy ratio (en percentage), which is defined as the ratio of the number of inpatient days and useable beds, is used to represent hospital capacity utilization</td>
</tr>
<tr>
<td>Degree of specialization</td>
<td>Number of departments available</td>
</tr>
<tr>
<td>The level of corruption</td>
<td>It means the level of corruption in the hospital. This is captured in public hospitals in Cameroon by the extra amount paid by the patient apart from those provided for by the government.</td>
</tr>
</tbody>
</table>

\(^7\) The formula is defined as \( \text{HI} = \sum_{i=1}^{\Pi} \Pi_i^2 \) where \( \Pi_i \) is the market share of a firm \( i \), and \( \Pi \) is a number of firms in that region.

\(^8\) Puenpatom and Rosenman (2008) formulation

\(^9\) \( O.C = \frac{DP}{\text{B}} \times 100 \); \( O.C \): Beds occupancy rate in percentage; \( DP \): inpatient days; \( B \): Beds.
\( \text{INEFF} = 1 - \text{EFF} \) is the dependent variable, with \( \text{EFF} \) efficiency score. A positive sign of coefficients indicates that the variable has a negative effect on efficiency, a negative sign, a positive effect on efficiency.

**Data Sources**

Data for this study is obtained from the national survey on public expenditure and beneficiary satisfaction in the health sector (PETS). The survey covered a sample spread over 12 areas including the cities of Yaoundé and Douala, and the 10 regions of the country with several survey units: the central and external services, health facilities with budgetary aspects, patients and households for the satisfaction component of beneficiaries. Units of the sample were drawn following a stratified sampling at one or more levels depending on the type of unit to investigate. Overall, the study examined 216 public hospitals (56 District Hospitals, 52 District Health Centres, and 108 Integrated District Health Centres), 1,512 households and 1,440 patients (PETS Reports, 2005;2010).

**EMPIRICAL RESULTS**

The results of the determinants of efficiency in public hospitals in Cameroon will be presented in two stages: first, estimation of the efficiency scores of public hospitals and second, evaluation of the determinants of efficiency.

**Estimation of efficiency scores in public hospitals.**

Sanitary establishments in Cameroon are not homogeneous; they do not have the same productive capacities. Some are better endowed in inputs than others and the rates of consultation and admission of patients vary from one establishment to another. Before presenting the efficiency levels of health establishments, we first present a summary descriptive statistic of the variables used.

**Descriptive statistics**

The determination of efficiency levels in public health institutions requires a preliminary grouping of the information on the inputs and outputs. Thus, we proceed to a descriptive statistics of the main inputs and available outputs in the public health institutions considered.

**Inputs**

Table 3 provides statistics on the factors of production considered to estimate the efficiency of public hospitals. From these statistics we observe: an upward trend of the quantities of inputs in the health establishments analyzed in the period of study; inputs endowments drop sharply from district hospitals to health centres; an almost permanent absence of medical staff in health structures graded below District hospital; the scarcity of administrative personnel, paramedical staff and technical staff in integrated health centres. These statistics suggest the following question: will this low endowment of
health centres – primary sanitary structures close to the vulnerable population - in human resources and in hospital beds not render the realization of the sector-based health strategy objectives difficult?

**Outputs**

Table 4 presents the volumes of outputs produced by the sanitary establishments studied during the periods 2002, 2003 and 2009. We observe that: generally, the levels of production; consultation activity is highest among all the health establishments analyzed irrespective of their category; hospitalization activity, with respect to admissions, also experience an increase in the period of study. This increase is particularly more important in district health centres. Hospitalization activity, with respect to the number of cumulated days of hospitalization, also witnesses an increase. The number of medical tests; number of maternal and child care are also higher in district hospitals than in health centres.
### Table 3: Descriptive statistics of inputs in public hospitals

