

**EXAMINING THE IMPACT OF BUDGETING AND FUNDING ON SERVICE DELIVERY IN MEDICAL EDUCATION IN NIGERIA –THE DEA APPROACH**

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**ABSTRACT**

This study examines how budgeting and funding affect service delivery in medical education in Nigeria using College of Medicine of the University of Lagos (CMUL) as the case study. Predicated on the human capital theory and the Resilience and Youth Development Module (RYDM) model, it employed the output-oriented Data Envelopment Analysis (DEA) as the main technique of analysis for measuring efficiency level of the CMUL. For robustness of result, the use of questionnaire complemented the DEA results through annual time-series data which was employed for both theoretical tests and estimations. The study developed a framework for funds allocation between core and non-core expenditures of medical schools that ensures sustainability of funds generation and utilisation by the CMUL.

While the study revealed lack of optimal utilisation of available financial resources, it confirmed that budgeting and funding are relevant to service delivery of medical education.

**Keywords:** Budgeting, Funding, Service Delivery, Data Envelopment Analysis (DEA), Sensitivity Analysis, Sustainability.

## **BACKGROUND TO THE STUDY**

The focus of this study is to examine how budgeting and funding affect the quality of service delivery with respect to the core mandate of teaching, research and service in medical education in Nigeria. Johnstone (2003) identifies that the financial problems faced by higher institutions worldwide have two broad dimensions. The first is the high and increasing unit or per-student cost of higher education. The second is the pressure from increasing enrolments. According to Johnstone (op. cit), these exacerbating conditions are more prevalent in Sub-Saharan Africa (SSA) than in other parts of the world. Whereas the quantum of funding available may play a significant role in the ability of an institution to carry out its services, the efficiency of the fund utilisation is central to the measurement of institutional performance (Lindsay, 1982). Institutions needs is taken in the context of identifying the essential needs of the larger worlds' poor juxtaposed on the limitations imposed by the environment's ability to meet the current needs as well as the future needs. According to Mirabent (2012), universities and their medical schools around the world are now operating in a turbulent environment and must adapt to changes to position them to deliver on their core mandates of teaching, research and service.

In the specific case of medical education, Malu (2010) emphasised that the universities constitute the mainstay of medical education in Nigeria. The government policies on medical education are translated into reality through the universities and regulatory bodies. A medical school, in turn, is the arm of a university that inculcates skills and knowledge in students that make them become medical doctors who can compete internationally with their counterparts in the provision of health care delivery (Shehu, 2002). Catto (2000) also established earlier that the relationship between the medical schools and the universities is complex and medical schools are often only inappropriately appreciated. Catto (op. cit) described a medical school as an integral part of a university which is a school with a curriculum leading to the award of a medical degree.

The situation with the funding of public tertiary institutions in Nigeria is different. Odusote (2013) observed that from 1990 to 2001, only 58% of the funding recommended by the National Universities Commission (NUC), to be released to federal universities and medical schools was released to the universities. The percentage shortfall in 2003 was 24.6% and in 2004, it was 43.5%. With such gross deficits funding of the parent universities, Odusote (op. cit) argued that public medical schools were and are still inadequately funded and recommended that medicine, being a public trust, the leadership of its medical schools and the medical profession, should be innovative and determined in their quest for sourcing additional funds to run their programmes. Hashim (2002) recognised that a major policy for the development plan of the health sector in Nigeria should involve measures designed to coordinate and intensify the development of training programmes, aimed at accelerating the production of health personnel in the country. Medical education training cuts across the medical schools and the teaching hospitals that serve as the laboratory for practical exposure. Medical schools and the teaching hospitals have funding challenges but they both failed to scientifically determine how to utilise their funds in the most efficient manner in their daily activities. In hospitals, for example, the consumption of a large number of inputs has not frequently corresponded to the production of the same or more proportion of outputs. Sometimes, the outputs even declined with increase in inputs due to the influence of the congestion effect on efficiency (Clement, Valdmanis, Bazzoli, Zhao and Chukmaitov, 2008). In the case of medical schools, a myriad of problems have been identified as militating factors against access to university education in Nigeria. According to Idogho and Imonikhe (2012), the problems of carrying capacity, infrastructural/facilities challenges, inadequate public

financing, economic constraints, labour market failure, curriculum development and curriculum delivery have hindered the provision of quality education in Nigeria. Training facilities in medical schools need to be upgraded and expanded to enhance the opportunity for the training of more doctors. In a situation where the government is unable to fund the tertiary institutions and the medical schools appropriately, an enabling environment must be provided to allow the institutions to raise funds and financial resources that would be adequate to render their services to the public. The Federal Government's policy of free tuition and lodging charges, among others, at the undergraduate level of university education has resulted in sharp deterioration of funding of the universities and pegging of boarding fees (Fafunwa, 1971).

### **Statement of the research problem**

The tertiary educational system in Nigeria has been bedevilled by inadequate financial resources to provide quality education to the citizenry; a situation prevalent in the last two decades (Oduote, op. cit). Federal universities have had to cope with the rapid growth in students' population since the restoration of democracy in Nigeria in 1999 when a large number of the teeming population saw the need to pursue higher education. The Federal Government of Nigeria pursues a policy of free tuition and assumes the responsibility of funding the tertiary institutions owned by it. The astronomical increase in students' enrolments is not matched by a commensurate public funding; this has led to inadequacies, such as overcrowded classes, shortage of library and laboratory facilities as well as poor hostel conditions, which have ultimately affected the quality of education in the country.

CMUL being a federally-owned medical institution adopts the normative and contractual funding model. The Federal Government, as the proprietor, requests the university and the medical school to prepare and submit to the government, financial estimates at the beginning of each academic year. The submission by each university is made through the supervisory agency, called the NUC; the body usually prunes down the figures to the level upon which the universities benchmark the preparation of the annual budget. According to Manasan (2012), normative funding refers to the application of a set of prescribed objective criteria and norms designed to promote and reward quality instruction, research and extension services as well as financial prudence and fiscal responsibility.

