TECHNICAL EFFICIENCY OF DISTRICT HOSPITALS IN AFGHANISTAN: A DATA ENVELOPMENT ANALYSIS APPROACH

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A Thesis Submitted in Partial Fulfillment of the Requirements
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ประสิทธิภาพทางเทคนิคของโรงพยาบาลในประเทศอัฟกานิสถาน: การวิเคราะห์โดยวิธีล้อมกรอบข้อมูล

นายอาห์เหม็ด เรเชด ออสมานิ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

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การศึกษานี้มีวัตถุประสงค์เพื่อวัดประสิทธิภาพทางเทคนิคของโรงพยาบาลชุมชนและปัจจัยที่มีผลต่อประสิทธิภาพของโรงพยาบาล โดยการวิเคราะห์ประสิทธิภาพทางเทคนิคและการวัดประสิทธิภาพต่อขนาดของโรงพยาบาลชุมชน 68 แห่งในปี 2553 และ 2554 ใช้แบบจำลอง Input Orientated Data Envelopment Analysis ส่วนการวิเคราะห์ปัจจัยที่มีผลต่อประสิทธิภาพของโรงพยาบาลใช้แบบจำลอง Tobit regression.

จากแบบจำลอง DEA พบว่า โรงพยาบาลชุมชน 40 แห่ง (59%) และ 38 แห่ง (56%) ไม่มีประสิทธิภาพในปี 2553 และ 2554 ตามลำดับ ค่าเฉลี่ยของประสิทธิภาพทางเทคนิคภายใต้ข้อสมมุติ Variable Return to Scale มีค่าเท่ากับ 90% และ 88% ในปี 2553 และ 2554 ตามลำดับ โรงพยาบาลชุมชนไม่มีประสิทธิภาพ ในลักษณะ Increasing Return to Scale 51 แห่ง (75%) และ 52 แห่ง (76%) ในปี 2553 และ 2554 ตามลำดับ พบการขาดแคลนของ แพทย์ พยาบาล ผดุงครรภ์ เจ้าหน้าที่สำนักงาน และเตียง ในปี 2553 (46.30, 19.57, 20.51, 10.46, 97.87) และ 2554 (29.97, 11.06, 12.28, 11.45, 70.50) จากแบบจำลองสมการ Tobit model ของจำนวนเตียง แพทย์ ผู้ป่วยใน ระยะเวลาเฉลี่ยของการนอนโรงพยาบาล อัตราการครองเตียง อัตราส่วนผู้ป่วยนอกต่อแพทย์ และอัตราส่วนเตียงต่อแพทย์ มีผลต่อประสิทธิภาพทางเทคนิคและประสิทธิภาพขนาดของโรงพยาบาลชุมชน จากแบบจำลอง Tobit regression พบว่าอัตราส่วนผู้ป่วยนอกต่อแพทย์ มีความสัมพันธ์ต่อประสิทธิภาพทางเทคนิค อย่างมีนัยสำคัญทางสถิติ ที่ระดับความเชื่อมั่น 95% ในปี 2553 และ 2554

สาขาวิชา สาขาวิชาเศรษฐศาสตร์สาธารณสุขและการจัดการบริการสุขภาพ ลายมือชื่อนิสิต…………………………

ปีการศึกษา 2555 ลายมือชื่อ อ. ที่ปรึกษาวิทยานิพนธ์หลัก………

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The objectives of this study were to measure the Technical Efficiency (TE) of District Hospitals (DHs) and to determine factors affecting the hospitals' efficiency. Input-orientated Data Envelopment Analysis (DEA) was applied to measure the technical and scale efficiency scores of 68 DHs in the year 1389 and 1390. At the second stage of this study, a Tobit regression analysis model was used to assess the influential determinants of the hospitals' efficiency.

Results of the DEA indicated that 40 (59%) and 38 (56%) of the DHs were inefficient in 1389 and 1390 respectively. Mean of Variable Return to Scale (VRS) TE was 90% and 88% during the two periods of the study, respectively. The Increasing Return to Scale (IRS) of DHs was 51 (75%) and 52 (76%) for their patterns of scale inefficiency for the years 1389 and 1390, respectively. Total number of slack inputs, such as, doctors, nurses, midwives, non-medical staff and beds were (46.30, 19.57, 20.51, 10.46, 97.87) in 1389 and (29.97, 11.06, 12.28, 11.45, 70.50) in 1390. Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), OPDPHY(Outpatient-Physician ratio) and (BEDPHY) Bed-Physician ratios have been regressed against VRSTE scores. Results of the Tobit regression model revealed that outpatient-physician ratio was significantly correlated to VRSTE at 95% Confidence Interval (CI) in the solar years of 1389 and 1390, while ALOS, BOR and BEDPHY were found insignificant during both periods of the study. However, their signs were similar to what was expected. Exclusion or omitted variables in the model might be possible reasons for insignificancy in the regression model.

Field of Study: Health Economics and Health care Management Student's Signature…………..
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Finally, I owe sincere thankfulness to my parents and my brothers who made me believe in myself and guided me through the whole processes of my studies. I am sure that this study would not have been possible without their encouragement.

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LIST OF ABBREVIATIONS

DEA	Data Envelopment Analysis
DMUs	Decision Making Units
TE	Technical Efficiency
SE	Scale Efficiency
CRS	Constant Scale to Return
VRS	Verbal Return To Scale
IRS	Increasing Return to Scale
DRS	Decreasing Return to Scale
WHO	World Health Organization
MoPH	Ministry of Public Health
RH	Regional Hospital
DH	District Hospital
HMIS	Health Management Information System
BPHS	Basic Package of Health Services
EPHS	Essential Package of Hospital Services
IEC	Information Education Communication
NGOs	Non-Governmental Organizations
AMS	Afghanistan Mortality Survey
CHC	Comprehensive Health Center
BHC	Basic Health Center

MHT	Mobile Health Team
SC	Sub Center
USAID	United States Agency For International Development
EC	European Commission
WB	World Bank
HFs	Health Facilities
DRGs	Diagnostic Related Groups
NHI	National Health Insurance
AHA	American Hospital Association
MRSC	Massachusetts Rate Setting Commission
ALOS	Average Length of Stay
BOR	Bed Occupancy Rate
OLS	Ordinary Least Square
OPD	Outpatient Department
IPD	Inpatient Department
QALYs	Quality Adjusted Life Years
DALYs	Disability Adjusted Life Years
E	East
N	North
AMI	Acute Myocardial Infarction
HMO	Healthcare Managed Organization

SFA	Stochastic Frontier Analysis
PPS	Prospective Payment System
USA	United States of America
UN	United Nations
CIA	Central Intelligence Agency

CHAPTER I
INTRODUCTION

1.1. Problem and Significance

Decades of conflict and political uncertainty in Afghanistan have almost ruined all sectors of the country, and Afghanistan's health sector has widely suffered from unstable situation of the country. Access to basic healthcare services and hospital services were inconceivably limited. After establishment of the transitional government in 2001 in Afghanistan, The Ministry of Public Health (MoPH) of Afghanistan decided to increase equitable distribution of healthcare services throughout the country. Therefore, MoPH introduced a comprehensive strategic package; Basic Package of Health Services (BPHS). The main purpose of (BPHS) is to provide a standardized package for delivering basic health care services. Fortunately, introduction of this package has increased coverage and accessibility in a considerable scale. Later on in 2005, another package was introduced as complementary to BPHS and it was Essential Package of Hospital Services (EPHS). In a general sense, BPHS provide primary healthcare services throughout the country while EPHS cover secondary and tertiary healthcare services. However, they are interrelated through District Hospitals (DH). According to Afghanistan's MoPH, types of facilities used by (BPHS) are consisted of Health Post (HP), Health Sub Center (HSC), Mobile Health Teams (MHT), Basic Health Center (BHC), Comprehensive Health Center (CHC) and District hospitals (DHs). Health facilities in (EPHS) are divided into three levels; Provincial Hospitals (PHs), Regional Hospitals (RH) and National Hospitals (NHs)(MoPH, 2010a).

At the district level, the DHs provide all BPHS services, including the most complicated patients and cases. Hospitals are part of the referral system in the health system of Afghanistan. For instance, patients who need macro surgeries under general anesthesia, X-ray services, and comprehensive obstetric care will be referred to DHs from other BPHS facilities. DHs handle comprehensive inpatient and outpatient care. Also, DHs provide a wide range of essential drug, treat malnutrition children.

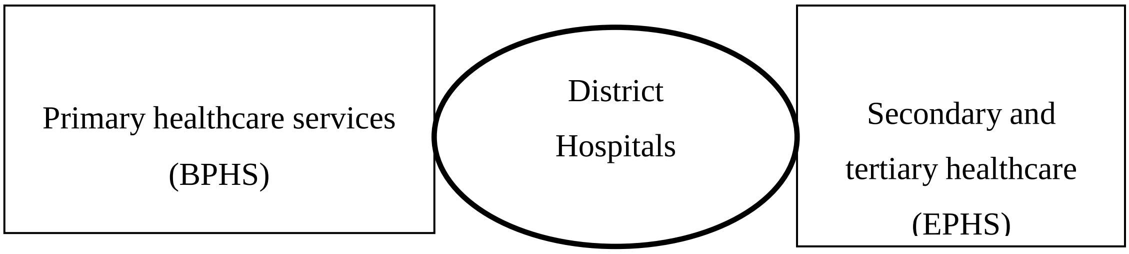
Rehabilitation of patients is also part of the services that are being provided by the DHs. According to the MoPH a DH is supplied by specific number of doctors, nurses/midwives, lab and x-ray technicians, pharmacist, dentist and dental technician and physiotherapists. Each DH covers a population of 10000-300000(MoPH, 2010a).

Cases which cannot be treated at the district level should be refereed to higher levels of health facilities. The PH provides more advanced services than DHs and covers the provincial population as a whole. Cases that cannot be treated at the PHs are referred to RHs. At the RH level, the hospital provides services that cannot be provided at the PHs and covers provinces located at the respective region. Ideally, there should be a referral system between all different levels of health facilities through which cases can be referred from one level of care provision to the next, where they can receive necessary treatment(MoPH, 2010a).

Even though MoPH has considerable achievements in terms of healthcare services distribution and coverage, challenges and problems are still exist. Afghanistan health system is widely dependent on external donations and aids of international agencies such as United States Agency for International Development (USAID), the World Bank (WB) and European Commission (EC)(MoPH, 2005-2009). Sustainability of the health system in long run is a major source of concern for the policy makers at the national level. Therefore, attempts are going on to build sustainable healthcare services for the citizens. Limited resources should be wisely used in all levels of healthcare provision. This paper can be a tool for policy makers to make wise decision in terms of wise allocation of resources. For instance, Concerning hospitals with outputs falling short of the DEA targets, MoPH policy makers can improve their efficiency by improving access to under-utilized health promotion, preventive and outpatient services, e.g. family planning services, antenatal and post natal care, hospital deliveries, child growth monitoring, immunization, Insecticide Treated Bed Nets, antimalarial treatment for fever(UNICEF, 2003). Alternatively, result of this study may improve efficiency of the DHs through transformation of human resources and capital resources for the health facilities experiencing shortages of resources. Savings of non-salary running costs could be invested in strengthening of primary level health facilities and community health out-reaches(MoPH, 2010b). Also, evidence based facts indicate that inefficiency of healthcare institutions can create problems for equitable delivery of healthcare services. Hence, my study will find Technical Efficiency (TE) of DHs as a proxy for performance of these institutions.

Another question might be asked that why DHs are the only facilities that are being studied in this research. According to the Statistical central office of Afghanistan, 20.6 million of populations out of 26 million live in rural areas of the country where DHs are the ultimate destination for the most of rural residents(MoPH, 2010c). Furthermore, hospital expenditure compose one third of total health expenditure in Afghanistan and therefore special attention should be given to hospitals at the country level. Bellow diagram manifest position of district hospital in the current health system of Afghanistan(MoPH, 2005).

Figure 1.1 DHs in the Health System of Afghanistan



1.2. Research Questions

1.2.1. Primary research question

What are the levels of technical efficiency scores and their determinants for the District Hospitals in Afghanistan?

1.2.2. Secondary research questions

1. What are the influential factors related to technically efficient performances of district hospitals in Afghanistan?
2. What is the level of inefficiency in the District Hospitals of Afghanistan?

1.3. Research objectives

1.3.1. General objective

Determine hospitals efficiency with an exclusive focus on technical efficiency of DHs through appraisal of efficiency score and identify determinants of DHs efficiency in Afghanistan.

1.3.2. Specific objectives

1. Measure and compare technical and scale efficiency of District Hospitals.
2. To understand magnitude of inefficiency in inefficient District Hospitals.
3. To identify efficiency determinants for District Hospitals in Afghanistan.

1.4. Scope of the study

This study is an analysis of Technical Efficiency of DHs within (BPHS) for the solar calendar of 1389 and 1390 in Afghanistan. Lately mentioned is a comprehensive strategic package that delivers primary healthcare and hospital services at DH level throughout Afghanistan. The data which was used for this study is cross sectional secondary data. Afghanistan's Health Management Information System (HMIS) data base has provided the required data.

1.5. Statement of Hypothesis

Factors such as Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), physician-bed ratio, outpatient-physician ratio are unlikely to be influential on the DHs technical efficiency after they quantified through econometric technique of sensor regression model analysis.

1.6. Possible Benefits

Technical Efficiency analysis of DHs in Afghanistan can make a major contribution to improving healthcare services in Afghanistan. For the sake of conciseness, all possible benefits from this study can be explained in the following two main levels.

National Level: At the national level, policy makers may use outcome of this study to formulate evidence based policies. For instance, based on efficiency scores, they may allocate resources efficiently in order to avoid waste of limited financial and technical resources. Furthermore, the relationship between MoPH and EPHS/BPHS implementer NGOs is a type of principal agent relationship. This relationship is rooted to informational asymmetries or contradiction in objectives. Hence, DEA findings might be used as a diagnostic tool to single out those Implementer NGOs that have an unsatisfactory performance patterns.

Local level: Based on DEA findings of each individual DH, hospital administrators understand input-output shortcomings of their hospitals and thereafter decide how to allocate all resources efficiently in order to have a technically and scale efficient hospital. To illustrate, the inefficient DHs in Afghanistan could operate as efficiently as their peers on the efficiency frontier either by increasing their outputs or reducing utilization of their inputs.

CHAPTER II
HEALTH SYSTEM OF AFGHANISTAN

2.1. Country Profile

Afghanistan, officially known as Islamic Republic of Afghanistan, is a land-locked state in South-Central Asia. It is mainly located at the intersection of major north-south and east-west trade routes. It locates at an area from latitude 29º 35'N to latitude 38º 40'N and longitude 60º 31'E to longitude 75º 00'E, with mountains ranging from 258 meters to 7,492 meters height from North to South and East to West. Kabul is the capital city of Afghanistan. The country has border with six different countries; Pakistan, Iran, Tajikistan, Uzbekistan, Turkmenistan, and China. Pakistan has the longest border with Afghanistan (at 2,430 kilometers), while China has the smallest border (at 76 kilometers). Afghanistan stretches 1,240 kilometers from east to west and 565 kilometers from north to south. The total land area of the country is 652,290 square kilometers(MoPH, 2011a).

Geographically, Afghanistan has three distinct ecological zones. The huge Hindu Kush mountain range divides the country into three different geographic areas, with altitude, climate, and natural resources that vary greatly. These are the central highland, the southern plateau, and the northern plains(MoPH, 2011a).

From administration point of view, Afghanistan is divided into eight development regions, namely the North Eastern, Northern, Western, Central Highland, Capital, Eastern, South-Eastern and Southern regions. Afghanistan is also divided into 34 provinces and 398 administrative districts. There are 15 large cities and 32 towns. Districts are further divided into smaller units called villages and municipalities (MoPH, 2011a).

2.2. Country Health Profiles

Decades of internal conflict and political uncertainty in Afghanistan have left its health system in ruins. Arguably, health status of Afghanistan's people was the poorest among all nations in the world. In 2001, Maternal Mortality Ratio was estimated to be 1600 deaths per 100,000 live births and similarly other national health indicators were unconceivable poor. Afghanistan Health System has widely changed in late 2001 after break down of dark Taliban regime in the country. Prior to that Nongovernmental Organizations (NGOs) were playing a strong role in providing health services. Services were being provided in a fragmented manner with no or less attention to rural and deep rural areas of the country. In addition, Ministry of Public Health has no stewardship role(MoPH, 2011d).