<table>
<thead>
<tr>
<th></th>
<th>2002 Mean</th>
<th>Std Deviation</th>
<th>2003 Mean</th>
<th>Std Deviation</th>
<th>2009 Mean</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>District hospital</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Beds</td>
<td>58.22</td>
<td>37.09</td>
<td>61.96</td>
<td>37.61</td>
<td>63.11</td>
<td>33.49</td>
</tr>
<tr>
<td>Medical staff</td>
<td>3.25</td>
<td>2.48</td>
<td>2.69</td>
<td>1.76</td>
<td>5.17</td>
<td>4.06</td>
</tr>
<tr>
<td>Para-medical staff</td>
<td>25.87</td>
<td>22.25</td>
<td>22.57</td>
<td>20.39</td>
<td>39.56</td>
<td>30.81</td>
</tr>
<tr>
<td>Administrative staff</td>
<td>10.85</td>
<td>10.65</td>
<td>10.69</td>
<td>11.05</td>
<td>10.91</td>
<td>11.25</td>
</tr>
<tr>
<td>Technicians</td>
<td>2.92</td>
<td>2.35</td>
<td>2.88</td>
<td>2.21</td>
<td>4.38</td>
<td>2.71</td>
</tr>
<tr>
<td><strong>District health centres</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beds</td>
<td>16.91</td>
<td>12.87</td>
<td>17.69</td>
<td>12.41</td>
<td>19.43</td>
<td>10.60</td>
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<tr>
<td>Medical staff</td>
<td>1.04</td>
<td>0.62</td>
<td>1.08</td>
<td>0.702</td>
<td>4.12</td>
<td>3.75</td>
</tr>
<tr>
<td>Para-medical staff</td>
<td>7.17</td>
<td>5.47</td>
<td>7.41</td>
<td>5.42</td>
<td>56.09</td>
<td>23.76</td>
</tr>
<tr>
<td>Administrative staff</td>
<td>3.12</td>
<td>5.22</td>
<td>3.19</td>
<td>4.22</td>
<td>5.90</td>
<td>4.18</td>
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<tr>
<td>Technicians</td>
<td>1.75</td>
<td>3.15</td>
<td>1.76</td>
<td>3.09</td>
<td>2.00</td>
<td>1.18</td>
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<tr>
<td><strong>Integrated health centres</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beds</td>
<td>6.04</td>
<td>12.98</td>
<td>5.55</td>
<td>5.43</td>
<td>6.94</td>
<td>5.27</td>
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<tr>
<td>Medical staff</td>
<td>0.1</td>
<td>0.30</td>
<td>0.11</td>
<td>0.32</td>
<td>0.25</td>
<td>0.423</td>
</tr>
<tr>
<td>Para-medical staff</td>
<td>2.98</td>
<td>3.02</td>
<td>3.65</td>
<td>3.41</td>
<td>7.45</td>
<td>9.96</td>
</tr>
<tr>
<td>Administrative staff</td>
<td>2.38</td>
<td>2.28</td>
<td>2.58</td>
<td>3.28</td>
<td>5.07</td>
<td>5.06</td>
</tr>
<tr>
<td>Technicians</td>
<td>0.63</td>
<td>1.34</td>
<td>0.65</td>
<td>1.32</td>
<td>1.57</td>
<td>1.78</td>
</tr>
<tr>
<td><strong>Together</strong></td>
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<td></td>
<td></td>
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<tr>
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<td>22.89</td>
<td>30.74</td>
<td>21.77</td>
<td>33.12</td>
<td>35.87</td>
<td>44.23</td>
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<tr>
<td>Medical staff</td>
<td>2.087</td>
<td>1.66</td>
<td>2.23</td>
<td>1.87</td>
<td>2.89</td>
<td>2.12</td>
</tr>
<tr>
<td>Para-medical staff</td>
<td>11.13</td>
<td>15.227</td>
<td>13.24</td>
<td>13.32</td>
<td>177</td>
<td>27.671</td>
</tr>
<tr>
<td>Administrative staff</td>
<td>4.83</td>
<td>6.60</td>
<td>5.32</td>
<td>4.58</td>
<td>7.89</td>
<td>6.712</td>
</tr>
<tr>
<td>Technicians</td>
<td>1.50</td>
<td>2.397</td>
<td>1.67</td>
<td>2.421</td>
<td>1.78</td>
<td>2.78</td>
</tr>
</tbody>
</table>

Source: From PETS (2003) and PETS (2010) data
Table 4: Descriptive statistics of outputs in health establishments