Funding for the smooth running of CMUL are sourced from Federal Government subventions, intervention funds and grants, school fees paid by post-graduate students, endowments and internally generated revenues (IGRs). The Federal Government of Nigeria in 1977 abolished the payment of school fees in all undergraduate programmes run by all its tertiary institutions and their medical schools. This policy has curtailed the ability of federally-owned medical institutions to raise funds that could have accrued from the payment of tuition fees by undergraduate students. The universities are only allowed to collect from the students' service charges for services such as, accommodation, sports and health services. Only postgraduate students are required to pay tuition fees and the amount paid by such students are grossly below the current market rates paid at states and private universities. This Federal Government's policy of free education was strongly criticised by Adaralegbe (1990) who questioned the so-called right to free education in a depressed economy such as Nigeria and argued that the government, parents or the people must pay for education so that it would not amount to an empty promise and a futile exercise. Bello (2014), at the Annual Memorial Lecture, delivered at the University of Lagos, cited Adesina (1990) who had noted that other countries that ran free education programmes provided opportunities for raising funds directly or indirectly within the system to finance

education. This opportunity does not exist in Nigeria which could have allowed students to access adequate loans to finance their education which could be repaid later in future when they start to work.

Although payment of tuition and granting of loans to brilliant and indigent students could have contributed significantly to support the level of funding available to medical schools in Nigeria, current government policy does not support charging of tuition and students loans scheme. Government releases of subventions and grants have been reducing on a yearly basis, due to the limited resources accruing to the government from crude oil sale; the mainstay of Nigeria's economy. Although this is not peculiar to Nigeria, the worldwide trend in funding of tertiary education is that rising costs are not fully covered by government due to the competing needs from other sectors of the economy that also require adequate financing. Such areas include primary and secondary education, public health, public infrastructure, economic development, safety and security (Johnstone, 2006). According to Wangenge-Ouma (2008), state funding for higher education per student in real terms in England, Botswana, Jamaica, Hungary, New Zealand and South Africa have been declining and that there had been inconsistencies in terms of the expectations placed on the universities, compared with the limited budgetary support they derived from the public. This development propelled the universities to design strategies to generate additional funds for economic self-determination and survival. It also impacted negatively on the ability of universities and medical schools to generate large pools of funds to execute their capital and recurrent expenditures maximally. The federal universities in Nigeria do not receive all their requests for funds from the Federal Government, yet, they are precluded from charging tuition on all undergraduate programmes run by these universities and cannot also charge market rates on postgraduate programmes like the state and private universities operating in the country.

## **REVIEW OF CONCEPTUAL LITERATURE**

Conceptual framework represents a set of interrelated theories that form the basis for a research. According to Vrasidas (2001), the conceptual framework is connected to a research because it guides the process of inquiry, provides a roadmap for the study and helps in communicating the purpose of the study to the researcher's audience.

Brief discussions of the key concepts covered in this study are as follows:

### **Concept of budgeting**

There are numerous definitions of a budget which have been espoused over the years by various scholars. The definition which suits the public sector segment relevant to the federally- owned medical school; the focus of this study was suggested by (Henley, Perrin, Evans, Lapsley and Whiteook ,1992). In it, "budgeting" was defined as a process of measuring and converting plans for the use of real (physical resources) into financial values. It is the classic problem of how to add quantities of apples and oranges into a meaningful economic measurement, the only practical way for everyday use is to express their economic values in terms of monetary costs and revenues. Through the process of budgeting, the finance function provides the essential link between management planning and management control.

Budgeting control is one of the most important forms of management controls used by organisations. The budgeting method adopted by an institution plays a significant role regarding the level of funding that may be available to execute the core

functions of such an organisation. Historically, budgeting has been synonymous with financial planning. Arising from this, Marti (2006) reasoned that the budget is the most important financial document of public sector organisations that needed to be made available to spell out clearly the expected streams of revenue derivable to any institution in any financial year. Higher education institutions (HEIs) comprising the universities and medical schools in Nigeria are entering a phase whereby they needed to consider very seriously the choice of their budgeting methods to ensure that adequate financial resources are generated to execute their core mandate of teaching, research and community service. The task is not only about sourcing adequate financial resources but more importantly, on how those financial resources are judiciously utilised.

## **REVIEW OF THEORETICAL LITERATURE**

### **Budgeting methods**

Budgeting methods and funding are the key elements of raising finances for provision of education to the populace (Kocher, 2007; Chen, Phillips, Schneeweiss, Andrilla, Hart, Fryer, Casey and Rosenblatt, 2002; Coleman and Letourneau, 2005; Marti, 2006; Chen, 2008). The choice of appropriate budgeting method influences the financial management adopted by organisations. Lopez (2006) argued that the search for more flexibility in the financial management of public universities requires adjustments in budgeting strategies adopted by such institutions. Profit and non-profit outfits are faced with making a choice of the type of budgeting method to be adopted by their organisations. Various scholars within the financial management sector have discussed extensively the types of budgeting techniques available. According to Zierdt (2009), organisations adopt the most suitable budgeting methods that facilitate the attainment of organisational goals and objectives within the limited financial resources.

### **Funding models for educational institutions**

Funding models were used as governance and management tools by institutions to maximise benefits of public management reforms. The literature contains a number of funding models that may be adopted by educational institutions to manage their finances. Finances to be accessed by medical institutions must be sustainable so as to satisfy both the current needs and the future needs of the society. This onerous obligation is particularly relevant in the developing world such as Nigeria. At the summit held in Apia in 2014 by Heads of State and Governments, the world leaders emphasised their commitment to sustainable development of developing countries which can only be achieved by all stakeholders coming together to make contributions towards realising the common goal i.e. funding of medical education. An educational institution could be classified as a public service, depending on the source of funding, whether privately funded or through the federation account. Educational Institutions must have clarity about how to fund their missions because this very important decision affects the delivery of their programmes to the various stakeholders.