In 2003, the MoPH with support of its developmental partners has changed it role and found a stewardship role over delivery of healthcare services in the country. As a result, contracting out modality had been found and Basic Package of Health Services (BPHS) has been given to contract out through implementing NGOs. “The goal in developing the BPHS was to provide a standardized package of basic services that would form the core of service delivery in all health care facilities”(MoPH, 2010a). In 2005, the BPHS was revised based on positive impacts on a number of health indicators (including maternal mortality, infant and under 5 mortality, increased access to services and increased immunization coverage). Details of change in the National Health Indicators over the course of five years are shown in the table 2.1.

An Essential Package of Hospital Services (EPHS) was later added, focusing on hospitals, improving their facilities and equipment, staff training and development and enhancing the referrals between different levels of the health system. Currently, contracting out by Non-governmental Organizations (NGOs) to deliver health services has been implemented in 31 provinces, with the support of the EU, USAID and the WB. Three provinces are “contracting in”; where MoPH staffs are contracted, similar to NGOs, to deliver the services(MoPH, 2011b).

Table 2. 1 National Health Indicators of Afghanistan's Health System

INDICATOR	Value	Year	Value	Year
Outpatient visits per capita per year	0.6	2003	1.04	2008
DPT3 immunization coverage	29.9%	2003	82.9%	2007
Skilled birth attendance at deliveries	6.0%	2003	18.9%	2006
Infant mortality rate (per 1,000 live births)	165	2000	129	2006
Under 5 mortality rate (per 1,000 live births)	257	2000	191	2006
Number of health facilities	1241	2003	1688	2009
Skilled Antenatal Care (at least 1 visit, excluding TT) (%)	4.6%	2003	32.3 %	2006

Source: MoPH, Basic Package of Health Services, 2010

Contracting modality with NGOs has been a successful experience in the health system of Afghanistan. It rapidly increased healthcare delivery coverage in the country especially to rural and deep rural areas of Afghanistan. Currently, 85% of the entire population lives in districts where primary care services are provided by NGOs, under contracts with the MoPH or through direct grants from donors, and the MoPH Strengthening Mechanism (“contracting in”). The rationale behind using contracting modality can be summarized as follow: i) all providers are implementing the BPHS and EPHS in accordance with technical guidelines; and ii) all providers are clearly responsible and held accountable for defined geographical areas and populations. Health indicators for Afghanistan have also dramatically improved since the introduction of the BPHS and EPHS(MoPH, 2011d).

Within the BPHS and EPHS packages, there are 1701 active health facilities throughout the country. Health Facilities are linked to each other on basis of a referral system. There are five different levels in the BPHS and three levels in EPHS. Table 2.2 indicates number of Health Facilities with more details.(MoPH, 2011c)

Table 2.2 Number and Type of Health Facilities in Afghanistan

EPHS				BPHS				
Special hospital	Regional Hospital	Provincial Hospital	DH	CHC	BHC	SC	MHT	Others
22	5	30	68	371	782	305	47	79

Source: MoPH, Health Management Information System, 2012

Special hospitals usually provide tertiary healthcare services and mainly located in the Kabul city and to some extend in the major cities of Afghanistan. Likewise, regional hospital are in the major cities of Afghanistan; namely, Balkh, Herat, Kandahar, Nangarhar and Kunduz. Rest of the HF is distributed throughout the country especially to rural areas where a large proportion of population lives.

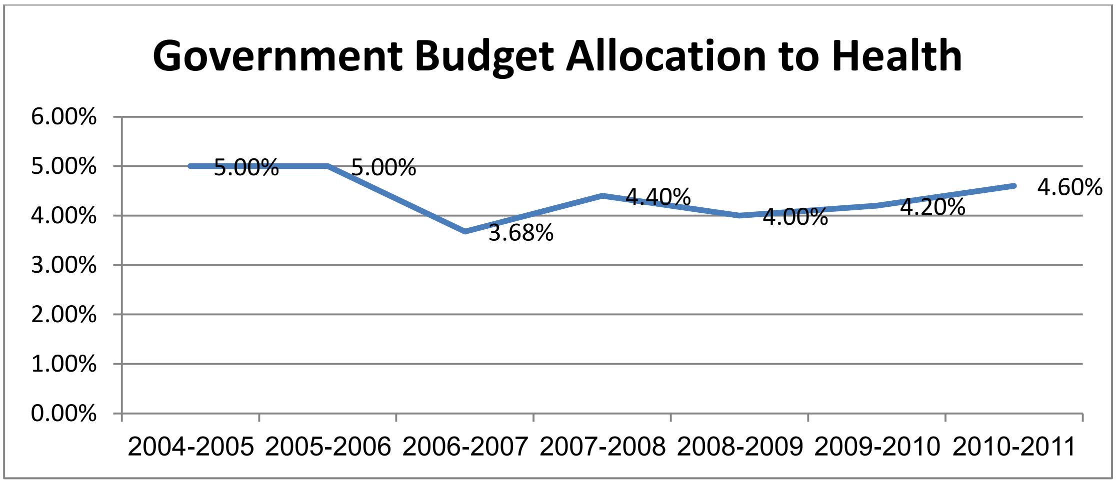
2.3. Healthcare Financing in Afghanistan

Afghanistan is at a critical stage of its recovery and economic development. As a conflict stricken country, the current achievements are marked by political liberalization, macroeconomic uncertainty, and significant donor reliance with uncertain sustainability. International statistics shows that Afghanistan has one of the lowest levels of per capita income worldwide. The risk to achieving the projected economic growth and macroeconomic stability is viewed as substantial in consideration with the fragile security situation(MoPH, 2011d).

Reliance on donor resources is important, and normally would be a source of great concern from a health financing perspective. However, given the post-conflict situation in Afghanistan such reliance is inevitable in the short- to medium-term. The reliance on donor and NGO assistance is complicated by the potential for unplanned government health spending as the much-needed support for health services is accepted across several ministries. The MoPH is starting to address this concern, and it will be critical for donors to be fully supportive of MoPH's efforts to systematically plan for much needed investments into the sector.

Since withdrawal of Taliban regime form the power, Afghanistan health budget as % of government budget is fluctuating. Overall, it is being changed between 4-5%. Figure 2.1 illustrates fluctuation of health budget between 2004 and 1390.

Figure 2.1 Health budget in the total budget of Afghanistan(2004-11)

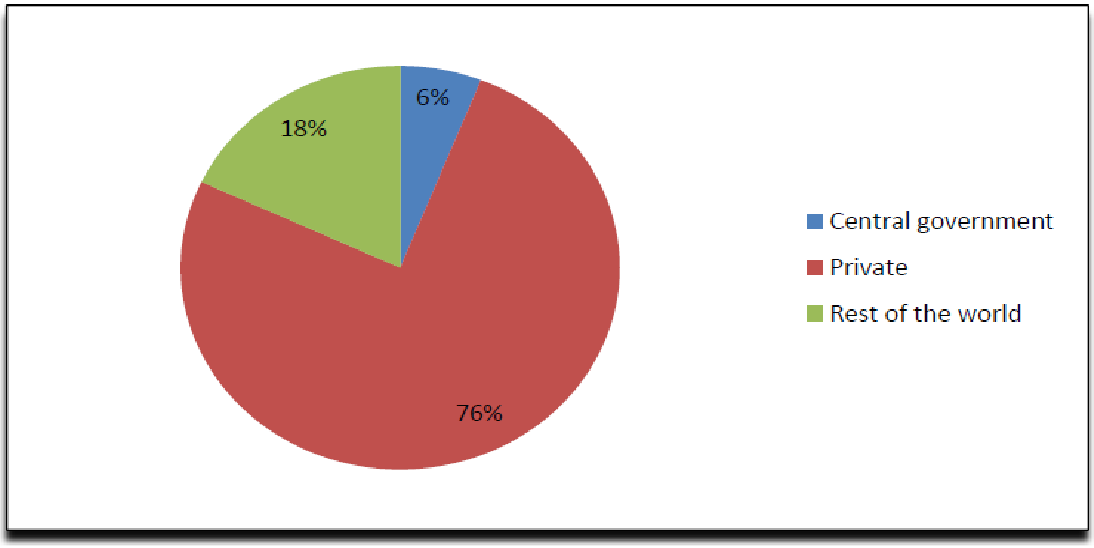


Source: MoPH, Health care Financing Policy paper

The role of the private sector will be critical for medium- to longer-term sustainability. For-profit providers and non-profit providers (NGOs) constitute large parts of the health system in many low-income countries. The MoPH's role should be to monitor and regulate health service delivery in these sectors, but not in a way that is obstructive or adversarial. Public sector doctors currently operate private practices after hours. Dual practice is not uncommon in many developing countries, but the arrangement with doctors and nurses needs to be structured and formalized in a cooperative manner. Lastly, anecdotal accounts refer to use of public facilities by private practitioners. Again, this is not uncommon in other countries, and the cost effectiveness of investments on equipment is often reliant upon some revenue generation from private providers. It is, however, important that use of public facilities by private providers be structured and are fully paid for(MoPH, 2005).

Afghanistan Health system lacks any risk pooling mechanism such as Social Health Insurance (SHI) or Community Health Insurance (CHI). Therefore, catastrophic health expenditure is a major concern for policy makers at the national level. Based on National Health Accounts (NHA) findings, a large portion (75%) of Total Health Expenditure (THE) comes from Out of Pocket (OOP). Figure 2.2 shows Health Expenditure by source of Financing.

Figure 2.2 Health Expenditure by Source of Funding 2008-2009



Source: MoPH, National Health Accounts Report 2008-2009

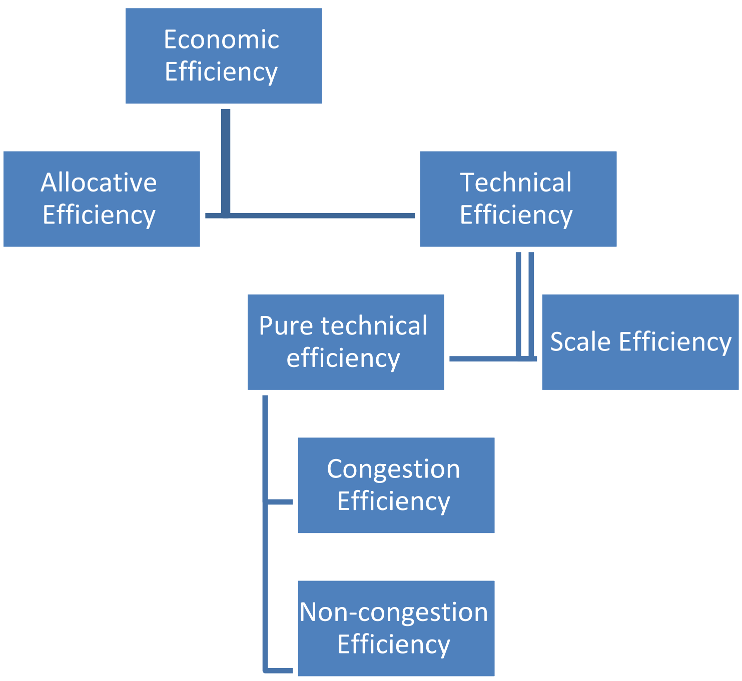
CHAPTER III

LITERATURE REVIEW

3.1. The Basic Concept of Efficiency

Focuses on understanding of efficiency concept began with prior work of Farrell (1957). He had developed his studies on basis of previous work in this regard which were done by Debren (1951) and Koopmans (1951). Farrell has discussed that efficiency of Decision Making Units (DMUs) or firms is the composition of technical efficiency which indicates the ability of a firm to obtain maximal output from a given set of input and allocative efficiency which reflects the ability of a firm use inputs in optimal level with given appropriate prices. Work of Farrell with concept of efficiency is considered to be inspirational for the development of methods that can estimate relative efficiency of firms. For the sake of simplicity below figure shows all types of economic efficiency (Sherman, 1984).

Figure 3.1 Types of Economic Efficiency



The very first definition of Technical Efficiency (TE) is assumed to be Pareto-Koopmans definition. "Full (100%) efficiency is attained by any (DMUs) if and only if none of its inputs or outputs can be improved without worsening some of its other outputs or inputs". Based on the given definition, distribution of resource might not be socially desirable or accepted. Hence, equity and social welfare are underestimated. Meanwhile, TE which is also called Productive Efficiency is best illustrated with production possibility frontier. Here, with the least given input most output should be produced(Roos, 2002).

Meanwhile, there are some other fashions of classification related to efficiency. Philosophical concept of efficiency point out to Kaldor –Hicks and pareto efficiency. In contrast, Lebenstein's X-efficiency is a practical form of efficiency. The term ‘Pareto efficiency’ comes from the name of F. Vilfredo Pareto, an Italian statistician and economist who used this term in his research of income distribution and economic efficiency (Sena, 1999). He explained Pareto Efficiency as if" Given an alternative allocation for individuals, an allocation shift from one individual to another can make the former better without worsening the later". The Kaldor-Hicks efficiency is related to the names of Nickolas Kaldor and John Hicks. This is considered to be another concept of economic efficiency that starts as an explanation of the limitation of unrealistic Pareto Efficiency. Kaldo and Hicks’s concept of efficiency is more applicable to normal environment with less restricted criteria (Such a preferred condition is unlikely to exist) (R.D.Banker, 1984). X-efficiency, in contrast, is a more practical and measurable concepts. For example, Lebenstein’s X-efficiency means that if a company produces the maximum output, given available input resources such as workers, and machinery and technology, it is called X-efficiency(Hossein Moshiri, 2010). If unit cost and unit price of factors of production are present, then the concept of allocative or overall efficiency flash in our mind. Here, the production of an output with the least cost of set of inputs is concerned.

3.2. Concept of Hospital Efficiency

Numerous challenges are still present within sustainable healthcare financing in different countries. Regardless of being high income, middle income or low income; increasing demand for healthcare services and inflationary cost of services are a major source of concern for the policy makers at the national agenda. Therefore, hospitals and other healthcare provider institutions functionality which compose a large portion of expenditure in the functional classification of total healthcare expenditure have drawn attention of health economists. Exclusive attention to efficient operations is becoming more pronounced. Similar to other fields, in healthcare systems, measurement of efficiency is a main and may be the first step in auditing individual performances as unit of production is paramount importance. Consequently, rational distribution of human and capital resources could be used on basis of their efficiency measurements. The term efficiency is widely used in the modern Economics and refers to wise utilization of resources in production of services. Commonly used type of efficiency is TE, referring to the effective use of resources in producing outputs(Hossein Moshiri, 2010)

In the Farrell (1957) perception, a hospital is considered to be technically efficient if it operates on the best practice production frontier in its hospital industry. In the original Farrell framework, the entire observations on a given sample are assumed to have access to same technology (Ozcan Y.A., 1993).

Magnussen (1996) said that measuring TE, allows us to compare hospitals in terms of their real use of inputs and outputs rather than costs or profits(Mangusson, 1996).

A hospital is considered to function technically efficient if an increase in an output requires a reduction in at least one other output, or an increase in at least one input. Alternatively, a reduction in any input must require an increase in at least one other input or a decrease in at least one output(R. Färe, 1994). On the other hand allocative efficiency or sometimes called cost efficiency occurs when inputs or outputs are combined to their best possible uses in the economy domain so that no further gains or achieve in output or welfare are possible.

To measure hospital's efficiency, the hospital's output(s) must be clearly defined. There are many aspects that can be considered for the measurement of a hospital's outputs such as number of outpatient visit, number of surgical procedures performed, number of patient days, number of lab test given, bed turnover, and average length of stay(ALOS), among others(Hossein Moshiri, 2010).

It should be kept in mind that in healthcare service provider institutions, usually output is measured in terms of number of services provided or number of patient days though later mentioned measures are only indicate intermediate outputs. In most cases, effectiveness of interventions and services is concerned(Cleverley, 1992).

A hospital can indicate constant returns to scale (CRS), increasing returns to scale (IRS) or decreasing returns to scale (DRS). Returns to scale stimulate health decision makers what happens if, for instance, they increase all hospital inputs by the same proportion or amount(Grosskopf, 1987). This could result in three different outcomes: (i) CRS – doubling of all inputs results in doubling of outputs; (ii) IRS – doubling of all inputs may lead to more than a doubling of output; and (iii) doubling of all inputs leads to less than doubling of output. The implications for policy depend on which scenario prevails(Joses Muthuri Kirigia, 2008).

