International Journal of Academic Research in Business and Social Sciences
2017, Vol. 7, No. 6
ISSN: 2222-6990

Determinants of the Inefficiency of Public Hospitals in Cameroon

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DOI: 10.6007/IJARBSS/v7-i6/2998 URL: http://dx.doi.org/10.6007/IJARBSS/v7-i6/2998

ABSTRACT
The purpose of this paper was to assess the determinants of the inefficiency of public hospitals in Cameroon. The methods employed in the study involved a two-stage analysis technique whereby Data Envelopment Analysis (DEA) was applied using the traditional inputs and outputs with data from the National Institute of Statistics (NIS) of Cameroon. The efficiency scores from the first stage were then transformed into inefficiency scores and regressed on the environmental variables using the censored regression model (Tobit Model). We found that corruption and location of health facility were signficant determinants of inefficiency; hospitals became more efficient when exposed to competition and when bed occupancy increased. The number of supervisions and size of health facility did not have a signficant effect on inefficiency while age of health facility, distance covered by patients to hospitals, distance separating public hospital from closest private hospital were negative but insignficant determinants of inefficiency. It was then concluded that Identifying the determinants of inefficiency helps hospitals to restructure how they manage their operations since improved performance helps better resource utilisation, control cost and increase accesss to healthcare.
Keywords: Inefficiency, Public Hospitals, DEA, Censored Regression.

1. Introduction

According to the National Institute of Statistics, Cameroons population was estimated at 19, 406, 100 inhabitants in 2010 and it was predominantly young with more than half of the population under 18 years (PETS2, 2010). Accordingly, there has been a lot of improvement in populations health with the elimination/reduction of a number of diseases including

poliomyelitis, measles, malaria just to name a few. Equally, Synthetic Fertility Index dropped from 7 children per woman to 2.5 between 1962 and 2004. There has also been improvement in vaccination coverage, healthcare support and malaria prevention. All these have been made possible through the various structures put in place by the Ministry of Public Health (PETS2, 2010)

The organisation of the health system was defined in 1989 by decree N°89/011. Accordingly, the Ministry of Public Health is in charge of the design and implementation of the national health policy. It oversees the development and technical control of services rendered by the public and private health units, supervises professional bodies and healthcare organisations, designs the training plan for staff working in the ministry of public health, manages public health facilities among others. It is organised in three distinct levels as follows:

1. The *Central level* which is in charge of the elaboration of concepts, policies and strategies, coordination and regulation of the health system through the central services of the Ministry of Public Health with structures like general reference hospitals, central hospitals and university teaching hospital centres,
2. The *Intermediary level* is in charge of technical support to health districts through regional delegations of public health, having structures like regional hospitals.
3. The *Peripheral level* is in charge of implementing health programmes through district health services having structures like health centres, district and sub divisional hospitals among others (NIS/PETS2, 2010). Each of the three levels is made up of the public sector, the private sector comprising of profit and non-profit (Denominational and NGOs) healthcare institutions and the traditional sector which is not yet regulated.

Many public health researchers have, over the past years, shown a lot of interest in measuring the performance of health systems elicited by the rising cost of caring for an ever-increasing population of countries, growths in medical innovations and technology (Molem & Beri, 2016). The focus of economics is to study how to allocate scarce resources throughout an unlimited number of wants and needs. A continuous increase in the demand for healthcare resources together with tightening budgets have compelled researchers to analyse the provision of healthcare services, understand whether healthcare resources are utilized efficiently or not and to find out whether proper incentives and healthcare systems exist or can be created to ensure efficiency (Marsha et al., 2008). It is important that these resources be put to their optimal use to translate inputs to outputs so that the healthcare services can be delivered to as many people as technically feasible because the goal of every public health delivery system is to provide the greatest benefit to society from its health interventions; hence healthcare production has to be optimal (Kirigia, et al., 2011; Beri et al., 2016). However, some researchers contend that healthcare markets do not stick to the traditional neo-classical optimizing behaviour of markets. The provision of healthcare services therefore necessitates market failure and non-profit maximising behaviour arising from institutional structures that differ from private ownership; hence, healthcare service institutions are often suspected of inefficiency and compromised productivity.