Broadly speaking, there are basically two major funding models; the activity-based (ABF) and the pay-for-performance (P4P).

In a situation where the universities experience shortfalls in state funding for the execution of their core mandate, missions and survival as effective organisation, quick remedial actions in terms of raising additional funds to prevent disequilibrium in the system will be required (Wangenge-Ouma, 2010). This is in line with resource dependence theory (Pfeffer and Salancik, 1978) which states that organisations deprived of critical resources will seek to survive by adopting strategies to ensure a continuous

flow of resources. For universities, this search usually entails the implementation of various income-generating strategies, including introduction and raising of tuition, commercialisation and donations from alumni (Wangenge-Ouma, op. cit).

Arikewuyo (2010) while reiterating the imperative of adequate financial resources of running educational institutions in Nigeria also stated that the desired funds need to be budgeted, released and properly managed to assist in achieving the desired quality. In order to ensure sustainable delivery of functional educational system in Nigeria, there is the need for the federal institutions and medical schools to reduce its overdependence on the Federal Government for its funding and explore other enduring sources of financing education. Odusote (op. cit) identified these alternative sources of financing medical education and research in Nigeria as tuition, endowment funds, gifts and services' fees. Service fee is a major source of revenue for medical schools in the US and the proportion of total revenue derived from clinical services. (Miller, Anderson and Cohen, 2012) reported that services' fees rose significantly from 6% as a portion of income realised in the 1960/1961 academic year to an average of 52% by the end of 2007/2008 academic year.

## **REVIEW OF METHODOLOGICAL LITERATURE**

Generally, the empirical literature on measuring efficiency revealed that three basic techniques have been prominent in the literature. These are the Data Envelopment Analysis (DEA) model; the Stochastic Frontier Analysis (SFA) and the traditional method of Financial Ratio Analysis (FRA). While both the DEA and SFA are more sophisticated, the latter is a parametric measure and the former a non-parametric model. Generally, studies on efficiency have been dichotomised into two; those that employed a one-stage approach and a two-stage approach. The studies that considered a two-stage approach did not only obtain efficiency scores or ranks of a productive centre but also proceeded to ascertaining the determinants of this efficiency. Basically, studies centred on both sides of the divide have bordered around country-specific to cross-country and even regional analysis. This review of extant literature on the efficiency will rather focus on the technique of analysis rather than other features of differences among studies.

According to Samy (2003), schools impact the individuals and the society as a whole; hence there is a need to formulate equitable education policies that would engender equity and equality in education. The United States of America have carried out series of reforms to ensure that education is accessible to every citizen (Caldwell and Roskam, 2002). The model of funding adopted in Canada, on the other hand, recognises the distinctions between need, demand, and utilisation as they affect the rationale for government involvement, models of the possible funding flows as they affect policy levels, and implications of various approaches to payment.

Deber, Hollander and Jacobs (2008) in trying to address the research question of determining the best way to pay providers to deliver health services, came up with the fact that no single method may serve all purposes. Each approach has its own relative advantages and disadvantages (Glaser, 1987; Robinson, 2001). Since education and health both impact training of medical doctors, the peculiar circumstances of the environment play significant roles in the appropriate policy direction of education adopted by the country.

## **REVIEW OF EMPIRICAL LITERATURE**

The review of empirical literature on the effectiveness of budgeting and funding on service delivery in medical education would be considered in three sub-sections such as evidence from developed countries, evidence from emerging and developing countries and evidence from Nigeria.

### **Evidence from developed economies**

Shaheed, Abdulla, Kwong, Rosella, Streiner, Johnson and Dhalla(2010) investigated the impact of tuition increases on medical student demographics, indebtedness and financial stress in Quebec Canada. Using a national survey of medical students in Quebec compared with students in other parts of Canada as the methodology, the study found that higher tuition was the factor most strongly associated with increased anticipated debt at the time of medical graduation. Although the available data do not conclusively demonstrate that increased tuition pose a barrier to access for students from lower-income families and other under-represented groups, it has been shown that lower tuition results in the public subsidy of all students, including those with very affluent families (Lee, 1984).

In Germany, the study by Kempkes and Pohl (2010) saw the justification for the introduction of tuition fees in public universities in the wake of dwindling federal allocation of financial resources by the government to the universities especially when the universities are faced with rising costs and high demand for admissions by students. Arising from this reality facing the German university system, the researchers supported the public and academic discussion that more private funding was needed in the German university landscape to support the smooth running of the educational system. According to them, many federal universities are currently introducing tuition fees in public universities as an option to improve the financial situation of the universities. Regardless of privatisation or tuition fees, information about university efficiency performances is essential in times of scarce public resources. The focus of this study was to examine how efficient German public universities were using funds at their disposal.

More recently, the environment in which US universities operate has changed. According to Just and Huffman (2009), there has been a slowing of federal research funding growth and a decline for real research funds for health programmes such as Medicare. At the same time, state governments have reduced real per capita subsidies to public institutions of higher education (Ehrenberg, 2006; Lyall and Sell, 2006). Since funding from government has taken a downward trend, institutions such as medical schools must take steps to ensure that limited funds at its disposal are judiciously utilised in order to maintain quality delivery. As a result of this, the trend around the developed world demands that public utilities increase the efficiency in the use of resources they manage (Martin, 2003).

The study conducted by Avkiran (2001) on Australian Universities brought out succinctly the relevance of DEA model in measuring efficiency within the educational sector. The study developed three models to measure efficiency – overall performance, performance on delivery of educational services, and performance on fee-paying enrolments. The findings, based on 1995 data, showed that the university sector was performing well on technical and scale efficiency but there was room for

improving performance on fee-paying enrolments. There were also small slacks in input utilisation. DEA helps in identifying the reference sets for inefficient institutions and objectively determines productivity improvements. As such, it can be an important benchmarking tool for educational administrators and assist in more efficiency allocation of scarce resources. In the absence of market mechanisms to price educational outputs, which renders traditional production or cost functions inappropriate, the study admonished universities to seek alternative efficiency analysis methods such as DEA to measure efficiency in their production processes.