3.3. Concept of Hospital Inefficiency

In reference to numerous papers written about hospital inefficiency, it can be concluded that a hospital is thus defined to be inefficient if it could have produced the same amount and quality of patient care and other outputs with fewer resources than it consumed or if it could have produced greater amounts of its output with the same amount of resources it used (Joses Muthuri Kirigia, 2008). A technically efficient hospital has a technical efficiency score of one (or 100%), while the inefficient ones have a score less than one (or less than 100%)(Linna, 1998). For example, pretend that the pure Technical Efficiency of hospital ‘A’ was 75%. This implies that the hospital could have attended to 25% more admissions than it is currently attending to with the same number of doctor hours. Alternatively, hospital ‘A’ could decrease medical doctor hours by 25% and still attend to its current number of admissions(Joses Muthuri Kirigia, 2008).

3.4. Determinants of Hospital Efficiency

Various factors can affect hospital efficiency. For instance, charter state of the firm (profit or not profit organizations) determines efficiency (L.Briker, 1989). Sign of the variable is positively hypothesized if institution is for profit and negatively hypothesized if it is non-profit institution. Meanwhile, other factors such conjunction of nursing home with hospital, reimbursement policy, BOR, ALOS, age of population might have positive or negative impact on efficiency level of hospitals and nursing homes(L.Briker, 1989).

Beyond to that, other involved studies with hospital efficiency explains quite different factors which have considerable influences on hospital efficiency as a proxy of hospital performances. Wage rate of doctors, teaching facilities, state of ownership; governmental or private, are the mentioned determinants of hospital efficiency(M.Sear, 2000).

According to another study which is a case study about central government owned hospitals in Taiwan(Chang, 1989) four operating characteristics are identified as determinants of hospital efficiency. Complexity of services, occupancy rate, proportion of veteran, anticipatory impact of National Health Insurance are hypothesized to have negative, positive, negative and positive impacts on hospital efficiency respectively(Marian Shanahan, 1999). Table 3.1 indicates a selected number of papers that deals with efficiency analysis and their determinants.

Table 3.1 Study papers on determinants of hospital efficiency

Authors	Name of the Paper	Number of DMUs	Results
Grosskopf and Valdmanis (1987)	Measuring hospital performance: A Non Parametric Approach	20 Public Hospitals and 60 Private Hospitals	Public Hospitals more Efficient than Private
Zuckerman, Hadley and Iezzoni (1994)	Measuring hospital efficiency with frontier cost function	15 Non for profit hospitals	16.2 % of all hospitals were inefficient
Ereth and Folland (1994)	The development and Evaluation of Hospital Performance Measures for Policy Analysis	35 Large and 442 Small hospitals	10.5 of All hospitals were inefficient
Joses Muthuri Kirigia, O. A. (2008)	Technical Efficiency of Zone Hospitals in Benn	32 Public Hospitals and Secondary data is used	48% of all hospitals were inefficient
M.Sear, T. N. (2005)	Measuring hospital efficiency: A comparison of two approaches.	127 Public Owned hospitals	Result of DEA and SFA are similar in some aspects while different in other cases.

Source: Extracted from the above selected studies

3.5. Methods to measure Hospital Efficiency

Lately published research papers on measuring efficiency in various areas especially in the hospital industry have widely focused on frontier efficiency. Frontier efficiency calculates deviations in performance as a proxy of technical efficiency from that of best practice firms on the efficient frontier(Nicholas M Potisek, 2007). In general there are two main methods. First, a nonparametric piecewise-linear convex isoquant constructed in a way that no observed point should lie to the left or below it .It is Also, introduced as the mathematical programming method to the construction of frontiers. Second method is a parametric function, such as the Cobb-Douglas form of function, fitted to the data, again in a such way that no observed point should lie to the left or below it (known as the econometric approach)(Sarah Wordsworth, 2005). Both aforementioned methodologies compute a best practice frontier (function) with the efficiency of clearly defined (DMUs) measured relative to the frontier. The frontier efficiency of a firm measures how well that firm performs relative to the predicted performance of the best firms in the industry market conditions(Hossein Moshiri, 2010).

In the econometric methods the specified production function recognizes that deviation away from this given technology (as measured by the error term) is made of two parts, one representing randomness (or statistical noise) and the other inefficiency(William W.Cooper, 2006). There is a well-defined assumption behind the two-component error structure. The inefficiencies component of the structure follows an asymmetric half-normal distribution whereas the random errors are normally distributed component of the structure(Nuti, 2011). It's assumed that the error term includes all events which are outside the control of the firm. These events encompass both uncontrollable factors directly related to the ‘actual’ production function (eg, differences in operating environments, weather matters, and geographical issues) and econometric errors (such as misspecification of the production function and measurement error). Above given reasons about error term, paved the way for the development of the stochastic frontier approach. In this approach all these external factors take into account while computing the efficiency of real-world firm(Hossein Moshiri, 2010).

Totally different from the econometric approaches which mainly focus to determine the absolute economic efficiency of firm against, the mathematical programming approach to evaluate the efficiency of a firm relative to other firms in the same industry (eg, hospital industry)(Pagan, 2006). The most famous version of this approach is a linear programming tool named to as Data Envelopment Analysis (DEA)(Hossein Moshiri, 2010).

Ferrier and Lovell (1990) illustrated that stochastic frontier analysis and data envelopment analysis may be used as crosscheck with each other. Below table shows a brief description of all the methods used to measure efficiency of hospital summarized by Hollingsworth et al (1998) in the table 3.2 shown below.

Table 3.2 Methods of Efficiency Measurements

Types	Parametric	Non-parametric
Deterministic	Parametric mathematical programming Econometric frontier analysis	Data envelopment analysis DEA
Stochastic	Stochastic Frontier Analysis	Stochastic Data Analysis

Source: Hollingsworth et al, 1998

In addition to above mentioned approaches, some relatively simple methods can calculate magnitude of hospital efficiency determinants as follow:

Ratio analysis-The wide use of different ratios for a collection of comparable hospitals to locate relationships that are abnormally high or low, such as cost per patient day, cost per patient, and personnel full-time equivalents per patient. Examples of this type of ratio data analysis are Monitored reports of the American Hospital Association (AHA) and the Massachusetts Rate Setting Commission(MRSC) ratios used for cost auditing(Joses Muthuri Kirigia, 2008).

Econometric regression technique –Used to create model between efficiency scores and its determinants. For instance, BOR, ALOS, number of physicians and type of institution is regressed with efficiency score and impact of aforementioned factors is identified(M.Sear, 2000).

3.6. Previous applied studies on Hospital Efficiency Measurement

Here, a review of selected efficiency studies regardless of the studies purpose of is presented. Valdmanis (1990) implemented the DEA method to two different groups of hospitals; government owned hospitals and private hospitals. He found that the government-owned hospitals were more efficient. This result might be due to an imperfect adjustment is made for the quality of output and patient day rather than admission are generally used to measure output. Another unexpected result of this study indicated that private hospitals tended to be among inefficient hospitals(V.Valdmanis, 1993)

Later on, Zuckerman, Hadley and Iezzoni (1994) employed another method to analysis hospital cost function. They used Stochastic Frontier Analysis (SFA) as their preferred method. Their study was based on determination of a cost model that widely focused on input prices, output volumes, and output characteristics (less tangible output results such as the Joint Commission on the Accreditation of Health care Organizations score). They concluded that the hospitals were inefficient on average 13.6 percent of total hospital cost. At the same time another study simultaneous to Zuckerman, Hadley had been done by Hofler and Folland (1996). Their result was quite similar in terms of inefficiency level(Zuckerman, 1994)

Grosskopf and Valdmanis (1987) applied DEA to study and analysis technical efficiency of more than 20 governmental hospitals (public hospitals-not for profit objective) and 60 private hospitals (not-for-profit objective) in the USA. They found two distinct production frontiers with public hospitals in that study. They presented that governmental hospital were more efficient then private hospitals(Ozcan, 1994).

Zuckerman et al. (1995) insisted to use apparently a new combined method which is called cross-sectional stochastic frontier model to derive hospital- specific measure of inefficiency. Their study just drew a borderline for the functionality of the hospitals. Based on study findings, they summarized that "one of the goals of Medicare’s PPS in the US is to promote efficiency by rewarding hospitals that are able to keep their costs below Perspective Payment System (PPS) rates and penalizing those that are not"(Tambour, 1997). Meanwhile, manifestation of hospital profitability range is another aspect of their study. A wide range of profitability among hospitals in 1990, which might be due to payment mechanisms reforms in the hospital sector were seen in the conclusion of the study. As far as the issue of profitability were concerned among set of hospitals that he studied he present another interesting question that whether profitable institutions are efficient and those experiencing losses are not. If this is a true story about hospital then it requires that inefficient hospitals should cut their costs and profitable hospitals should expand production(Zuckerman, 1994). Their proposed model for this that study (cross sectional stochastic frontier model) measured the relative efficiency of hospitals instead of absolute economic efficiency. As a result, they were able to appraise the relationship between profits and efficiency easier, so that their question was easily answered. According to their findings, they concluded that" inefficiency accounts for 13.6 percent of total hospital costs' and that the PPS which rewards efficiency and penalizes inefficiency, provides hospitals with appropriates incentives". It indicates that there is direct relationship between level of higher inefficiency and cost inflation of the services. Authors determined that any reduction in inefficiency level will be followed by reduction in cost of services. Their model indicates that by eliminating the 13.6 percent estimated inefficiency, costs of healthcare services would reduce by approximately $ 31 billion in the USA in 1991(N. Maniadakis, 1999).

Arguably one of the first applications of SFA to medical institutions was led by Hofler and Folland (1991). Hofler and Folland believed that Stochostic frontier Analysis (SFA) is the most accepted method to estimate cost and efficiency because this method will provide minimum cost level and inefficiency score. They also found that DEA is not entirely satisfactory because it cannot capture random fluctuations present in the data observations (biasedness emerge). In their study, Hofler and Folland perceived that "structural cost differences are based on ownership (for profit or not for profit categorization), teaching status, metropolitan or rural categorization, and Medicare volume ratio (high, low)". They found that inefficiency was responsible for about 10.5% of total hospital. The number of cost equations (12 equations based on the assumed differences in cost structure) and the disturbances of the assigned group size (smaller group as 35 and larger group was 442 hospitals) served to manifest some of the problems associated with SFA: several equations could not be estimated, as the Maximum Likelihood Estimates did not converge.

In the study which was done by Stanford's (2004), he investigated the performance of 107 hospitals in treatment of Acute Myocardial Infarction (AMI) by using DEA. His aim was to determine clinical efficiency and quality of treatment. Cross efficiencies were used to improve the efficiency discrimination between hospitals.

Bates (2006) tried data envelopment analysis and multiple regression analysis to study empirically the influence of various market-structure elements on the technical efficiency of the hospital services industry in various urban areas of the United States. Base on his explanation, "market-structure elements include the degree of rivalry among hospitals, extent of HMO activity, and health insurer concentration". The DEA results indicated the typical hospital services industry had eleven percent inefficiency in 1999. Moreover, multiple regression analysis indicated the level of technical efficiency was different across metropolitan hospital services industries in response to greater HMO activity and private health insurer concentration in the state. The analysis concludes that the degree of rivalry among hospitals had no marginal effect on technical efficiency at the industry level. Evidence also implies that the presence of a state Certificate of Need law was not associated with a greater degree of inefficiency in the typical metropolitan hospital services industry.

Dismuke and Sena (1999) had used Malmquist productivity index to find the relationship between DRG, Technology and productivity. Malmquist indices together with SFA had been applied to Portuguese district and central hospitals. Their Panel data set consisted of data for cerebrovascular disorders and heart failure for the years 1992 to 1994. Conclusively, they found that productivity is related with DRG system and technology. They included some quality measures a in theirs study (Sena C. D., 2001).

Tambour (1997) applied DEA model combined with Malmquist index of productivity in two Swedish ophthalmology departments for the years 1988 to 1993.

He found that productivity the mentioned sector is significant and positive. Average change in the overall productivity is positive but not significant. Meanwhile medical technology such as installation of new operation machines in the operator theatre and computerization of administrative sections had influential impact on progression of productivity.

Roos (2002) investigated 865 ophthalmology patients before and after surgery. He concluded that activity of those patients without any problem in another eye is increased about 74% after operation. Similar to this study, Wilson and Burgess looked for two different hospitals federal and non-federal hospitals. Furthermore, Fare et al. had found considerable productivity within hospital functionality during specific period of time (R. Färe, 1994)

Linna (1998) used Malmquist index of productivity together with SFA to investigate trend of productivity in 42 hospitals for the year 1988 to 1994. He concluded that there is an average 3 to 5% productivity which is equal to cost efficiency and technical change in the studied hospitals.

Maniadakis et al (1999) had applied Malmquist indices to see the productivity and quality changes in 75 acute care hospitals around Scotland for two different periods 1991/1992 and 1995/1996. He found productivity slowdown in the first period after NHS reforms and increase in productivity in the subsequent years. Also, he summarized that technology had less impact on efficiency while beneficial for productivity at some levels. Same Authors reinvestigate the same hospital for the years 1991/1992 to 1995/1992. This time they saw some obvious signs of productivity progress.

McCallion et al (2000) studied two groups of hospital; small and large hospitals for the years 1986 to 1992. They found that larger hospitals show productivity by 2.31% while smaller hospitals indicate productivity by 22.53%. However, obvious decline had seen in scale efficiency in the hospitals. Similarly, Sommersguter-Reichmann (2000) studied 22 Austrian hospitals from 1994 to 1998 (public and private hospitals included in his study). He found an increase in productivity in the last two years (1.093 to 1.038). He related the improvement to due to technology improvement, based on financing a new system.

Zera et al (1994) studied 86 hospitals in South Africa in 1992/1993 to find productivity changes. He found about 12 declines in productivity because of technology regression. Also, efficiency change was marginally high(Sarah Wordsworth, 2005).

Analysis of hospital services consumption was an interesting study that had been done by Riedel and Fitzpatrick. He exclusively focused on length of stay and consumption of lab and radiologic services. He selected six group of explanatory variables in his theirs study; patient characteristics (age, sex, existence of complications, surgery), physician characteristics (specialty status), hospital characteristics, (size and location) and financial influences. Some of the variables such as patient characteristics were consistently found to be the most important in explaining ALOS variations for the diagnostic groups. For all diagnoses, the presence of complications substantially increased length of stay. Other patient characteristics also were found to be important but had less impact than the complication variables(S. E. Berki, 1984).

3.7. Data Envelopment Analysis (DEA)

Researchers in field of hospital efficiency have recently developed a comprehensive theoretical model to assess changes in production cost and efficiency and this is called production function model. Production function model is a normative model in its abstract concept, which expresses how the total, average, and marginal costs of a product change based on the correlation between inputs and outputs. Technology has a substantial impact on the cost of inputs and quality of care provided within the health care industry. There are two analytic approaches that have been proposed for measuring hospital performance and efficiency, both of which are derived from different academic disciplines(Ehreth, 1994). The first and most commonly used is financial ratio analysis which is derived from the finance and accounting disciplines. The analysis of financial statements within the hospital industry was further studied by Cleverley who developed a number of capital and operating ratios used in assessing hospital performance(Cleverley, 1992). The advantages of ratio analyses are the simplicity of calculation and the quality of the underlying financial data. However, an important disadvantage of ratio analysis is that while comparison can be made to group averages, an average is not an optimum, so that there is no assurance that this comparison will distinguish the most efficient or best performing hospitals(Sommersguter-Reichmann, 2000). The second measure of hospital performance comes from operations research and management science, industrial engineering, and economics. The technique is called data envelopment analysis (DEA) and determines the relative relationships among different organizations compared to the most technically efficient organization in the sample. DEA is a linear programming methodology that generates a single summary measure of the relative performance for individual hospitals (DMUs) as well as determines the "efficiency frontier" for the set of hospitals being analyzed(Ozcan, 1994).

Measuring technical efficiency through data envelopment analysis is proved to be an effective tool to put all the local health authorities on the same level for outputs delivered. Furthermore, it obviously sheds light on the possibility of improving the use of resources(William W.Cooper, 2006)

It should be kept in mind that although data envelopment analysis has been accepted by the chief executive officers as a valid tool to measure efficiency, it proved to be a sophisticated tool as well to manage efficiency. At the same time, the chief executive officers found it problematic to translate the efficiency scores into specific actions to be taken in order to improve their performance(Joses Muthuri Kirigia, 2008). DEA can provide top managers with a valid technique to measure efficiency in benchmarking. However, it is useful only to detect lack of efficiency, and not to identify the actions that need to be carried out for improvement. Involving top managers in the selection process of inputs and outputs is fundamental in order to make results accepted. Tables 3.3 summarize some weakness and strengths of DEA as a tool for evaluating pure TE.