The outbreak of the Ebola epidemic in the first quater of 2014 in the Mano River Union (MRU) which comprises Guinea, Liberia and Sierra Leone resulted in 28,091 cases with around 11,303

deaths. This according to recent records constituted one of the greatest dangers to public health. The rapid killing of thousands of affected persons resulted in some protectionist measures which ranged from exit and entry controls, such as temperature checks and mandatory monitoring and quarantining of travellers from MRU states, flight bans and denial of visas to holders of MRU passports which required that the health systems put in place to combat the epidemic be efficient. The presence of the virus however posed little threat to richer countries with more efficient health systems compared to poorer West African Countries (Yusuf, 2014). The Cameroon government had to close its borders with countries that were affected by the virus. The Cameroon-Nigeria borders was closed for months. Moreover, the virus posed a threat to health workers, home caregivers and those who were engaged in the practices of washing dead bodies. Early 2016 also saw the rebirth of the Zika Virus which has been an emerging infectious public health threat. This virus, transmitted through mosquito bites, and sexual intercourse can cause severe birth defects. It started in Brazil, and then spread through Latin America eventually, reaching some U.S. territories like Florida.Tackling such epidemics requires an efficient healthcare delivery system since the most efficient healthcare systems have the best chance of obtaining better benefits (Rutlege, Parsons & Knaebel, 1995).

Reports from the Ministry of Public Health in Cameroon show that despite the creation and construction of health units and the existence of a national strategy document of health technology, physical accessibility to healthcare remains a great challenge to the population because of inequality in the distribution of healthcare establishments due to the absence of a national health map and inadequate maintenance of existing infrastructure and equipment (PET10). This then calls into question the problem of an efficient healthcare delivery system in a country plagued with profuse healthcare challenges and a startling rate of corruption.

Marie Koumate recently made the headlines when she tried saving the twins inside her dead and pregnant aunt [Monique Koumate] at the Laquantinie hospital in Douala who was denied medical care because of the lack of money and died at the gate of the hospital. Marie who accompanied the aunt to the hospital bought a razor blade at a nearby pharmacy and sliced the womb of the deceased in which one of the twins came out dead while the other who came out breathing gave up the ghost minutes later (Bada, 2016). This is just one of the multiple challenges faced by developing nations especially in their public health delivery systems. Such tragic incidents may not happen if health systems are properly organized and managed, and if patients have a good and reliable health insurance coverage (Beri, Molem, & Ofeh, 2016).

Furthermore, the years 2016/2017 for the first time in Cameroon saw a series of successful nationwide strike actions organised and staged by the syndicate of medical doctors which have been demanding for better working conditions, universal health insurance coverage for all Cameroonians, integration of doctors into active service, increase in retirement ages from 55-65 years amongst others. The government which has always considered the trade union illegal responded by transferring medical doctors active in the strike action from reference hospitals to district hospitals in rural areas which is expected to lead to underemployment and the consequent negative effects on hospital performance. These and many others only contribute to making health facilities in Cameroon to produce at less than their optimal levels.

International Journal of Academic Research in Business and Social Sciences
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Fraud and corruption have a direct negative effect on access and quality of patient care which have also been prevailing the public health sector in Cameroon (PETS2, 2010). Employee theft of supplies can leave patients without medicines, and extorted. Under-the-table payments create anxiety and reduce access to care (Vian, 2006; Simborg, 2008). As resources are drained from hospital budgets through embezzlement and procurement fraud, less money is available to motivate staff and this leads to greater absenteeism as medical personnel seek private income from outside jobs lowering access and decreasing quality of care (Gee et al., 2010). The existence of corruption in a health system weakens healthcare delivery by reducing access to care and makes people to be fed up with the system. Losing trust in a public hospitals' ability to provide expected outcomes as well as render quality services especially in a developing country where very few private individuals are able to finance and run such facilities is disastrous considering the vital role they are expected to play as the major suppliers of these services. Further, the increasing healthcare challenges justify the need for efficiency studies in Cameroon public hospitals.

The existing evidence suggests there is mass inefficiency in the public health sector in Cameroon (Molem & Beri, 2016; Beri, Molem, & Ofeh, 2016; Nguenda & Sikod, 2014; Njong & Ngantcha, 2013; Sjaak, 1982). The fundamental issue therefore is to examine the determinants of inefficiency of public hospitals in Cameron. The rest of the study is organized as follows: section 2 presents literature review; section 3 presents the methodology of the study, empirical results are presented in Section 4 while the last section provides the concluding remarks.

