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Editor's Note

The health sector in Ethiopia is confronted with a multiple of inter-related problems that encompass economic, social, distributional, management and welfare dimensions. Because of these distinctive features of the health sector, the problems the sector is facing are believed to go beyond the realm of economics. However, the sector remains to have substantial economic elements.

The Ethiopian Economic Association (EEA) believes that economic analysis of the health sector provides important inputs that are of both academic and policy interest. EEA also believes that health care financing is one potential problem area in the provision of health care services. Hence, with the view of initiating policy dialogue among academics, researchers and practitioners regarding health care financing, EEA had organized a panel discussion forum in collaboration with ESHE/JSI Project/USAID on 02 February 2001. The presentations were also published in the Economic Focus series of the Association to disseminate the highlights of the major issues in health care financing.

The research findings and views reflected at the panel discussion have urged the Executive Committee of the Association to further follow up and deepen research and debate on the theme. To that effect, EEA proposed to organize a one-day Workshop where operational research papers would be presented and criticized in a joint forum of academics, researchers, health development partners and health management personnel. The proposal was well received by ESHE/JSI Project/USAID.

Therefore, with the main objective of encouraging operational research in the area of health care financing, a one-day Workshop was organized by EEA with the full financial support of ESHE/JSI Project on 20 December 2002 at Semien Hotel. As this junction, EEA would like to thank ESHE Project for fully funding this Workshop. The Association believes that such collaboration would also continue in the future.

For this Workshop three papers were selected based on the advertized theme of the Workshop: Health Care Financing in Ethiopia. The major comment provided by ESHE Project and the Health Care Secretariat at the Workshop was the fact that the papers presented are too technical as they involve econometrics jargons that would significantly limit their readability by all individuals working and studying in areas related to the health sector. Taking note of this comment, we spent sometime to rewrite the papers in a manner that make them not only readable but also comprehendible by all practitioners in the health sector. This, therefore, is partly the reason for the delay in the publication and dissemination of these papers.

Willingness to Pay for Insecticide-Impregnated Bed Nets: The Case of Selected Rural Kebeles in Ilu Woreda of Western Shoa Zone[1]

Belaineh Taye[2]

Abstract

The use of insecticide impregnated bed nets is one of the available means to protect households against infective mosquito bites. This paper, therefore, is directed towards estimating households' willingness to pay for such bed nets in one of malaria prone areas of Western Shoa Zone. The empirical findings reveal that the mean willingness to pay for a medium size insecticide impregnated bed net is Birr 44.26 if sold in cash and Birr 65.05 if provided on credit basis. These figures, however, are much lower than the current price of bed nets, which ranges between Birr 100 and 130. Moreover, households are willing to buy only one bed net in the former case and two in the latter case. Households' characteristics, burden of malaria on households and income are among the major factors influencing the willingness to pay decisions. Particularly, as the extremely low income of the society highly limits the use of bed nets, it calls for a support scheme in order to reduce the burden of malaria on rural households

1. Introduction

1.1. Background

Malaria is a significant public health concern for many developing countries of Asia, Latin America, the Pacific and Africa. In sub-Saharan Africa, where mosquito vectors are abundant and where malaria transmission is very intense, malaria is one of the major killers responsible for nearly one million deaths and 300 to 500 million clinical

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cases every year. Of the global deaths due to malaria about 90 percent now occur in Africa (Martin, et al., 1998).

Malaria is a common parasitic disease in Ethiopia in almost all areas below 2500 meters altitude, covering nearly 75% of the area of the country. Malaria affects nearly 4 to 5 million people annually, and of the total 350 DLY's[3] per 1000 population lost annually, it accounts for 10.5 percent. This makes malaria the second largest killer disease in the country. Furthermore, on average 400,000 to 600,000 cases with positive blood film for malaria are treated annually. However, the number of cases seen at facilities with no microscopic diagnostic service and by community health workers is estimated to be 3 to 4 times higher than this figure (MOH, 2000). On the other hand, the 1999 MOH's report puts the risk of malaria infection as high as two-thirds of the country's population because of the assumption that quite a significant number of people suffering from the disease might not visit any formal health facilities due to lack of access to health services, socio-cultural and economic factors.

In Ethiopia the transmission of malaria is unstable and many areas are either epidemic prone or moderately endemic with marked seasonality. The main transmission seasons are closely linked with the rainy seasons, mainly occurring between September to December and April to May.

Though major epidemics of malaria occurred at intervals of approximately 5 to 8 years since 1958 (MOH, 1999), recent trend shows a frequent epidemic in different parts of the country. Since the outbreak of the first malaria epidemic in 1958, which was responsible for an estimated 3 million cases and 150,000 deaths in span of only 6 months, the epidemic has been expanding (MOH, 2000). Consequently, the government of Ethiopia has been committing itself to malaria control and eradication activities starting from 1959. But the problem seems not to have been resolved mainly due to, among others, increasing insecticide resistance of malaria vectors, financial constraints, institutional problems and the unstable and seasonal nature of its transmission. Moreover, important vector control supplies such as drugs, laboratory and medical supplies and bed nets are not available as required.

The decentralization of the national malaria control programme that followed the 1993 health sector reform has also exerted its own impact on the country's malaria control effort. For instance, the drastic reduction of manpower in the Federal Malaria Control

[3] DLY refers Disability Life Year.

Unit and lack of the necessary capacity at the Regional level coupled with ecological changes resulted in large-scale malaria epidemic in the country in 1998 (MOH, 1999).

Currently the government is working, in collaboration with the World Bank, WHO, UNICEF, UNDP and USAID, under the Global Roll Back Malaria Initiative which aims at reducing the burden of malaria by 50 percent within ten years. For the implementation of this objective, National Malaria Control Support Team was established and its activities are to be integrated to the National and Regional Health Sector Development Programmes. All these efforts depict the growing awareness to the burden of malaria, which in fact is one of the top priority development problems.

In light of this government concern on the one hand and serious resource constraint on the other, this study aims at estimating the willingness to pay for insecticide impregnated bed nets in selected rural Kebeles of Ilu Woreda. The study area is found in Western Shoa Zone of Oromiya Region, some 55 km away from Addis Ababa on the road to Jimma. The total population of the Woreda is 53,700, out of which 48,700 (90.7%) living in 18 peasant associations or rural kebeles and the rest residing in 2 rural town kebeles. Though it is a case study, the results obtained are hoped to serve as preliminary indicators of the implications of government health care financing schemes in rural Ethiopia.

1.2. Problems, significance and objectives of the study

As a leading cause of mortality and morbidity, malaria is one of Ethiopia's foremost health problems top ranking among communicable diseases. Assessment of the country's outpatient morbidly statistics reveals that malaria stands as the number one of the top 15 diseases (World Bank, 1999). From the 10 leading causes for hospitalisation malaria is the second diseases and the first for outpatient visits (MOH, 2000).

Apart from its mortality and morbidity consequences, malaria exerts immense adverse impacts on a country's economy. For instance, the recurrent infections and the associated attacks of fever could adversely affect productivity by causing loss of working time and efficiency. Particularly in the agricultural sector these could lead to late planting and harvesting. The loss in productivity, and hence the reduction in the overall household income, could be further exacerbated when some members of the family are forced to spend their time taking care of the malaria infected family

members. The rise in the costs of treatment resulting from the spread of drug resistant malaria is also the other negative impact of malaria (Jamison, et al, 1998).

Generally, the total costs borne by families and individuals include payments for treatment, time and transport costs in seeking treatment, time costs for family members who look after the patient, and time and money costs of preventive action taken by households and the community (ibid).

Beyond these short run costs, malaria impedes economic growth and long-term development in many ways. Malaria may impede the flows of trade, foreign investment, and commerce, thereby affecting a country's entire population. Malaria tends to hinder a child's physical and cognitive development, and may reduce a child's attendance and performance at school. It exposes individuals to chronic malnutrition and increased vulnerability to other diseases (Rwegasira, 2000).

Hence, it is this treat of malaria to human lives and its serious impact on the whole economy that have always necessitated the malaria prevention and control efforts. To this effect, insecticide impregnated bed nets have been proved by a range of trials in different countries to be one of the best malaria control measures available (Target and Brain, 1998).

In Ethiopia various malaria control and prevention actions have been in use, including residual insecticide house and aerial spraying, environmental management and chemoprophylaxis. However, the use of these chemical insecticides and biological agents is constrained by limited availability of human and economic resources, poor health infrastructure and resistance to drugs. The environmental management endeavour, though one of the available malaria preventive action, is not yet a fully utilized mechanism due to low awareness creation and community mobilization efforts.

Insecticide treated bed nets, on the other hand, have been introduced only on a trail basis in several areas of the country as part of a community-based malaria control endeavour. The scheme is reported to have shown some success notably in the Tigray Regional State. But the current combined tax rate of 62% levied on mosquito nets is reported to have limited its availability and affordability (World Bank et al, 1999).

In this situation where exposure to the use of insecticide impregnated bed[4] nets is limited and where it is highly taxed, the willingness and the ability to pay for them by most agricultural households need thorough assessment. This is thus the motivation to conduct the study at a randomly selected malaria endemic Woreda in Oromiya Regional State.

Therefore, in addition to investigating the attitude of rural households towards insecticide impregnated bed nets, the study estimates their willingness to pay for the bed nets, and identify the factors that determine the households' willingness to pay for the bed nets. Finally, attempt is also made to show the implications of the results obtained on health care financing scheme of the government.

2. Theoretical and empirical perspectives

2.1. Theoretical background

Malaria is a disease caused by the presence in the red blood corpuscles, or in the liver cells, of a unicellular parasite – a protozoon – belonging to the genus of plasmodium (Pampana, 1969).

There are four main species of human malaria parasites: *plasmodium falciparum, plasmodium vivax*, *plasmodium malariae* and *plasmodium ovale*. Of these four species *plasmodium falciparum* causes the severest type of malaria. These species together with *plasmodium vivax* account for more than 95 percent of malaria cases in the world. The rest two cause less severe symptoms (WHO 1992).

Malaria is transmitted through the bite of female *anopheles* mosquito, which sucks blood from an infected person and eventually transmits it to other human beings. Once the *sporozoite* is inoculated into man, it remains undetectable hidden in the liver cells, where the parasites grow and divide their *nucleus* and their *cytoplasm*. After few days hundreds of daughter forms escape from the remains of the mother cell and red blood *corpuscles* and invade new red blood *corpuscles*. This cycle repeats unless interrupted by drugs or immunity developed in the body. It is estimated that malaria parasites can multiply 10 times every 2 days, destroying the red blood cells and infecting new cells throughout the body (UNICEF, 2000)

[4] Note that bed in the context of the majority of the rural households in Ethiopia refers to any space or material used for sleeping.

The incubation period, which is the interval between mosquito bite and the appearance of fever, varies from a minimum of 6 to a maximum of 25 days for *plasmodium falciparum* and from 8 to 27 days for *plasmodium vivax* infections (Pampana, 1969). Malaria is mostly a disease of hot climate. The *anopheles mosquito* which transmits the malaria parasite thrives in warm and humid climate where a pool of water provides perfect breeding grounds. Hence, the transmission intensity of malaria varies depending on altitude, amount of rainfall, temperature, humidity and other human factors. It is based on these factors that the disease is classified as endemic or epidemic.

While endemic malaria refers to a constant measurable incidence both in terms of cases and natural transmission over a succession of years, endemic malaria indicates a periodic or occasional sharp increase in morbidity or mortality, or acute exacerbation of the disease in unusual proportions, compared to what a particular community is used to face.

The chief symptom of malaria is fever, periodic bouts of which tend to alternate with days of less or no fever. The classical *paroxysm* of fever lasts eight to twelve hours, typically in three stages: cold shivering rigor, burning dry skin and drenching sweat that lowers the temperature (Jamison et al, 1998). Children and adults infected with malaria commonly suffer from severe headache, cough, nausea, vomiting, abdominal pain, poor appetite, thirst and diarrhea in addition to high fever.

Malaria may become complicated unless treated in time. The symptoms for complicated malaria include: very high body temperature, drowsiness, convulsions, shock and coma indicating heavy *parasitaemia*, severe anemia, *hemoglobin urea* (black water fever), *jaundice*, renal failure and respiratory distress. Unless timely treated, *plasmodium falciparum* can also lead to death (WHO 1992).

The risk of severe malaria is almost exclusively limited to those who are not immune. In highly endemic areas, this risk affects children from the age of three to six months up to the age of five years. Because those who lose the immunity acquired from their mothers will develop their own immunity after this period of time (Jamison et al, 1998). Moreover, pregnant women are more easily infected mainly because their placenta is a preferential site for parasite development. Consequently, *plasmodium falciparum* could lead to death, abortion, premature delivery or low birth weight. Particularly, malaria is an important cause of low birth weight and high neonatal mortality in first and second born children in endemic areas.

Therefore, treatment of malaria should aim at preventing the disease from developing into a severe condition, which could be fatal. However treatment alone could not solve the incidence and prevalence of malaria since repeated bites by the vector is still possible. In addition, treatment of malaria should be based on the severity of the cases, parasite species, and pattern of drug resistance.

In general, there is no single appropriate intervention for all cases of malaria. Interventions are case and place specific. But the most general intervention for the prevention of malaria infection should aim at protecting individuals against infective mosquito bites and transmission control so as to reduce the risk of malaria to entire population.

Personal protection can be exercised in a variety of ways: using protective clothing, repellents, screening of houses, insecticide-impregnated bed nets, etc. On the other hand, the measures available for the control of malaria transmission include: residual insecticide house and aerial spraying, larviciding, drying of water containers and pools, draining of swaps, environmental sanitation and *chemoprophylaxis*. These control measures are broadly categorized into two: use of chemical insecticides and biological agents and environmental management (WHO, 1993).

2.2. Empirical literature review

This sub-section reviews empirical findings of some previous studies conducted on estimating the economic cost of malaria and the willingness to pay for insecticide-impregnated bed nets.

2.2.1. Burden of malaria

Malaria is a classic example of a debilitating disease that impairs productivity. As the most prevalent disease in the poorest rural areas, malaria produces recurrent infections with attacks of fever in the warm and rainy seasons, when most workers are needed to collect crops. Often the malaria vulnerable people could also be those who already suffer from malnutrition and other infections and lack of medical care. In areas subject to epidemics, these also tend to strike at times of peak demand for agricultural work (Jamison et al, 1998).

Though the impact of malaria on economic growth and development remained immense, studies made on the area are few and did not concentrate on rural

households. Moreover, the studies conducted so far are heterogeneous in their purposes, design and result (Abdulhamid, 1995). Nevertheless, this paper tries to briefly review some of the studies conducted on the economic impact of malaria and the extent to which insecticide impregnated bed nets contribute to its control.

During the period 1965 - 1990, highly malarious countries suffered a growth penalty of more than one percentage point per year (compared with countries without malaria), even after taking into account the effects of economic policy and other factors that also influence economic growth. The annual loss of growth from malaria is estimated to range as high as 1.3 percentage points per year. Compounding the loss over the fifteen years period of analysis reveals that the GNP level in the fifteenth year would be reduced by nearly a fifth, and the toll would continue to mount with time (Rewagasira, 2000). For instance, in 1995 the estimated direct and indirect costs of malaria in Africa were US $ 1.8 billion (African Development Report, 1998).

A survey conducted on low income households in Malawi focusing on costs of malaria estimated the average annual expenditure on malaria treatment to be US $ 11.07, representing 9.6% of a household's income. The study also depicted that malaria morbidity accounts for a loss of 2 - 3 days of work and lower productivity, costing a household approximately US $2.70 per annum (Shepard et al in World Bank, 2000).

In Ethiopia, a case study made by Abdulhamid (1995) on two villages, with the aim of assessing the impact of malaria on peasant production, showed the occurrence of malaria affecting the total output of *teff*. In Ghana, a health assessment team found recurring disability from clinical attacks of malaria averaging 7 days of illness per year (Nimo et al, 1981). A study conducted in Pakistan using the human capital method revealed the annual economic cost of malaria to be 81 million Rupees (Khan, 1966). It can thus be concluded that as the burden of malaria is immense, it demands appropriate prevention and control measures.

2.2.2. Malaria prevention and control

As no single biological, economic or political reason can be adduced for the observed patterns and trends in malaria transmission, no single intervention, therefore, is appropriate in all contexts (Rewagasira, 2000). Interventions should be adapted to specific local ecological, epidemiological, economic and social conditions. Accordingly, timely care seeking, combined with a health system capable of

diagnosing and treating malaria cases, could significantly reduce the burden of malaria, and is essential to sustaining a reduction (World Bank, 1999).