Table 3.3 Strengths and Weaknesses of DEA

Strength of DEA	Weakness of DEA
DEA has the capability to handle multiple inputs and multiple outputs without any prior assumptions	Measurement error can cause significant problems. DEA is not able to capture statistical noise or factor factors that can affect performance of firms
DEA doesn't require relating inputs to outputs. Two wings of DEA can have homogenous or heterogeneous and mixed of them	DEA does not measure "absolute" efficiency. DEA based on its understanding from efficiency definition can only estimate relative efficiency
Comparisons are directly made against peers in the study	Hypothesis cannot be test when using DEA
Inputs and outputs can have very different units	Large problems can be computationally intensive in some cases

Source: Technical and Scale Efficiency of Zonn area Hospital in Benin

The popularity of nonparametric techniques, collectively termed as DEA, has largely contributed to the increased interest in the measurement of hospital efficiency during the last decade. This methodological framework facilitates the measurement of efficiency in organizations producing multiple outputs with the aid of multiple inputs, and where information about factor or product prices is lacking. Thus, it should be well fitted for the measurement of hospital efficiency. Indeed, multiple inputs/outputs is a frequently recurring justification for using DEA-type methods in the measurement of hospital efficiency(R.D.Banker, 1984).

DEA is preferred to other efficiency measures for the following reasons: (1) Usually estimation of hospital efficiency requires cost function analysis but DEA allows us to calculate efficiency on basis of input use rather than input price especially in in the settings that data related to price of factor is lacking. (2) In most cases healthcare institutions function with numerous input and outputs. DEA is an effective tool to produce efficiency score with multiple out in healthcare institutions. (3) Cost management problems in health care is extremely severe and the nature of health care, with the provision of multiple services with multiple types of resources, many with no market price, makes DEA a potentially powerful management tool to improve productivity and reduce the cost of care (Mills, 1990)

CHAPTER IV
RESEARCH METHODOLOGY

4.1. Study Design

This is a cross-sectional descriptive analysis. Calculation and Analysis of technical efficiency of District Hospitals within BPHS in Afghanistan is the core objective of this study, and determination of influential factors affecting technical efficiency is secondarily assessed in this study.

In the first stage of study, technical efficiency of DHs is calculated for two consecutive years. Solar years of 1389 and 1390 are selected for the purpose of this study. DEA tool was applied to calculate technical and scale efficiency of all hospitals. In the second stage, determinants of hospital efficiency which had been selected on basis of literature review and contextual issues are regressed against a number of utilization factors of hospitals using censor regression analysis (Tobit model).

4.2. Type and Source of Data

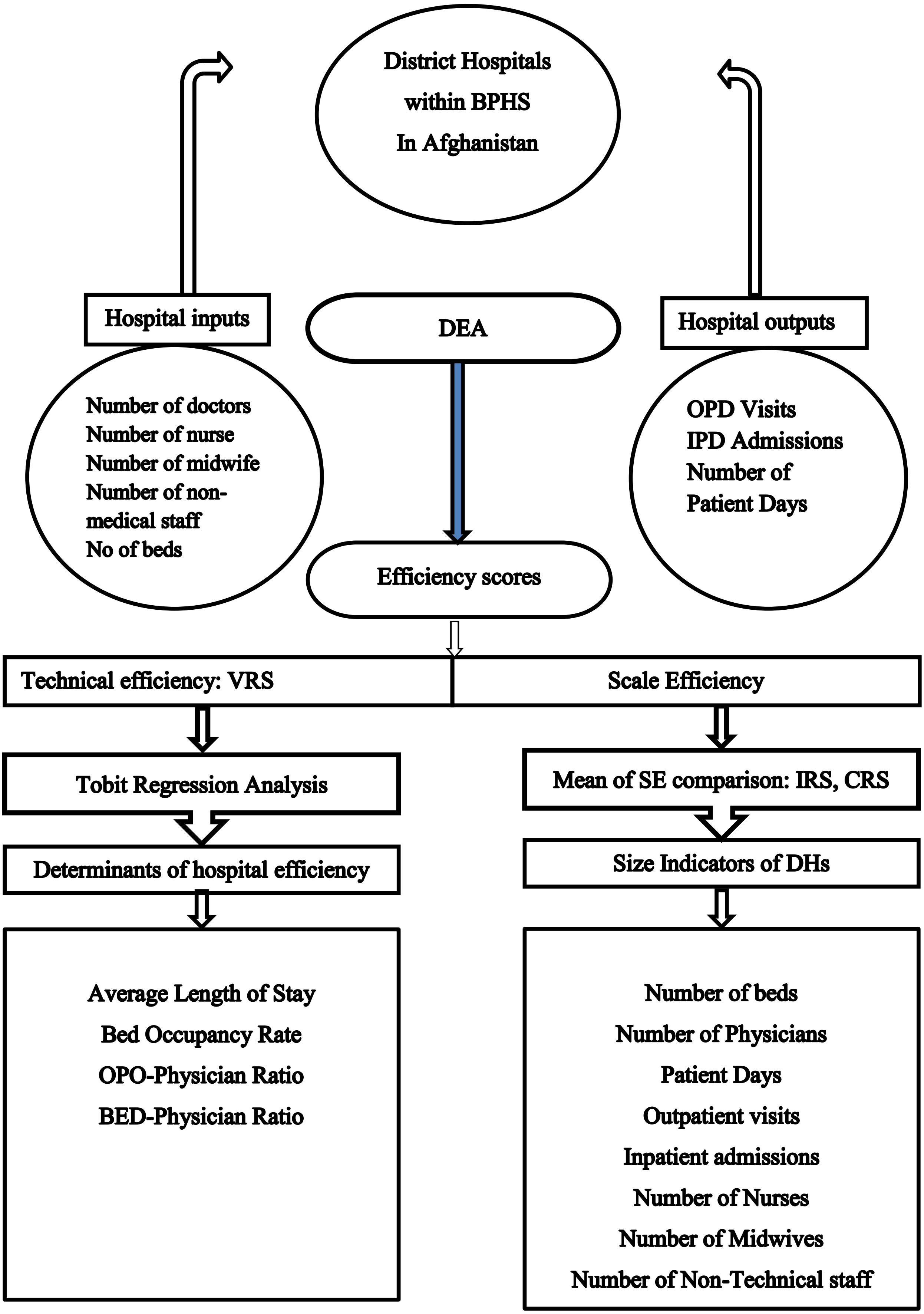
Cross sectional data was used from Afghanistan's HMIS database for the solar calendar of 1389 and 1390. Available secondary data Set includes different numerical variables. For the purpose of efficiency determination with DEA, a set of input variables (number of physicians, midwives, nurses, number of non-medical staff, and number of bed) and set of output variables (number of outpatient visits, number inpatient admission and number of patient days).Also, determinant of hospital efficiency (average length of stay, bed occupancy rate, number of patient days , number of hospital beds which is a proxy for hospital size, bed-physician and outpatient physician ratio and physician number) is taken from HMIS data base and used in the study.

4.3. Conceptual Framework

This study is consisted of two stages. In the first stage, Technical Efficiency (TE) of the District Hospitals (DHs) in Afghanistan was calculated by DEA. Input and out orientated measurements is required to find out efficiency scores(Ozcan Y.A., 1993). In this study, input orientated DEA is used because there might be no or less control over output indicators of hospitals. Technical efficiency scores are estimated from the underlying assumption of Variable Return to Scale (VRS). Mean of Scale efficiency scores of DHs are compared in two different years to see if they are critically different on basis of their scale pattern.

In the second stage, factors affecting efficiency (Determinants of hospital efficiency) are identified using econometric technique of Tobit regressions analysis. Figure 4.1 indicates brief illustration of stages.

Figure IV.1 Conceptual Framework



4.4. Rationale of the selected variables in the study

4.4.1. Input Variables

A number of Cost Analysis studies in the MoPH indicated that doctors, nurses and other operating staff compose a considerable portion of expenditure being spent annually(MoPH, 2012). In a context that provision of hospital services is extensively dependent to international assistances, all resources especially physicians and other operating staffs should be wisely allocated. According to United Nation (UN) findings, labor force crises in medical arena are a potential threat for Afghanistan. According to CIA census, Afghanistan has 0.19 physicians per 1000 population and 0.4 hospital beds per 1000 populations. It is arguably one of lowest in the world.

A number of studies have selected different variables as input categories to estimate hospital's technical efficiency using DEA. Some studies preferred to use cost of labor forces (Including doctor cost and operating personal cost) while some other studies insist on abstract number of physicians, nurses/midwives and other operating staff within a hospital. In this study, having all constraints such as lack of data; especially costing data, abstract number of physicians, operating and supportive staffs(Labor inputs) and number of beds in each hospital for a specific year(capital input and proxy of hospital size) as my inputs to estimate technical efficiency. table Ⅳ.1 provide brief explanation of input variables for DEA(MoPH, 2010a).

Table 4.1 Input variables for DEA

Name of variable	Definition of variable
Number of physicians	Total Number of Physicians in a DH in 1389 and 90
Number of Nurses	Total Number of Nurses in a DH in 1389 and 90
Number of Midwives	Total Number of Midwives in a DH in 1389 and 90
Number of Non-Medical staff	Total Number of Non-Medical staff in a DH in 1389 and 90
Number of Beds	Total Number of Beds in a DH in 1389 and 90

Source: MoPH, Health Management Information System, 2012

4.4.2. Output variables

Determination of hospital output is a controversial issue because context of healthcare services is totally different from others. Usually in the research paper that aims to study hospital's technical efficiency, physical relationship between the resources allocated (capital, labor and equipment) and certain health outcomes are taken into consideration. Health outcomes can be intermediate outcomes (number of outpatient visits, total number of admission) or final health outcomes (expected data of life, mortality rate)(Hossein Moshiri, 2010).

Some studies use a combination of dis-aggregation of patient care into different levels of intensity and differential weighting of outputs by some type of case mix index to account for variations across hospitals(Grosskopf, 1987). Compared the results of DEA models using weighted and unweight outputs. They found there to be no significant differences between the results. However, as they suggested, their sample was quite homogeneous which may have influenced the results. In this study, I want to consider some intermediate outputs (Number of outpatient services, number of inpatient services, number of patient days) to estimate technical efficiency. Objectives and level of measurement of DHs is the reason for selection of above mentioned intermediate outputs. Hospitals in Afghanistan are non-for profit organizations and affirmed to maximize their output. Furthermore, measurement level is based departmental level. Table Ⅳ.2 shows output variables and their explanations

Table 4.2 Output Variables for DEA

Name of Variable	Definition of variable
Number of Inpatient services in (i) hospital ir the (t) year	It includes total number of general surgical services (operating theater, anesthesia, recovery room services, and sterilization services), general obstetrics and gynecology services, general pediatric services (including therapeutic feeding services), general medical services(MoPH, 2011c)
Number of Outpatient services in (i) hospita in the (t) year	It includes number of vaccinations, mental health, and dental services(MoPH, 2011c).

Number of patient days in (i) hospital in (t) year	Total number of patients who stayed each night during the (t) year(MoPH, 2011c).

Source: MoPH, Health Management Information System, 2012

4.5. Determinants of Hospital Efficiency

Since hospital efficiency performance may also be associated with organizational and environmental factors it is worthwhile for hospitals to identify and evaluate factors that are associated with efficiency. Only if such factors are identified can relevant strategies be adopted to reduce and eliminate inefficiency within hospitals. Selection of hospital efficiency determinants is supported by quite different reasoning in the previous studies. Environmental factors such as Competition, Rurality, munificence, uncertainty and organizational factors like Size, System Affiliation, Ownership, Medicare Payer mix, Financial Resources, Teaching Status and some others(Ozcan, 1994). In the current paper, selection the variables are considered on basis of contextual issue such as Rurality of hospitals, residents educational level, objectives of the under study hospitals and distribution of population. Table IV.3 indicates various variables with their expected signs.

Table 4.3 Determinants of Hospital Efficiency

Name of Variable	Explanation of variable	Sign
Bed Occupancy Rate	The number of hospital bed days divided by the number of available hospital beds multiplied by the number of days in a year	(+)
Average Length of Stay	The average number of days a patient spends in a District Hospital. It is measured by dividing the total number of days stayed by all inpatients in District Hospitals during a year by the number of admissions	(-)
OPD-Physician Ratio	Indicator of Input Combination	(+)
Bed- Physician Ratio	Indicator of Capital and Labour	(-) &(+)

Source: MoPH, Health Management Information System, 2012

4.6. Data Envelopment Analysis (DEA) Model

Current study has two stages. In the first stage DEA will be used to calculate efficiency scores of DHs. In the second stage, econometric Tobit model was applied using explanatory variables mentioned in the illustration of conceptual framework.

DEA is a commonly used data orientated approach. Evaluation of performance in an entity or a group of peer entities and firms is easily estimated and quantified by this approach. Generally speaking, a set of peer entities or firms are called Decision Making Units (DMUs). In a DMU, there are many inputs and outputs and its definition depends on the founder of that specific DMU. No specific and constant definition can be given. Recent research papers indicate that DEA is widely used for evaluation of performance in various kinds of entities, activities, different countries and contexts(Coelli, 2008). For instance, DEA is used to analysis performance of hospitals in the healthcare industry, universities, military institutions, courts, business entities, cities, countries and ultimately performance of regions. DEA is very famous for having no or less assumptions behind. Sometimes existence of many heterogeneous inputs and outputs make it impossible for other methods to estimate efficiency of DMUs. However, DEA is totally desirable in these aspects. Besides above given simplistic characteristics of DEA, it is an effective tool to provide s standard benchmarks in many applied studies. As it is commented by cooper, seiford and Tone (2000), DEA has recently distinguished some shortcomings related to profitability of firms which were estimated by other methods(Muening, 2007). Previously, other estimation techniques found inefficient firms to be efficient and considered them as benchmarking for performance of other firms. Similarly, DEA has reconsidered pre and post-merger performance of the banks and stock markets. After introduction of DEA in its current form, many institutions found that DEA is a smart methodology for modeling operational process for performance evaluations. Simultaneous attempts have been made since its first introduction(Zuckerman, 1994).

He introduced some spreadsheet models of DEA to for evaluation of performance and benchmarking. Moreover, simplicity of DEA in terms of not having prior and complicated standard assumptions such as standard form of statistical regression analysis, paved the way for its unconceivable applications in many different institutions.

Current form of DEA is first introduced by Charnes, Cooper, and Rhodes (1978). They described DEA as a "mathematical programming model applied to observational data that provides a new way of obtaining empirical estimates of relations - such as the production functions and/or efficient production possibility surfaces – that are cornerstones of modern economics".

Later on, DEA is defined to be a methodology with presenting a frontier rather than a central tendency measure such fitting a regression plan through the center of the data as in statistical regression. Therefore, DEA simplify hidden relationships between inputs and outputs of DMUs very explicitly which still hidden in other methodologies. Definition of efficient or inefficient DMUs is very clear and straightforward which is totally different from linear or non-linear regression models with predefined assumptions(William W.Cooper, 2006).

Relative efficiency which refers to pure technical efficiency is explicitly defined on basis of the following definitions in DEA methodology without any prior modeling or assumption:

Efficiency – Extended Pareto-Koopmans Definition: Full (100%) efficiency is attained by any DMU if and only if none of its inputs or outputs can be improved without worsening some of its other inputs or outputs.

In most management or social science applications the theoretically possible levels of efficiency will not be known. The preceding definition is therefore replaced by emphasizing its uses with only the information that is empirically available as in the following definition:

Relative Efficiency: A DMU is to be rated as fully (100%) efficient on the basis of available evidence if and only if the performances of other DMUs does not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs.

For the sake of simplicity in application of DEA as the selected methodology, the term DMUs is used. These units have the capability to convert given inputs into outputs. It's understood that these DMUs can be public agencies or not for profit private institutions with some comparable or non-comparable characteristics.

To be more specific let's say that there are n hospitals as DMUs in this study to be evaluated. Each hospital (DMU) consumes many different inputs to produce different outputs. Concisely, every DMUj use Xij amount of inputs (i) and make Yrj of output (r).

It is simply assumed that Xij≥0 and Yrj≥0. Furthermore, we assumed that every individual DMU has at least one positive input and one positive output.