2. Literature Review:

Extensive literature has been published on health and healthcare delivery systems. Measuring efficiency in the provision of healthcare services is necessary for any health system that employs inputs to produce outputs or services. This can help in policy development and assist in the resource allocation process. According to Maniadakis et al., (2008), assessment of efficiency can be effectively utilized for the evaluation of input-ouput producers that operate in imperfect markets, for exemple healthcare institutions such as hospitals. They opined that healthcare markets do not adhere firmly to the traditional neo-classical optimizing behaviour of markets. Therefore, the provision of healthcare services neccessitate market failure and non-profit maximising behaviour arising from institutional structures that differ from private ownership; hence, healthcare service institutions are often suspected of inefficiency and compromised productivity.

Agency Theory and Property-rights Theory, as well as Public Choice Theory provide different explanations for common outcomes in the hospital sector. The theories hypothesize that private for-profit ownership is superior to public and private non-profit ownership because private for-profit ownership is associated with a higher productive efficiency. These theories purport that differences in efficiency emerge as a consequence of the variance in objectives, incentives, and control mechanisms between ownership types just to name a few (Beri & Molem, 2016).

"Property rights consist of all the social institutions that define the range of privileges that individuals can have over specific resources such as land or water. Private ownership of these

resources can involve a variety of rights, including the right to exclude non-owners from access, the right to appropriate the stream of economic rents from use of and investments in the resource, and the rights to sell or otherwise transfer the resource to others" (Mahoney, 2004). This implies that property rights define the allocation and use of property. When rights are not properly defined, property will be in danger of misappropriation by others due to reasons such as adverse selection, free-riding behaviour, and shirking

According to Libecap (1989), property rights provide the basic economic incentive system that shape resource allocation. He argued that property rights are usually formed and enforced by political entities and that these rights often reflect the conflicting economic interests and bargaining strength of those affected. In most large firms, ownership and control are in different hands. This may change the objectives since the property rights to control resources is given to management whereas the right to benefit from residual income stays with the owners. It is the responsibility of the owners to impose pressure on management to monitor factor inputs or output efficiently. The idea that ownership might affect efficiency (as well as other performance indicators) is grounded in property rights theory. In fact, this has been presented theoretically by different writers in the following ways as cited in Medema & Zerbe, (1999):

"*If one assumes rationality, no transaction costs, and no legal impediments to bargaining, all misallocations of resources would be fully cured in the market by bargains*" (Calabresi, 1968)";

"*In a world of perfect competition, perfect information, and zero transaction costs, the allocation of resources in the economy will be efficient and will be unaffected by legal rules regarding the initial impact of costs resulting from externalities"* (Regan, 1972)

Government organisations have no specific residual claimants. Property rights may therefore be weak or non-existent in both not-for-profits and public organisations leaving resources in danger of misappropriation. However, for-profit organizations are always interested in maximizing the benefits of shareholders and consequently, they focus on the bottom line (profit maximisation/loss minimisation), and this may make them more efficient than either not-for-profit or governmental organizations. Furthermore, property rights provide "incentives to invest and innovate" that are not present in the public sector (Schleifer, 1998). He further points out that the presence of private alternatives bent on providing high quality services coupled with the possibility of corruption in government officials reduces preference for government ownership. Theories on the incentives created by property rights and the effectiveness of monitoring from either participation in the market or through principal-agent relationships are used to explain why both government and not-for-profit institutions should be inferior to for-profit ownership in terms of efficiency. Some economists argue that not for profit hospitals experience more exposure to market forces than government organisations and thus should be more efficient.

The Agency Theory has extended risk sharing relationship which was developed by economists during the 1960s and early 1970s to include the agency problem that occurs when the principal and the agent have different goals. The theory explains a relationship in which one party (the principal) delegates work to another (the agent) who performs that work (Kathleen, 1989). The focus of this theory is with problems that may occur in agency relationships; these problems