Efficiency and funding of public universities remains another important dimension to be considered by this study. Education managers have a responsibility to ensure judicious utilisation of available scarce financial and human resources while the proprietors of the educational institutions relate performance to funding extended to the universities.

### **Evidence from emerging and developing economies**

Generally, it has been argued that funding of higher education has not been accorded adequate attention. Studies carried out by scholars have revealed the lack of appropriate level of funding by government to support education. According to Banya and Elu (2001), the national governments of developing countries almost single-handedly finance education and this led to the dearth of empirical research on higher education financing except to the extent of identifying what proportion of the national budget is allocated to higher education. Earlier studies carried out by Johnstone, Arora and Experton (1998), Zidermann and Albrecht (1995), reaffirmed similar findings. African leaders saw their systems of formal education, especially from early 60s when significant African countries got independence from their colonial masters, as the principal means of achieving economic and social development of the continent (Azrael, 1965). Banya and Elu (1997) concluded that indeed, economic transformation of the continent was to follow from attainment of university education. According to Banya and Elu (op. cit), the main source of funding from early independence to now is central government grants.

The significance of reform in higher education brings out the quality of education that would make the graduates of developing countries to be competitive in the global space. This fact was reiterated by Collings and Rhoads (2008) who posited that the first challenge faced in developing nations is raising adequate funds for expanding the size, scope, and quality for their universities. The researchers argued that overcoming this challenge is critical if nations are to build forms of human capacity suitable for competing in a global knowledge-based economy. The second major challenge is that financial constraints also limit the ability of universities in the developing world to contribute forms of research-based knowledge suitable for advancing a nation's role in the global economy. Overcoming this challenge requires developing nations to address a variety of complex issues, including brain drain, the inadequacy of scientific facilities and laboratories, and limited knowledge-based cultures upon which to advance science and technology (Peters and Besley, 2006; Collings and Rhoads, op. cit).

### **Evidence from Nigeria**

There has been a rapid increase in demand for university education, with medical education constituting a significant aspect of this demand. According to Okojie (2014), the objective of government in this regard is to provide adequate access to university education to those who desire it and have the requisite qualifications for admission. The challenge of government and education managers however, is to raise the necessary financial resources to support the huge demand for university education in Nigeria.

The inability of both government and the higher education institutions to realise funding expectations has heightened the concerns about the quality of university education in Nigeria. Constitutionally, the National Assembly makes appropriation to all sectors of the economy including education. The Federal Government, through the NUC, disburses funds to federal universities. The block grants were differentiated into capital and recurrent; with the recurrent component distributed using FTE and historical/incremental funding method to the universities as the case may be. The challenge faced by the stakeholders in the education sector in Nigeria bothers on regular complaint of inadequate funding by the higher educational institutions. Federal government funds the public universities and all other sectors of the economy based on projected earnings accruing to the federation account. Due to the paucity of funds available in the federation account, federal universities and the medical schools are allocated fractions of their funding requirements and the funds allocated regrettably, do not cover their requirements for teaching and learning. Interestingly, federal universities are not allowed to charge tuition fees to augment the funds available to run the system.

Obansa and Orimisan (2013) argued that health and education are the two important prerequisites for human capital development of a country. According to Arikewuyo (2010), however, both sectors have not been accorded the appropriate attention in Nigeria.

The major challenge however, facing educational development in Nigeria is lack of adequate finance (Adewuyi and Okemakinde, 2013; Okojie, 2014). In order to ensure that quality of education is maintained, there have been various studies that suggested that funding is a major factor and may not be the sole responsibility of the government.

Adeniyi and Taiwo (2011), while agreeing that one of the main challenges facing higher education in Nigeria is low level of funding, also observed that the admissions of students into higher educational institutions have significantly outstripped the available facilities provided by the proprietors, and this has hampered the educational delivery, monitoring, inspection and other quality assurance activities. A study, conducted by Akinwande (2013), showed paltry details of fees paid by undergraduate students in federal universities in Nigeria, which appeared inadequate to support students' training and academic activities. This is a far cry from what is obtainable in other parts of the world.

According to Omigbodun (2010), while the ultimate goal of medical education is to improve the health delivery services to the citizenry in general, the quality of health care must be assured at all times. The researcher further argued that the quality of practice is generally a function of the quality of education received by the practitioners. Thus, to ensure that quality is obtained, it is germane that improvement in medical education needed to be assured. It has also been argued by various scholars that an important component of quality of education is the availability of functional and well equipped library (Kachoka and Hoskins, 2009; Tunde and Issa, 2013).

### **Trends of budgeting and funding of medical education at the CMUL**

In CMUL, it is observed that the students' population had grown from 236 in the 1991/92 academic year to 571 students' intake in the 2010/11 academic session. The funding level of the CMUL has remained almost static in relative terms, as the total revenue generated inclusive of subvention, has largely been utilised in paying staff salaries and emoluments and other overhead costs, leaving a paltry amount for teaching and learning costs.

The dearth of funds available made it extremely difficult to maintain and upgrade the equipment and facilities available in the College to train the students. Table 1 below shows an increase in the absolute total amount realised by the CMUL during the period under review; but the aggregate fund is grossly inadequate in relative terms because of inflationary trends which have negatively affected the value in real terms.