Based on evidences from the many research paper in healthcare industry, ratio-form of DEA is considered to be the most appropriate form of DEA. This form is called CCR model. In this form the ratio of outputs to inputs is considered to measure the relative efficiency of the DMUj and J=1, 2, 3…..n. Actually, the CCR model is the reduction form of multiple outputs / to multiple inputs and it is indicated as single output/ single input for every DMU existed in this study. This ratio is the function of multiplier and measure efficiency of a specific DMU. Mathematically, this ratio which is shown as maximized form is the objective function of the every DMU.

Maxh0 (u, v) = ∑ ur ,yr0 / ∑vi ,xi0

In the above formula, ur's and the vi’s and the yr0's and xi0's are the given output and input values, respectively of DMU0.

In the given formula, we can put some constraints which help us to assume that efficiency score of every DMU within this study is 1 or less than 1 and thereafter it can be elaborated as following.

Maxh0 (u, v) = ∑ ur ,yr0 / ∑vi ,xi0

Subject to

∑ ur ,yr0 / ∑vi ,xi0 < 1 for j = 1, …, n,

ur , vi ≥ 0 for all i and r.

Having two given above mathematical formulas, it is concluded that, the DEA model which will be employed in this paper can be specified in terms of the following linear program:

(1.1) $e(X_0; Y_0) \equiv \text{Min} \quad e$

(1.2) $\Sigma_{j=1} \lambda_j X_j \leq eX_0$

(1.3) $\Sigma_{j=1} \lambda_j Y_j \geq Y_0$

(1.3) $\Sigma_{j=1}\lambda_j = 1$

(1.5) e and $\lambda_j \geq 0$

Where e is the relative efficiency score, Xj and Yj are vectors of given inputs and outputs , respectively, for each of n DMUs, andX0 and Y0 represent the one to be evaluated. The above DEA model is also referred to as the BCC model which allows the production possibility set to exhibit variable returns to scale.

The two conditions given to the linear program in Eq. (1.1) to Eq. (1.5) can be formulated as follows:

(2.1) $h(X_0; Y_0) \equiv \text{Max} \quad UY_0 + u_0$

(2.2) $UY_j - VX_j + u_0 \leq 0 \quad \text{for} \quad j = 1,..n$

(2.3) $VX_0 = 1$

(2.4) $U \geq \epsilon, \quad V \geq \epsilon, \quad \text{and} \quad u_0 \quad \text{is unconstrained in sign}$

Where U and V are vectors of dual variables associated with the vectors Yj and Xj, respectively; ϵ is a small positive number (i.e. ϵ=0.001).

4.6.1. Input oriented DEA

As it is already stated, DEA is a data oriented tool for evaluating efficiency. Some categories of DEA models have been developed to measure efficiency and capacity in different ways. Generally speaking, these categories can be either input-oriented or output-oriented models. In the following study as ministry of public health of Afghanistan has full control over the utilization of resources, it is wise to adopt input oriented DEA model. In this model input is subject to change while output is assumed to be constant.

With input-oriented DEA, the linear programming model is defined so as to determine how much the input use of a hospital (DMU) could contract if used efficiently in order to achieve the same output level. the input-oriented DEA approach is less relevant in the estimation of capacity utilization. Modifications to the traditional input-oriented DEA model, however, could be done such that it would be possible to determine the reduction in the levels of the variable inputs conditional on fixed outputs and a desired output level(Grosskopf, 1987). Below are the given mathematical formula related to input oriented DEA.

$$
(M\ 3)\quad
\begin{aligned}
& Min\left\{k_0 - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right]\right\} \\
& s.t \\
& \sum_{j=1}^{N} \lambda_j x_{ij} - k_0 x_{ij_0} + S_i^- = 0 \qquad i = 1,\ldots,m \\
& \sum_{j=1}^{N} \lambda_j y_{rj} - S_r^+ = y_{rj_0} \qquad r = 1,\ldots,s \\
& \lambda_j \geq 0 \qquad j = 1,\ldots,N \\
& S_i^-, S_r^+ \geq 0 \qquad i = 1,\ldots,m;\ r = 1,\ldots,s \\
& k_0 \text{ free}
\end{aligned}
$$

Above formula is extracted from Tim Coelli guide book to DEA version 2.1(Coelli, 2008). In the above given formula Ko is constant term. Lamda indicates slack term that their multiplication should make 1 and (i) indicates number of input while (r) indicates number of outputs. So is constant term like Ko in the formula.

4.7. Censor Regression (Tobit) model analysis

To determine and understand influential factors affecting technical efficiency of the DHs in Afghanistan, estimated efficiency scores for every individual hospital will be regressed to a number of utilization variables (ALOS, BOR , bed-physician and outpatient physician ratios) as a dependent variable. Tobit regression analysis is used for this purpose.

Tobit regression or censor regression model is an extension form of probit regression. It was first developed by James Tobin. It's a choice model for specific conditions such as limited dependent variable which is true in case of DEA result. It is evident that technical and scale efficiency scores of DEA result are exactly between zero and one. Nevertheless, in practice, efficiency scores are not equal to zero. The fundamental understanding of Tobit model can be explained as follows:

$$y'i = \beta 1 + \beta 2Xi + ui$$

y' is considered as a latent variable which is observed for the values greater than truncation point (T) (In this study 1) and censored otherwise. Therefore, observed y can defined as bellow:

$$y' \quad = \begin{cases} y' \;\; if\; y' > T \\ T\; y \;\; if \;\; 1 \leq 1 \end{cases}$$

The model with an assumption of T=1 (observations are censored at 1). Then the equation can be presented as follow:

$$y' \quad = \begin{cases} y' \;\; if\; y' > 1 \\ 1 \quad if\; 1 \leq 1 \end{cases}$$

The model for the purpose of this study is presented as follow:

$$VRSTEi = \beta 0 + \beta 1ALOS + \beta 2BOR + \beta 3BEDPHY + \beta 4OPDPHY$$

Where

VRSTEi= Variable Return to Scale (VRS) technical efficiency scores

β0 = Constant Term

β1 = Cofiecient of ALOS

β2 = Coefficient of BOR

β3 = Coefficient of BEDPHY

β4 = Coefficient of OPDPHY

ALOS (Average Length of Stay)

Average length of stay (ALOS) is expected to have (+) association with technical efficiency scores of District Hospitals.

Average Length of Stay (ALOS) is an important efficiency indicator. Higher ALOS indicates proper resource utilization although the more the ALOS, the higher would be cost per inpatient. Therefore, ALOS is positively associated with efficiency scores.

BOR (Bed Occupancy Rate)

Bed Occupancy Rate (BOR) is expected to have (+) relationship with technical efficiency scores of District Hospitals.

Bed Occupancy Rate can be thought as a potential measure of demand for hospital services. It can be inferred that hospitals with better BOR are functioning in a proper way with no underutilization of allocated resources. Taking into consideration of high BOR, cost per hospital service will be reduced and efficiency will be gained. Consequently, BOR is expected to have a positive relationship with efficiency(V.Valdmanis, 1993).

BEDPHY (Bed Physician Ratio)

Bed-Physician Ratio is indicating combination of Capital and Labour factors in this study. This variable shows that if a doctor manage more inpatient or more beds, the hospital will be more efficient. Therefore, the coefficient is expected to have positive relationship.

OPDPHY (Outpatient Physician Ratio)

OPD/Physician Ratio has been selected to indicate combination of input and output in the hospitals. The more a doctor examines OPD patients, the better is hospital efficiency; however, it sometimes affects quality of the services. Therefore, it is positively related with efficiency.

In a general sense, all given independent variables are mainly utilization indicators of DHs hospitals. There might be some variables like geographic location of each hospital, security condition, and catchment area of the health facility, level of income, literacy rate and some others might affect the model but lately mentioned variables could not be captured and remained as a limitation of this study.

CHAPTER V
RESULT AND DISCUSSION

5.1. General Description of Data

Data set for this study has been provided by Health Management Information System (HMIS) department of the Ministry of Public Health (MoPH) of Afghanistan. Data set includes 68 DHs that are functioning under the BPHS. The hospitals are firmly distributed throughout the country with exclusive focus on the rural areas of the country. Tables' 5.1 and 5.2 indicate total number of input and output variables and descriptive statistics (Mean, Standard Deviation, Maximum and Minimum) and their trends over the two period of study for all the input and output variables.

Table 5.1 Total Number of inputs and outputs

Name of Variables	1389	1390	Changes in %
Total Number of Beds	2151	2116	-2%
Total Number of Inpatient admission	158779	174978	10%
Total Number of Outpatient Visits	3782351	4195618	11%
Total Number of Patient Days	397148	426221	7%
Total Number Doctors	406	398	-2%
Total Number of Nurses	944	902	-4%
Total Number of Midwives	240	245	2%
Total Number of Non-Medical Staffs	1089	1047	-4%
Mean of Bed Occupancy Rate	50	59	20%
Mean of Average Length of Stay	6.0	3.7	-39%

Above table presents changes between the solar years 1389 and 1390 in DHs. Average length of Stay (ALOS) and Bed Occupancy Rate (BOR) are improved in 1390 in DH. In addition, utilization of services; inpatient admissions and outpatient visits indicate a 10% and 11% increase in 1390 respectively. It can be inferred from the above table that Human Resources were underutilization in 1389 because more Outputs were produced in 1390 with reduced number of Human Resources.

Table 5.2 Descriptive Statistics of input and output data of DHs

Year	1389					1390				
Variables	**Mean**	**Median**	**Max**	**Min**	**SD**	**Mean**	**Median**	**Max**	**Min**	**SD**
OPD visits	55417	49536	170906	8453	30896	61700	54078	168048	13862	33217
IPD Admission	2337	1717	9543	70	2017	2573	1935	9913	103	2189
Patient Days	5784	4253	23092	27	4829	6268	4991	29230	179	5254
ALOS	6	3	41	1	9	4	3	19	0	3
BOR	49	43	135	0.7	28	59	49	534	1	65
Doctors	6	6	18	2	3	6	6	18	0	3
Nurse	14	13	89	6	10	13	12	89	2	10
Midwife	4	4	10	0	1	4	4	10	1	1
NMD Staff	16	13	96	8	11	15	14	96	8	11
Beds	32	28	80	10	16	31	29	75	10	14

It is found that trend of descriptive statistics has been changed considerably during the study period of 1389 and 1390. In year 1389, a DH was functioning with an average number of 6 doctors, 14 nurses, 4 midwives and 16 non-medical staff with an average capacity of 32 beds. Given above human and capital resources, a DH on average produced 55,417 OPD, 2337 IPD and 5784 Patient Days. On average, BOR and ALOS were found 49% and 6 days respectively in 1389 at a DH in Afghanistan.

In the year 1390, a district hospital on average employed 6 doctors, 13 nurses, 4 midwives and 15 non-medical staff with an average capacity of 31 beds. Production level of a DH in 1390, on average was 61,700 OPD, 2573 IPD and 6268 Patient Days. It is obviously indicating more production level in 1390 consider to 1389.

5.2. Efficiency Results from DEA Model

In this study number of physicians, nurses, midwives, non-medical staff and number of beds have been used as inputs while number of Outpatient visits, Inpatient admissions and Patient Days are used as outputs. As we have already defined that efficiency means ability of a DMU such as a hospital is to produce outputs with the given level of inputs.

To find the relative efficiency of DHs for the study period of 1389 and 1390, input oriented CRS and VRS Technical Efficiency scores have been found using DEA software. Table 5.3 indicates descriptive summary of input oriented CRS and VRS efficiency scores for the given study periods.

Table 5.3 Descriptive Statistics of technical efficiency for 1389 and 1390

	1389		1390	
	VRS TE	**CRS TE**	**VRS TE**	**CRS TE**
Mean	0.897	0.721	0.883	0.691
Median	0.959	0.733	0.952	0.664
Maximum	1.000	1.000	1.000	1.000
Minimum	0.393	0.195	0.541	0.086
Std. Dev.	0.130	0.229	0.136	0.242
Number of Observations	68.000	68.000	68.000	68.000

The result manifests that the average VRS TE and CRS TE of District Hospitals in 1389 are 0.897 and 0.721 respectively. VRS TE and CRS TE in 1390 are found slightly lower than the year 1389. This implies that DHs had been less efficient in the year 1390 than 1389 although level of production was comparatively higher in the year 1390. In addition, it can be said that if hospitals had functioned efficiently, they could have produced 11% and 12% more outputs given their available resources.

Table 5.4 presents the frequency of technical efficiency scores in the year 1389 and 1390. In 1389, 28 (42%) out of 68 hospitals were technically fully efficient with efficiency score of 1.00. Rest of the hospitals showed technical efficiency score of less than 1; 26 (38%), 13 (19%) of DHs had an efficiency levels of (80-99%) and (60-79%) respectively. It is worth to mention that only one hospital which composes 1% of total observations were functioning with an efficiency score of less than 60%.

In 1390, less than half of the hospitals (44%) were technically efficient. 26% of the hospitals had efficiency score of (80-99%) while 17 hospitals were between (60-79%) and finally 3 hospitals had below 60% level of efficiency.

Table 5.4 Frequency of Technical Efficiency scores

	1389		1390	
Level of Efficiency	**Number of DH**	**%**	**Number of DH**	**%**
100%	28	42%	30	44%
80-99%	26	38%	18	26%
60-79%	13	19%	17	25%
<60%	1	1%	3	4%
Total	68	100%	68	100%

Figure 5.1 indicates pattern of efficiency levels in the year 1389 and 1390. It is clearly obvious that overall efficiency scores are marginally reduced in 1390. However, number of hospitals at (80-99%) level of efficiency had been in 1389 considering to 1390.

Figure 5.1 Frequency of Technical Efficiency Scores in 1389 and 1390

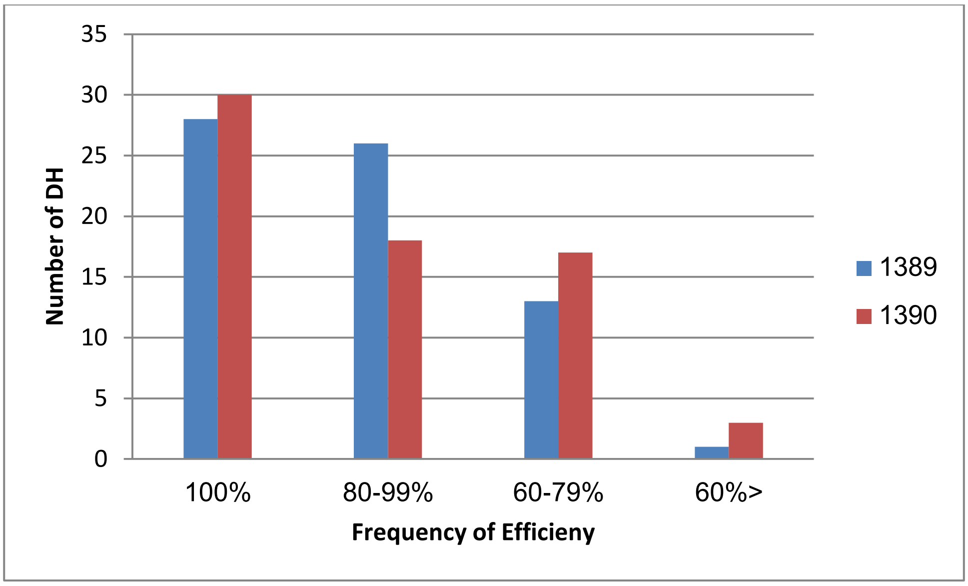


Table 5.5 provides information about CRS and VRS Technical Efficiency, Scale Efficiency scores of all 68 DHs in the years 1389 and 1390 in Afghanistan.