There are various malaria control mechanisms including spraying of residual insecticides, the use of insecticide-impregnated bed nets, space or aerial spraying, larvaciding and source reduction. Insecticide-impregnated bed nets have been proved by a range of trials in different countries to offer one of the best malaria control measures available. Their use has contributed to substantial reduction in malaria in many parts of China. In Africa the number of clinical attacks of malaria on children protected by treated bed nets was reduced by 30% to 60%. In Gambia overall child mortality was reduced by more than 60%. In subsequent trials elsewhere in Africa mortality was reduced by between 15 and 33 % (Target and Brain, 1998).

The use of insecticide-impregnated nets substantially affects the frequency and severity of clinical episodes of malaria (Lengeler, et al, 1996). Below is the summary of the results of some studies that support the above view and depict the impact of insecticide-treated mosquito nets on malaria morbidity on African children based on selected trials.

Table 2.1: Impact of insecticide-impregnated bed nets on African children

Country	Morbidity reduction (%)	Year
Gambia	63	1988
Kenya	40	1993
Guinea Bissau	29	1994
Sierra Leone	49	1995
Tanzania	55	1995

Source: WHO 1992

Although insecticide-treated mosquito nets provide a cost effective means of ameliorating the effects of malaria, this protection measure will be expensive if large human population is to be protected (Rwegasira, 2000). In this regard, various studies revealed the problems relating to availability and affordability of insecticide-treated beds nets.

Bed nets are observed to be widely used in countries where they are produced, private markets for nets prevail and where government subsidy exists. For instance, a recent unpublished study by London School of Hygiene and Tropical Medicine (2000)

revealed that in Tanzania, Kenya and Zimbabwe, where active net market and large scale commercial production exist, there is high level of net ownership. It was estimated in 1993 that 62 and 35% of households in Dare Salaam and Burkina Faso, respectively, owned mosquito nets. The study also indicated that in China and Vietnam, where private markets exist, the coverage is high.

In Ethiopia insecticide-impregnated mosquito nets have been introduced on a trail basis in several areas of the country as part of community-based malaria control initiatives, with some notable success in the Tigray Regional State (World Bank et al, 1999).

A study conducted in Tigray in 1997 to examine the affordability and community willingness to buy bed nets on a sample of 100 households selected from a resettlement community residing in an area of highest malaria prevalence, estimated the mean amount a family could spend for one bed net to be only US $ 1.80 (about 13 Birr). In addition, only 22 % of the respondents stated that they would try to purchase nets if provided at a time when cash is available, while 17% responded that they were too poor to buy bed nets. On the other hand, 61% of the respondents are of opinion that they would buy the nets if only provided by the government at a balanced cost (WHO, 1999). It has to be noted that currently mosquito nets are taxed a combined rate of 62% in Ethiopia (World Bank et al, 1999).

3. Methodology

3.1. Method of analysis and data sources

The study focuses on estimating the willingness to pay for insecticide-impregnated bed nets using the contingent valuation method (CVM). This method, which was originally designed to elicit the value of non-marketable environmental amenities, is now being widely used even for marketed goods that have a substantial impact on the welfare of the society. Though a bed net is a good that has a market value, the serious impacts of malaria on production, productivity and investment make it a community good.

Hence, in this study an open-ended structured questionnaire is used to elicit values that rural households are willing to pay for bed nets and to identify the factors that influence their willingness to pay decisions. The use of an open-ended questionnaire

is justified by its advantage in directly eliciting the maximum willingness to pay amount by avoiding the use of starting values, which in most cases could be a major source of bias. Moreover, the data compiled on income, asset ownership, economic cost of malaria and other related variables extends for five consecutive years (1989-1993 E.C.) and the averages of these variables are used in the analysis mainly to avoid specific yearly variations that might occur due to peculiar situations.

The survey was conducted at Ilu Woreda, a systematically selected Woreda from among 158 malaria endemic Woredas in Oromiya Regional State. This Woreda was selected mainly considering the fact that it is the number one priority area in Western Shoa Zone as well as on reasons of cost effectiveness and administrative convenience to conduct the survey. The survey covered a total of 300 households selected using appropriate sampling techniques.

The study employed both descriptive and multiple linear regression methods of analysis. The descriptive statistics are used to check the reasonability of the information collected through the survey, while the multiple regression model is utilized to identify the relationships between the dependent variable (WTP) and the independent variables (the various household characteristics).

3.2. Model specification

A general multiple regression model with κ explanatory variables can be stated as:

$$y = f(x_1, x_2, x_3, ..., x_k) + U$$

where y is the independent variable, $x_1, x_2, x_3, ..., x_k$ are the explanatory variables, and U is the random or error term. This equation can be regressed using the Ordinary Least Square (OLS) method in the following form:

$$y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ... + \beta_k x_k) + U$$

where $\beta_o, \beta_1, \beta_2, \beta_3, \ldots, \beta_k$ are the unknown parameters or coefficients of the respective explanatory variables.

In this study while the maximum willingness to pay (MWTP) is the dependent variable, the household characteristics and other relevant variables that determine WTP are the explanatory variables. Such explanatory variables include: *sex, age, and educational level of the household head, income and family size of the household, number of family members infected in the last five years by malaria, size of land holdings, number of oxen owned, and total economic cost of malaria incurred by households*.

Based on this functional specification, the model regressed using ordinary least squares (OLS) method is:

$$MWTP = \beta_O + \beta_1 SXHH + \beta_2 AHH + \beta_3 EDUHH + \beta_4 FSZH + \beta_5 SZLOH + \beta_6 NOXOH + \beta_7 INCH + \beta_8 NMIMH + \beta_9 TCMH + U$$

The following table depicts the descriptions and hypothesized relationships of the explanatory variables with the independent variable, MWTP for insecticide-impregnated bed nets.

Table 3.1: Descriptions and hypothesized relationships of the explanatory variables

Variable	Description of the variable	Hypothesized relationship
SXHH	Sex of the household head. **Dummy variable** 1 if head is female 0 otherwise	Women household heads are expected to be highly cautious for the health of their family. It is also assumed that women suffer more in taking care of the diseased household member. They are expected to react actively to the prevention and treatment of malaria. Hence, their willingness to pay for bed nets is hypothesized to be greater than that of men household heads.
AHH	Age of the household head	Younger household heads are expected to have better preference for modern means of health care facilities than older ones. Hence, the willingness to pay for bed nets may get lower and lower with increasing age.
EDUHH	Education level of the household head	It can in general be hypothesized that the more the household head is educated, the more would he/she be willing to participate in any intervention that reduces the incidences of malaria infection to the family members so that the higher would be the WTP f or bed nets.

Table 3.1 continued

Variable	Description of the variable	Hypothesized relationship
FSZH	Family size of the household	Other things remaining the same, households with large family size may inevitably have higher consumption expenditures. Therefore, due to higher household expenditure on the one hand and the more number of bed nets that might be needed for the whole household members on the other, the willingness to pay for bed nets is expected to be lower with the increase in family size.
SZLOH	Size of land owned by the household	Size of land holdings could be used as one means to estimate the wealth of rural households. Hence, households with larger plot of land are expected to have a better income and enjoy relatively better standard of living. Such households are hypothesized to have a greater WTP for bed nets
NOXOH	Number of oxen owned by the household	Ownership of oxen is one of the proxies for asset ownership. Those who own oxen not only can effectively cultivate their plots of land but also can lease land from those who do not own oxen and from female household heads and other aged households who can not plough on their own. Such households therefore would relatively be in a better position to have greater willingness to pay for bed nets.
INCH	Income of the household	The higher the income the greater will be the ability to pay for health facilities. Hence, the greater will be the WTP for bed nets.
NMIMH	Number of malaria infected members of the household in the last five years.	The higher the number of family members infected by malaria the greater is the suffering of the household. Hence such households are assumed to be highly willing to take any malaria prevention action. Therefore, it is hypothesized that WTP for bed nets will be greater with the increase in the number of household members who were infected by malaria.
TCMH	Total economic cost incurred for the prevention and treatment of malaria.	Households with higher expenditure for prevention and treatment of malaria would have more WTP for any intervention that could protect malaria infection and hence reduce the burden inflicted by the infection. Therefore, it is hypothesized that such households will have greater WTP for bed nets.

4. Findings of the survey

This section presents the empirical survey results on the willingness to pay for insecticide-impregnated bed nets of rural households in two subsections. The first presents descriptive statistical results of the survey while the second reports on the multivariate regression estimation of WTP.

4.1. Descriptive analysis

a) Households characteristics

Out of the total 300 sample households contacted 230 (76.7%) are male-headed while the rest 70 (23.3%) are female-headed households. The proportion of younger household heads (18 to 30 years of age) constitutes 21.3% of the total sample households. Those between 31 to 45, 46 to 65 and greater than 65 years of age account for 37.7, 28 and 13%, respectively.

The majority of the household heads (57%) are found to be illiterate, and those who can only read and write account for nearly 16%. It is only about 23% the household heads that have education levels ranging from primary to secondary.

Table 4.1: Education level of household heads

Education level	No	%
Illiterate	168	56.8
Read and write	47	15.9
Elementary	47	15.9
Junior Secondary	21	7.1
Secondary	13	4.4
Total	**296**	**100**

The average family size in all the five sample kebeles does not show significant variation, the lowest being 6.06 and the largest 6.81. The overall average family size is therefore 6.31. However, variations are observed at individual household level. Hence, out of the total sample households contacted, 3% of them have a family size of 1 to 2, while those with 3 to 5 family members are nearly 39%. The majority of the households (58%) are found to have more than 5 family members.

Average size of land holding per household is found to be 2.83 hectare, which is by far better than the national average. It is only 5 households (nearly 2% of the sample)

that reported not to own any land of their own. The proportion of landless households is relatively low due to voluntary redistribution of land by the elderly to their own youth family members.

Table 4.2: Average size of land holdings by sample kebeles

Name of Kebele	Number	Average land holdings *(in hectare)*
Weserbi Besi	44	3.4
Alengo Tulu	81	2.68
Bili	47	2.62
Mida Jigdu	52	3.21
Wereso Kelina	71	2.51
Total	**295**	**2.83**

However, variations in land holding are observed at individual household levels. While the majority (71%) of the households contacted owns 2 or more hectares of land, nearly 24% own between 1 to 2 hectares. The proportion of those owning less than 1 hectare is very small (5%). The landless group reported to rent or lease land from those who could not plough on their own due to various reasons.

Table 4.3: Size of land holdings per household (in hectare)

Size	No	%
<1	16	5.4
1.01 – 2	70	23.7
2.01 – 3	130	44.1
>3	79	26.8
Total	**295**	**100**

Oxen are one of the important assets for agricultural households in Ethiopia, since almost all rural households earn their livelihood from farming. The survey revealed that only a very small proportion (about 2%) of the sample households does not own oxen. The vast majority (nearly 77%) have reported to own 2 to 4 oxen.

Table 4.4: Ownership of oxen by households

Number of oxen	No	%
0	6	2.2
1	47	17.2
2	143	52.4
3 – 4	66	24.2
>4	11	4.0
Total	**273**	**100**

b) The malaria situation and its burden

Asked whether any member of their family has been ill with malaria in the last five years, the majority of the households (271 or 93%) responded in the affirmative. And large proportion of these households (97%) has also reported to have taken the sick family members to the nearby health facilities for treatment, predominantly to the nearest clinic (63%). Treatment at hospital level is low (5%) as compared to the proportion that used traditional health facilities (12%).

The number of household members infected by malaria has shown variations from household to household and from year to year. For instance, in a period of five years (1989-1993 E.C.) three to five family members were infected in nearly half (52%) of the sample households. It has to be noted that the proportion of households that reported more than five malaria infection cases per family are not also small (29%).

Table 4.5: Average number of people infected by malaria per household

Average number of sick family members	No	%
1-2	55	19.6
3-5	146	52
>5	80	28.5
Total	**281**	**100**

The total number of people reported to have been infected by the disease in the five years of analysis has also shown variations: 11.3% of the infection was in 1989, 22.1% in 1990, 43.4% in 1991, 15.8% in 1992 and 7.3% in 1993 (all in E.C). Malaria infection is reported to be the lowest in 1993 E.C. primarily because of DDT spraying in the preceding year and partly due to the change in the intensity of rainfall in the area.

On the other hand, compared to the higher rate of morbidity, mortality caused by malaria is lower. Out of the total sample households 13% have reported deaths of family members as a result of malaria infection during the above five years period of analysis. All in all, a total of 43 people are reported to have died of malaria in the five years period, about 37% of which were children under 5 years of age.

c) Willingness to pay

Reduction of man-mosquito contact is one of the malaria control measures suggested by professionals in the area. In this regard, insecticide-impregnated bed net is one of the protective measures available to reduce man-mosquito contact. This study

therefore has focused on estimating the maximum amount that rural households are willing to pay for insecticide-impregnated bed nets.

The survey questionnaire was designed in such a way that the information and knowledge that households have concerning insecticide-impregnated bed nets could be investigated before the willingness to pay questions were posed. To this end, household heads were asked if they have any information on bed nets. Accordingly, it was observed that not only nearly 97% of the respondents lack any information on bed nets, but also almost all of them (97%) have not even seen it before let alone have prior experience in using it (99%).

Recognizing the difficulty that respondents may face in answering willingness to pay questions, they were given a comprehensive explanation what an insecticide-impregnated bed net is, its importance and the results obtained in reducing malaria morbidity and mortality in many parts of the world. Posters and some items with which the rural households are familiar (for example Netela) were used to visually demonstrate bed nets. This approach has assisted a lot to ease the difficulties that respondents would have encountered in responding to the open ended willingness to pay questions.

Right after it was believed that respondents have grasped sufficient information on bed nets and the need for impregnation every six month with a cost of Birr 2.00, they were asked whether they would be willing to buy or not if it were available in the market. In this regard, about 290 (97%) household heads have positively responded to the participation question. The remaining 10 (3%) respondents, who have expressed their unwillingness to buy bed nets, were asked as to why they were not willing to buy the stated bed net. The majority (8) responded that they would not afford it.

Those who were willing to buy stated the maximum amount they would be willing to pay for a bed net as shown in Table 4.6. The table reveals that larger proportion (81%) of the respondents is willing to pay up to Birr 50 for a medium sized rectangular bed net. Household heads that are willing to pay between Birr 51 to 100 account for 15.2 percent, while those who have shown a willingness to pay above Birr 100 constitute only 3.7 percent.

Table 4.6: Willingness to pay data

WTP intervals (Birr)	Mid point (Birr)	Frequency	Relative frequency	Cumulative frequency
5 – 25	15	93	32.1	32.1
26 – 50	38	142	49.0	81.0
51 – 75	63	20	6.9	87.9
76 – 100	88	24	8.3	96.2
101 – 125	113	3	1.0	97.2
126 – 150	138	3	1.0	98.3
151 – 200	175.50	5	1.7	100
Total		**290**	**100**	

Moreover, the households were asked to state the amounts they would be willing to pay on cash and credit basis and the number of bed nets they would be willing to buy under each option. The responses obtained indicate that households would be willing to pay Birr 44.26 for a bed net sold in cash and Birr 65.05 if provided on credit basis. And the number of bed nets that each household would be willing to buy under the two scenarios is found to be one and two, respectively. It can thus be concluded that under a situation where the average family size in the survey area is close to six, the number of bed nets proposed to be purchased by respondents in either case could not be sufficient to protect the whole family against mosquito bites.

In an attempt to identify the factors that might influence the WTP decisions, the WTP responses are cross tabulated in terms of household characteristics in the tables to follow. Accordingly, no significant difference is observed in the responses of male and female respondents for WTP amounts ranging from Birr 5 to 100. However, the percentage of female household heads willing to pay above Birr 101 for a bed net is observed to be slightly greater than that of male household heads (Table 4.7).

Table 4.7: Willingness to pay amounts by type of household head

Willingness to pay interval	Male		Female	
	No	%	No	%
5 – 50	182	81.2	52	80
51 – 100	35	15.7	9	13.8
>101	7	3.1	4	6.2
Total	**224**	**100**	**65**	**100**

Viewed in terms of age, larger proportions of adult (31 – 45 years) and older (greater than 46 years) household heads are found to be willing to pay in the range of Birr 5 to

50 than the younger ones (18 – 30 years) (Table 4.8). However, the percentage of younger household heads that show willingness to pay higher amounts for bed nets is relatively greater than the other groups of respondents.