<table>
<thead>
<tr>
<th></th>
<th>District Hospitals</th>
<th>District health centres</th>
<th>Integrated health centres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2002</td>
<td>2003</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Std Deviation</td>
<td>Mean</td>
</tr>
<tr>
<td>Consultations</td>
<td>4327,411</td>
<td>6544,267</td>
<td>4467,266</td>
</tr>
<tr>
<td>Admissions</td>
<td>1581</td>
<td>1426,7</td>
<td>1108,392</td>
</tr>
<tr>
<td>Cumulated days of hospitalisation</td>
<td>2822,740</td>
<td>6268,842</td>
<td>3377,15</td>
</tr>
<tr>
<td>number of medical tests</td>
<td>4875</td>
<td>2721,34</td>
<td>4012</td>
</tr>
<tr>
<td>number of maternal and child care</td>
<td>70,456</td>
<td>33,12</td>
<td>88,09</td>
</tr>
<tr>
<td>Consultations</td>
<td>3969,476</td>
<td>4133,372</td>
<td>2745,95</td>
</tr>
<tr>
<td>Admissions</td>
<td>756,458</td>
<td>1049,17</td>
<td>1907,76</td>
</tr>
<tr>
<td>Cumulated days of hospitalisation</td>
<td>2156,03</td>
<td>6189,58</td>
<td>470,38</td>
</tr>
<tr>
<td>number of medical tests</td>
<td>4122,33</td>
<td>5011,12</td>
<td>3987,212</td>
</tr>
<tr>
<td>number of maternal and child care</td>
<td>80,34</td>
<td>111,23</td>
<td>123,87</td>
</tr>
<tr>
<td>Consultations</td>
<td>3752,68</td>
<td>5850,66</td>
<td>1688,58</td>
</tr>
<tr>
<td>Admissions</td>
<td>394,384</td>
<td>883,21</td>
<td>261,28</td>
</tr>
<tr>
<td>Cumulated days of hospitalisation</td>
<td>810,71</td>
<td>2370,68</td>
<td>96,081</td>
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<tr>
<td>number of medical tests</td>
<td>1782</td>
<td>4987,98</td>
<td>2002,23</td>
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<tr>
<td>number of</td>
<td>112,22</td>
<td>103,99</td>
<td>127,23</td>
</tr>
</tbody>
</table>
Source: From PETS (2003) and PETS (2010) data

Notes: medical tests: urinary tract infections, intestinal worms, respiratory disease visits, blood tests, HIV test, malaria test, typhoid test, cholera test

**Efficiency Scores in Public hospitals**

The results will be presented on the basis of a common efficiency frontier for the district hospitals, district health centres and integrated health centres in the periods of analysis (2002, 2003 and 2009). The results of the measures of efficiency in public hospitals are summarized in Table 5.

**Table 5: Public hospital efficiency results**

<table>
<thead>
<tr>
<th>Year</th>
<th>Means</th>
<th>Number of public hospitals on frontier</th>
<th>Public hospitals more efficient</th>
<th>Public hospitals less efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.630</td>
<td>Total : 60</td>
<td>IHC</td>
<td>DH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DH : 15</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>DHC : 17</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>IHC : 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>0.687</td>
<td>Total : 64</td>
<td>IHC</td>
<td>DH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DH : 12</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>DHC : 21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IHC : 31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>0.756</td>
<td>Total : 76</td>
<td>IHC</td>
<td>DH</td>
</tr>
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<td></td>
<td></td>
<td>DH : 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DHC : 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IHC : 42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
According to our results, CSIs and CMAs are more efficient than HDs. More so, the number of CSIs and CMAs on the common frontier increases meanwhile the number of HDs on the same frontier decreases during the period of study.

Public HDs are first reference establishments. They received patients that are beyond the competences of CSIs and CMAs, and possess a higher level of material, human and financial resources than CSIs and CMAs. Meanwhile, HDs are less efficient than CSIs and CMAs that suffer from acute shortage of resources. This result is particularly important because it confirms that the fall in production in public hospitals in Cameroon is explained more by a lack of efficiency than by a shortage of available resources.

**Determinants of efficiency in public hospitals in Cameroon**

Before we present the estimation results of the determinants of efficiency in public hospitals, let’s first present summarily the descriptive statistics of variables used in the analysis.