Table 5.5 Technical and Scale Efficiency Scores of the District Hospitals

	1389				1390			
Code of Hospital	CRSTE	VRSTE	SE	Pattern	CRSTE	VRSTE	SE	Pattern
407	0.66	0.91	0.73	IRS	0.89	1	0.89	IRS
1167	0.8	1	0.8	IRS	1	1	1	CRS
618	1	1	1	CRS	0.65	0.81	0.8	CRS
459	0.2	0.39	0.5	IRS	1	1	1	CRS
1529	1	1	1	CRS	0.68	1	0.68	IRS
554	0.54	0.92	0.59	IRS	0.43	0.73	0.59	IRS
561	0.54	0.81	0.66	IRS	0.49	0.8	0.61	IRS
570	0.44	0.7	0.63	IRS	0.5	0.79	0.64	IRS
575	0.57	0.79	0.73	IRS	0.58	0.76	0.77	IRS
1539	0.46	0.72	0.64	IRS	0.65	1	0.65	IRS
805	0.4	0.75	0.53	IRS	0.37	0.78	0.48	IRS
809	0.55	0.76	0.72	IRS	0.58	0.78	0.74	IRS
810	0.55	0.78	0.7	IRS	0.44	0.73	0.6	IRS
777	0.37	0.73	0.51	IRS	0.32	0.72	0.45	IRS
1512	0.51	0.99	0.51	IRS	0.66	1	0.66	IRS
2175	0.94	1	0.94	IRS	0.8	1	0.8	IRS
681	1	1	1	CRS	1	1	1	CRS
608	0.45	0.73	0.63	IRS	0.69	0.9	0.77	IRS
2018	1	1	1	CRS	0.65	0.72	0.9	IRS
270	1	1	1	CRS	0.96	1	0.96	IRS
1511	0.66	0.86	0.77	IRS	0.84	1	0.84	IRS
796	0.75	1	0.75	IRS	0.95	1	0.95	IRS
2178	0.86	0.99	0.87	IRS	0.5	0.76	0.66	IRS
692	0.91	0.94	0.96	IRS	0.83	1	0.83	IRS
694	0.73	1	0.73	IRS	1	1	1	CRS
706	0.73	0.84	0.87	IRS	0.67	0.79	0.84	IRS
648	0.57	0.63	0.91	IRS	0.47	0.54	0.87	IRS
658	1	1	1	CRS	1	1	1	CRS
662	0.79	0.95	0.84	IRS	0.63	0.92	0.72	IRS
1192	0.76	0.82	0.92	IRS	0.82	0.87	0.94	IRS
586	0.75	0.97	0.77	IRS	0.7	0.96	0.73	IRS
590	1	1	1	IRS	0.82	0.95	0.86	IRS
5	1	1	1	CRS	1	1	1	CRS
27	0.73	0.93	0.79	IRS	0.79	1	0.79	IRS
40	0.73	0.86	0.85	IRS	0.72	0.87	0.82	IRS
170	0.97	1	0.97	IRS	0.38	1	0.38	IRS

172	0.99	1	1	IRS	1	1	1	CRS
2313	0.58	0.71	0.83	IRS	0.44	0.61	0.73	IRS
751	1	1	1	CRS	0.54	0.86	0.63	IRS
1018	0.63	0.86	0.73	IRS	0.59	0.85	0.69	IRS
1590	0.49	1	0.49	IRS	0.64	1	0.64	IRS
1159	1	1	1	CRS	0.87	0.9	0.97	IRS
231	1	1	1	CRS	1	1	1	CRS
238	1	1	1	CRS	1	1	1	CRS
320	1	1	1	CRS	1	1	1	CRS
341	1	1	1	CRS	1	1	1	CRS
2676	0.74	0.84	0.87	IRS	0.66	0.74	0.89	IRS
845	0.75	1	0.75	IRS	0.43	0.93	0.46	IRS
1589	0.28	0.6	0.46	IRS	0.09	0.57	0.15	IRS
2078	0.47	0.95	0.49	IRS	0.2	0.8	0.25	IRS
815	0.57	1	0.57	IRS	0.39	1	0.39	IRS
836	1	1	1	CRS	0.91	1	0.91	IRS
289	1	1	1	CRS	0.89	0.96	0.93	IRS
293	0.98	1	0.98	IRS	0.67	0.73	0.92	IRS
21	0.52	0.85	0.62	IRS	0.19	0.61	0.31	IRS
1110	0.76	1	0.76	DRS	1	1	1	CRS
1109	0.55	1	0.56	IRS	0.87	1	0.87	IRS
532	0.7	0.99	0.71	IRS	1	1	1	CRS
2857	0.37	0.93	0.39	IRS	0.58	0.97	0.58	IRS
856	0.71	0.79	0.89	IRS	1	1	1	CRS
1880	0.68	1	0.68	IRS	0.65	0.95	0.69	IRS
439	0.53	0.84	0.63	IRS	0.5	0.81	0.62	IRS
449	1	1	1	CRS	1	1	1	CRS
1162	0.42	0.78	0.54	IRS	0.44	0.76	0.57	IRS
202	0.29	0.81	0.36	IRS	0.46	0.82	0.57	IRS
205	0.69	0.69	1	IRS	0.55	0.58	0.94	IRS
213	0.64	0.81	0.79	IRS	0.64	0.83	0.78	IRS
759	0.77	0.85	0.91	IRS	0.35	0.62	0.57	IRS

As the table above shows, in the year 1389, 28 (42%) DHs manifested Constant Return to Scale (CRS) which means that they had the most productive size for the given input-output mix. On the other hand, 39 (57%) displayed Increasing Return to Scale (IRS) which is a rationale for the expansion of the DHs. IRS (Economies of Scale) is an Economic concept that explains reduction in the unit costs as level of outputs increases to a certain point. Only 1 Hospital (1%) showed

Decreasing Return to Scale (DRS) that should have scaled down both its inputs and outputs in order to be changed as the most productive scale size. When we look at 16 fully efficient hospitals with the pattern of CRS in the year 1389, we can identify that these hospitals are mainly located in the northeastern and partly in the eastern and surrounding provinces of capital, Kabul. These zones of the country are relatively secured than Southern provinces based on a report by International Assistance Force in Afghanistan. It can be concluded that efficiency score of the hospitals might have been affected by security of the province. Besides that, catchment area of the DH might also positively affect efficiency of the hospitals. Based on distribution of DHs' efficiency scores, all DHs are mainly classified in four main groups. First group are 28 DHs with full efficiency score of one. Second group is the DHs with the efficiency scores ranging between 0.88 and 0.99. There are 26 hospitals in this group. Likewise, the third group is composed of 13 DHs with a variation score from 0.60 to 0.79. Finally, the last group is the hospitals with efficiency score of less than 0.60 and only one hospital had efficiency score of less than 0.60 in the year 1389.

In the year 1390, 30 (44%) of DHs were fully efficient with indication of CRS while 38 (56%) had been inefficient at different levels of efficiency. Similar to DHs in the year 1899, all DHs in 1390 are categorized in four main groups based on their efficiency scores distribution. Thirty hospitals are indicating efficiency scores one with consideration of fully efficient frontier. In the second group, there are 18 hospitals with efficiency scores between 0.80 and 0.99. In the third and fourth groups, 17 and 3 hospitals are showing efficiency scores of 0.60 to 0.79 and less than 0.60 respectively. It is obvious that in the year 1390, number of hospitals with efficiency score of less than 0.60 have been increased by two (2%). Again, fully efficient hospitals are mainly located in the secure provinces of Afghanistan rather than unsecure ones.

5.2.1. Input Savings

DEA results provide us with information that could be used as decision making tool to redistribute input resources in order to bring inefficient hospitals to efficient frontiers. Therefore, DEA produces slack variables for each inefficient hospital which will be indicated in the Table (Appendix. C). Table 5.6 provides summary information on actual and excess inputs within DHs in 1389 and 1390.

Table 5.6 Excess Number of Labour and Capital Resources in the DHs

	1389		**1390**	
	Actual	**Excess**	**Actual**	**Excess**
Number of Doctors	411	46.30	398	29.97
Number of Nurses	949	19.57	904	11.06
Number of Midwives	240	20.51	245	12.28
Number Non-Medical staff	1062	10.46	1046	11.45
Number of Beds	2151	97.87	2116	70.50

The inefficient DHs could have been efficient if they had reduced their available inputs such as number of doctors, Nurses, Midwives, Non-Medical Staffs and Beds by 46, 21, 20, 10, 98 respectively in 1389 and 30, 11, 12, 11, 71 in the year 1390.

5.2.2. Output Inducement

Similar to input slacks, DEA provide data on required magnitude of the Hospitals output in order to make them fully efficient. Table 5.7 shows summary of outputs shortfall for 1389 and 1390.

Table 5.7 Shortfall of Outputs in the DHs

Variables	1389		1390	
	Actual	**Shortfall**	**Actual**	**Shortfall**
Number of Outpatient Visits	3,782,351	326,922	4,195,618	611,256
Number of Inpatient Admissions	158,190	13,537	174,978	6,963
Number of Patient Days	391,984	17,119	426,221	13,793

As far as the issue of outputs is concerned, they are mainly consumer related facets of input-output mix. However, MoPH or hospital managers may think about some policies such as demand side financing to increase overall outputs in the district hospitals. Detailed outputs slack is attached in the appendix section of this paper (Appendix .D).

5.3. Result of Regression Analysis Model

5.3.1. Tobit Regression Model of technical efficiency scores

As it is already mentioned, at the second stage of this study Efficiency scores (VRSTE) of two years 1389 and 1390 are regressed against a group of hospital utilization outputs. Tobit Regression Model has been applied to see magnitude and direction of efficiency determinants in the hospitals. The model is given in the below:

$$VRSTE = \beta 0 + \beta 1 * ALOS(Average\ Length\ of\ Stay + \beta 2 * BOR(Bed\ Occupancy\ Rate) + \beta 3 * BEDPH(Bed\ Physician\ Ratio + \beta 4 * OPDPHY(Outpatient\ physician\ ratio) + \varepsilon$$

There are four utilization variables in the above equation. Average Length of Stay (ALOS), Bed Occupancy Rate (BOR), Bed-Physician Ratio and Outpatient-Physician Ratio are the given independent variables. VRS Technical Efficiency is the dependent variables in the equation. Table 5.8 and 5.9 shows the result of regression

Table 5.8 Result of Tobit Regression Analysis for VRSTE in 1389

Name of Variable	**Coefficient and Standard error**
BOR	0.001 (0.0006)
ALOS	0.005 (0.0066)
OPDPHY	0.00003*** (0.00)
BEDPHY	-0.003 (0.0105)
Pseudo R-Square	1.07
Number of observation	68
Chi Square	0.000
Left censored observation	0
Right Censored observation	30
Uncensored observation	38

*** At 5% significance level

It can be seen from the above result that, among all utilization variables, outpatient physician ratio is significant. Other variables in the model have indicating expected signs and they are all positively correlated with the technical efficiency scores. It should be said that Bed physician ratio may have positive and negative signs based on the context. To illustrate, sometimes managing too many beds by a doctor will lead the inefficiency of hospitals. On the other hand, failure of to manage reasonable number of beds by a doctor would cause inefficiency. Furthermore, pseudo R-square has no meaning for the Tobit model. From all the above observations, 38 hospitals have indicated uncensored status. Thirty hospitals showed censored status to the right.

Table 5.9 Result of Tobit Regression Analysis of VRSTE scores in 1390

Name of Variable	**Coefficient and Standard error**
BOR	0.004 (0.001)
ALOS	0.010 (0.006)
OPDPHY	0.00001*** (0.000)
BEDPHY	-0.002 (0.006)
Left censored observation	0
Right Censored observation	30
Uncensored observation	38

***At 5% level of significance

As it is indicated in the result of Tobit regression analysis, among all the utilization variables, coefficient of outpatient-physician ratio is also significant as the year 1389. All other variables with expected sign of coefficients are not significant at 5% level of significance. Thirty of observations are equaled uncensored while 38 of the hospitals are censored at right. The model for Tobit regression analysis of DHs in the year 1390 is shown below:

$$VRSTE = \beta 0 + \beta 1 * BOR(Bed\ Occupancy\ Rate) + \beta 2 * ALOS(Average\ Length\ of\ Stay) + \beta 3 * BEDPHY(Bedphysician\ Ratio) + \beta 4 * OPDPHY(Out\ patient\ Physician\ Ratio) + \varepsilon$$

5.3.2. Scale Efficiency analysis of District Hospitals

For the analysis of scale efficiency of hospitals in two different study periods, mean of size variables for the hospitals indicating IRS, CRS and DRS are calculated and thereafter compared. Gaps between two mutually exclusive variables are evaluated. The wider the gap, the critical is the variable.

Table 5.10 Scale efficiency analysis in 1389

Size Variables	Increasing Return to Scale (IRS)	Constant Return to Scale (CRS)	Decreasing Return to Scale (DRS)
Number of Beds	30.94	28.88	80
Number of Physician	6.08	5.31	10
Patient Days	4,491.16	8,486.49	22,660
Outpatient Visits	48,256.43	77,158.91	38,474
Inpatient Admission	1,718.71	3,843.83	7,316
Number of Nurse	12.45	13.28	89
Number of Midwives	3.51	2.97	10
Number of Non- Medical staff	14.02	14.81	96

Mean of size variables are calculated among IRS, DRS and CRS hospitals was calculated in the above table. It is found that among all the size variables in the DHs in the year 1389, only two of them; patient days and outpatients visits are considered to be critical variables because there is big gap among IRS and CRS hospitals. Only one hospital has shown DRS and its size variables are not significantly different from other hospitals with IRS and CRS.

Table 5.11 Scale efficiency analysis in 1390

Size Variables	Increasing Return to Scale (IRS)	Constant Return to Scale (CRS)
Number of Beds	31.85	28.75
Number of Physician	5.88	5.81
Patient Days	5,515.44	8,713.63
Outpatient Visits	62,500.92	59,098.13
Inpatient Admission	2,298.10	3,467.31
Number of Nurse	12.42	16.13
Number of Midwives	3.63	3.50
Number of Non- Medical staff	14.73	17.50

Above table is indicating comparative result of size variables mean in the year 1390. There are a number of size variables with critical gaps among CRS and IRS hospitals. Patient days, number of nurse, number of non- medical staff with having the biggest gap are significant variables. Therefore, significant size variables should be closely evaluated in order to change the IRS hospitals (those too small) to an optimal size of functionality. Furthermore, it can be seen that number admissions is not a good size variable for the DHs in the year 1390.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The objectives of this study are to measure the Technical Efficiency of District Hospitals (DHs) in Afghanistan during the years 1389 and 1390 by using Data Envelopment Analysis (DEA) model and identify determinants of hospital efficiency through Tobit regression analysis estimation. For determination of DHs efficiency scores, input orientated DEA were applied because the MoPH of Afghanistan have enough control over adjustment of medical Labour force and capital resources in the hospitals. Results of this study are mainly analyzed in three main directions:

1. Input orientated DEA District Hospitals Efficiency Analysis
2. Analysis of District Hospitals efficiency determinants
3. Analysis of District Hospitals scale Efficiency

6.1.1. Input Orientated District Hospitals Efficiency Analysis

The result of input orientated DEA indicated that from 68 District Hospitals in Afghanistan, 28 (41%) and 30 (44%) of them were fully efficient in the years 1389 and 1390 respectively. Most of the inefficient hospitals had efficiency scores between 0.99 and 0.6. However, 1 (1%) and 3(4%) of the DHs displayed efficiency scores of less than 0.6 in the years 1389 and 1390 respectively. Maximum efficiency scores were 1 for both period of the study while 0.393 and 0.541 were minimum scores for 1389 and 1390 respectively. The mean of technical efficiency scores was reduced by 0.014 in 1390. In both years of study, almost all the DHs indicated an Increasing Return to Scale (IRS) of Inefficiency Patterns. Only one DH displayed Decreasing Return to Scale (DRS) in the year 1389. Excess numbers of Labour and Capital resources are identified. Overall, 46 doctors, 20 nurses, 21 midwives, 10 non-medical staff and 98 beds were underutilization in the year 1389. Similarly, 30 doctors, 11 nurses, 12 midwives, 11 nonmedical staffs and 71 beds were found to be excess in the year 1390.

6.1.2. Analysis of Efficiency in the District Hospitals

Result of Tobit regression analysis revealed that among all the factors that were regressed against pure technical efficiency scores, outpatient visits/physician ratio was significantly correlated with efficiency of District Hospitals in 1389 and 1390. It is found that if number of outpatient physician ratio increase by one than efficiency scores of district hospitals would increase by 0.00003 and 0.00001 respectively for the year 1389 and 1390. Average Length of Stay, Bed Occupancy Rate and Bed Physician ratios are indicating coefficients which are compatible with the expected signs, yet their signs found to be insignificant. For both years of study 38 DHs are remained uncensored while remaining 30 hospitals found to be censored at the right. Likewise, psedo R square which is indicating the goodness of fit in the model are higher than one. However, its importance for the Tobit model is under question.

All given information can be used as policy tools for redistribution of excess resources among DHs throughout the country. Furthermore, Shortfalls of DHs outputs are pinpointed and it could be evidence based facts for policy analysis at MoPH level.

6.1.3. Analysis of Scale Efficiency in the District Hospitals

Result of scale efficiency analysis of district hospitals using their mean comparison within the IRS, CRS and DRS hospitals, shows that Patient days and outpatient visits are the most critical variables in the year 1389. There is a difference of 3995 patient days between mean of CRS and IRS hospitals. Likewise, mean number of outpatient visits is 28,902 OPD less in the IRS hospitals than CRS hospitals. Rest of the variables is not significantly different.