Table 4.8: Willingness to pay amounts by age

Willingness to pay Interval	18-30		31-45		46-65		>65	
	No	%	No	%	No	%	No	%
5 – 50	44	71	95	87.2	63	79	32	84.1
51 – 100	10	16.1	13	11.9	16	20.2	5	13.2
>101	8	12.9	1	0.9	1	1.3	1	2.6
Total	**62**	**100**	**109**	**100**	**80**	**100**	**38**	**100**

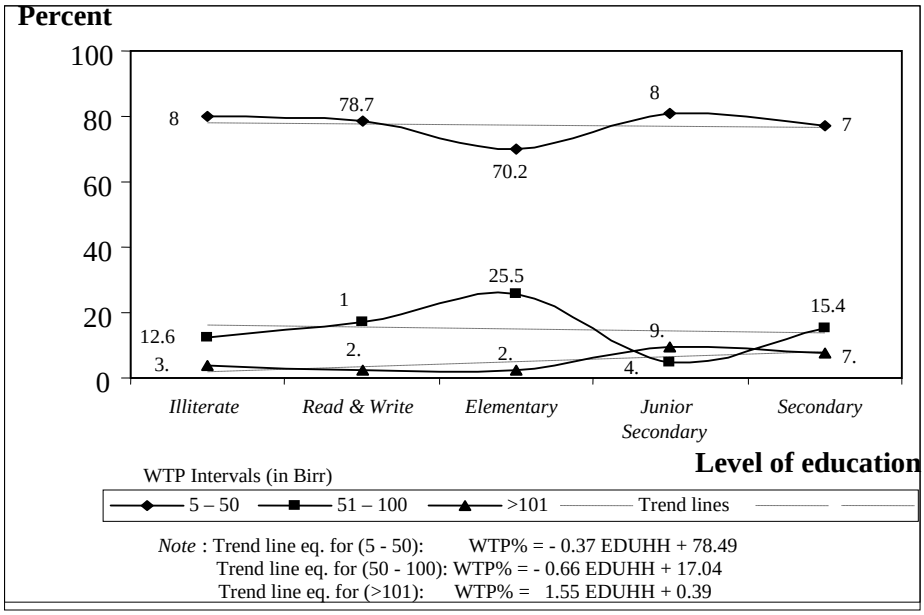
Annual income of households is also cross tabulated against WTP. The vast majority (92%) of households with mean annual income of Birr 1000 or less are willing to pay Birr 5 - 50 for an insecticide-impregnated bet net. This proportion is large compared to the respondents of higher income groups (i.e., Birr 1001 – 2000 and greater than Birr 2000). However, the proportions of households willing to pay higher amounts for bed nets (i.e., Birr 51 – 100 and greater than Birr 101) seem to increase with the level of annual income. For instance, while close to 11% of those with mean annual income of Birr 1001 – 2000 are willing to pay Birr 51 – 100, 26% of households with mean annual income exceeding Birr 2000 are willing to pay greater than Birr 101 per a bed net (Table 4.9).

As opposed to the theoretical expectation, cross tabulation of WTP with level of education failed to show any clear trend. Viewed generally, the data does not show a clear association between WTP amounts and the level of education of household heads (categorized into groups extending from those who have no formal education to those who completed secondary school) (Figure 4.1).

Table 4.9: Willingness to pay amounts by mean annual income

Willingness to pay interval	Average Total Income					
	≤1000		1001-2000		>2001	
	No	%	No	%	No	%
5 – 50	65	91.6	106	89.1	64	64
51 – 100	5	7	13	10.9	26	26
>101	1	1.4	0	0	10	10
Total	**71**	**100**	**119**	**100**	**100**	**100**

Figure 4.1: WTP responses vs level of schooling



Note : Trend line eq. for (5 - 50): WTP% = - 0.37 EDUHH + 78.49
Trend line eq. for (50 - 100): WTP% = - 0.66 EDUHH + 17.04
Trend line eq. for (>101): WTP% = 1.55 EDUHH + 0.39

However, closely examining the data using the trend lines generated for the different WTP responses, one may draw the following observations: (a) 70 to 81 percent of the respondents in all categories are willing to pay Birr 5 – 50 for a mosquito bed net; (b) the negative slopes of the trend lines for lower and medium payment levels indicate that the proportion of household heads willing to pay the specified amounts decreases with the education level of the respondents; and (c) for those willing to pay more than Birr 101 for a single bed net, the percentage of WTP responses and level of education are positively related, implying that the more educated the household head, the higher is the amount s/he would be willing to pay for the prevention scheme. The last observation may prompt one to conclude that 'education to have a positive influence on the WTP decisions the amount of payment involved needs to be higher'.

Ownership of land and oxen are believed to be important agricultural assets in the rural Ethiopia. It is common to observe those owning only one of these physical assets to enter into a certain form of arrangement with those having the other asset. For instance, farmers who do not have any plot of land can lease, rent or enter into share cropping practices if they own oxen. Hence, ownerships of land and oxen are hypothesized to positively influence the WTP decisions through their impacts on the income of agricultural households.

Since individual farmers are observed to differ in the size of land holdings and number of oxen they own, WTP responses are cross tabulated against these latter variables. However, the results obtained failed to clearly confirm to the proposed hypotheses. According to the study, there is no clear indication that the amount households are willing to pay for an insecticide-impregnated bed net increases with the increase in land size and number of oxen they own. Rather close examinations of the results obtained seem to reveal that WTP responses are showing generally a decreasing trend at the lower WTP interval and an increasing trend at medium and higher WTP amount when land size and number of oxen are increasing (Figures 4.2 and 4.3).

Generally, two major conclusions can be drawn from the above analysis. First, the majority of the respondents (55 – 83%) are willing to pay in the range of Birr 5 to 50 for a bed net. Secondly, large land holdings and owning many oxen have a positive influence on WTP decisions if only the amount of payment involved is higher.

Figure 4.2: WTP responses vs land size

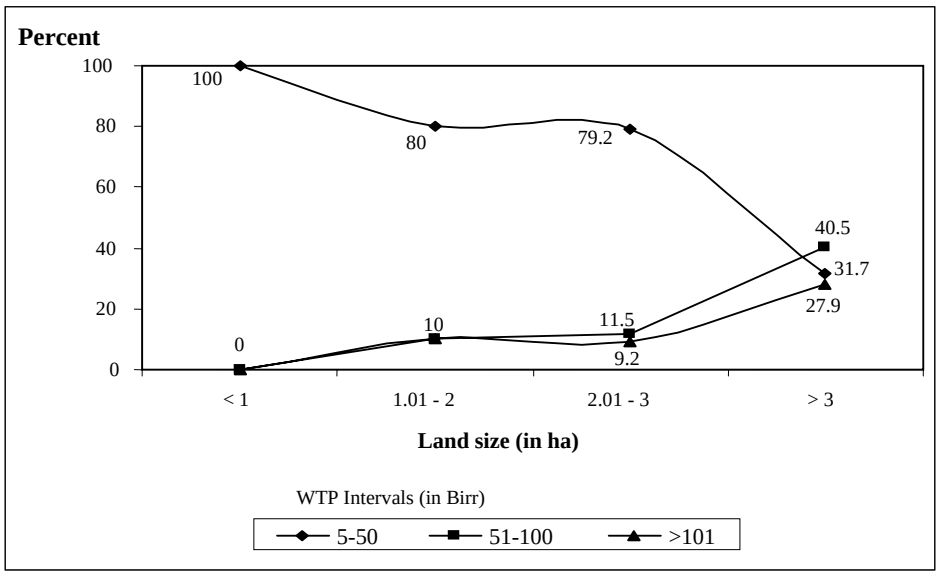
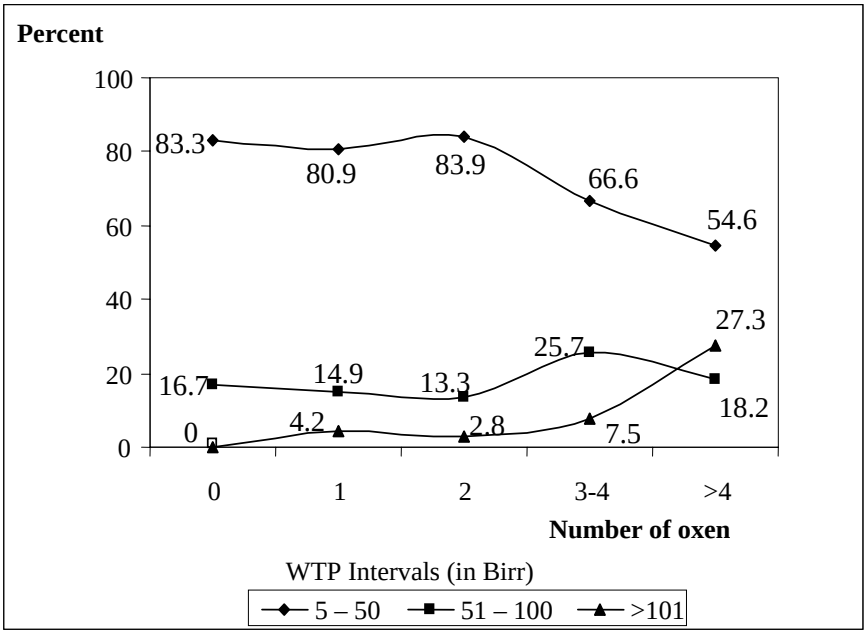


Figure 4.3: WTP responses vs number of oxen owned



Cross tabulation of WTP responses with family size has also produced mixed results: a negative relationship at the lower level of payment and a positive association at medium and higher payment levels. While the former is in perfect agreement with the proposed hypothesis, the latter is not. That is, except at the lower level of payment (Birr 5 – 50), the larger the family size the higher is the households' willingness to pay higher amounts for a bed net (Table 4.10). This result could probably show the larger marginal contribution of family size on income of the household compared to its effect in increasing the total expenditure of the household. In this regard, one could argue that large family size provides more agricultural labour force, which of course is the basis for intensive and extensive farming practices, that would likely result in higher household income.

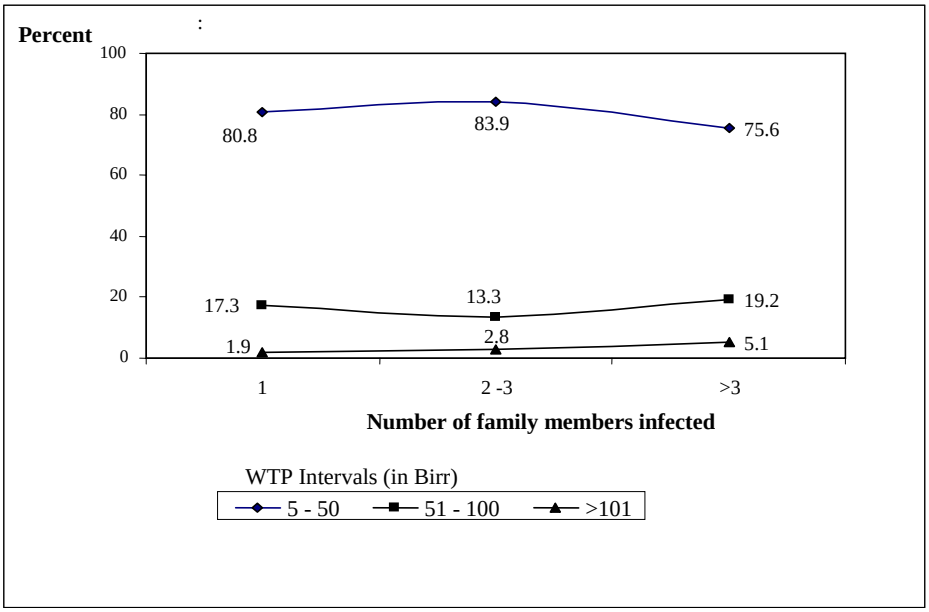
However, it may be reasonable to accept the negative association as it is the one depicted by the majority of the cases. Because for the vast majority (81 – 87%) of the respondents under each category who prefer to pay only Birr 5 – 50 for a single bed net, the proportion of WTP responses decreases with the increase in the family size.

Table 4.10: Willingness to pay by family size

Willingness to pay interval	1-2		3-5		>5	
	No	%	No	%	No	%
5 – 50	7	87. 5	91	81.3	137	80.6
51 – 100	1	12.5	17	15.2	26	15.3
>101	0	0	4	3.5	7	4.1
Total	**8**	**100**	**112**	**100**	**170**	**100**

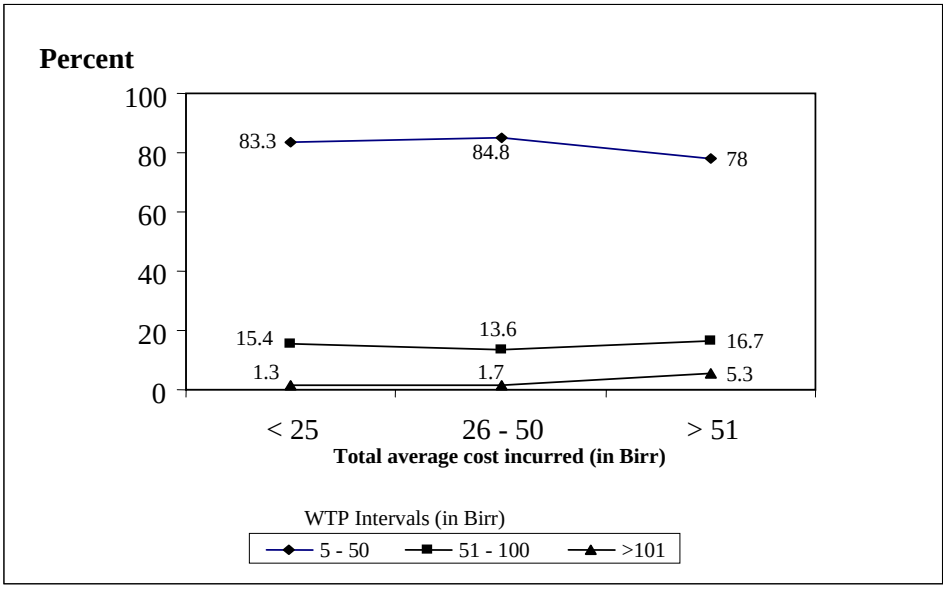
Finally, cross tabulation seems to depict positive associations, though not consistently, between WTP amounts and two related variables: the number of family members infected by malaria, and the associated expenditure on malaria prevention, treatment and other expenses. Except at the lower level of payment (Birr 5 – 50), which more than 75% of the respondents are willing to pay, WTP decisions are observed to vary directly with both the number of malaria infected family members and the total average cost incurred due to malaria infection (Figures 4.4 and 4.5). For instance, the larger the number of family members infected with malaria the higher is the proportion of households willing to pay more than Birr 101 for a bed net. The same relationship is also observed between WTP responses and the average amount of money expended on malaria prevention, treatment and other associated costs.

Figure 4.4: WTP responses vs number of malaria infected family members



All the above relationships depicted by cross tabulation would be further examined and elaborate discussions would be made how significantly the explanatory variables affect the WTP decisions using regression analysis.

Figure 4.5: WTP responses vs total average cost incurred due to malaria infection



4.2. Regression results

As stated in the introduction, identifying the determinants of households' willingness to pay for insecticide-impregnated bed nets is one of the objectives of this study. For such an exercise the multivariate analysis is usually employed for the quality of information it provides. In a contingent valuation method (CVM) that attempts to elicit how much individuals or households are willing to pay, the ordinary least square (OLS) method could be used when the number of non affirmative responses to the participation question is few. For the study since only 12 households, out of the 300 sample households covered by the survey, responded "no" to the WTP question, the OLS method could therefore qualify and hence is used for the estimation. Moreover the correlation between all explanatory variables was checked against a bivarate correlation matrix of the SPSS econometric package. Thus there is a positive correlation between number of infected family members and total economic cost of

malaria as depicted by Pearson correlation coefficient test, which is found to be o.407. This confirms that the higher the number of family members infected by malaria the higher is the cost incurred.

After checking that there is no heteroscdasticity[5] problem in the data set the linear model

$$MWTP = \beta_O + \beta_1 SXHH + \beta_2 AHH + \beta_3 EDUHH + \beta_4 FSZH + \beta_5 SZLOH + \beta_6 NOXOH + \beta_7 INCH + \beta_8 NMIMH + \beta_9 TCMH + U$$

is regressed using OLS and the estimation results indicated in Table 4.11 are generated.