**Table 1:** College of Medicine funding requests (1991/1992 – 2010/2011)

Period	Amount requested by CMUL (₦)	Amount allocated in budget (₦)	Amount received by CMUL (₦)	Amount allocated (%)	Amount received (%)
1991/1992-1995/1996	75,258,808.00	68,147,356.80	85,723,418.20	92.10	114
1996/1997-2000/2001	381,380,301.60	252,146,950.20	305,940,387.20	75.54	80.2
2001/2002-2005/2006	1,469,447,521.00	1,008,447,521.00	656,164,539.20	71.90	44.7
2006/2007-2010/2011	3,954,485,298.00	2,286,639,823.20	1,558,850,993.00	66.78	39.4

**Note:** Where receipts exceed allocation, supplementary grants were made to the university/medical school.

**Source:** Audited financial statements of CMUL from 1991/1992 to 2010/2011

Generally, the amount received by from Federal Government by the CMUL was lower to the amount requested by the institution for the years under review. This had compelling implications on the smooth running of medical education.

The released funds do not fully cover the estimates made by the medical school. In fact, the major components of the released funds were meant for staff salaries and allowances. There are minimal allocations for teaching equipment, consumables and reagents and staff training which ought to constitute area of emphasis that would bring out the desired quality expected of medical students produced by the College.

The funding contribution by the federal government has accounted for between 90% and 97% of the total income of the College. Due to the dwindling revenue accruing to the national treasury, funding from government has not adequately covered the total requests made by the College over the years. The College has a mission to produce world class medical doctors and dentists and as such cannot afford not to be adequately funded if it is to realise its mission and objectives. Government policy needs to allow institutions to introduce tuition at both undergraduate and postgraduate levels to shore up the low base of funds in the system. Income generated by the school on school fees was grossly below 5% over the 20 years period covered by the study. There is a yearning gap that could be explored if there is an enabling environment. The local income from internally generated revenue can also be substantially improved upon by the management of the medical school.

The government policy of no tuition fees at the undergraduate level of federal institutions including CMUL has impacted negatively in the provision of adequate financial resources by the medical school to carry out its core activities of teaching, research and community service.

## **METHODOLOGY**

### **Introduction**

This is an evaluative study carried out at the College of Medicine of the University of Lagos (CMUL). College of Medicine is the medical school of University of Lagos, a federally-owned tertiary institution in Nigeria. The medical school has the same funding model like any other federally-owned medical school in Nigeria. Therefore, the case study of CMUL may reflect the funding pattern of each of federally-owned medical schools in Nigeria.

### **Justification for use of data envelopment analysis (DEA)**

DEA is a measure of relative efficiency among DMUs, taking a particular unit as a reference in relation to others. The technique is particularly relevant for measurement of efficiency in private and the public sectors. It is a robust means of incorporating multiple input variables and output variables in the process of determining their interrelationships towards achieving the set objectives. It is instructive to emphasise that this study's main focus is on the assumption that funding is invested on the provision of teaching equipment and other relevant expenditures that directly promote service delivery in medical education. It is expected that a significant improvement brought about by efficiency in fund utilisation would impact the quality of medical education provided by CMUL.

Both public and private institutions have discovered the relevance of DEA to measure the efficiency of service delivery since its introduction in 1988. DEA methods have been used to analyse the production (or technical) efficiency of private and public organisations with respect to achieving outputs and outcomes. In the public sector, researchers have used DEA to analyse the efficiency of educational institutions (Coates and Lamdin, 2002; Thanassoulis and Dunstan, 1994; Mancebon and Molinero, 2000; Thanassoulis, 1996a, 1996b). However, the use of DEA methods to assess how well public agencies utilise their financial and human resources (HR, i.e., inputs) to achieve workforce diversity (i.e., outcome) has not taken place.

## ANALYSIS OF RESULTS

**Table 2: Efficiency score: 1991/1992 to 2010/2011**

(1)	(2)	Extended models		
		(3)	(4)	(5)
Academic session	Baseline model	Baseline + budget	Baseline + funding	Baseline + budget + funding
1991/1992	-4.69E-10	15.487	3.814	3.716
1992/1993	0	12.93	3.220	3.143
1993/1994	0	-1.737	0.324	0.325
1994/1995	0	-2.249	-0.140	0.123
1995/1996	0	11.764	2.983	2.890
1996/1997	0	9.132	2.555	2.473
1997/1998	0	13.832	3.040	2.946
1998/1999	0	10.347	2.763	2.686
1999/2000	0	12.727	3.165	3.098
2000/2001	0	7.562	3.695	4.766
2001/2002	0	7.658	1.675	1.652
2002/2003	0	6.44	1.728	1.584
2003/2004	0	1.926	0.257	0.183
2004/2005	0	-9.704	-1.382	-1.303
2005/2006	0	14.785	3.152	3.013
2006/2007	0	7.295	1.094	0.944
2007/2008	0	9.808	1.738	1.457
2008/2009	0	-28.75	-7.487	-7.686
2009/2010	0	-7.988	-3.165	-3.087
2010/2011	0	1.549	1.785	1.936
Aggregate	3.93E-13	3.21E-05	7.65E-06	7.52E-06

## DISCUSSION OF RESULTS USING DEA TECHNIQUE

Efficiency is measured between the range of 0 and 1. The closer the score is to 1, the better the efficiency level. A negative efficiency score is termed inefficiency; efficiency score of 1 is constant return to scale; efficiency score ranging between 0 and 1 is relative and decreasing return to scale while score greater than 1 is increasing return to scale.

Table 2 above summarises the results obtained on baseline model and extended models. These are discussed as follows:

#### **Baseline model**

The baseline model shows a negative efficiency score of  $-4.69E-10$  at commencement (i.e. 1991/1992 academic session). This implies that the CMUL was moving towards inefficiency in its allocated expenses during this period. For the period 1992/1993 to 2010/2011, the results show that increasing the input factors of general expenses and academic expenses do not increase the output factors of undergraduate and postgraduate education; hence, zero efficiency level.

#### **Extended model - baseline + budget**

For the first extension of the model, only budget was included as an intervening variable into the baseline model which only had general and academic expenses as its first set of input variables. With the inclusion of budget, the study examined its effect on the output variables of students who graduated at undergraduate and postgraduate levels. This inclusion was imperative; predicated on the findings that the general and academic expenses alone were grossly irrelevant to obtain a desirable efficiency level for effective teaching of medical students at the CMUL.