originate from the fact that the desires and goals of the principal and agent may conflict and that it may also be difficult for the principal to verify what the agent is actually doing or whether the agent has behaved as expected. This theory is one of the most recurrent theories used in public sector economics to analyse public sector delivery. The agency theory postulates that managers (or agents) seek to maximize their own utility rather than that of the organization or its owners (or principals). It examines the relationship between citizens (the voting public), politicians and service providers. The issue emerges when the principal decides that a task has to be accomplished but cannot perform the task herself. This leaves the principal with no other option but to hire the services of an agent to work on her behalf. Citizens acting as the principals' delegate responsibilities to elected officials (state) to provide public services and pay taxes to fund them. Politicians in turn delegate service delivery to providers by creating incentives and appropriating budgets (World Bank, 2004; Njong & Ngantcha, 2013). The market, which monitors agents' performance in private organizations, is assumed a better means of monitoring agents' behaviour for principals than the political processes at work in government organizations. When neither a profit motive nor an adequate monitoring mechanism exists, substandard performance can manifest itself in several ways. Niskanen theorized that bureaucrats chose to maximize discretionary budgets rather than profits, leading to inefficiency in the public sector, overproduction, or some combination thereof (Niskanen, 1975). Migue and Belanger hypothesized that bureaucrats might pursue other goals such as a preference for larger staffs or greater capital – that would reduce efficiency. Theoretical evidence from both property rights and agency theories therefore suggest that the public healthcare delivery system may produce inefficiently and advocate the need for effective monitoring to save cost. This explains why many empirical studies are being carried out to monitor the productivity of government organisations. Maniadakis, et al., (2008) opined that the measurement of efficiency is of great value to any organisation that employs inputs to produce outputs or services. They sought to measure intra-hospital clinic efficiency and productivity in Greek University General Hospital. They used non-parametric mathematical programming method of DEA which encapsulates a very popular approach to productivity measurement , malmquist productivity index (Malmquist, 1953) and focuses on technical efficiency. They utililised in their study in consistence with other studies factors such as labour inputs the number of physician, number of nurses and equivalents employed in each clinic as well as the number of beds which they assumed to be a proxy measure of capital expenditure. On the output part, they used the number of patient discharges and the number of inpatient days. They included only inpatient clinics to increase homogeneity of output. According to their results, two clinics achieved efficiency scores of 100% in 2005 whereas in 2001, four clinics achieved efficiency. The mean efficiency scores was 78.4% in 2001 and 76.2% in 2005. In other words, technical efficiency experienced a small reduction. Nedelea, Fannin, & Barnes (2010) analysed differnces in efficiency between critical access hospitals and prospectively paid rural hospitals using a two-stage, semi-parametric model with bootstrapping procedure. They wanted to find out whether critical access hospitals were less efficient than rural hospital that did not convert to the CAH status and whether medicare cost-based reimbursement was one of the main causes of CAHs higher inefficiency. They thus calculated the cost, technical and

allocative efficiencies of CAHs and compared them with those of nonconverting, non-CAH rural hospitals because of differences in reimbursement facing these hospitals. They adopted an input oriented DEA approach based on the assumption that cost containment is a primary goal of hospital administrators and policy makers. They used the number of outpatients visits as a measure of hospital outpatient output, number of admissions and number of inpatient days were included as a measure of hospital inpatient output, number of surgeries performed as hospitals output; but they disaggregated surgeries into outpatient surgeries and inpatient surgeries. Inputs used consisted of full time equivlent (FTE) facility personnel staffed and licensed facility beds. Two input prices were used in the analysis: the price of labour approximated by the sum of payroll expenses and employee benefits divided by the full time equivalent facility personnel; the price of capital approximated by the sum of depreciation expenses and interest expenses divided by the number of facility beds. Their results showed that the average level of cost efficiency was 60% for CAH and 70.7% for non-CAH rural hospitals. They thus establisehed that hospitals that converted to CAH status are less cost efficient than non-CAH rural hospitals. This cost inefficiency was caused by excessive inputs (technical inefficiency) and non-optimal mix of inputs (allocative inefficiency). They conclude that CAH were costly, technically and allocatively inefficient than non-CAH rural hospitals. It was also established that government hospitals were less efficient than non-profit hospitals while for-profit hospitals were more efficient than their non-profit counterparts. Occupancy rate and medicare HMO penetration also contributed to increases in the cost and technical efficiencies of hospitals. Further studies by Samsudin et al., (2014) found that admission rate, number of outpatient per doctor and types of hospitals have significant influence on inefficiency.