The result revealed that income of the household is the most dominant factor in positively influencing the willingness to pay decisions. This is in perfect conformity with economic theory that postulates income to be one of the positive determinants of demand for goods and services. In addition, the cross tabulation of these variables had also generated the same result.

Table 4.11: OLS estimation results

Variables	Coefficients	Standard Error	t-ratio	Significance Level
Constant	32.302	5.410	5.970	.000
SXHH	-1.214	2.947	-.412	.681
AHH	-.222	.081	-2.751	.006
EDUHH	-7.457	2.674	-2.788	.006
FSZH	-1.506	.574	-2.624	.009
SZLOH	1.256	1.281	.980	.328
NOXOH	4.281	1.418	3.020	.003
INCH	9.716	.000	5.123	.000
SZMIMH	1.669	.530	3.148	.002
TCMH	4.404	.002	2.227	.027
Adjusted R^2 = .240		Standard error of the estimate = 18.5983		
F-value = 10.562		Number of observation = 274		

[5] A standard econometric test for the equality of variances; i.e., a method of testing whether or not the variances between the actual sample values and the sample mean are remaining constant between observations.

The other important factor found to determine willingness to pay is ownership of oxen. Oxen are one of the important assets to the rural households in determining their well being. Households with more oxen could cultivate more plots of land by renting, leasing or sharecropping in addition to their own plots. Farmers owning more oxen could also generate more income by renting them to other households. Hence, the positive coefficient indicates that the higher the number of oxen owned the greater is the willingness to pay for bed nets. As opposed to the ambiguous cross tabulation results obtained earlier, the regression analysis indicates a statistically significant association between the maximum willingness to pay amounts and ownership of oxen.

The regression result further revealed that those households whose family members are suffering from malaria infection are highly willing to purchase insecticide-impregnated bed nets. The higher the number of malaria ill family members the larger is the households' willingness to pay for a measure that help reduce the malaria infection incidence.

The household expenditure on malaria prevention, treatment and other associated costs, referred to as total cost of malaria to rural households, is another important explanatory variable included in the model. Theoretically households with higher expenditure for the prevention and treatment of any disease are expected to have a greater willingness to pay for any intervention that could reduce or totally abandon the burden inflicted by the disease. The result of the regression confirmed the above expectation. Total cost incurred by households due to malaria is found to be a statistically significant factor positively influencing the WTP decisions.

It has to be recalled that mixed results were obtained earlier by cross tabulating the above two variables (the number of malaria infected family members and the associated economic cost) against WTP amounts. The regression analysis has now provided a statistical justification that it is the positive relationships that are governing the associations between the variables under consideration.

On the other hand, the model estimation revealed that WTP amounts have negative and significant associations with three explanatory variables: age and education level of the household head and family size of the household. Note also that similar results were also obtained by cross tabulation of these variables with WTP amounts.

The negative coefficient for age depicts that younger household heads have more preference for modern means of health care goods and services than older

household heads. Hence, the amount the household is willing to pay for a bed net may fall with the increase in the age of the family head.

Better education is generally assumed to create more awareness for health and hence a positive relationship was expected to exist between educational level of the household head and the willingness to pay for bed nets. But contrary to the expected relationship, the coefficient of education is found to be negative and significant, indicating a decline in the WTP amounts with education level. No valid theoretical explanation could be suggested for such an outcome other than suspecting strategic bias on the parts of respondents. It may not be wrong to assume that the power to link the present with the future increases with an increase in the level of education. If this is the case, relatively more educated household heads might have suspected their willingness to pay responses to influence the future price of bed nets and therefore deliberately quoted lower willingness to pay amounts.

The other variable with a negative coefficient is the family size of the household. The statistically significant and negative coefficient of this variable shows the decline in the maximum willingness to pay amounts as the number of family members increases. Actually this result confirms with the hypothesized relationship. Other things remaining constant, consumption expenditure is expected to be inevitably higher in households with large family size. Therefore, due to higher household expenditure on the one hand and the increased amount of bed nets that might be needed for the whole household members on the other, the amount such households would be willing to pay for a bed net is likely to be lower.

Finally, contrary to the proposed hypotheses, sex of the household head and size of land holdings are turned out to be statistically insignificant determinants of the WTP decisions.

Women household heads were expected to be highly cautious for the health of their family. It was also assumed that women would be the one who devote much of their time and energy in taking care of the family members that have fallen ill. From these the assumption that 'women react more actively to any intervention directed towards the prevention and treatment of malaria' followed. Accordingly, their willingness to pay for bed nets was hypothesized to be greater than that of men household heads. Nevertheless, the coefficient for the sex of the household head is found to be negative and insignificant, implying that gender has no significant role in influencing the amount of money households would be spending on the purchase of bed nets. It

has to be noted that the slight difference observed between the responses of male and female household heads as depicted by the cross tabulation (Table 4.7) is proved to be insignificant.

As a proxy measure of the wealth of rural households, though the size of land holdings is expected to produce a positive impact on the WTP decisions, the regression analysis failed to support the assertion. Other things remaining the same, the size of land a household owns is observed to have no effect at all on the amount it is willing to pay for mosquito bed nets. The regression analysis result has, therefore, invalidated the dominantly opposite relationship generated by cross tabulating WTP amounts with the size of land holdings. This means that the association observed between the two variables (Figure 4.2) is statistically insignificant.

Summing up, all the explanatory variables, except sex of the household head and size of land holdings, are found to be statistically significant factors having sound relationships with the maximum willingness to pay amounts.

5. Summary and policy implications

5.1. Summary

Health is both a capital and consumption good. As capital good it contributes to economic development since labour is one of the most important factors of production. As consumption good it provides satisfaction by reducing suffering from ill health.

Malaria is a communicable disease that threatens the health and lives of millions around the world. In Ethiopia about two third of the country's population and 75 percent of the area of the country are at risk of malaria. It is the second largest killer disease that affects about 4 to 5 million people annually. The rural households are more vulnerable to malaria because they are the ones who severely suffer from lack of access to health services, low income and socio-cultural factors.

The fact that malaria is a health problem posed on the nation as a whole necessitates a concerted action from the government and the public alike in designing and implementing appropriate prevention and control schemes. Accordingly, this study

has attempted not only to estimate the willingness to pay for insecticide-impregnated bed-net but also to identify the factors that determine the amount rural households are willingness to pay for it.

Thus, the survey has estimated the mean willingness to pay for an insecticide-impregnated bed net to be Birr 44.26 if paid in cash and Birr 65.05 if provided on credit basis. Viewed in terms of the willingness to pay intervals, it was observed that 81 percent of the respondents were willing to pay up to Birr 50 for a medium sized rectangular bed net. Households willing to pay between Birr 51 to 100 constituted 15.2 percent and those who would be willing to pay more than Birr 101 accounted for only 3.7 percent. All in all about 97% of the respondents have shown willingness to pay for insecticide-impregnated bed nets. As to the number of bed nets households would be willing to buy, the respondents indicated that they would buy one if sold in cash and two if supplied on credit.

An attempt has been made to identify the factors that might influence the willingness to pay decisions through cross tabulation and multivariate statistical technique, specifically using ordinary least squares method.

Hence, number of oxen owned, mean annual income, number of malaria infected family members and total cost incurred for the prevention and treatment of malaria are found to have a positive influence on the maximum willingness to pay amounts. On the other hand, age and educational level of the household head and family size of the household have opposite influence on the willingness to pay decisions. Except the level of education of the household head, the results obtained for the other two variables conform to the theoretical expectations. Furthermore, contrary to the hypothesized relationships, sex of the household head and size of land holdings are found to have no impact at all on the maximum willing to pay amounts.

5.2. Policy implications

The last objective of the study is to indicate some policy implications that could assist in decision making. To this end, the following policy implications can be extracted from the results of study.

a) In addition to the environmental sanitation endeavour, the use of insecticide-impregnated bed nets is one of the best and easiest methods of malaria prevention and control measures. Despite this fact, the great majority of the

households surveyed (97%) reported that they had no prior information about an insecticide-impregnated bed net and its role in preventing mosquito bites. This, therefore, is an indication of the massive work that should be done in community mobilization (through awareness creation and health education at the grass root level, for instance) on the one hand, and the emphasis to be placed on the preventive measures in order to control the rapid spread of the disease, on the other.

These require, among others, not only mobilizing the existing human, material and financial resources deployed in the area, but also allocating more financial resources and recruiting and training additional manpower. In this regard, the Ministry of Health is expected to design appropriate national strategies that help mobilize the required finance and coordinate and direct the activities of all those involved in the sector.

b) Among the various explanatory variables income is found to be the most important determinant of the willingness to pay for insecticide-impregnated bed nets. This was confirmed both by the descriptive and multivariate statistical analyses. Moreover, various statistical sources indicate that the mean annual income of the Ethiopian population as a whole is one of the lowest in the world.

The implication of this, therefore, is that the willingness to pay for bed nets is highly constrained mainly by the low income of the society. Hence, the majority of the rural households in Ethiopia can not afford to purchase insecticide-impregnated bed nets at the current market price, which is between Birr 100 to 130 for medium sized rectangular bed net. It should be noted that on the average the maximum amount the surveyed households were willing to pay for a bed net is only Birr 44.26.

c) The wide gap between the market price of insecticide-impregnated bed net and the maximum willingness to pay amount could be significantly narrowed down if the 62% combined tax rate (World Bank et al, 1992) levied on mosquito nets is completely lifted. If the government introduces a special cost sharing arrangement or provides a special tax incentive that promotes domestic production of insecticide-impregnated bed nets, the market price is likely to fall to the amount the society affords to pay. This in turn is expected to produce a positive impact on the extensive use of mosquito bed nets, which could be a

major achievement in the endeavour being made to halt the rapid expansion of malaria infection in the country.

d) The need for impregnation every six months, which is part of the effective utilization of mosquito nets, implies the necessity of providing special orientation to the rural households regarding the need for treating the nets with insecticide and the precaution to be taken. It should also be noted that this could be an additional factor that further constrains the purchase of bed nets under the current price level.

Finally, as this is a case study the results obtained could not be used to make generalization about the whole country regarding the issues raised relating to the WTP decisions. The study, therefore, recommends an extensive research to be conducted on sample areas that would represent the whole country. Such a study not only estimates the willingness to pay for insecticide-impregnated bed nets but also may generate substantial information that could be used as an input in the decisions to be taken regarding the prevention and control of the deadly disease, malaria.

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Technical Efficiency of Selected Public Hospitals in Ethiopia[1]

Getachew Abebe[2]

Abstract

The paper primarily attempts to investigate the level of efficiency at which public hospitals are operating in Ethiopia by taking eight sample hospitals from selected regions of the country. The study employs both descriptive and regression analyses. While the former method mainly focuses on the description of the sample hospitals' major characteristics and the relationships among them, the latter one tries to measure technical efficiency by conducting production frontier analyses on two major health care service areas: outpatient and inpatient services. The major variables included in the production frontier function are the labour time of the technical staff (that consists of physicians, nurses, health assistants, laboratory and X-ray technicians, and pharmacists), the labour time of the administrative and support staff, and values attached to depreciation and supply of drugs.

The preliminary tests undergone reveal that some degree of inefficiencies are observed in the provision of outpatient services of three hospitals and inpatient services of only one hospital. According to the production frontier result, the outpatient visits in the efficiently operating hospitals tend to increase with the increase in the labour input of the technical staff and decrease with that of the non-technical staff. But in the inefficiently operating hospitals, the activities of both the technical and non-technical staff are seen to produce a positive impact on the outpatient visits. On the other hand, the values attached to depreciation and costs of drugs are found to strongly and directly affect the production process of only two of the efficiently operating health care providing units and one of the inefficient ones. The inadequate remuneration provided to the technical staff is the main cause for the inefficiency of the outpatient services.

With regards to the inpatient services, the activities of the technical staff and depreciation and drug costs are found to positively contribute to the number of inpatient days in the majority of efficiently functioning hospitals. But the production of inpatient health care in the only inefficient hospital is highly and negatively affected by the labour time of the non-technical staff.

It can thus be suggested that improving the number and quality of the professional health staff and upgrading the physical and technical capabilities of hospitals increases the efficiency with which they are producing health care services. It would also be necessary to take further policy measures in order to reduce the burden of public hospitals and improve the quality of health care services in the country.

[1] The final version of this article was submitted in January 2006.
[2] Ministry of Finance and Economic Development.

1. Introduction

1.1. Background

Rapid economic development is the key factor for the improvement of health care systems and that expenditure on the health sector is determined largely by other sectors. Growth in the health sector also affects the performance of the rest of the economy. Health and economic development are therefore interdependent means that reinforce each other. As a healthy labour force is a prerequisite for a successful economy, the wealth created by the rest of the economy may be partly earmarked so that the health sector would expand to reinforce other sectors. However, due to low level of income at the household level and concentration of the available health facilities at the urban areas the majority of the population in developing countries has limited access to modern health facilities. This problem is compounded with poor transport system and unaffordable price for the large proportion of the population, albeit the service provided may not be dubbed sufficiently acceptable (Barnum & Kutzin, 1993).

Hospitals as recognizable institutions appeared at different times in different places, reflecting existing social and, particularly, religious context. History recorded the first hospital to be in the Byzantine Empire in the fifth and sixth centuries AD. Hospitals in Western Europe emerged later starting in the monasteries, a bequest reflected by many of present day European hospitals (Mckee & Healy, 2000).

History tells us Ethiopians have been mainly benefiting from traditional health care system comprising both empirical-rational and magical religious elements. A huge set of remedies using traditional plants and medicines made up of animals, inoculation, thermal and holy water, minor surgeries have been serving the people as the integral element of the health care system of the country in terms of both the prevention and cure of diseases (Pankhurst,1965a).

According to Pankhurst though Ethiopia's long standing trade relationship with the outside world goes back to Axumite civilization , its contact to modern medicine may be attributed to the reign of Emperor Libne Dingel (1508-1540) with the arrival of the Portuguese mission. Since then modern health care was being spread by other several Europeans: travelers, missionaries, and members of diplomatic community. Historical records further show that successive rulers of Ethiopia have introduced modern medical care primarily for the benefit of themselves and for the well-being of

their families. The Minilik era is recorded as the most important landmark for the expansion of better medical care.

Emperor Minilik had deep interest in modern medical care and other scientific innovations. It is further indicated that while he had good relationship with Italy, he had several Italians engaged in the provision of the modern medical care for himself and his family. However the Italo-Ethiopian War (1885-1889) disrupted the service and was soon replaced by the Russian Red Cross Mission, which is still running one the large hospitals in Addis Ababa. The era had also witnessed the inauguration of modern vaccination, clinics and other health care facilities. It is also recorded that the nucleus of the current Ministry of Health was founded in 1908 under the then Ministry of Interior (Pankhurst, 1965b).

Up to the end of the Imperial era (mid 1974) there were 65 government-owned hospitals with staff members of 377 physicians, 573 nurses, 350 x-ray and laboratory technicians and 1,398 other employees. The distribution of health facilities, particularly that of hospitals, had been very uneven. They were concentrated in the major urban areas where only 10 percent of the total population used to live (CSA, 1978).

Following the downfall of the Dergue regime, measures aimed at implementing the principles of free-market economy have been taken by the government. The new policies instituted allowed the private sector to take part in various economic activities while the role of the government is limited to the areas where the private sector is less willing to involve. Since the private sector is investing only in the areas where it can reap immediate returns, it would not be strange to observe its reluctance to engage in the expansion of the health sector as envisaged. For instance, in the past decade the construction of private hospitals is limited to merely 9 (8 in Addis Ababa and 1 in Mekele), indicating low participation in the major part of health investment by the private sector (EIA, 2000).

Currently available data indicate that the total number of hospitals in the country is 110, of which 72.7% are under the Ministry of Health while 11.8, 8.2 and 7.3 % are owned by the OGA (e.g. teaching hospitals), the private sector, and NGOs, respectively. All these hospitals are endowed with 10,736 beds, 1,366 physicians, 7,723 nurses and 7,386 health assistants, 1,050 lab technicians, 920 environmental health workers, 513 pharmacy technicians, 296 health officers, and 4,379 other health workers. The health system of Ethiopia is also supported by 382 health

centers, 2,393 health stations, 1,023 health posts, and 1,170 privately owned clinics of various types. Moreover, 311 pharmacies, 249 drug shops and 1,917 rural drug vendors are operating throughout the nation (MOH, 2000).