The results show positive outcomes on two fronts. First, the level of efficiency moved from irrelevance to significant efficiency as 15 out of the 20 years of investigations recorded increasing return to scale with efficiency score greater than one as against zero values for efficiency in the baseline model. Second and consequently, the average efficiency score significantly improved for the period of investigation from  $3.93E-13$  to  $3.21E-05$  with the inclusion of the budget component as another input variable together with the general and academic expenses.

#### **Extended model - baseline + funding**

Similarly, the baseline model is extended, with the inclusion of funding as another input variable. The results obtained also show that for most of the period under review, a mixture of decreasing and increasing return to scale performances were established which imply that there is efficiency of service delivery but of relative efficiency, on the whole. The implication is that though the increasing return to scale of efficiency for most of these periods should have translated to overall efficiency, the negligible relative efficiency level obtained for the overall period is indicative of the culture of poor fund management in the institution. This also reinforced the earlier findings on budgeting as an input variable.

#### **Extended model - baseline + budget + funding**

This is the overall extended model that incorporated budgeting and funding into the baseline model of general and academic expenses. It is apparent from the results tabulated in column (5) that the efficiency level had improved; only that the available funding and budgeting were not substantial enough to meet the desirable level of efficiency of 1.0 or better still, an increasing return to scale efficiency level.

### Sensitivity analysis

Sensitivity analysis, otherwise known as scenario analysis is where the study investigated the effect of parameter changes on the efficiency objective of the CMUL. In this section, the possible increment and reduction that will maintain the envisaged level of efficiency or to what extent will possible adjustments in the input factor(s) reduce or improve the level of efficiency towards the delivery of medical education of the CMUL were examined.

The results of the sensitivity analyses carried out on the data used for this study are presented as follows:-

**Table 3.1: Table of sensitivity analyses: 1991/1992 to 2010/2011**

<b>Table 3.1a: Sensitivity outcome for baseline model</b>			
Variable	Shadow price	Allowable increase	Allowable decrease
General expenses	-0.000302	0	0.00065382
Academic expenses	0.00060377	0.00068209	0
Undergraduate graduated	0	1.00E+30	0.04208775
Postgraduate graduated	0	0.00038169	1.00E+30
Efficiency score	0	3	1.00E+30

#### Sensitivity analysis on baseline model

Arising from this sensitivity analysis, the results show that there is no allowable increase or decrease to general and academic expenses, respectively. This finding is highly instructive as it suggests that for the CMUL to meet its efficiency objective in the delivery of medical education; more expenses should be devoted to academic activities that border on conferences and training of medical students. In other words, better funding should be allocated to the core activities of teaching and learning rather than on non-core activities such as general overhead. Aside these input variables, there are allowable increases or decreases to the number of undergraduate and postgraduate students who graduated. Although, this appears counter-intuitive (in the case of the postgraduate, the allowable decrease of 1E+30 tends towards zero. Technically, it can be assumed that only the allowable increase of 0.00038169 is allowed) but the result is striking in that it suggests that the CMUL should rather reduce its students' intakes in order to align with the available resources to attain efficiency in her service delivery of medical education or it should increase students' intakes towards increasing the expenditure devoted to the academic activities of the institution. Apparently, the institution will want to take the latter option as it is obvious it is operating below its capacity going by the yearly students' enrolments for the session under consideration. All the input and output variables had shadow prices, approximated to zero at the optimum (when allowable increases or decreases had been effected) while that of general expenses was negative. This suggests that to obtain one additional unit of this expense (general expenses) would be counterproductive

as well as detrimental to the institution’s objective of efficiency in service delivery. For academic expenses, undergraduate and postgraduate enrolments with zero shadow prices, these combined would amount to the institution bearing no additional cost if put to optimal use. It is evident that the amount of allowable increases varied while those of allowable decreases remained constant for the academic sessions of 1992/1993 to 2010/2011. This is highly instructive as it suggests that only a uniform decrease in the amount was allowable but a varying amount of increases will facilitate the attainment of efficient service delivery at the CMUL (Table 3.1a).

**Table 3.1b: Sensitivity outcome for baseline + budget model**

Variable	Lagrange multiplier
General expenses	0
Academic expenses	2.79E-06
Budget	0
Undergraduate graduated	0
Postgraduate graduated	0

**Sensitivity analysis on extended model - baseline + budget**

The sensitivity analysis indicates that the Lagrange multiplier is approximately zero for all the input and output variables. This implies that the marginal utility of money is zero. The implication is that the additional benefit derived from an additional ₦1 obtained through budgeting is zero. This is an indication that budgeting matters for the efficient service delivery of medical education in Nigeria. The additional money spent on academic expenses is more beneficial with 2.78995E-06. This lends credence to the fact that more resources should be devoted to academic activities as this would spontaneously improve the service delivery of CMUL (Table 3.1b).

**Table 3.1c: Sensitivity outcome for baseline + funding model**

Variable	Lagrange multiplier
General expenses	0
Academic expenses	1.43462E-06
Funding	0
Undergraduate graduated	0
Postgraduate graduated	0

**Sensitivity analysis on extended model - baseline + funding**

This section dwells on the sensitivity analysis of the extended model which had to do with the infusion of funding into the baseline model. As evident in the result presented in Table 3.1c, the marginal utility of money as denoted by the Lagrange multipliers were zeros for the general expenses, funding, undergraduate and postgraduate students graduated except for the academic expenses with a value of 1.434E-06. This implies that additional efficiency derived from additional expenses on general expenses and that additional efficiencies obtained through additional students graduated either at the undergraduate or postgraduate levels were not value-adding. Meanwhile, the additional benefit to be derived from additional academic expenses is beneficial to the service delivery of medical education at the CMUL. For this to be attained, the marginal benefit of funding has to be directed towards academic expenses to improve teaching and learning at the CMUL (Table 3.1c).