Zuckerman et al., (1994), Vitaliano & Toren (1996) hypothesized from standard economic theory that one would expect hospital efficiency to increase with size. Other studies use the number of beds as a proxy for size of hospitals; however, Procházková & Šťastná (2011) has found a high correlation between number of beds and patients treated. Young and Harris (1999) found using available beds to account for size, that efficiency decreases with size. The mixed empirical findings suggest that size effect is region-specific((Procházková & Šťastná, 2011). Therefore, either of the effects might result; unclear either that size decreases inefficiency due to economies of scale effect or that size increases inefficiency due to increased costs connected with the management of complex care.

The level of competition has also been found to be a vital variable influencing the performance of a hospitals. Theory suggest that the introduction of hospital competition and the easy entrance of private sector providers within a market with regulated prices will prompt public hospitals to increase efficiency. Therefore, if a hospital is located in a more competitive market, it will perform better than those in less competitive areas (Cooper, Gibbons, Jones & McGuire, 2012). Hospital market areas are usually defined from two perspectives: the individual hospital and the overall market. From the hospital perspective, the relevant market includes other hospitals that compete for the same physicians or patients. Other researchers define Herfindahl-Hirschman Index (HHI) 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. Higher HHI values reflect less competitive pressure which can be a positive determinant of inefficiency.

Many studies in Sub-Saharan African countries have used DEA to estimate the technical efficiency of hospitals since its original development by Charnes, Cooper & Rhodes (1978). These include those by Molem & Beri, 2016; Kirigia JM, 2013; Tlotlego et al., 2010; Marschall & Flessa, 2009; Lambo & Sambo, 2003, etc. A majority of these studies focused only on measuring technical efficiency without conducting second stage analysis that could permit them delve into the potential determinants of inefficiency. The current study employs panel data to estimates determinants of the inefficiency of public hospitals in Cameroon. The study by Ali, Debela, & Bamud, (2017) suggested that having multiple observations (panel data) on the same Decision Making Unit (DMU) allows controlling for unobserved heterogenous characteristics of hospitals which facilitate casual inference. Estimating the determinants of inefficiency is important in designing ways to improve and monitor public hospital performance levels as well as in determining the likely savings from their improvements. This will further enable health planners and policy makers to design appropriate ways to allocate health sector resources to maximise the returns from its investments.

3. Methodology

The type of *Research Design* employed for this study was the non-experimental design. We utilized the non-experimental design because we cannot control, manipulate or alter the predictor variables or subjects. Instead, we relied on interpretations to come to our conclusions. Further, we had no control over the environment in which the study was being carried out and the design is generally exploratory in nature (Jacobs, Smith, & Street, 2006). Specifically, the study adopted the panel design, which involved pooling cross-sectional and time series data. In the design, quantitative research approach was adopted. No in-depth analysis was carried out on each of the selected hospitals. However, quantitative data on the required variables were collected for each of the hospitals selected. The results of the analysis of the quantitative data were used to make generalisation for the entire health sector in Cameroon.

We used secondary data based on the first Public Expenditure Tracking Survey (PETS1) jointly carried out in Cameroon by the World Bank and the National institute of Statistics. The survey collected information on the health sector at the front line, including resource use, delivery processes, services, staff and patient behaviour and characteristics. Data were collected using questionnaires administered to health regional delegates, medical doctors, and heads of health centres, health employees and patients (Njong & Ngantcha, 2013). In order to estimate the technical efficiency of public hospitals, we used panel data for 109 health facilities observed for two time periods that is 2002 and 2003. The choice of variables used in this study as potential determinants of inefficiency was guided by healthcare studies and data availability.

The *Methods of Data Analysis* employed in this study involves a *Two-Stage Analysis*, whereby *Data Envelopment Analysis(DEA)* was solved using the traditional inputs and outputs, and the efficiency scores from the first stage were then transformed into inefficiency scores and regressed on the environmental variables using the censored regression model (Tobit Model)

DEA makes use of linear programming in its methodology to estimate the efficiency score for each health facility which can be specified as follows:

Max $h_{c=}$ $=$ $\frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$ …… (1.1)

Subject to:

$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}$ $\mu_r, v_r \geq 0, r=1,\ldots s;, i=1,\ldots m$

j =	Number of DMUs being compared in the DEA analysis	y_{rj} =	Amount of output r from DMU j
DMUj=	Decision Making Unit number j	x_{ij} =	Amount of input *i* to DMU *j*
h_c =	Efficiency score of the DMU being evaluated by DEA	*i* =	Number of inputs used by the DMUs
r =	Number of outputs generated by the DMUs	u_r=	Coefficient or weight assigned by DEA to output *r*
v_i =	Coefficient or weight assigned by DEA to input *i*		

Source: (Beri & Molem, 2016)

DMUs with an efficiency score of 1 are qualified as best "practice frontier" and thus provide a benchmark which allows a reference for judging other DMUs that obtain efficiency scores of less than one. DEAPv2.1 developed by Coelli (1996) was used to estimate the efficiency scores for public health facilities and Eviewsv7.3 was used to run the regression analysis.