Due to various reasons (including limited physical access of the population to health facilities and shortage of health professionals) the total outpatient utilization of government health facilities is, on the average, limited to 0.25 visits per person per year. Studies have found that only 10 percent of people reporting illness certainly received treatment for their conditions from any government or privately owned health facilities. The utilization level of health care providing units by rural population is restricted to 9.5% while that of urban population is 14 % (MOH, 1998).

The health service coverage is estimated to be 48.5%, and this coverage would vary if the coverage of individual programs is examined (MEDaC, 1999). For instance, under EPI program about 47% of children are estimated to have obtained DPT3 immunizations in 1995 while the proportion of pregnant women immunized for tetanus is estimated to be over 30%. The percentage of births attended by trained health personnel is 10% while antenatal coverage is about 30%. All these indicate that the utilization level of health facilities is still at its low level compared to the Sub-Saharan Africa average.

The access of a household to health care providing units is determined by a number of factors: income of the household, quality of the service being provided, age, religion, proximity to health facilities, individuals' perception about specific health care providing units, availability of drugs, and the lifestyle pursued (Folland, et al ,1993).

As health services form part of the basic social needs of a society, health care providing units are not only essential for a society's welfare but also play a major role in the growth of an economy. However, the health status of Ethiopia is among the least in the world. The spread of communicable diseases and poor nutrition are the leading outcomes of poor housing and environmental conditions almost in all parts of the country. Not only shortage of health facilities but also underutilization of the existing health care providing units (arising from many factors including long distance from clinics in remote rural areas, low income, etc) is part of the cause for the miserable state of health in Ethiopia (MOH, 1998).

A study by Abdulhamid (2000) noted that only half of the total population has access to modern medical care services. It is also further indicated that under normal

circumstance, 20 percent of the total population needs curative modern medical care. Thus, establishing health care units would be essential to raise the level and promotion of good health, where both the preventive and curative services are important. The objective of public health policy is, therefore, not only limited to the promotion of good health but also it may have political features by which interested groups would be more sympathetic to certain segment of society.

Assuming that all the health care providing units are offering the appropriate services for which they are established and the health personnel are discharging their duties to the maximum capacity possible, one can then embark on measuring the technical efficiency of health care providing units.

As public hospitals are the main health care providing units in the health system of the country, their share in terms of skilled labour (70.1%) and government budget is very significant. A study of 25 developing countries (including Ethiopia) confirmed that 50 – 80 percent of the public sector health resources are being used in hospitals (Barnum and Kutzin, 1993). It is, therefore, no surprise for this study to limit itself to measuring the technical efficiency of some representative public hospitals selected from the three largest regions of the country and Addis Ababa.

1.2. Problems, significance and objectives of the study

The theory of economic efficiency is pertinent to both the demand and supply side of the health sector. During evaluating economic efficiency, one requires that the rate (and type) of output be "optimal". Economic efficiency in demand is related to efficiency in supply through prices. The optimal rate of output appears when the marginal benefit of the last unit equals the price of that unit. Several reasons are given why economic efficiency does not occur on the demand side. For instance, the lack of full information about prices, quality of the physician, the diagnosis process, and the treatment needs makes possible for physicians to manipulate patient demands for medical services (Feldstein, 1999).

With regard to the supply side of the medical care sector, the criterion of economic efficiency is equally important. Generally, the elasticity of any industry's supply is affected by the industry's market structure and the nature of the production function for producing its services. Thus, if the various markets within the health care sector are not economically efficient, the cost of health care would be higher than it should be.

By scrutinizing the reasons for the variations from economic efficiency point of view, one can make policy recommendations to upgrade the efficiency of the market and cut the rise in the cost of health care. For instance, the economic efficiency of the supply side of the health sector could have important implications for redistributive policies. If the supply side of the medical care were relatively price inelastic, needing relatively large price increases to produce an increase in health care, it would affect the type of redistribution programs suggested on the demand side. It could in particular affect the considerations that should be given to the relatively disadvantaged group of population. Higher price inelasticity, on the other hand, would benefit the health care providers: the higher the price rises the higher would be the wages and incomes of medical service providers. The rise in prices would of course be financed by the rest of the population, which eventually would have lower incomes.

However, as non-profit institutions, public hospitals have been criticized for providing health care to the public with little consideration of the parallel market prices for the equivalent services. In such a case, it is likely a big potential for technical inefficiency to exist since the operations of public hospitals are at variance with the basic assumptions of perfectly competitive markets, where the most appropriate allocation of resources is assumed.

In the effort being made to improve efficiency through the influence of market forces, cost sharing is one of the mechanisms gaining momentum. However, this mechanism is being criticized as having a tendency of excluding the bottom poor. Though the measurement of efficiency is a multidimensional matter, the concern of this study is limited only to examining the technical efficiency of public hospitals with major health interventions. Hence, those hospitals which are assumed to have been providing significant health care services are included in the sample with the aim of clearly examining and indicating the possibility for better resource allocation in the health sector of the country.

Measurement of technical efficiency being its overall objective, the paper more specifically tries to identify the inputs and outputs that contribute most to the low performances of inefficiently operating public hospitals, and also attempts to draw appropriate conclusions.

2. Theoretical and empirical perspectives

2.1. General background

Due to the strong need for protecting the public health using the resources available, it would not be surprising if the concerns of governments are focused on issues related to the sources of finance for health services, the ability of the public sector and the efficiency of health services delivery (WHO, 1990). The magnitude of expenditures on health services, constituting 5 percent of the gross domestic product (GDP) and 5 to 10 percent of the government expenditures in developing countries, might justify these concerns (Akin et al., 1987). The 1999/00 data for Ethiopia, for instance, indicate that the expenditure on the health sector accounts for only 1.15 percent of the GDP, implying the need for raising the level of expenditure to the extent that guarantees an improved health status for each citizen (MEDaC, 1999).

a) The relevance of hospital economics

The high costs involved and the relatively considerable amounts of resources being used to provide health care services make essential the closer investigation of the operation of hospitals.

During the 1980s hospitals in developing countries tended to be overlooked as the focus of policymakers was almost exclusively on activities related to primary health care, whose coverage was limited to the community level (Barnum and Kutzin, 1993). It is only a recent phenomenon to observe rising interest to look into public resources allocated to hospitals. To this effect, the case studies done by Barnum and Kutzin (1993) have contributed a lot in enriching hospital economics in developing countries.

There is greater desire in dealing with the costs of operating hospitals amid indications of widespread wastage within the health sector. According to WHO (1989) estimate, wastage accounts for as much as 40 percent of the available health resources in the America's. This would probably imply a developing country like Ethiopia to have a higher level of wastage in terms of utilizing the available resources. In such circumstances, the resources that could be derived from the efficiency gains may be considerably high because of the level of resources employed in the large scale hospital operations. For instance, a study conducted in Malawi (Creese, 1990) estimated that simple management correction of inefficient practices could save 44 percent of the nation's major hospital non- personal recurrent costs.

b) The role of hospitals in the health system

Lack of integration of hospitals into the primary health care (PHC) system resulted in overcrowding of outpatient services, mainly making referral systems nonfunctioning. The imbalance in human resource allocation among facilities and at different levels of the health care system is another problem area. While it resulted in underutilization of nurses in tertiary hospitals, on the contrary maternal and child health (MCH) nurses in rural health centers failed to meet immunization targets because of overload of work. Due to misallocation of capital budgets it is not also very strange to find underutilized or inoperable high technology equipment in hospitals while health centers lack basic laboratory or diagnostic equipment (Van Lergeghe and Lafort, 1991 and WHO, 1987).

The WHO (1992) assessment of the role of hospitals in the health care system identified the following reasons for the problems observed:

- Attitude toward elitism of hospitals desiring to maintain the status quo and refusing to participate in the PHC approach.
- Negative reactions on the part of non-hospital elements toward the dominance of hospitals in the health system.
- Because hospitals compete with PHC health services for scarce health resources they are viewed as opponents rather than allies.
- Hospitals perform critical functions in the health system that should complement rather than compete with PHC services.
- Hospitals, with their significant level of human, physical and financial resources, have often continued to operate independently of the other elements of the health system.
- The absence of clearly delineated and defined roles and responsibilities results in a fragmented system with widespread disparities in financial and human resources between hospitals and primary health care facilities.

WHO's assessment has also listed the following as main problems hindering the operations of hospitals:

- patients overcrowding in the wards
- long waiting queues in outpatient clinics
- questionable quality of care
- shortages of basic pharmaceuticals and medical supplies
- lack of or inoperable diagnostic and treatment equipment
- low staff morale
- untidy and decaying facilities.

According to the same document, the causes for the above problems of hospitals are:

- lack of a clearly defined role and relationship to other parts of the health system
- organizational weaknesses
- lack of responsiveness to the service needs of the population and communities
- management deficiencies including poor planning and monitoring.

All these problems are directly or indirectly related to the availability and use of resources by hospitals. Experience indicates that there is considerable scope for improving the resource management practices of the hospital sector.

2.2. Resource allocation, management and generation in the hospital sector

The resource issues common to hospitals in developing countries may be analyzed under three major topics: resource allocation, resource management and resource (revenue) generation.

2.2.1. Resource allocation to hospitals

The distribution of resources to hospitals within the health sector, as well as the allocation among hospitals (e.g., zonal hospitals), geographic regions, and population groups served must be examined in light of cost effectiveness and equity concerns to ensure that the objectives of society and the health system are best served.

The allocation issues are at two levels. Primarily, the system level allocation deals with the allocation of health resources to hospitals relative to other areas of the health sector, and involves making choices among alternative means of providing health services. For instance, decision-makers at national level determine the proportions of government health resources that go to hospitals and PHC facilities. Secondly, the institutional level allocation is concerned with resource allocations between hospitals. Decisions are made (usually at national level) regarding the portion of total hospital resources that go to secondary versus tertiary level facilities, the per capita allocation to hospitals in Region A compared to Region B, urban versus rural hospital resources, or between specialized and referral hospitals.

For resource allocation purposes concepts revolving around production and cost functions are very important. A production function depicts the relationship between an output and various inputs by specifically indicating how inputs are combined in order to produce a given level of output. It also shows the productivity of each input. For instance, Feldestein (1999) has attempted to demonstrate the production function of British hospitals by taking output as weighted mix and inputs comprising hospital beds, medical supplies, nursing and housekeeping.

On the other hand, a cost function represents the relationship between costs of hospitals and their output levels. It also helps to establish the relationship between hospital costs and size, or economies of scale. As in any other production sector, the economies of scale in the health sector can take three forms: constant, increasing and decreasing returns to scale.

2.2.2. Resource management by hospitals

Poor management of hospital resources could imply the existence of low level of health services or outputs achieved with far fewer resources. This in turn may imply the need for measuring the efficiency at which hospitals are performing. However, issues pertaining to efficiency in the health sector may not have similar interpretations among scholars as the concept of health is very complex. It is obvious that the type of care needed determines the level of expenditure. Thus, a patient with a complex health problem is likely to require high level of care that entails a relatively high level of per unit expenditure. It is, therefore, evident that a higher unit cost does not necessarily imply inefficiency or wastage of resources since the degree of sickness of a patient determines the level of resources required.

Though the measurement of efficiency in a particular hospital is a dubious issue as mentioned above, the comparison of the efficiency levels of various hospitals is relatively less controversial since it involves comparing ratios. That is, in the comparison of different efficiency levels the input used and the output produced need not necessarily be similar. Consequently, this clearly avoids the measurement problems arising from the complexity of health status.

There are three types of production efficiencies: technical, economic and scale efficiencies (Coelli, 2000).

Technical efficiency

Technical efficiency in the hospital sector refers to the input mixes that produce a given level of output. In other words, it is a measure of the level of health services a certain hospital produces with the lowest possible level of input mix. For instance, to produce an inpatient stay (the output), the clinical case could be managed by using several combinations of inputs, such as physician time, nursing care, diagnostic services and hotel services. On the contrary, technical inefficiency is said to exist if, for instance, there are excess prescriptions of drugs to patients, where the drugs may be more than necessary for successfully treating the patient.

Economic efficiency

Economic efficiency relates to identifying the least-cost combination of inputs that produce the desired output level. With this concept two questions may be posed. Given the fixed budget of a hospital, is output (e.g., patient days, admissions, etc) maximized? Or given a fixed quantity of health services to be produced by the hospital, is total cost minimized? The assumption here is that there are various combinations of inputs which could be used to achieve the same qualitative output.

Scale efficiency

Scale efficiency in general indicates whether a system as a whole is providing services at least cost. From a macroeconomic point of view, economies of scale are important not only for planning the size and number of hospitals in a country but also for planning in individual hospitals since the size of a facility will have an impact on its operating cost and the efficiency that can be achieved in the short- and long-run. In the short-run a hospital's bed capacity and facilities are fixed. This limits the range of input combinations (staff, supplies, equipment, and buildings) that can be used to produce the desired output, which in turn limits the efficiency the hospital can achieve in the term.

Scale efficiencies can be achieved mainly by increasing size through spreading large fixed costs over a large number of patients and by enhancing greater degree of specialization among staff and departments which ultimately result in divisibility of functions.

Finally, it can be concluded that the problems prevailing in the hospital sector can be solved and its resources utilized efficiently and effectively if the following main issues are properly addressed (Feldstein, 1999):

a) Defining the role of hospitals:

Clear demarcation of the roles of the different elements of the overall health system will facilitate a way for changes that improve the allocation of the health sector resources. It is therefore important to address the issue of the role of hospitals if there is a need for planning rationally regarding the proper number, type and size of hospitals and allocate the appropriate human, physical and financial resources for their operation.

b) *Improving information about hospitals:*
For the improvement of the hospital sector the following broad categories of information are needed on the hospitals:
- resource allocations
- income and expenditure pattern
- recurrent and capital costs
- behaviour relative to allocation and payment systems
- performance relative to type of ownership (public, private not-for-profit, private-for-profit)

c) *Developing hospital performance indicators:*
For proper assessment of the performance of hospitals, it would be essential to develop appropriate performance indicators that may include**:**
- community, population and services measures
- cost and revenue measures
- quantity or output measures
- quality measure
- inpatient and outpatient case mix measures

d) *Enhancing hospital management capacity:*
Undertaking the actions outlined above would necessitate the need for skilled hospital managers with broad managerial skills necessary to plan, implement, monitor and evaluate the utilization of hospitals' resources. Planners at macro level must also have the necessary skills in hospital management in order to analyze and address the financing and operational issues facing hospitals.

2.2.3. Resource generation in hospitals

For its proper provision of health services, the hospital sector undoubtedly needs additional resources. Health insurance, user charges and community financing of

hospital services are the most commonly proposed options for generating additional funds. The design of such systems must balance the revenue raising objective against the distributional issues of access to and equity in the use of hospital services (Jack, 1999).

But for developing counties user fees and insurance may be the best options to generate revenues for the provision of hospital services. However, the proportion of revenues raised by public hospitals from user fees may not be sufficient enough to cover their operating costs, usually falling short by 10 percent (Mills, 1990). In addition, concerns pertaining to the issues of equity of access and utilization of hospital services are usually raised when such a scheme is introduced. These, therefore, call for the need to employ financing policies not only to generate additional resources but to realize simultaneously the efficiency, equity and revenue objectives. Furthermore, examining the problems facing hospitals in a developing country like Ethiopia requires not only looking at the expenditures of hospitals but also assessing the underlying policy and management practices that are likely to affect these trends.

Finally, in order to assess the allocation of resources in the health sector, relevant information relating to type of facilities, level of services and geographic location are required to determine the budget and level of expenditure. In addition, the health status and dispersion of the population and difficult topography may be considered as important factors in determining the level of allocation. However, so far there is no as such a suitable mechanism designed for allocating health resources in developing nations, though some developed countries (e.g., the UK) are claiming to have developed such formulas (Newbrander, 1987). It can thus be concluded that a detailed research must be conducted in order to develop appropriate methods by which health resources can be allocated based on the existing situation and national priorities.

3. Methodology

3.1. Method of analysis and data sources

This study has employed analytical method and for this a stochastic frontier production function approach is applied to estimate firm level technical efficiencies of the sample hospitals for the provision of outpatient and inpatient services.

Hospital level technical inefficiency obtained from the first stage maximum likelihood estimation (MLE) method is considered as dependent variable in the second stage regression analysis while the payment allocated to the two types of labour (i.e. technical and non-technical) is considered as independent variable.