**Table 3.1d: Sensitivity outcome for baseline + budgeting + funding model**

Variable	Lagrange multiplier
General expenses	0
Academic expenses	0
Budget + Funding	0
Undergraduate graduated	0
Postgraduate graduated	0

**Sensitivity analysis on extended model - baseline + budget + funding**

This section dwells on the sensitivity analysis of the overall extended model which had to do with the infusion of budgeting and funding into the baseline model. As evident in the result presented in Table 3.1d, the marginal utility of money as denoted

by the Lagrange multipliers were zeros for all the input and output variables considered viz.: general expenses, academic expenses, budgeting, funding, undergraduate and postgraduate students graduated. This implies that attraction of additional funding is necessary for the efficient delivery of medical education at the CMUL. In other words, a level of equilibrium will be attained which will not require further input for the fulfillment of the desirable level of efficiency; at least, on a constant return to scale basis. Thus, this lends credence to the fitness of the model. This is a reliability and robustness check for the goodness of fit of the DEA model adopted in this study.

It is observed from Table 3.1d that despite the respective addition of budgeting and funding to the baseline model there was no improvement in efficiency of service delivery at least relatively. The combined effects performed better from the baseline. This manifested as the sensitivity as well as scenario analyses suggest that the Lagrange multiplier; which is the marginal utility of money is absolutely zero (Table 3.1d); as against approximately zero (Tables 3.1b and 3.1c) for all the constraints. As the marginal utility of money is absolutely zero, the implication is that additional benefit derived from additional funding or budgeting would not contribute meaningfully to the service delivery on medical education. This brought to the fore the fact that budgeting and funding were required to obtain optimum efficiency in service delivery of medical education at the CMUL.

Further attempts were made in the study to remove the scale effects by obtaining the percentages of these inputs and output variables but found that no convergence could be reached for optimality. Admittedly, the results obtained for the extent of service delivery made as well as its efficiency at the CMUL were quite revealing. The various results obtained revealed different scenarios that funding had affected the expected outcome variables of the CMUL; thereby addressing one of the objectives of the study. In order to recognise the perception of key stakeholders involved in this analysis and for the sake of complementarity of results, the use of questionnaire was also explored in the study.

## **DISCUSSION/IMPLICATIONS OF FINDINGS**

Students at federal universities and medical schools in Nigeria do not pay tuition fees at undergraduate levels but are permitted to pay minimal services charges only. Education is generally considered as the greatest form of investment in human resources. It elevates the learners' intellect, improves their quality of life as well as individuals' skills and efficiency in the production process (Machlup, 1982). Students and their parents invest in their education through payment of tuition fees, purchase of books and other learning materials, and living expenses among others. According to Steel and Sausman (1997), the social rates represent the costs and benefits borne by the society. Akinwande (2013) shows the paltry details of fees paid by undergraduate students in federal universities in Nigeria which appeared to be grossly inadequate to support students' training in the absence of adequate government funding. Earlier studies by Adaralegbe (1990) and Adesina (1990) cited by Bello (2014) buttressed the fact that parents and students must pay for education so that government policy on free tuition does not amount to an empty promise. They further argued that other countries that run free education programmes usually provide opportunities for students to raise funds either directly or indirectly towards financing of their education. This could be in form of bursary grants or students loans payable after graduation and subsequent employment.

The studies that have adopted the DEA method have been numerous. Beginning with the pioneer studies of Ahn, Charnes and Cooper (1988), other empirical studies that have adopted the DEA methods include Coelli (1996); McMillan and Data (1998); Stevens (2001); Robst (2001); Avkiran (2001); (Grosskopf, Margaritis and Valdmanis, 2001); Salerno (2002); Abott and Coucouliagos (2003), (Valdmanis, Kumanarayeke and Lertiendumrong,2004); (Ferrier, Valdmanis and West ,2005); (Ferrier, Rosko and Valdmanis, 2006); (Leitner, Prikoszovits, Schaffhauser, Stowasser and Wagner, 2007); (Clement et al.,2008); (Valdmanis, Rosko, Muller, 2008); Tzeremes and Halkos (2010); Kempkes and Pohl (2010); and recently, Al-Shayea and Battal (2013); Guajardo (2015) and (Sacoto, Castorena, Cook and Delgado, 2015)have also contributed to the methodological literature. Given these rich empirical studies on the DEA method of efficiency delivery of medical education, this study has covered the gap by bringing the study on financing of medical education up-to-date in Nigeria. It therefore provided a valuable information tool to guide policy formulators as well as other relevant stakeholders in the financing of medical education in Nigeria. This study found that the amount of money received towards financing medical education at the CMUL was persistently less than the amount allocated in the budget in most cases. Also, the amount set aside for general overheads were largely consumed by running costs, leaving small amounts for teaching and research expenses. In fact, the major components of the funds were often expended on staff salaries and allowances. There were minimal allocations for teaching equipment, consumables and reagents as well as staff training, which ought to constitute a major area of emphasis in order to have the desired quality expected of medical staff and students.

## **CONCLUSION**

This study affirmed that budgeting and funding were relevant to the service delivery of medical education in Nigeria; using the CMUL as a case study. It was noted that scale-effect did not matter for the estimation of the DEA model as no convergence for optimality could be reached during the iteration process. Prior to the inclusion of budgeting and funding, it was found that the marginal utility of money as represented by the Lagrange Multiplier, was approximately non-zero as slacks existed within the DEA estimations. Meanwhile, with the inclusion of budgeting or funding, the marginal utility of money became approximately but absolutely zero for the inclusion of both budgeting and funding. This study found that funding was the least effective in the funding of medical education at the CMUL.

The issue of funding may continue to be a mirage if the funding models adopted by medical institutions are not sustainable both in meeting the current needs as well as future requirements in promoting medical education. This goal will be achievable if there is effective collaboration among all stakeholders in the education sector.