We employed the *Censored regression* model (Tobit Model) in the second stage of our analysis. The technical efficiency score obtained from our DEA results was modified to describe the degree of inefficiency by the following formula (Miika & Unto, 2001).

$$y*_{i=}\ (1/\theta) - 1$$

Where $y*_i$ is the inefficiency scores of a hospital and θ is the technical efficiency scores. This transformation implies that hospitals that are fully efficient with a score of 1 are transformed to 0. In this case the inefficiency scores are regressed, that means that the negative sign of a coefficient implies an association with efficiency.

The Tobit model suggests that there is a latent variable y_i* that linearly depends on a vector of explanatory variables, x_i: (Samsudin, Shri, Ahmad, Jamal, & Rahimah, 2014) which are a combination of external and internal environmental variables. Tobin considered the example of households' expenditure on automobile where in the sample, there was a large number of observations for which expenditures on automobile was zero. He then argued that in such a situation, the censored regression model should be used (Maddala, 1992).

We observe the dependent variable y_i linking y_i* by:

$$y_i = f(x) = \begin{cases} y_i^*, if\ y_i^* > 0 \\ 0,\ if\ y_i^* \leq 0 \end{cases}$$ i.e.

$$y_{it}=\beta_0+\beta_1 AGE_{it}+\beta_2 Corruption_{it}+\beta_3 d1_{it}+\beta_4 d2_{it}+\beta_5 HHI_{it}+\beta_6 ldummy_{it}+\beta_7 Super_{it}+\beta_8 bOcc_{it}+\beta_9 Size_{it}\ \varepsilon_{it}$$

Where β_1-β_9 are coefficients of explanatory variables which include age of health facility, corruption, distance covered by patients to the health facility, distance separating public health

facility from the private health facility, Competition measured by calculating Hirfindal Hirschman Index; location which is a dummy (1=Urban, and 0=Otherwise); number of supervisions, bed occupancy and size of health facility respectively;

ε_{it} is the error term.

Some key environmental variables need proper attention:

1. Corruption: Two key variables were used to calculate the extent of corruption (leakage) in the health facilities that is total financial resources effectively used and total budget of the institution. In other to get the extent of leakage (Njong & Ngantcha, 2013), we then calculated the extent of the leakage rate:

Leakage rate for *hi*= $1 - \frac{Financial\ resources\ effectively\ used\ by\ hospital\ i}{total\ budget\ for\ hospitals\ i}$ We expect corruption to be a positive determinant of inefficiency.

2. Competition: We measure the intensity of competition for each market using Hirfindal Hirschman Index. To derive the HHI, we let χ_h be the total number of beds owned by hospitals h_i in market $H(h \in H_j)$given market j where each market constitutes health facilties in a particular division . We define S_h as the market share of $h \in H_j$, that is $S_h = \chi_h \Big/ \sum_{\chi \in H_j} \chi_k$. The HHI for market j was computed as $HHI_j = \sum_{h \in H_j} {S_h}^2$, which ranges from 0 to 1, where the former corresponds to a perfectly competitive market and the latter to a monopoly. We re-scaled the index by multiplying the number with 10,000 so that it ranges from 0 to 10,000. Under the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission, three types of markets are distinguished: (i) non-concentrated markets are those with HHI lower than 1,000; (ii) moderately concentrated markets are those with HHI between 1,000 and 1,800; and (iii) highly concentrated markets are those with HHI greater than 1,800 (Palangkaraya & Yong, 2009). Hospitals located in less concentrated markets are likely to be less efficient than those in concentrated markets
3. Bed Occupancy: It is defined as the number of inpatient days divided by the cumulative number of beds maintained during the year (number of hospital beds ×365 days). To calculate occupancy rate, we used inpatient days of care and bed days available viz:

$$Bed\ Occupancy = \frac{\text{Inpatient Days of Care(length of stay)}}{\text{Bed Days Available}} * 100$$

Higher occupancy rate increases the efficiency level of hospitals while lower occupancy rates reduces efficiency or increases inefficiency.