The estimation of the frontier production function has been performed using frontier version 4.1 software developed by Coelli (1994).

Depending on the availability of data the paper has employed different techniques for measuring the level of efficiency of selected public hospitals in Ethiopia. For this purpose eight sample hospitals are selected from the three largest regions of the country (Amhara, Oromiya and SNNP) and from the capital city Addis Ababa. Those hospitals that are assumed to provide significant health care services in selected health programs are included in the sample. In addition, various sets of secondary sources (e.g., MOH, 2000 and CSA, 1999) have also been utilized. Whenever there is information gap different tools (e.g., similar cases of a developing country) have been considered so as to make the estimation process acceptable in the court of academics. Furthermore, in order to corroborate the existing data professional discussions with pertinent medical directors and researchers working in the health sector have also been held.

The following are basic assumptions pertaining to the sample health care units and the data collected thereof.

a) The sampling is fundamentally purposive because the intention is basically to measure the cost-effectiveness of a program intervention in a health care providing unit.
b) To estimate the labour time spent on the provision of health care by medical staff and other supporting personnel, the average daily outpatient visit is assumed to be the output of the health care providing unit.
c) The outpatient visits and inpatient services are assumed to be interchangeable so that aggregating various outputs of the hospital would not be unworkable.
d) As there are no explicit standards regarding the sizes of hospitals, it would not be far from reality if differences in the productivity of hospitals are measured based on the same types of inputs and outputs.
e) Even though there is difficulty of measuring the contribution of capital goods (e.g., buildings), which considerably affect the outcome of the essential parameters, for the purpose of this study the life-span of a building is assumed to be 30 years.

f) As drugs are the major components in the provision of health care, it is important to take them as major inputs for providing health care in the individual hospitals.
g) Excluding exceptional activities in certain areas of health care, it is presumed that there is a reasonable degree of substitution between various types of labour so that the outcome would be the same on the health status of a patient.
h) The explanatory variables involved in the production of health care are assumed to be time invariant since the data used are cross-sectional (i.e., cross-sectional data gathered at some particular time from N health care units).
i) Similar technology is assumed to be in place and access to it is assumed to be non problematic.

3.2. Conceptual and measurement problems

Various studies discuss alternative measures of inputs productivity used in the Eastern Europe, such as the productivity for socially necessary output, of direct and indirect labour (using input-output matrices for labour coefficients) and that of embodied labour (Silver, 1984).

The measurement of output and labour input are required in the computation of labour productivity indices. However, the measurement of both seems to be problematic. Though output can most easily be measured by counting the physical units produced of a narrowly defined good, comparing goods produced by different firms may not be easy, owning to quality differences. This might particularly be a problem when comparing the productivity of a service industry (ibid). For instance, comparison of health care services produced by different hospitals across the nation may be difficult since the quality of the health care services is likely to be affected by the type of labour (professional and non-professional), equipment, drugs, etc. devoted to them.

On the other hand, measuring inputs is equally problematic particularly when they are heterogeneous (for instance, in terms of such factors as level of education, age, sex, and type of employment, full- or part-time). In such a case, using appropriate weights would be essential to sum up labour inputs. There is also the question of whether to compute productivity per employee, per production worker, per hour paid, per hour actually paid, or per actually worked (ibid).

Theoretically, one can find a productivity index for a single good and form aggregates for various sectors using weights. However, in the real world one could obtain a productivity index by dividing aggregate output figures to input figures. Unfortunately, output and input indices are usually aggregated separately using different weights.

The estimation of total productivity is envisaged to require the aggregation of outputs produced by similar set of inputs. One approach is first to estimate a production function and find the distance of individual firms (e.g., health care units) from the regression line. One can then derive an index relating actual productivity to estimated productivity. The average regression line fitted, therefore, represents the average level of inefficiency (Figure 3.1)[1]. A practical drawback in this case is the difficulty one would face when comparing firms using different input patterns, particularly when the pattern of the inputs are correlated with the average inefficiencies in use.

Figure 3.1: Estimation of the average regression line

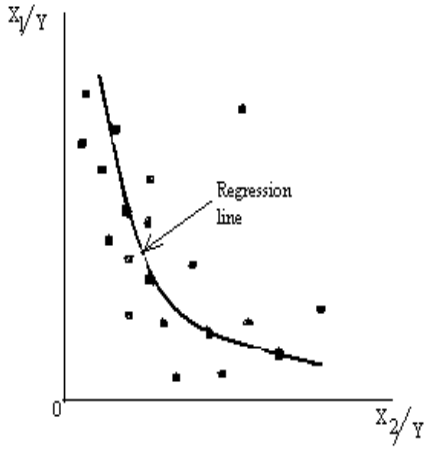
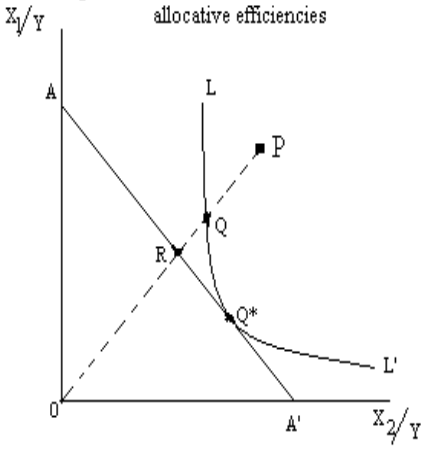


Figure 3.2: Measurements of technical and allocative efficiencies



It is argued that as the production function is defined as the maximum possible quantity of output obtained from a given set of inputs, the traditional regression estimates are observed not to fit in this definition because (a) the regression line in

[1] In Figures 3.1, the ratios x_1/Y *and* x_2/Y represent the proportions of the two inputs used in the production of a single output Y, implying the relative prices of the inputs; and the heavy dots denote the level of production of the various firms (health units in our case).

essence measures the mean output rather than the maximum one, and (b) the regression estimates have either positive or negative residuals (Schmidt, 1986). This is basically the failure of standard statistical techniques in explaining the maximum output attained from a given set of inputs. As a way out, Schmidt proposed to qualify the production function as 'frontier' production function.

An alternative means developed by Farrell (1957) was to use two to six boundary observations to define the frontier, and on the assumption that these are efficient firms, to compare other firms to the boundary ones. For this method to work there is a need to set a standard for the firms in question (i.e., health care units) based on which the level of efficiency can be measured without much difficulty.

The estimation of the frontier can be done using linear programming techniques. The method helps one to separate technical inefficiency from allocative inefficiency. The former is measured by the relative distance of a firm from the efficiency frontier, as measured along a ray of current input proportions frontier. Whereas, apparent differences in factor prices paid by firms reflect differences in allocative efficiency. The measurements of inefficiencies would then be followed by hypotheses testing about the sources of inefficiencies. The assumption of constant returns to scale and errors that arise in the measurement of extreme frontier observation are the two major practical limitation and statistical problem of this method, respectively.

To alleviate the statistical problem Aigner, Lovell and Schmidt (1977) developed a statistical approach that has allowed researchers to distinguish between two types of disturbances: the usual normally distributed measurement error and the one-sided inefficiency disturbance (since firms can not be more efficient than the frontier). This actually provides a frontier with identified statistical properties. Moreover, the frontier technique developed by Farrell has an advantage over conventional methods in that it does not specify *a priory* a functional form for the frontier.

The above original ideas of Farrell can be illustrated using two-space diagrams and the associated measures of efficiencies derived in the paragraphs to follow.

Let the isoquant LL' denote the constant level of the single output Y produced by a firm using two inputs x_1 and x_2 (under the assumption of constant returns to scale). Consider four levels of inputs, lying on and off the isoquant. While the points on the isoquant denote the efficient utilization of the inputs, the points lying off the isoquant (R and P) represent the firm's inefficient utilization of the two inputs. Such inefficiency

levels of the firm can be measured by using rays emanating from the origin. Assume, for instance, the points lying off the isoquant are along the ray emanating from the origin (Figure 3.2). Thus, for point P, the distance QP represents the amount of the inefficiency level that could be reduced. In other words, the technical efficiency level could be measured by the ratio:

$$TE_I = \frac{OQ}{OP}$$
$$= 1 - \frac{QP}{OP}$$

Furthermore, if there is information about the price ratio, the allocative efficiency (also known as price efficiency) of the firm operating at point P is measured by the ratio:

$$AE_I = \frac{OR}{OQ}.$$

Note that at the point where the isoquant is tangent to the line depicting the price ratio (i.e., at point Q*) production is both technically and allocatively efficient. Whereas, at point Q production is technically efficient but allocatively inefficient. Hence, the distance RQ denotes the reduction in production costs that would occur if production were to take place at Q* than at Q.

The overall economic efficiency, therefore, is defined as the product of the technical and allocative efficiencies:

$$EE_I = TE_I * AE_I$$
$$= \frac{OQ}{OP} * \frac{OR}{OQ}$$
$$= \frac{OR}{OP}$$

The above exposition has dwelt on an input-oriented measure of technical efficiency in which the basic question is: how much should quantities of inputs be proportionally reduced without reducing the level of output? Alternatively, the output-oriented measure raises a counter question: by how much should output be proportionally

expanded leaving inputs unchanged? For the purpose of comparison, the latter approach is also illustrated below.

In terms of output-oriented efficiency measures, Farrell defines the distance AB in Figure 3.3 as representing technically inefficiency level of production because point A indicates that all the available resources are not efficiently utilized to attain the maximum possible level of output denoted by the production frontier ZZ'. Thus, the distance AB implies the amount by which output could be increased without requiring extra inputs. The measures of output-oriented technical efficiency would then be:

$$TE_0 = \frac{OA}{OB}.$$

If the price of the output were known, one could draw the isorevenue line DD' and define the allocative efficiency as:

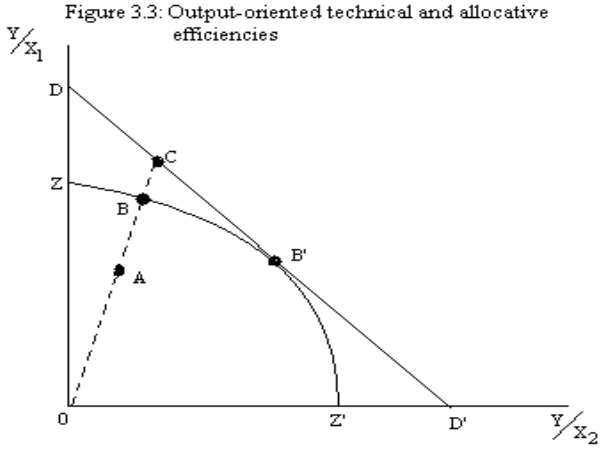
$$AE_0 = \frac{OB}{OC}.$$

Note that this has a revenue increasing interpretation similar to that of cost reducing under input-oriented measure of allocative efficiency. Finally, one may also define the overall economic efficiency as the product of the two measures as:

$$\begin{aligned} EE_0 &= TE_0 * AE_0 \\ &= \frac{OA}{OB} * \frac{OB}{OC} \\ &= \frac{OA}{OC} \end{aligned}$$

In summary, in the exposition of Farrell's proposition one may note that all the efficiency measures (input- and output-oriented) use a ray drawn from the origin to the observed production point. Furthermore, in all cases it is assumed that the relative proportions of inputs (outputs) are constant. This method is advantageous over other methods as it is unit invariant.

Figure 3.3: Output-oriented technical and allocative efficiencies



In light of the above detailed exposition, the basic concern of this paper is examining the efficiency level of government owned hospitals. As health care producing units, since all their inputs and outputs may not be easily measurable, comparative performance evaluation becomes an essential element of managerial control function. And the performance of such service producing units may be measured against time or by comparing them with other similar facilities in the same sector (Chang, 1998).

In this regard, comparative efficiency assessment of how well inputs are utilized to produce health care services becomes an important tool in measuring the performance of a given health care providing unit (ibid). Moreover, since public hospitals are the major health care providers in several countries including Ethiopia, the issue whether the health care units are sufficiently efficient is a major concern. As the efficiency with which state owned sector resources are utilized has also been considered as an engine of a developing economy, understanding the operations of public owned hospitals becomes a pertinent issue in checking whether the economy is progressing on the right track. In addition, as the efficient performance of hospitals may also be associated with other organizational and environmental factors, it would be useful for hospitals to identify and evaluate those factors that influence efficiency.

For evaluating the efficiency level of an economic entity many methods are stated in the literature, such as R*atio Analysis*, *Ordinary Least Square Regression Analysis, Data Envelopment Analysis, Frontier Production Function Approach,* and *Non-Frontier Efficiency Models.* It should, however, be noted that the choice from among

these approaches depends on the objective of the study, availability and type of data, characteristics related to technology, etc.

3.3 Model Specification: Frontier Production Function Approach

Assuming that hospitals are producing only one type of output (i.e., health care) by combining a number of inputs, a mathematical model that is presumed to capture the interactions taking place in the production process and which can be used to empirically estimate the contribution of each input in the delivery of hospital services can be derived as follows.

Health output (OH_i) is defined as the set containing outpatient visits (Q_i) and inpatient days (ID_i),

$$HO_i = f(Q_i, ID_i) \qquad (3.1)$$

Since these variables themselves are the functions of a number of inputs, the health output can be rewritten as a function of these inputs, namely, the labour time spent by different professionals and administrative staff, the budget allocated to drugs available, the number of beds for inpatients, and the depreciation rate of capital goods of the health care providing units. Mathematically,

$$HO_i = F(G_i, N_i, XT_i, LT_i, HA_i, R_i, OT_i, DR_i, B_i, BC_i) \qquad (3.2)$$

where $i = 1,2,3,.....,n$ (the number of health care units)

G_i = time spent by the general practitioners of health care unit i

N_i = time spent by nurses of health care unit i

XT_i = time spent by X-ray technicians of health care unit i

LT_i = time spent by laboratory technician of health care unit i

HA_i = time spent by health assistants of health care unit i

R_i = labour time spent by the registrar of health care unit i

OT_i = labour time spent by other staff of health care unit i

DR_i = budget allocated to drugs for the i_{th} health care unit

B_i = number of beds for the i_{th} health care unit

BC_i = value attached to the depreciation of the i_{th} health care unit capital goods

As health care provision is believed to be the outcome of team work, one may then justifiably argue that the labour time spent by professional and administrative staff of a health care unit is the best available option to measure the productivity of their respective contributions in the process of health care production.

In order to measure the technical efficiency of hospitals under scrutiny, a stochastic frontier production function of the Cobb-Douglas production type is defined as:

$$Y_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + V_i - U_i \qquad (3.3)$$

where Y_i = the natural logarithm of output form the i_{th} health care unit, which is assumed to be non-negative

X_i = the natural logarithm of inputs form the i_{th} health care unit, which is assumed to be non-negative and time invariant

V_i = random error term (or statistical noise) representing events that are outside the control of the i_{th} health care unit, and which is assumed to have a two-sided normal distribution and independent of the $U_i's$.[2]

U_i = disturbance term representing the technical inefficiency of the i_{th} health care unit, but which is assumed to have a one-sided distribution. U_i is expected to measure the level of technical inefficiency in terms of the

[2] V_i is a random variable normally distributed with zero mean and constant variance σ_V^2; whereas, U_i has a half-normal distribution with unknown mean μ and variance σ_U^2. These are mathematically denoted as $V_i \sim N(0, \sigma_V^2)$ and $U_i \sim N(\mu, \sigma_U^2)$.

shortfall of output Y_i from its maximum possible value given by the stochastic frontier function.

However, in order to avoid the problem of micro-numerousity one may classify labour time into two: the labour time of those health professionals (i.e, physicians, nurses, laboratory technicians, etc.) who are directly involved in the delivery of health care services, and that of the administrative staff having supplementary role in the production process. Moreover, the values attached to depreciation and drugs can also be considered as "other" inputs.

Then, based on these simplified representations the functional relationship between the health output and the associated inputs depicted by equation (3.3) may be modified as:

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 S_i + \beta_3 D_i + V_i - U_i \qquad (3.4)$$

where $Y_i, V_i \text{ and } U_i$ are as defined above, and

T_i = time spent by the technical (professional) staff (e.g., physicians, nurses, etc.) of the i_{th} health care unit

S_i = time spent by the support staff of the i_{th} health care unit

D_i = other inputs comprising the values attached to depreciation and drugs of the i_{th} health care unit

Note that since the estimation is based on cross-sectional data the time subscripts can be assumed away for ease of presentation.