Comparative result of size variables within IRS and CRS hospitals in the solar year 1390 indicates a number of variables with wide gap. Patient days, number of admissions, number of nurse, number of non -medical staff. The difference among means of patient days, number of admission, number of nurse and number of non-technical staff is 3198, 1169, 3.7 and 2.7 respectively for the year 1390.

6.2. Limitations of this Study

First of all, DEA does not have the capability to estimate random noise (emergence of epidemics, natural and man-made disasters, security issues), and hence, it inadvertently attributes any deviation from frontier to inefficiency. Consequently, by applying DEA we may have overlooked the existing magnitudes of inefficiencies in the study.

Further to that, it would be argued that the ultimate output of hospitals is the aggregate change in health status of the patients who received hospital outpatient and inpatient services. Due to the lack of data on health status indices such as Quality Adjusted Life Years or health disability (QALY) indicators or Disability Adjusted Life Years (DALY), this study used intermediate outputs, such as number of outpatient visits and number of hospital admissions. Moreover, If I had had the chance to use ultimate health outcomes, it would have been the issues of attribution and thereafter the need to totally control the exogenous factors.

More than to that, it is quite difficult to ensure the data quality of all the given outputs and inputs in this study (such as desirable outpatient visits and inpatient admissions in terms of full recovery from diagnosed disease, or differences in the level of severity) and inputs (identify skill and hardworking aspects of health workers who are considered as inputs). Furthermore, a number of some other variables such as catchment area, education level and security status of the each district should have been collected and evaluated. However, mentioned data was not available.

Finally, unavailability of health system inputs prices hampered estimation of allocative efficiency, and hence, calculation of total economic efficiency of hospitals.

6.3. Policy Implications

Analyses and result of this study displayed wide range areas regarding human and capital resource distribution and application of efficiency benchmarking which all need be focused.

First of all, excess medical and non-medical labor forces should be closely evaluated. Based on a recent study by Health Economics and Financing Directorate (HEFD) of the MoPH, staff salaries are the main cost driver (61%) in Kabul's hospitals(MoPH, 2012). In addition *Cost Analysis of BPHS- 2012* indicated that salaries and wages compose 43% of total BPHS cost. Therefore, human resources should be used wisely in order to make the inefficient hospitals element of efficient frontier. It is suggested to reduce number of doctors and nurse and instead improve other health facilities within BPHS with excess staff of DHs. To illustrate, total number of slack inputs; doctors, nurses, midwives, non-medical staff and beds were 46.30, 19.57, 20.51, 10.46 and 97.87) in the Solar year of 1389. Similarly, slacks of the total number of doctors, nurses, midwives, non-medical staffs and beds were found 29.27, 11.06, 12.28, 11.45 and 70.50 in the year 1390. Even though result of the study indicates that excess number of human and capital resources have been reduced during the two consecutive years of the study, more decrease in the excess number of resources could have brought the inefficient hospitals to the efficient frontier. Consider to other Labour forces in the DHs, number of midwifes is almost at efficient level. Furthermore, result of this study has shown that number of Beds as an indicator of Capital Resources is high. It can be compensated with inducement of DHs inpatient service utilization.

Besides adjustments to Labour and Capital resources, Scale Efficiency and patterns of DEA results can be used by policy makers at MoPH level to upsize DHs. Comparative analysis of DHs size variables within the IRS, CRS and DRS hospitals, shows that number of patient days and outpatient visits should have been improved at the hospitals with IRS pattern by 3995 and 28902 in 1389 while patient days and inpatient admissions needs improvement by 3198 and 1669 respectively in order to bring inefficient hospital to an optimal size of functionality . In the hospitals with Increasing Return to Scale (IRS) patterns, improvement in the number beds would make the hospital efficient. Nevertheless, evidence based input-output mix is necessary to have fully efficient hospitals.

Finally, methods of efficiency measurement and benchmarking should be incorporated and institutionalized with Health Management Information System (HMIS) systems. It will provide evidences to local administrator of the DHs to make their hospitals efficient.

To sum up, wise allocation of human and capital resources, thinking about effective polices to increase demand for health services utilization and institutionalization of efficiency measurement methods are considered of paramount importance aspects and implication of this study.

6.4. Possible extension of this study

Allocative Efficiency and Qualitative study together with quantitive study would be helpful for policy makers and hospital managers. It should be reminded that only increasing the outputs or decreasing the inputs may not change inefficient hospitals to efficient ones. Therefore, combing allocative efficiency with this study to get complete economic efficiency is highly recommended.

For the regression models, some other factors and indicators such cost components, qualitative variables, catchment area, literacy rate, geographic location of the hospitals and technology availability should be considered as independent variables.

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APPENDICES

Appendix A.

Row Data set for Data Envelopment Analysis 1389

Hospital Name	OPD	IPD	Patient Days	Doctors	Nurses	Midwives	Non-Medical Staff	Beds
Kishim Hospital	64,036	1,862	3,127	8	11	4	12	20
Baharak Hospital	63,832	1,717	4,894	6	16	4	10	20
Bala Murghab Hospital	51,257	596	2,073	3	11	1	12	20
Centeral Baghlan Hospital	10,594	1,736	4,688	18	22	4	31	70
10 Beds Hospital of Nahrin	8,453	374	814	4	13	0	18	15
Dawlat Abad Hospital	47,653	1,046	2,614	7	8	3	13	50
Shulgareh Hospital	47,089	1,761	5,082	7	14	4	12	50
Dihdadi Hospital	35,549	1,477	6,153	6	15	4	15	45
Khulm Hospital	32,793	3,313	8,608	8	16	4	15	50
Balkh Hospital	38,953	1,898	5,722	6	17	4	14	50
Yakawlang Hospital	32,424	1,810	4,253	5	14	4	13	32
Panjab Hospital	34,365	2,663	7,451	7	12	4	16	36
Waras Clinic	29,882	2,683	5,915	9	12	4	16	26
Ulqan Hospital	37,733	1,150	2,629	8	12	4	12	30
Mir Amor Hospital	24,062	899	2,281	3	7	3	13	13
Kesaw Hospital	44,131	1,674	4,145	3	8	2	12	12
Pusht-i- koh Hospital	56,840	3,290	9,714	4	8	3	14	32
Shar-Naw	44,803	1,812	4,379	7	13	4	13	40
Shrin Tagab (Feyzabad)	78,061	1,850	1,207	4	13	4	14	13
Mawlawi Abdul Zahir Shahed Hospital	80,377	3,606	9,841	4	11	4	13	30
Qarabagh Hospital	60,848	1,565	5,924	6	13	3	13	28
Taywara	44,017	698	2,410	3	7	3	12	20
Lal Bazaar Hospital	52,395	1,483	4,083	3	9	4	13	24
Girishk Hospital	88,819	1,417	3,884	5	14	3	14	30
Musa Qala Clinic	33,751	634	1,715	3	8	1	8	20
Hazar Joft Hospital	72,074	1,807	3,262	5	17	3	13	30
Gozara Hospital	79,218	4,893	9,491	11	18	7	25	57
Gulran Hospital	115,772	1,973	2,652	7	10	4	13	21
Ghoryan public Health Hospital	76,061	2,527	3,979	5	10	4	13	28
Shindan Hospital	84,724	1,518	4,554	7	11	4	16	27
Darzab Hospital	49,536	1,935	4,024	6	9	4	12	17
Aqcha Hospital	99,210	2,686	5,423	5	13	4	14	40
Qara Bagh Hospital	113,181	4,844	5,984	6	16	4	15	20
Chahar Asyab Hospital	61,863	2,727	5,195	6	14	4	13	20
Surobi Hospital	66,998	2,399	4,232	6	12	3	14	20
Dasht-e- Barchi Hospital	56,529	70	345	7	13	3	9	10
Ahmad Shah Mena Clinic	57,994	122	27	7	13	3	9	10
Rahman-Mina	67,766	727	158	6	14	4	15	30
Spin Blodak Hospital	45,343	667	3,892	5	14	1	14	25
Nijrab(Sharwani) Hospital	41,643	1,334	5,279	4	13	2	15	50
Mano Gai Hospital	35,984	694	1,574	4	7	4	9	20
Imam Sahib 50 Beds Hospital	71,274	6,409	23,092	8	19	4	23	50
Baraki Rojan 52 Beds Hospital	78,645	8,125	18,019	6	16	3	18	52
S.Safiqullah Ludin Hospital	55,806	5,881	10,185	6	13	4	17	25
Khogyani Hospital	170,906	7,090	12,370	9	16	4	20	50
Ghani Khel Hospital	157,171	9,543	15,092	10	26	4	20	45
Kama Hospital	93,869	3,143	8,473	10	18	4	16	40
Do Aaba Hospital	27,691	1,522	3,051	2	8	3	13	20
Kamdesh Hospital	17,013	1,167	3,053	15	17	4	17	25
Want Waigal	22,678	1,279	3,378	3	10	4	11	20
Khair Kot Clinic	24,381	558	1,796	3	6	2	15	10
Urgun Hospital	35,043	3,223	9,886	5	11	3	16	20
Chamkani Hospital	79,487	4,785	11,466	6	12	4	13	55
Zazi Aryob (Haji Aryub) Hospital	60,053	1,601	6,016	3	9	4	13	35
Rukha 40 Beds Hospital	18,830	2,391	5,321	5	9	3	22	40
Anaba Hospital	38,474	7,316	22,660	10	89	10	96	80
Lolanj Clinic	21,892	607	2,473	5	9	1	12	40
Dehi Hospital	39,621	1,298	4,861	4	8	2	12	20
Bazar Sokhta Hospital	25,149	659	2,416	5	9	3	9	30
Tukzar Hospital	56,868	1,271	5,362	6	15	4	16	20
Tarkhuch Hospital	27,751	711	2,957	2	9	4	11	20
Farkhar Hospital	47,487	1,481	3,966	5	16	4	11	30
Rustaq Hospital	85,183	964	3,988	4	16	4	11	20
Sina Hospital	35,457	1,128	4,113	7	15	4	12	33
Tagab Hospital	17,589	679	2,585	4	9	3	13	25
Chak Deh Merdad Hospital	76,482	5,668	18,444	9	26	5	27	75
Ghazi Mohd Jan Khan Hospital	61,525	4,149	8,832	8	17	4	16	40
Shahjoy Hospital	69,413	1,605	4,452	7	13	2	15	30

Appendix B.

Row Data for Data Envelopment Analysis 1390

Hospital Name	OPD	IPD	Patient Days	Doctors	Nurses	Midwives	Non-Medical S	Beds
Kishim Hospital	70,371	1,055	2,604	8	10	1	10	20
Baharak Hospital	73,332	2,224	12,490	6	16	5	11	20
Bala Murghab Hospital	66,805	789	2,802	4	10	3	14	20
Centeral Baghlan Hospital	80,731	9,508	26,558	18	17	4	21	70
10 Beds Hospital of Nahrin	43,262	3,106	6,135	4	13	2	17	25
Dawlat Abad Hospital	53,277	934	2,329	7	10	4	12	30
Shulgareh Hospital	49,006	1,867	4,948	7	11	4	12	50
Dihdadi Hospital	32,330	1,781	6,139	6	12	4	12	45
Khulm Hospital	37,331	3,617	8,591	7	16	4	15	50
Balkh Hospital	44,571	2,420	5,720	6	14	4	9	50
Yakawlang Hospital	34,153	1,907	3,766	5	14	4	12	32
Panjab Hospital	27,960	3,121	7,819	8	11	4	16	36
Waras Clinic	25,966	2,068	5,232	7	14	4	15	26
Ulqan Hospital	37,182	1,148	3,010	8	12	4	12	30
Mir Amor Hospital	29,587	1,471	3,704	3	7	3	12	13
Kesaw Hospital	44,960	1,230	3,103	2	9	3	16	12
Pusht-i- koh Hospital	47,507	2,036	6,507	1	10	4	9	32
Shar-Naw	86,505	3,053	5,409	7	12	4	12	40
Shrin Tagab (Feyzabad)	63,464	1,988	1,878	3	13	4	14	40
Mawlawi Abdul Zahir Shahed Hospital	79,839	3,781	9,869	5	11	3	13	30
Qarabagh Hospital	71,128	1,962	7,472	5	12	3	10	28
Taywara	38,196	837	2,382	1	5	2	11	20
Lal Bazaar Hospital	53,318	1,576	3,457	4	13	4	14	24
Girishk Hospital	92,616	2,483	5,375	7	13	2	10	30
Musa Qala Clinic	62,116	634	1,715	3	8	1	8	20
Hazar Joft Hospital	66,088	2,848	7,063	5	15	4	15	30
Gozara Hospital	96,009	4,617	9,042	12	23	5	25	55
Gulran Hospital	129,047	2,508	2,954	6	11	4	11	21
Ghoryan public Health Hospital	87,889	3,107	5,014	7	14	4	12	28
Shindan Hospital	93,889	2,057	6,244	5	11	4	14	27
Darzab Hospital	50,028	2,334	4,352	4	9	4	13	17
Aqcha Hospital	97,552	3,596	7,202	6	11	4	13	40
Qara Bagh Hospital	130,439	5,219	6,148	6	16	4	15	20
Chahar Asyab Hospital	64,454	3,563	5,584	6	17	4	12	20
Surobi Hospital	72,168	2,636	4,015	6	10	4	15	20
Dasht-e- Barchi Hospital	30,328	169	1,879	7	13	3	9	10
Ahmad Shah Mena Clinic	144,289	414	2,040	7	13	3	9	10
Rahman-Mina	65,138	1,071	1,799	6	14	4	15	30
Spin Blodak Hospital	53,412	712	4,611	5	13	2	15	25
Nijrab(Sharwani) Hospital	40,405	1,550	5,332	4	9	2	16	50
Mano Gai Hospital	54,744	1,245	1,698	4	7	4	9	20
Imam Sahib 50 Beds Hospital	69,184	6,104	14,429	6	16	4	23	50
Baraki Rojan 52 Beds Hospital	74,462	7,235	16,345	5	15	4	19	52
S.Safiqullah Ludin Hospital	54,884	5,503	10,959	7	13	4	17	25
Khogyani Hospital	165,598	7,325	14,094	9	12	4	21	50
Ghani Khel Hospital	168,048	9,152	14,553	9	18	2	18	45
Kama Hospital	94,035	3,161	9,992	15	17	4	17	45
Do Aaba Hospital	25,653	1,209	2,220	3	6	3	12	20
Kamdesh Hospital	13,862	297	718	15	17	4	17	25
Want Waigal	20,906	356	733	3	11	4	14	20
Khair Kot Clinic	29,644	614	1,247	4	8	3	14	10
Urgun Hospital	36,136	2,588	7,899	7	8	3	16	20
Chamkani Hospital	105,638	4,842	9,505	6	13	4	14	55
Zazi Aryob (Haji Aryub) Hospital	78,547	1,540	5,299	4	16	4	14	35
Rukha 40 Beds Hospital	20,308	103	179	5	9	3	22	40
Anaba Hospital	58,543	9,913	29,230	10	89	10	96	15
Lolanj Clinic	24,055	1,511	4,177	2	9	1	13	50
Dehi Hospital	45,872	1,382	5,714	6	2	3	13	20
Bazar Sokhta Hospital	37,827	1,604	4,952	5	9	3	9	30
Tukzar Hospital	60,329	1,187	4,967	1	17	4	16	20
Tarkhuch Hospital	32,465	1,080	4,034	2	9	3	12	20
Farkhar Hospital	47,262	1,443	4,476	5	12	4	11	30
Rustaq Hospital	93,544	1,158	4,165	2	10	4	11	20
Sina Hospital	44,852	1,188	3,482	5	13	4	11	33
Tagab Hospital	21,067	1,083	3,850	4	7	4	13	25
Chak Deh Merdad Hospital	56,820	4,053	13,778	10	22	6	36	75
Ghazi Mohd Jan Khan Hospital	50,744	4,048	8,372	5	16	3	16	40
Shahjoy Hospital	43,941	1,057	2,861	6	11	3	16	30

Appendix C.