4. Size: It is assumed in economic theory that being of a certain size might reveal some economies or diseconomies of scale and thus influence efficiency and as such, Hospital size in this study was measured by the number of beds available for patient care in the health facility.

However, Jacobs et al., (2006) in citing Simar and Wilson (2004) warns that the approach is problematic because the efficiency/inefficiency scores used as the dependent variable are serially correlated violating the classical regression assumption of variables being independent and identically distributed which invalidate standard approaches to inference. They therefore caution that conclusions arrived at from this approach are for exploratory purposes as they

indicate which environmental variables appear to have the most influence on performance. Coelli, et al., (1998) then suggest that the information obtained could be used to formulate a single-stage DEA model where the environmental variable is included in the DEA model as either an input or output.

As a validation technique**,** the Wald test was used to test for our model specification/misspecification. This is because it checks the common null hypotheses that all coefficients as well as the sum of the coefficients in our equations are (jointly) zero. The Wald test computes the test statistics by estimating the unrestricted regression without imposing the coefficient restrictions specified by the null hypothesis. The Wald statistic measures how close the unrestricted estimates come to satisfying the restrictions under the null hypothesis. It gave us an F-statistic of 5.215779; chi-square value of 46.94201 with 9 degrees of freedom and these values were highly significant suggesting that our model was well specified. We also performed a histogram and normality test to verify whether the distribution of our error terms violated the basic assumption of normality, findings demonstrated by the approximately bell-shaped nature of our histogram revealed that our error terms was normal. We also used the Z-scores/ t-test and the p-value in our censored regression results to justify whether the estimated parameters were significant.

Table 1 presents the distribution of health facilities(sample) included for the study by type and location. It would be observed that 24.8% of the health facilities were Sub Divisional Medical Centres (CMA); 49.5% were Integrated Health Centres and 25.7% of them were District Hospitals with observations for two years.

Table 1: Distribution of Health Facilities by type and location

Hospital Characteristics	N	Percentage
Type of Health Facility		
CMA	27	24.8
CSI	54	49.5
HD	28	25.7
TOTAL	109	100
Location of Health Facility		
Urban	28	25.7
Semi-Urban	23	21.1
Rural	58	53.2
TOTAL	109	100

Source (By Author, from PETS1 Data)

Further, 25.7% of them were located in urban areas; 21.1% in semi-urban areas and 53.2% were in rural areas. This can have serious implications on efficiency since a majority tends to be located in rural areas.

4. Results

Table 2 presents results of Tobit analysis and their corresponding OLS estimates in which measures of technical inefficiencies were regressed against the potential determinants of

International Journal of Academic Research in Business and Social Sciences
2017, Vol. 7, No. 6
ISSN: 2222-6990

inefficiency of public hospitals. The Tobit coefficient estimates are the same sign as their corresponding OLS estimates, and the statistical significance of the estimates are also similar. Accordingly, the coefficient of the variable age is negative (-0.0204) implying that inefficiency of the public hospital tend to decrease as the hospital becomes older or that older hospitals tend to be more efficient than younger ones which is in line with our expectations. This is however not statistically signficant. The coefficient of Curruption is a positive (3.0206) and significant determinant of inefficiency of public. This is no surprise for a country that has twice been ranked the most corrupt in the world; corruption remains one of the greatest challenges to the social and economic development of the country. Employee theft of resources from health facilities leaves them with shortages hence they continue to produce at less than their optimal level.

Table2: Tobit and OLS results for the determinants of inefficiency

Dependent Variable: Inefficiency		
Independent Variable	Censored Tobit	Linear(OLS)
Age	-0.0204	-0.2501
	(-1.3913)	(-0.7836)
Corruption	3.0206*	1.7858*
	(2.1734)	(2.0034)
Patients Distance	-0.0966	-0.0207
	(-1.5674)	(-0.7986)
Distance_ private	-0.0232	-0.0052
	(-1.4723)	(-0.7682)
Competition	-4.7292**	-1.4860**
	(-4.4622)	(-5.3039)
Location	1.5409**	0.9488**
	(3.0373)	(3.0913)
Supervisions	0.1122	0.1031*
	(1.4141)	(2.0903)
Occupancy	-0.0533*	-0.0084
	(-1.9996)	(-0.9086)
Size	0.0132	0.0065
	(1.1507)	(1.1322)
Constant	15.1861**	12.0121**
	(3.9434)	(4.7806)
Log likelihood	-111.4091	-165.999
R^{-2}		0.3207
F-Stat =		5.8279
Prob(F-Stat)		0.0000

Source: By Author, (2017) *Significant at 5%, **Significant at 1%,
Values in parenthesis are Z-Statistics & t-statistics for Censored and OLS estimates respectively.