The parameters of equation (3.4) may be estimated by applying either the *maximum-likelihood* (ML) method or using a variant of the corrected ordinary least squares (COLS) method. However, since the ML estimator is asymptotically more efficient than that of the COLS, it may be reasonable to use ML estimators in preference to COLS estimators whenever necessary.

In order to use the ML method one needs to derive a new function, known as the *log-likelihood function,* from the random frontier function and express it in terms of the

two variance parameters (i.e., $\sigma_S^2 = \sigma_U^2 + \sigma_V^2$) following Aignor, Lovell and Schmidt's (1977) formulation. And Battese and Corra (1977) also posited the parameter $\gamma = \sigma_U^2 / \sigma_S^2$ mainly because of the advantage it provides in selecting appropriate starting values in the iterative maximization process involved as its value lies between 0 and 1. Then, the ML estimates of β, σ_S^2 and γ are obtained by maximizing the log-likelihood function. These ML estimators are consistent and asymptotically efficient.
Finally, in order to explore the possible causes of inefficient technical situation in each health care unit in terms of interventions made, it would be important to specify the inefficiency model as follows:

$$U_i = \delta_0 + \delta_1 PS_i + \delta_2 AS_i + \omega_i \qquad (3.5)$$

where $U_i =$ inefficiency level for each health care unit

$\delta_0 =$ a constant

$\delta_1 =$ coefficient of salary paid to the professional staff (PS)

$\delta_2 =$ coefficient of salary paid to the non professional (administrative) staff (AS)

$\omega_i =$ the disturbance term that may capture other influencing factors, and which is assumed to be normally distributed with zero mean and constant variance.

4. Findings of the study

4.1. Descriptive analyses

4.1.1. General description

According to the publication of the Ministry of Health (MOH, 2001), there are 110 hospitals, 382 health centers and 2,393 health stations serving over 65 million people. Hence, the eight sampled hospitals constitute 10 percent of the government-owned hospitals suggesting that this would allow one to conduct investigation on the technical efficiency of each hospital, since the data are assumed to be representative of the population (Cochran, 1977).

The data collected have been basically aimed at examining the cost-effectiveness of the major health programs in the country, and the selected hospitals are those in which significant health care services are assumed to have been provided.

The sample hospitals consist of four from Amhara, two from Oromiya, one from Addis Ababa and one from SNNPs regions. The regional distribution of sample hospitals is not uniform since the sampling technique is based on the selection of the health care providing units with major contribution to the public health care in selected health programs.

4.1.2. Profiles of the sample hospitals

The general profiles of the sample hospitals are presented in *Appendices I - III*. This sub-section provides highlights on the major characteristics of the hospitals under consideration.

(a) Composition of the total health staff

The total health staff comprises the technical staff, which is directly involved with the provision of health care services, and the non-technical staff that consists of the administrative and support staff. Under the former group we have specialist doctors, general practitioners (or MDs), nurses, laboratory and X-ray technicians, health assistants and pharmacists. Comparison of the two groups of personnel reveals that, in the majority of the sample hospitals (i.e., except at *Shashemene, Debre Markos* and *Yekatit 12* hospitals) the number of technical staff exceeds that of the non-technical staff (Figure 4.1).

Figure 4.1: Total technical and non-technical staff

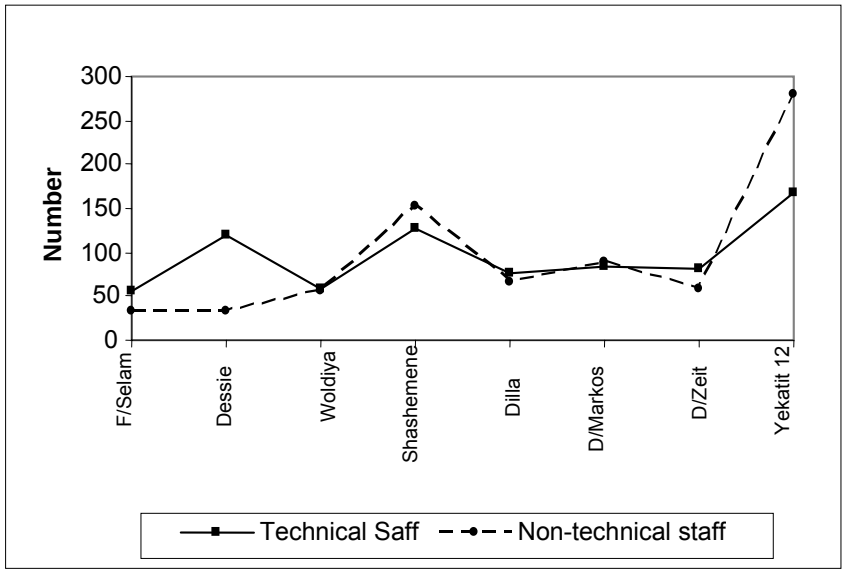
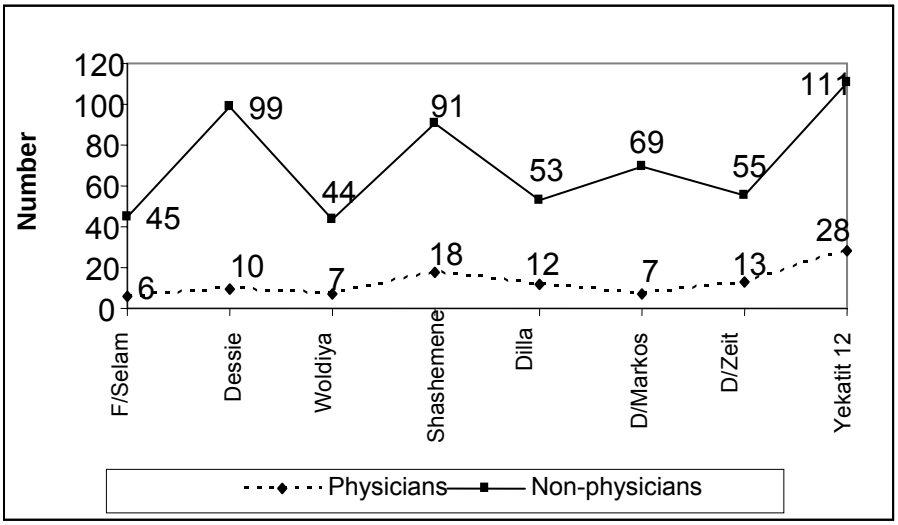


Figure 4.2: Composition of the technical staff

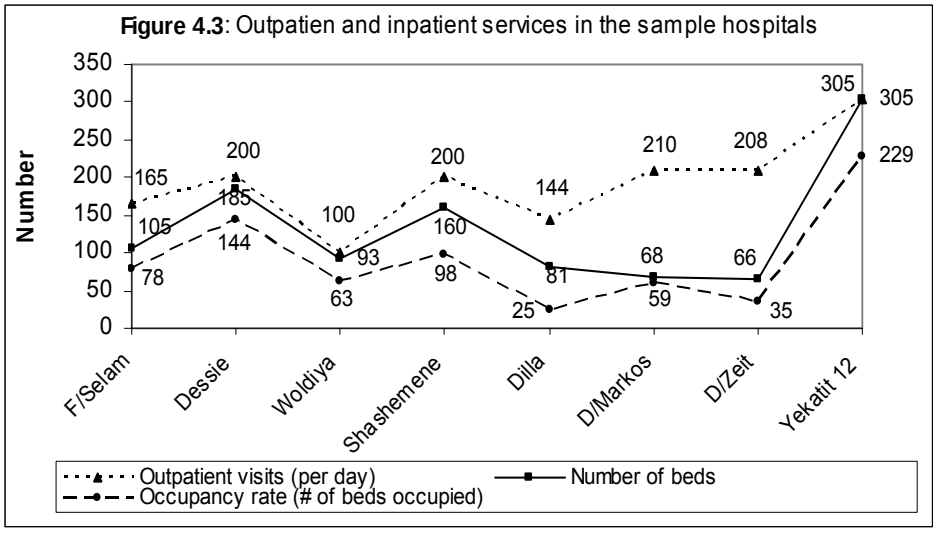


In the majority of the sample hospitals the number of specialist doctors is found to be very few, with the exception of *Yekatit 12* hospital where more than 20 specialists were operating at the time of data collection. With regards to the composition of the technical staff, not only small variation is observed among the sample hospitals but also all these hospitals are staffed with relatively lower number of physicians (MDs and specialist doctors). Except at *Shashemene* and *Yekatit 12* hospitals where there are 18 and 28 physicians, respectively, only 6 – 13 physicians are found in the rest of the sample hospitals (Figure 4.2).

On the other hand, large variations are observed in the number of non-physicians (nurses, laboratory and X-ray technicians, health assistants and pharmacists). While *Dessie, Shashemene* and *Yekatit 12* hospitals are staffed with more than 90 non-physicians, the corresponding figure for the remaining sample hospitals is much lower than this.

(b) Outpatient and inpatient services

The sample hospitals on average serve about 192 outpatients each day. Though variations are observed between the different hospitals, the majority of them provide outpatient services for more than 200 patients per day. It is only *Finote Selam, Woldiya* and *Dilla* hospitals that are found to serve relatively less number of outpatients. As a zonal hospital whose service is not limited to patients from Addis Ababa alone, Yekatit 12 hospital receives on average 305 visitors per day (Figure 4.3).



The sample hospitals also show variations in terms of the number of beds they have, the average being 133 beds. Again with 305 beds, *Yekatit 12* hospital is the largest of all the sample hospitals, followed by *Dessie* (185) and *Shashemene* (105) hospitals. The rest are relatively small hospitals with only 66 – 105 beds. However, despite the much talked scarcity of hospital beds, the inpatient intake of the sample hospitals is observed to be limited only to about an average of 91 inpatients per day. That is, only closer to 66% of the hospital beds on average are occupied each day. *Debre Markos* hospital registers the maximum occupancy rate (87%).

The workload of physicians in the surveyed hospitals and the quality of health care services being provided can be examined in terms of outpatient-, inpatient- and bed-physician ratios. Thus, as Table 4.1 shows a physician in any one sample area can treat on average 18 and 8 outpatients and inpatients per day, respectively. In addition, 11 beds on average are available per each physician in the surveyed hospitals. However, *Dilla*, *Debre Zeit* and *Shashemene* hospitals are observed to have the lowest inpatient-physician ratios which are far below the sample average, signifying that these hospitals have better opportunity to provide quality medical services to their patients as the physicians would have reasonable time to devote to each patient.

Table 4.1: Patients/bed-physician ratios per day

Hospital	(O/P)/Physician	(I/P)/Physician	Bed/Physician
Finote Selam	27.5	13.0	17.5
Dessie	20.0	14.4	18.5
Woldiya	14.3	9.0	13.3
Shashemene	11.1	5.4	8.9
Dilla	12.0	2.1	6.8
Debre Markos	30.0	8.4	9.7
Debre Zeit	16.0	2.7	5.1
Yekatit 12	10.9	8.2	10.9
Average	**17.7**	**7.9**	**11.3**

Note: O/P = Outpatient; I/P = Inpatient; Physician = specialists plus MDs

On the other hand, the outpatient-, inpatient- and bed-physician ratios of the hospitals in Amhara region are relatively higher than those in the other sample areas and the sample average. For instance, the highest ratio observed in the outpatient service unit at *Fintote Selam* hospital may characterize the burden of the health worker in that unit, as a physician in this unit is required to attend as many as 28 outpatients in one day. This may have serious repercussions on individuals' health status. Thus, it would not be unreasonable to conclude that such a large coverage of outpatient services per day can only be attained at the expense of quality service.

The ratios presented above may imply that the medical care services available at any one hospital can be affected mainly by the distribution and quality of the health personnel, the type of diseases prevailing in the area (e.g. malaria in low land areas), the proximity of health facilities and the perception of individual users about a particular health care providing unit.

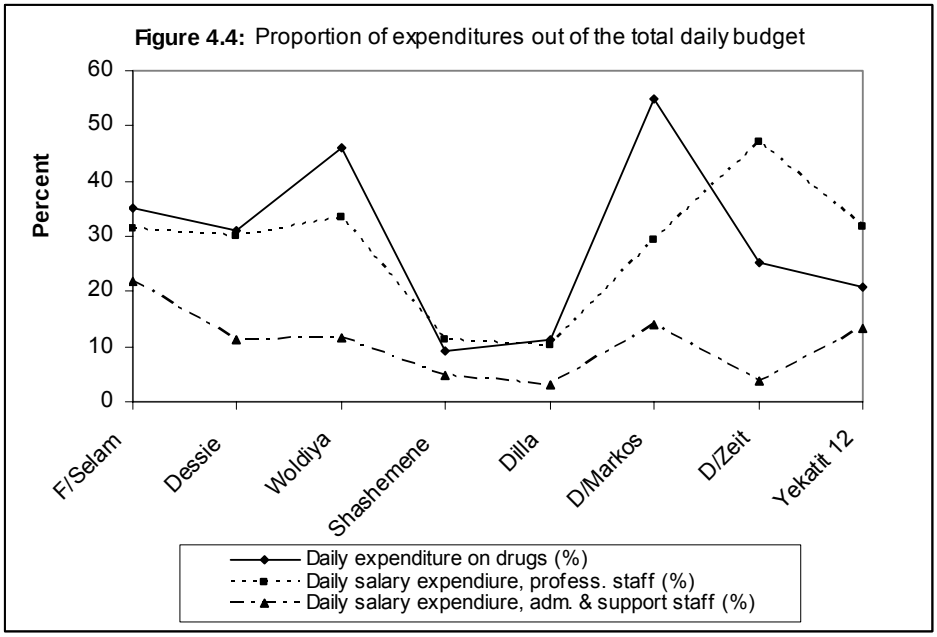
(c) Average daily budget and expenditures

With a daily budget ranging from Birr 13.34 – 20.84 thousand, *Dilla, Yekatit 12* and *Shashemene* hospitals, respectively, are the ones with the highest budget allocated for their daily operations. In contrast, the rest sample hospitals are observed to have very low daily budget (Birr 4 – 8 thousand) (Appendix I). Out of the total daily budget the average proportions allocated for drugs, salary of professional staff and salary of administrative staff are 29, 28 and 11%, respectively.

For the majority of the sample hospitals the daily expenditure on drugs is relatively higher than the amount spent on the salary of the professional health care providers.

In this case, *Debre Zeit* and *Yekatit 12* hospitals are found to be exceptions, where not only the former is much lower than the latter, but also a good proportion of the total daily budget (47 and 32%, respectively) is taken by the salary of the professional staff. However, the share of the salary of the administrative and support staff in the total budget is smaller in all the sample hospitals (Figure 4.4).

Figure 4.4: Proportion of expenditures out of the total daily budget



(d) Time spent by total health staff on outpatient and inpatient services

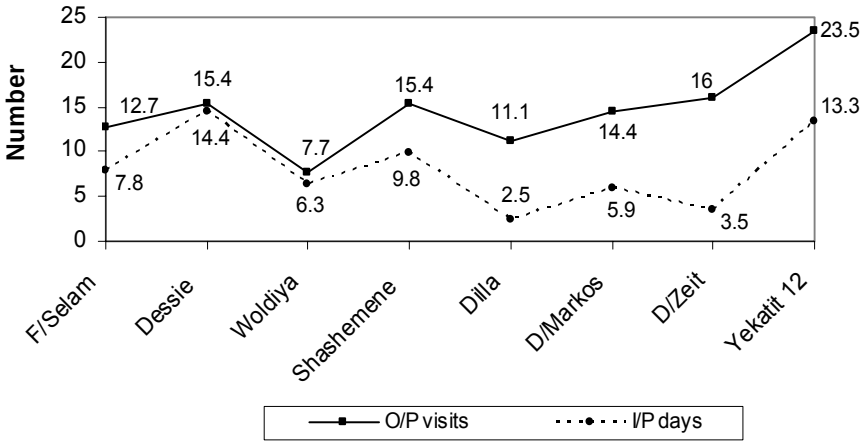
The contributions made by each health staff on the delivery of health care services is analyzed based on some selected intervention areas. Hence, by considering the most prevalent types of diseases common to all the sample hospitals*, 13 and 10 intervention areas were identified for outpatient and inpatient services, respectively. And based on these outpatient and inpatient services, the mean number of outpatient

* *Such diseases may include acute upper respiratory infections, eye infections, tuberculosis of respiratory system, bacillary dysentery, other infective and parasitic diseases, and injuries from external causes, gastric and duodenal complications, pneumonia, sexually transmitted diseases, and other genitor-urinary diseases.*

visits and inpatient days and the average time spent by each of the technical and non-technical staff on each patient is computed (Appendices II and III).