**Descriptive Statistics of explanatory variables**

Table 6 submits the descriptive statistics of variables susceptible to explain efficiency in public hospitals. These statistics suggest that: the average amount of public subsidy decreases from district hospitals to health centres. This is justified by the reference status of the establishment which district hospitals benefit. But since health centres are important in the vulgarization of primary health care, it is interesting to question whether these budgets allocations allow them to realize this goal; the rates of occupation of hospitals beds and staff premiums are also higher in district hospitals with respect to health centres; the level of corruption and the Herfindhal-Hirschman index are also relatively high in district hospitals than in the health centres. However, we realise that: district hospitals have a higher number of departments with respect to health centres; the cost of health care for patients decreases from district hospitals to health centres; the average distance between the patient and the health establishment also decreases from district hospitals to health centres.
Table 6: Explanatory variables
<table>
<thead>
<tr>
<th>Variables</th>
<th>Public Subvention (in thousands)</th>
<th>Staff Premiums (in thousands)</th>
<th>Occupation rate of hospital beds</th>
<th>Level of corruption</th>
<th>Herfindahl-Hirschman Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>District hospitals</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>2002</td>
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</tr>
<tr>
<td>Mean</td>
<td>6592,0223</td>
<td>3519.2</td>
<td>53.70</td>
<td>2215.12</td>
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<td>2009</td>
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<td>Mean</td>
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<td>2640,30</td>
<td>53.7</td>
<td>1807</td>
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<tr>
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<td>34.13</td>
<td>1675.61</td>
<td>0.167</td>
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<tr>
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<td>50.23</td>
<td>935.23</td>
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<tr>
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<td>37.6</td>
<td>1875</td>
<td>0.165</td>
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<td>37.6</td>
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</table>

From PETS (2003, 2010) data
Empirical Evidence

The estimation results of the determinants of efficiency are presented in the table 7

Public subvention reduces the inefficiency in a significant manner. The staff premium reduce inefficiency in public hospitals, though the coefficients are not significant. The rate of occupation of hospital beds is positively and significantly correlated with inefficiency contrary to what is generally observed in the empirical literature, where the occupation rate is negatively related to inefficiency. This result suggests that the use of beds in public hospitals in Cameroon is still far from world standards, an occupation rate ranging from 80 to 90%, to guarantee efficiency in the establishment. The coefficient of the variable corruption is positive and significant. The coefficient of the Herfindhal-Hirschman index is negative but not significant. This suggests that an increase in competition would reduce inefficiency in public hospitals. The average cost of health care improves inefficiency significantly. The degree of specialization is positively correlated to inefficiency though in a significant manner. Finally, distance is positively related to inefficiency.

Table 7: Determinants of inefficiency in public hospitals.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>public Subvention</td>
<td>-0.047</td>
</tr>
<tr>
<td></td>
<td>(-3.05)***</td>
</tr>
<tr>
<td>Staff premiums</td>
<td>-0.024</td>
</tr>
<tr>
<td></td>
<td>(-1.03)</td>
</tr>
<tr>
<td>Rate of occupation of beds</td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>(2.24)**</td>
</tr>
<tr>
<td>Level of corruption</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>(2.64)**</td>
</tr>
<tr>
<td>Herfindhal-Hirschman Index</td>
<td>-0.069</td>
</tr>
<tr>
<td></td>
<td>(-0.27)</td>
</tr>
<tr>
<td>Average cost of health care</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(1.84)*</td>
</tr>
<tr>
<td>Degree of specialisation</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>(2.41)**</td>
</tr>
<tr>
<td>Distance</td>
<td>0.056</td>
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<tr>
<td></td>
<td>(1.01)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.303</td>
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<tr>
<td></td>
<td>(0.430)</td>
</tr>
</tbody>
</table>

Number of district hospital: 216
Log likelihood : 143.76
Chi2 0.0000

Notes: Dependent Variable: level of inefficiency in public hospitals.

*** (**) [ *] significance at 1% ;5% et 10% respectively.
CONCLUSIONS

The objective of this study was to identify the determinants of efficiency in public hospitals in Cameroon. Estimating the efficiency levels in public health institutions using the DEA approach, we obtained the following results:

- District Health centres and Integrated Health Centres characterized mainly by a low level of available resources, appear to be more efficient than district hospitals that instead have higher levels of resource.

Haven generated the efficiency scores using the DEA method, a censored Tobit model is employed to investigate the determinants of efficiency in public health institutions. Our estimation gave us the following result:

-the inefficiency rate of public hospitals in Cameroon is mainly explained by the occupation rate of hospital beds, corruption, the cost of health care and the degree of specialization.

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45. Ministry of Public Health(2009), *National Health Policy*


65. WHO(2009), *World health statistics*

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