The coefficients of distance covered by patients to the health facility is negative (-0.0966) implying that as the distance increases, the hospital becomes more efficient which is not in agreement with our expectations. It should be noted here that Cameroon like most African countries has a serious problem with road infrastructure which acts as a hinderence to accessing health facilties and some patients even die before reachng the hosptals because of the poor nature of roads. However, a lot has been done in improving the nature of the roads that now makes hospitals more accessible to the patients.

Furthermore, distance separating the public health facility from the closest private hospital has a negative coefficient (-0.0232) on inefficiency implying that public hospitals become more efficient the further away private health facilties are located from them. This further contradicts our expectations that when public hospitals operate solely in an environment, it will be in total control of the market which can promt it to be less efficient since it faces little or no competition. It should be noted here that when public hospitals operate soley in an environment, there is a high number of admissions (hospitalisations). Occupancy rates are high, which can improve hospital performance.

Hospital competitoin has a negative (-4.7292) impact on inefficiency implying that health facilities located in a more competitive markets perform better than those in less competitive markets which is in agreement with our expectations and significant at 1% level hence we reject the null hypothesis of a positive effect of competition on inefficiency. Our findings are in line with that of Cooper et al., (2012) & Zuckerman et al. (1994).

Location(dummy) of a hospital is a positive determinant of inefficiency (1.5409) implying that hospitals located in an urban areas are likely to be more efficient than others (those located in semi-urban and rural areas). This is because they have access to a larger population which increases the number of admissions (hosptalisations), increaeses bed occupancy and length of stay (Votápková & Šťastná, 2013). The situation is not the same in semi-urban and rural areas where many tend to trust traditional ways of treating themselves by going to traditional healers. This reduces the number of admissions in hospitals/hospitalisations leading to compromised productivity.

The coefficient of the number of supervisions is positive (0.1122) implying that increasing the number of supervisions may increase public hospital inefficiency, this contradicts our expectations since supervision was expected to reduce the level of inefficiency in public hospitals. However, it should be noted here that supervision in most public health facilities is usually not effective due to the agency problem in which supporters contend that when neither a profit motive nor an adequate monitoring mechanism exist, substandard performance can manifest.

The coefficient of bed occupancy is negatively (-0.0533) associated with inefficiency which is in agreement with our expecation. This implies that increasing the occupancy rate of beds in hospitals will reduce the level of inefficiency or increase the efficiency level of the hospital. The coefficient of size is positive suggesting that increasing the number of beds may increase public hospital inefficiency or that smaller hospitals tend to be more efficient than bigger hospitals. This is possibly so because the choice on the number of beds per hospital in Cameroon is

sometimes based on political decisions and the government may procure more beds for hospitals which remain unoccupied.

5. Conclusion

This paper employed the Tobit Model to identify the environmental variables that determine inefficiency for a sample of 109 public hospitals in Cameroon. This was a two stage analysis in which efficiency scores were estimated in the first stage, transformed into inefficiency scores in the second stage and used as the dependent variable to run a censored regression. We found that corruption and location of health facilities were signficant determinants of inefficiency, the level of competition and bed occupancy negatively impacted on hospital inefficiency hence hospitals become more efficient when exposed to competition and increased bed occupancy. The number of supervisions and size of health facilities were positive but insignficant determinants of inefficiency. Conversely, age of health facility, distance covered by patients to hospitals, distance separating public hospital from closest private hospital are negative but insignficant determinants of inefficiency. Identifying the determinants of inefficiency helps hospitals to restructure how they manage their operations since improved performance helps better resource utilisation, control cost and increase accesss to healthcare. However, a study of this nature cannot serve as a bedrock upon which immediate policy actions can be taken; rather, it provokes critical thinking and further research on the health system. In order to arrive at a conclusion about the health system, surveys of satisfaction with the quality of healthcare in the public healthcare delivery system in Cameroon should be carried out to supplement this study.

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