Input slacks for 1389 and 1390

	2010					2011				
Name of Hospital	Doctors	Nurses	Midwives	Non-medical staff	Beds	Doctors	Nurses	Midwives	Non-Medical staff	Beds
Kishim Hospital	3.01	0.00	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baharak Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bala Murghab Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Centeral Baghlan Hospital	3.63	0.00	0.00	2.15	2.46	0.00	0.00	0.00	0.00	0.00
10 Beds Hospital of Nahrin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dawlat Abad Hospital	3.08	0.00	0.00	0.00	25.26	1.69	0.00	0.81	0.00	1.27
Shulgareh Hospital	1.64	1.97	1.21	0.00	8.44	2.83	0.00	0.00	0.00	12.80
Dihdadi Hospital	0.00	0.31	0.20	0.00	0.00	2.19	0.00	0.00	0.00	5.41
Khulm Hospital	1.59	1.78	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
Balkh Hospital	0.08	2.57	0.64	0.00	1.53	0.00	0.00	0.00	0.00	0.00
Yakawlang Hospital	0.00	0.48	1.28	0.00	0.00	1.00	0.00	0.20	0.00	0.00
Panjab Hospital	1.57	0.00	0.23	0.00	0.00	1.29	0.00	0.00	0.00	0.00
Waras Clinic	3.15	0.00	0.66	0.00	0.00	0.93	0.00	0.00	0.00	0.00
Ulqan Hospital	2.54	0.00	1.73	0.00	0.00	2.47	0.00	0.85	0.00	0.00
Mir Amor Hospital	0.00	0.00	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kesaw Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pusht-i- koh Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shar-Naw	1.25	0.19	1.13	0.00	0.00	1.97	0.00	1.69	0.00	7.78
Shrin Tagab (Feyzabad)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.65
Abdul Zahir Shahed Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qarabagh Hospital	1.24	0.86	0.00	0.00	0.00	0.43	0.00	0.00	0.00	4.64
Taywara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lal Bazaar Hospital	0.00	0.00	0.73	0.09	0.00	0.00	1.29	0.47	0.00	0.00
Girishk Hospital	0.00	0.00	0.00	0.00	2.53	0.00	0.00	0.00	0.00	0.00
Musa Qala Clinic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hazar Joft Hospital	0.00	2.48	0.00	0.00	0.53	0.00	1.03	0.00	0.00	0.00
Gozara Hospital	1.62	0.00	0.98	0.00	0.00	0.19	0.00	0.00	0.00	0.00
Gulran Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ghoryan public Health Hospital	0.00	0.00	0.03	0.00	0.52	1.48	0.94	1.91	0.00	0.00
Shindan Hospital	0.34	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Darzab Hospital	2.54	0.00	1.67	0.00	0.00	0.00	0.00	0.68	0.00	0.00
Aqcha Hospital	0.00	0.00	0.00	0.00	8.04	0.43	0.00	0.52	0.00	9.04
Qara Bagh Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chahar Asyab Hospital	0.58	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surobi Hospital	1.06	0.00	0.03	0.00	0.00	0.21	0.00	0.13	0.00	0.00
Dasht-e- Barchi Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ahmad Shah Mena Clinic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rahman-Mina	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.34	0.00	0.00
Spin Blodak Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00
Nijrab(Sharwani) Hospital	0.00	0.00	0.00	0.00	16.55	0.00	0.00	0.00	0.32	2.47
Mano Gai Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Imam Sahib 50 Beds Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	0.00
Baraki Rojan 52 Beds Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S.Safiqullah Ludin Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Khogyani Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ghani Khel Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kama Hospital	2.75	0.00	0.00	0.00	0.00	2.24	0.00	0.00	0.00	0.08
Do Aaba Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Kamdesh Hospital	4.82	0.00	0.13	0.00	0.00	3.96	0.00	0.00	0.00	0.00
Want Waigal	0.00	1.08	1.65	0.00	0.00	0.00	2.27	0.75	0.00	0.00
Khair Kot Clinic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Urgun Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chamkani Hospital	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.90	0.00	18.55
(Haji Aryub) Hospital	0.00	0.00	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00
Rukha 40 Beds Hospital	0.56	0.00	0.00	5.18	7.77	0.70	0.00	0.00	3.09	4.44
Anaba Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lolanj Clinic	1.71	0.00	0.00	2.34	18.71	0.00	0.00	0.00	0.00	0.00
Dehi Hospital	0.68	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00
Bazar Sokhta Hospital	1.43	0.07	1.57	0.00	5.35	2.98	0.00	0.00	0.00	2.37
Tukzar Hospital	1.18	2.39	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tarkhuch Hospital	0.00	0.00	0.00	0.00	0.00	0.00	1.21	0.21	0.00	0.00
Farkhar Hospital	0.00	2.85	1.16	0.00	0.00	1.16	0.00	0.92	0.00	0.00
Rustaq Hospital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sina Hospital	1.18	0.94	0.85	0.00	0.00	1.44	1.02	0.89	0.00	0.00
Tagab Hospital	0.00	0.00	0.00	0.00	0.18	0.00	0.00	1.00	0.00	0.00
Chak Deh Merdad Hospital	0.00	1.61	0.32	0.09	0.00	0.00	0.00	0.00	4.36	0.00
Ghazi Mohd Jan Khan Hospital	1.30	0.00	0.64	0.00	0.00	0.00	2.05	0.00	0.00	0.00
Shahjoy Hospital	1.77	0.00	0.00	0.06	0.00	0.13	0.00	0.00	0.00	0.00
Total	46.30	19.57	20.51	10.46	97.87	29.97	11.06	12.28	11.45	70.50

Appendix D.

Output Slacks for 1389 and 1390

	2010			2010		
Name of Hospital	OPD	IPD	PDAYS	OPD	OPD	PDAYS
Kishim Hospital	-	-	17	-	-	-
Baharak Hospital	-	-	-	-	-	-
Bala Murghab Hospital	-	-	-	-	82	-
Centeral Baghlan Hospital	31,561	55	-	-	-	-
10 Beds Hospital of Nahrin	-	-	-	-	-	-
Dawlat Abad Hospital	-	-	484	4,687	-	-
Shulgareh Hospital	2,455	306	-	8,246	-	-
Dihdadi Hospital	21,640	932	-	20,595	206	-
Khulm Hospital	34,311	156	-	34,884	-	-
Balkh Hospital	13,592	442	-	-	-	-
Yakawlang Hospital	13,491	-	-	22,890	-	832
Panjab Hospital	23,952	-	-	43,780	-	-
Waras Clinic	18,247	-	-	39,160	-	-
Ulqan Hospital	793	-	61	25,336	-	-
Mir Amor Hospital	7,127	-	138	-	-	-
Kesaw Hospital	-	-	-	-	-	-
Pusht-i- koh Hospital	-	-	-	-	-	-
Shar-Naw	1,914	-	-	-	-	270
Shrin Tagab (Feyzabad)	-	-	-	-	-	3,269
Abdul Zahir Shahed Hospital	-	-	-	-	-	-
Qarabagh Hospital	-	814	-	-	-	-
Taywara	-	-	-	-	-	-
Lal Bazaar Hospital	-	154	543	-	-	111
Girishk Hospital	-	692	1,023	-	-	-
Musa Qala Clinic	-	-	-	-	-	-
Hazar Joft Hospital	-	-	1,111	-	-	-
Gozara Hospital	-	-	1,743	6,211	-	-
Gulran Hospital	-	-	-	-	-	-
Ghoryan public Health Hospital	-	-	2,289	-	-	341
Shindan Hospital	-	640	-	-	130	-
Darzab Hospital	-	-	711	2,053	-	111
Aqcha Hospital	-	1,067	3,709	-	-	-
Qara Bagh Hospital	-	-	-	-	-	-
Chahar Asyab Hospital	4,657	-	-	-	-	-
Surobi Hospital	-	-	70	-	-	956
Dasht-e- Barchi Hospital	-	-	-	113,961	245	161
Ahmad Shah Mena Clinic	-	-	-	-	-	-
Rahman-Mina	-	800	3,473	1,825	-	431
Spin Blodak Hospital	-	-	-	12,074	1,133	-
Nijrab(Sharwani) Hospital	8,950	876	-	-	474	-
Mano Gai Hospital	-	-	-	-	-	-
Imam Sahib 50 Beds Hospital	-	-	-	14,980	296	-
Baraki Rojan 52 Beds Hospital	-	-	-	-	-	-
S.Safiqullah Ludin Hospital	-	-	-	-	-	-
Khogyani Hospital	-	-	-	-	-	-
Ghani Khel Hospital	-	-	-	-	-	-
Kama Hospital	-	982	-	-	268	-
Do Aaba Hospital	-	-	-	15,984	-	877
Kamdesh Hospital	30,044	-	-	69,283	401	1,416
Want Waigal	16,409	-	-	15,385	818	2,322
Khair Kot Clinic	-	-	-	-	-	-
Urgun Hospital	-	-	-	-	-	-
Chamkani Hospital	-	-	-	-	-	-
(Haji Aryub) Hospital	-	-	-	-	482	-
Rukha 40 Beds Hospital	28,459	-	1,747	26,478	750	2,480
Anaba Hospital	-	-	-	-	-	-
Lolanj Clinic	11,461	392	-	-	-	-
Dehi Hospital	4,114	467	-	-	-	-
Bazar Sokhta Hospital	11,890	273	-	15,212	-	-
Tukzar Hospital	-	1,090	-	-	-	-
Tarkhuch Hospital	-	-	-	10,216	49	-
Farkhar Hospital	625	43	-	14,258	-	-
Rustaq Hospital	-	-	-	-	-	-
Sina Hospital	13,479	457	-	11,522	-	67
Tagab Hospital	21,139	198	-	27,745	-	-
Chak Deh Merdad Hospital	1,421	2,224	-	15,231	1,627	-
Ghazi Mohd Jan Khan Hospital	5,192	-	-	30,544	-	-
Shahjoy Hospital	-	477	-	8,715	-	149
Total	326,922	13,537	17,119	611,256	6,963	13,793

Appendix E.

Row data for Regression Analysis 1389

VRSTE	BOR	ALOS	OPDPHY	BEDPHY
0.91	35.70	2.60	8004.50	2.50
1.00	171.10	2.90	10638.67	3.33
1.00	38.40	3.60	17085.67	6.67
0.39	103.90	2.90	588.56	3.89
1.00	67.20	2.20	2113.25	3.75
0.92	21.30	2.40	6807.57	7.14
0.81	27.10	3.50	6727.00	7.14
0.70	37.40	13.80	5924.83	7.50
0.79	47.10	2.50	4099.13	6.25
0.72	31.30	4.40	6492.17	8.33
0.75	32.20	1.90	6484.80	6.40
0.76	59.50	2.50	4909.29	5.14
0.78	55.10	2.70	3320.22	2.89
0.73	27.50	2.60	4716.63	3.75
0.99	78.10	2.40	8020.67	4.33
1.00	70.80	2.30	14710.33	4.00
1.00	55.70	3.20	14210.00	8.00
0.73	37.00	1.80	6400.43	5.71
1.00	12.90	2.10	19515.25	3.25
1.00	90.10	2.50	20094.25	7.50
0.86	73.10	3.60	10141.33	4.67
1.00	32.60	2.60	14672.33	6.67
0.99	39.50	2.20	17465.00	8.00
0.94	49.10	3.00	17763.80	6.00
1.00	23.50	3.10	11250.33	6.67
0.84	64.50	2.50	14414.80	6.00
0.63	45.00	2.20	7201.64	5.18
1.00	38.50	0.90	16538.86	3.00
0.95	49.10	1.90	15212.20	5.60
0.82	63.40	2.80	12103.43	3.86
0.97	70.10	2.30	8256.00	2.83
1.00	49.30	6.50	19842.00	8.00
1.00	84.20	2.10	18863.50	3.33
0.93	76.50	6.60	10310.50	3.33
0.86	55.00	2.00	11166.33	3.33
1.00	51.50	1.40	8075.57	1.43
1.00	55.90	3.60	8284.86	1.43
0.71	16.40	0.00	11294.33	5.00
1.00	50.50	6.50	9068.60	5.00
0.86	29.20	18.70	10410.75	12.50
1.00	23.30	13.20	8996.00	5.00
1.00	79.10	2.80	8909.25	6.25
1.00	86.10	2.70	13107.50	8.67
1.00	120.10	3.90	9301.00	4.17
1.00	77.20	2.50	18989.56	5.56
1.00	88.60	1.90	15717.10	4.50
0.84	60.80	3.00	9386.90	4.00
1.00	30.40	1.90	13845.50	10.00
0.60	7.90	2.00	1134.20	1.67
0.95	10.00	2.30	7559.33	6.67
1.00	34.20	2.50	8127.00	3.33
1.00	108.20	2.90	7008.60	4.00
1.00	47.30	2.60	13247.83	9.17
1.00	41.50	3.50	20017.67	11.67
0.85	1.20	1.30	3766.00	8.00
1.00	533.90	3.60	3847.40	8.00
1.00	22.90	8.10	4378.40	8.00
0.99	78.30	3.80	9905.25	5.00
0.93	45.20	14.70	5029.80	6.00
0.79	68.00	3.90	9478.00	3.33
1.00	55.30	3.70	13875.50	10.00
0.84	40.90	3.10	9497.40	6.00
1.00	57.10	3.60	21295.75	5.00
0.78	28.90	3.20	5065.29	4.71
0.81	42.20	4.00	4397.25	6.25
0.69	50.30	3.30	8498.00	8.33
0.81	57.30	2.90	7690.63	5.00
0.85	26.10	2.60	9916.14	4.29

Appendix F.

Row Data for Regression Analysis 1390

VRSTE	BOR	ALOS	OPDPHY	BEDPHY
1.00	35.67	2.55	8796	2.50
1.00	171.10	2.85	12222	3.33
0.81	38.38	3.65	16701	5.00
1.00	103.95	2.88	4485	3.89
1.00	67.23	2.23	10816	6.25
0.73	21.27	2.42	7611	4.29
0.80	27.11	3.46	7001	7.14
0.79	37.38	13.79	5388	7.50
0.76	47.07	2.48	5333	7.14
1.00	31.34	4.42	7429	8.33
0.78	32.24	1.92	6831	6.40
0.78	59.51	2.52	3495	4.50
0.73	55.13	2.69	3709	3.71
0.72	27.49	2.57	4648	3.75
1.00	78.06	2.38	9862	4.33
1.00	70.84	2.27	22480	6.00
1.00	55.71	3.23	47507	32.00
0.90	37.05	1.82	12358	5.71
0.72	12.86	2.06	21155	13.33
1.00	90.13	2.48	15968	6.00
1.00	73.11	3.58	14226	5.60
1.00	32.63	2.58	38196	20.00
0.76	39.46	2.23	13330	6.00
1.00	49.09	3.02	13231	4.29
1.00	23.49	3.05	20705	6.67
0.79	64.50	2.54	13218	6.00
0.54	45.04	2.21	8001	4.58
1.00	38.54	0.94	21508	3.50
0.92	49.06	1.92	12556	4.00
0.87	63.36	2.81	18778	5.40
0.96	70.14	2.29	12507	4.25
0.95	49.33	6.54	16259	6.67
1.00	84.22	2.10	21740	3.33
1.00	76.49	6.56	10742	3.33
0.87	55.00	1.98	12028	3.33
1.00	51.48	1.44	4333	1.43
1.00	55.89	3.63	20613	1.43
0.61	16.43	0.00	10856	5.00
0.86	50.53	6.48	10682	5.00
0.85	29.22	18.68	10101	12.50
1.00	23.26	13.17	13686	5.00
0.90	79.06	2.77	11531	8.33
1.00	86.12	2.71	14892	10.40
1.00	120.10	3.90	7841	3.57
1.00	77.23	2.46	18400	5.56
1.00	88.60	1.90	18672	5.00
0.74	60.83	3.02	6269	3.00
0.93	30.41	1.92	8551	6.67
0.57	7.87	2.00	924	1.67
0.80	10.04	2.29	6969	6.67
1.00	34.16	2.48	7411	2.50
1.00	108.21	2.94	5162	2.86
0.96	47.35	2.58	17606	9.17
0.73	41.48	3.54	19637	8.75
0.61	1.23	1.25	4062	8.00
1.00	533.88	3.60	5854	1.50
1.00	22.89	8.06	12028	25.00
1.00	78.27	3.79	7645	3.33
0.97	45.22	14.71	7565	6.00
1.00	68.04	3.92	60329	20.00
0.95	55.26	3.71	16233	10.00
0.81	40.88	3.06	9452	6.00
1.00	57.05	3.56	46772	10.00
0.76	28.91	3.17	8970	6.60
0.82	42.19	3.98	5267	6.25
0.58	50.33	3.25	5682	7.50
0.83	57.34	2.85	10149	8.00
0.62	26.13	2.60	7324	5.00

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