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## Appendix A

### Data used for baseline model

Year	General Expenses (₱)	Academic Expenses (₱)	Number of Undergraduates	Number of Postgraduates
1991/1992	22,381,342	362,764	219	86
1992/1993	53,145,233	1,310,529	252	77
1993/1994	62,443,242	2,959,341		
1994/1995	80,603,538	3,401,760	232	
1995/1996	111,076,373	4,797,460	190	88
1996/1997	107,445,696	5,894,283	202	77
1997/1998	125,467,574	5,091,012	140	102
1998/1999	214,832,616	5,996,507	167	91
1999/2000	318,237,978	1,218,705	218	92
2000/2001	576,328,478	8,882,583	181	109
2001/2002	669,946,116	8,025,354	93	112
2002/2003	587,783,301	5,172,185	187	90
2003/2004	775,582,441	7,279,389	174	84
2004/2005	774,302,813	3,300,486	169	
2005/2006	936,546,295	4,348,738	317	156
2006/2007	1,002,277,348	9,368,333	220	138
2007/2008	1,460,362,388	8,469,210	358	179
2008/2009	1,431,941,344	19,563,730	181	153
2009/2010	2,055,233,489	9,779,057	272	117
2010/2011	2,458,853,405	8,334,055	229	191

## Appendix B

### Data used for baseline and budget model

Year	General Expenses (₦)	Academic Expenses (₦)	Budget (₦)	Number of under graduates	Number of post graduates
1991/1992	22,381,342	362,764	2,122,600	219	86
1992/1993	53,145,233	1,310,529	2,637,620	252	77
1993/1994	62,443,242	2,959,341	4,900,335		
1994/1995	80,603,538	3,401,760	6,207,524	232	
1995/1996	111,076,373	4,797,460	6,837,484	190	88
1996/1997	107,445,696	5,894,283	5,731,576	202	77
1997/1998	125,467,574	5,091,012	8,064,617	140	102
1998/1999	214,832,616	5,996,507	9,082,724	167	91
1999/2000	318,237,978	1,218,705	15,304,896	218	92
2000/2001	576,328,478	8,882,583	23,270,273	181	109
2001/2002	669,946,116	8,025,354	28,612,132	93	112
2002/2003	587,783,301	5,172,185	52,187,622	187	90
2003/2004	775,582,441	7,279,389	56,831,259	174	84
2004/2005	774,302,813	3,300,486	38,179,514	169	
2005/2006	936,546,295	4,348,738	61,540,361	317	156
2006/2007	1,002,277,348	9,368,333	77,703,338	220	138
2007/2008	1,460,362,388	8,469,210	126,483,004	358	179
2008/2009	1,431,941,344	19,563,730	131,059,259	181	153
2009/2010	2,055,233,489	9,779,057	118,097,002	272	117
2010/2011	2,458,853,405	8,334,055	140,096,663	229	191

## Appendix C

### Data used for baseline and funding model

Year	General Expenses (₦)	Academic Expenses (₦)	Subvention Grant (₦)	Number of Under graduates	Number of Post graduates
1991/1992	22,381,342	362,764	19,957,539	219	86
1992/1993	53,145,233	1,310,529	61,579,576	252	77
1993/1994	62,443,242	2,959,341	75,558,094		
1994/1995	80,603,538	3,401,760	162,995,730	232	
1995/1996	111,076,373	4,797,460	108,526,152	190	88
1996/1997	107,445,696	5,894,283	88,858,550	202	77
1997/1998	125,467,574	5,091,012	190,092,575	140	102
1998/1999	214,832,616	5,996,507	171,335,179	167	91
1999/2000	318,237,978	1,218,705	254,476,342	218	92
2000/2001	576,328,478	8,882,583	824,939,290	181	109
2001/2002	669,946,116	8,025,354	612,657,982	93	112
2002/2003	587,783,301	5,172,185	503,097,229	187	90
2003/2004	775,582,441	7,279,389	757,325,030	174	84
2004/2005	774,302,813	3,300,486	615,835,520	169	
2005/2006	936,546,295	4,348,738	791,906,935	317	156
2006/2007	1,002,277,348	9,368,333	969,105,746	220	138
2007/2008	1,460,362,388	8,469,210	1,276,646,181	358	179
2008/2009	1,431,941,344	19,563,730	1,382,995,154	181	153
2009/2010	2,055,233,489	9,779,057	1,978,111,351	272	117
2010/2011	2,458,853,405	8,334,055	2,167,706,906	229	191

## Appendix D

### Data used for baseline, budget and funding model

Year	General Expenses (₦)	Academic Expenses (₦)	Budget+ funding (₦)	Number of Under graduates	Number of Post graduates
1991/1992	22,381,342	362,764	22,080,139	219	86
1992/1993	53,145,233	1,310,529	64,217,196	252	77
1993/1994	62,443,242	2,959,341	80,458,429		
1994/1995	80,603,538	3,401,760	169,203,254	232	
1995/1996	111,076,373	4,797,460	115,363,636	190	88
1996/1997	107,445,696	5,894,283	94,590,126	202	77
1997/1998	125,467,574	5,091,012	198,157,192	140	102
1998/1999	214,832,616	5,996,507	180,417,903	167	91
1999/2000	318,237,978	1,218,705	269,781,238	218	92
2000/2001	576,328,478	8,882,583	848,209,563	181	109
2001/2002	669,946,116	8,025,354	641,270,114	93	112
2002/2003	587,783,301	5,172,185	555,284,851	187	90
2003/2004	775,582,441	7,279,389	814,156,289	174	84
2004/2005	774,302,813	3,300,486	654,015,034	169	
2005/2006	936,546,295	4,348,738	853,447,296	317	156
2006/2007	1,002,277,348	9,368,333	1,046,809,084	220	138
2007/2008	1,460,362,388	8,469,210	1,403,129,185	358	179
2008/2009	1,431,941,344	19,563,730	1,514,054,413	181	153
2009/2010	2,055,233,489	9,779,057	2,096,208,353	272	117
2010/2011	2,458,853,405	8,334,055	2,307,803,569	229	191

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