Accordingly, viewed in terms of the selected intervention areas, all the health care institutions under consideration provide health care services on average to nearly 15 outpatients each day and an inpatient on average stays for about 8 days in a hospital. Considering each sample hospital, it can be observed that *Woldiya* and *Yekatit 12* hospitals register the minimum and maximum mean number of outpatients, respectively. On the other hand, while an inpatient stayed in *Dessie* hospital for about 14 days on average at the time of the survey, the mean number of inpatient days for *Dilla* and *Debre Zeit* hospitals ranged between 2 to 4 days (Figure 4.5).

Figure 4.5: Mean number of outpatient visits and inpatient days

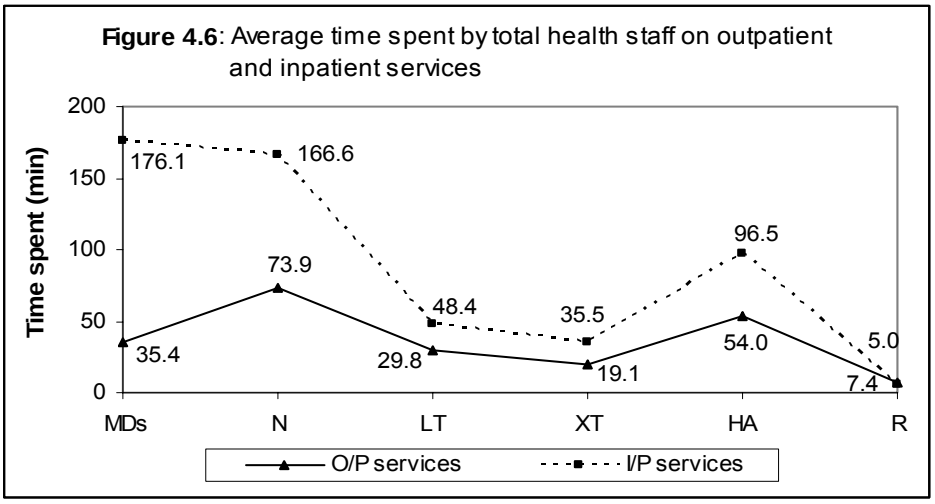


The survey also revealed that the time spent by individual health staff varies depending on the types of interventions made on outpatient and inpatient services. Based on the selected outpatient and inpatient service areas (13 and 10 respectively), all the medical staff are observed to devote much of their time to inpatient services as compared to outpatient services (Figure 4.6*). Hence, the average time spent by the technical staff on inpatient services is observed to extend from about half an hour to 3 hours. In contrast, outpatients receive a time that spans on average between 19 minutes and an hour and a quarter. In both cases, the labour

* In Figure 4.6, MDs denote time spent by general practitioners (medical doctors), N by nurses, LT by laboratory technicians, XT by X-ray technicians, HA by health assistants, and R by the registrar.

time spent by the registrar office is found to be the minimum of all with an average value of less than 8 minutes.

Figure 4.6: Average time spent by total health staff on outpatient and inpatient services



However, the contributions made, in terms of the time spent per each intervention, by the different technical health staff are observed to vary significantly between the sample hospitals and the types of services provided. Consequently, the maximum time spent for the outpatient services is registered by nurses with an average time of about 74 minutes per each intervention, followed by health assistants (54 minutes) and medical doctors (35 minutes). Laboratory and X-ray technicians also contribute closer to 30 and 20 minutes, respectively, on average on each intervention area.

With regards to the inpatient services, general practitioner doctors are observed to have spent a maximum of 2.9 hours on average on each of the ten intervention areas. The next highest time is registered by nurses and health assistants (2.8 and 1.6 hours respectively). For the provision of the selected inpatient services laboratory and X-ray technicians are also found to devote on average more than half an hour.

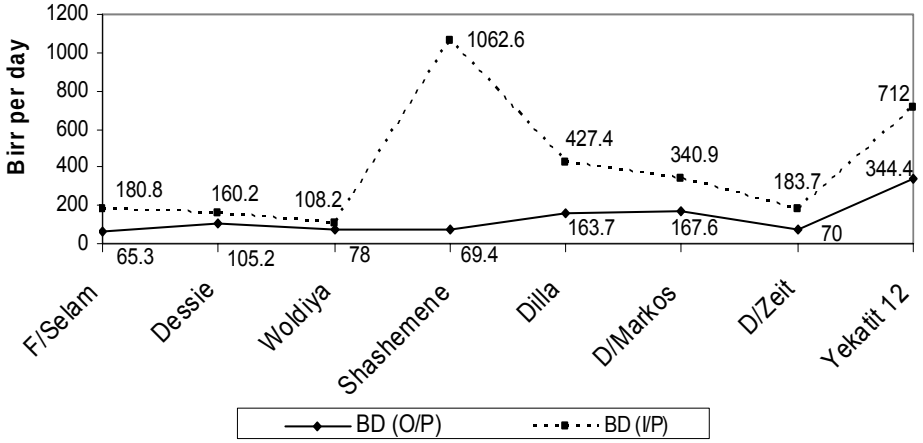
(e) Values attributed to depreciation and drug supplies

The nonlabour contribution to the provision of the selected health care services for outpatients and inpatients is expressed in terms of the expenditures attached to the depreciation of the equipment and infrastructure of the sample hospitals under consideration and the values of drugs supplied by them. Accordingly, viewing across

all the sample hospitals, one observes that the mean values attributed to depreciation and drug supplies associated with the inpatient services are higher than that of the outpatient services (Figure 4.7). In other words, the daily average expenditure on depreciation and drugs required for the provision of the outpatient services is almost one-third of that for inpatient services, with average expenditure of Birr 133 against Birr 397 per day.

Comparison of the sample hospitals reveals that, with daily expenditure of closer to Birr 1,063 on its inpatient services, *Shashemene* hospital registers the highest depreciation and drug values, followed by *Yekatit 12* and *Dilla* hospitals that expend about Birr 712 and 427 per day, respectively. Since the percentage share of the daily expenditure on drugs in *Shashemene* hospital is lower than the entire sample hospitals (Figure 4.4), such higher value might be due to higher depreciation values of its equipments and infrastructure. On the other hand, there seems to be relatively small variations in the values attributed to depreciation and drugs for the provision of the outpatient services in the majority of the sample hospitals. With a mean expenditure of Birr 344 per day, *Yekatit 12* hospital stands out from among the sample institutions. All the rest expend on average between Birr 65 and 168 on daily basis.

Figure 4.7: Comparison of values attached to depreciation and drug supplies



BD denotes values of depreciation and drug supplies associated with outpatient (O/P) and inpatient (I/P) services.

(f) Relationships between outpatient visits and other factors

Table 4.2 clearly exhibits the relationships existing between outpatient visits and factors related to proximity of facilities, types of medical services (in- and out-referrals) and income levels of the patients. Accordingly, consistent with *a priori* theoretical expectations, proximity to the major urban areas is found to have bigger impact on the utilization of health care units. In this regard, the negative correlation coefficient between outpatient visits and distance from Addis Ababa indicates that the further away a health care unit from Addis Ababa the lesser would be the outpatient visits. The large population in bigger urban areas is believed to increase the probability of making a visit to a health facility.

Table 4.2: Relationships between outpatient visits & other factors

Item	Correlation coefficient (r)
Outpatient visit vs distance from Addis Ababa	-0.8521
Outpatient visit vs in-referrals	0.2965
Outpatient visit vs out-referrals	-0.1206
Outpatient visit vs absolute poverty level	-0.4490
Outpatient visit vs relative poverty level	-0.3374

On the other hand, there seems to be negative associations between absolute and relative poverty levels of patients and outpatient visits. Nevertheless, the low level of correlation coefficients suggests that there are other factors than these that play important roles in the outpatient visits. Moreover, the low positive and negative correlations between outpatient visits and in-referral and out-referral services, respectively, further reinforce the significant role of other factors than those discussed here which predominantly affect outpatient services. A case in point could be the number of health personnel.

Table 4.3 exhibits the associations between outpatient visits and the various health care practitioners in the sample hospitals. The results obtained reveal that the availability of health personnel plays an important role in providing the required health care services in a sufficient manner. As demonstrated for individual segment of labour in the table, the highest correlation coefficient is registered between the number of outpatient visits and physicians (82%), indicating that the higher the number of medical doctors in a hospital the larger would be the number of outpatient visits. The coefficient between health assistants and outpatient visits is the second highest (73.8%), followed by fairly strong relationship between the number of nurses and outpatient visits (66.8%).

Table 4.3: Correlations between outpatient visits and health personnel in the sample hospitals

No	Item	Correlation coefficient (r)
1	Medical Doctor vs outpatient visits	0.8201
2	Nurses vs outpatient visits	0.6679
3	Lab.& X-ray technicians vs outpatient visits	0.5180
4	Health assistants vs outpatient visits	0.7375
5	THP* (= 1+2+3+4) vs outpatients visits	0.8591
6	Administrative staff vs outpatient visits	0.7229
7	THS** (= 5+6) vs outpatient visits	0.8405

*Note: *THP = Total number of Health Personnel*
***THS = Total number of Health Staff*

The table further demonstrates a stronger relationship between the number of outpatient visits and the total number of health care personnel than between that of administrative staff, signifying the central role being played by the professional health care workers compared to the non-technical staff. This would in general imply the need for appropriate allocation of health personnel, particularly the skilled ones, in order to enable hospitals extend their services efficiently and in the standard required.

4.2. Production Frontier Results

A production function is a mathematical statement that establishes a technological relationship between the maximum amount of output that can be produced and a given set of inputs. For the case at hand, a production function for hospital services indicates the maximum level of outpatient/inpatient services that can be produced from a given set of inputs (physician, drugs, etc.).

It should be noted that not all hospitals produce the maximum output possible from a given set of inputs due to various reasons. For instance, various hospitals have different level of technological capacity that would make the output level different. Some may enjoy economies of scale depending on the number of outpatient visits to their service providing units. Thus, it would be hardly surprising to observe higher level of output in hospitals with higher technological capacity. Therefore, in order to avoid complications in measuring the technical efficiency of various service providing units it is necessary to assume homogenous level of technology in all the sample hospitals.

It is also important to remember that production efficiency is attained at that level of output where it becomes impossible to redistribute inputs to produce more of one product without reducing the output of another product. In other words, if the output of one product increases at the expense of another one, then such allocation of inputs is said to be inefficient.

In order to measure the technical efficiency of individual hospitals, different approaches may be employed. Microeconomic theory explains that the maximum output from a given set of inputs may be expressed by the level of technical efficiency. Hence, to measure the level of technical efficiency of a certain hospital in terms of the interventions made one may need to identify the types of interventions in order to examine the contribution of each input to the production process. The production process, which is the outcome of a mix of inputs, can be expressed in terms of the services delivered to visitors of health care units. And the health care services provided by a hospital may be divided into two parts: outpatient services and inpatient days. The differentiation between the two is basically dependent on the burden of the disease on an individual patient. The severity of the illness may determine whether an individual patient be provided with closer care (admitted as an inpatient) or considered as an outpatient.

4.2.1.Outpatient visits

(a) Preliminary Tests

In order to determine the existence of technical inefficiency, we need to test whether the production function is appropriately represented either by OLS estimate or by frontier analysis. This can be done by testing the null hypothesis $H_0 : \mu = \gamma = 0$ which states that the term denoting the technical inefficiency (U_i) has both zero mean and variance, implying the absence of technical inefficiency in the hospitals under investigation, against the alternative hypothesis $H_1 : \mu \neq \gamma \neq 0$ which asserts the existence of technical inefficiency.

Table 4.4 indicates that the OLS and ML estimates of the log-likelihood function show significant differences for only three of the sample hospitals, namely *Dessie, Dilla* and *Debre Markos* hospitals. That is, for these three hospitals the null hypothesis is rejected at 5% level of significance and the alternative hypothesis, that there exists technical inefficiency, is accepted. This would also mean that there is some degree of technical inefficiency in the provision of outpatient services by these three hospitals.

Put differently, all interventions made by the three hospitals have been proved to suffer from technical inefficiency problems.

It has to be noted that rejecting the null hypothesis for the three hospitals would equally mean accepting the alternative hypothesis, which in a way is stating that the production functions of these hospitals are best represented by ML estimates than OLS estimates. By the same token, OLS is found to be the best method of estimation for the remaining five sample hospitals performing without showing any significant level of inefficiency. The level of efficiency of these hospitals may be explained either by the high number of visits frequented by people being served or by less amount of resources allocated to provide the health care services.

Table 4.4: Hypothesis testing for parameters on deciding the existence of inefficiency in the delivery of outpatient services

Name of Hospital	Log-likelihood		χ^2_{cal}**	$\chi^2_{2,0.95}$
	OLS $(H_0 : \mu = \gamma = 0)$	MLE $(H_1 : \mu \neq \gamma \neq 0)$		
Finote Selam	17.23	19.33	4.19	5.99
Dessie	1.43	6.03	*9.22	5.99
Woldiya	8.83	9.83	2.02	5.99
Shashemene	25.52	26.38	1.72	5.99
Dilla	-38.18	-33.18	*10.00	5.99
Debre Markos	11.54	16.19	*9.30	5.99
Debre Zeit	10.40	11.61	2.42	5.99
Yekatit	24.76	26.41	3.30	5.99

Note: The degree of freedom for the χ^2 test is 2, denoting the number of restrictions

* Significant at 5 percent level of significance

** $LR = -2\left[L(H_0) - L(H_1)\right]$

(b) Production Frontier Analyses

Using equation *(3.4)* * production frontier estimation has been conducted for each hospital in order to investigate the contribution of each factor included in the model. It

* $Y_i = \beta_0 + \beta_1 T_i + \beta_2 S_i + \beta_3 D_i + V_i - U_i$ where Y_i is output (outpatient visits, in this case), T_i time spent by the technical (professional) staff, S_i time spent by the support staff, D_i values attached to depreciation and drugs, V_i error term, U_i technical inefficiency, and i denoting the i_{th} health care unit.

may be necessary to indicate at the outset that (a) strangely enough the estimated autonomous parameter (β_0) may have less theoretical plausibility since it seems a bit unclear compared to other estimated parameters; and (b) the estimated parameters for health workers, non technical staff, and the depreciation and drug costs associated with the health provision entail different explanations since the degree of influence on delivering the services depends on the individual characteristics of the inputs. The following two sub-topics provide the analyses of the regression results presented in Table 4.5.

(b.1) Technically efficient hospitals

As indicated by the preliminary tests five sample hospitals (*Finote Selam, Woldiya, Shashemene, Debre Zeit and Yekatit 12*) have been found to operate without significant level of inefficiency. For all these hospitals the coefficient estimate of the variable denoting the time spent by technical health staff β_1 (comprising physicians, nurses, health assistants, laboratory and x-ray technicians, and pharmacists) is found to be statistically significant at 5 percent level of significance. In addition, the positive magnitude of this parameter signifies the direct contribution of the health professionals' labour to the delivery of the outpatient services.

For instance, the parameter β_1 for Finote Selam hospital is found to be 0.822, indicating that the responsiveness of outpatient visits for a percentage increase in the labour of the technicians would be less than one percent. This means, other things remaining the same, an increase in the time spent by the technicians would attract less proportion of outpatient visits, exhibiting the inelasticity of outpatient visits to the labour involvement of technicians. Whereas, for Yekatit 12 hospital, the largest service providing unit among the sample health care providing units which is relatively well staffed and equipped (Appendix I), the estimated parameter (1.814) indicates that a percentage increase in the employment of health professionals would almost double the outpatient visits.

With regards to the coefficient estimate β_2 that denotes the impact the labour time of administrative and support staff has on outpatient services, negative association is observed between these variables for all the five hospitals, where an increase in the former leads to a decrease in the latter variable. However, the variation in the number of outpatient visits is found to be significantly explained by the activities of the support staff only for three of the hospitals (*Finote Selam, Wodiya* and *Debre Zeit*), while for the rest two hospitals the variable has no impact at all on outpatient services.

Nevertheless, far less inelasticity of outpatient visits to the labour time of administrative staff is registered. It is estimated, for instance, that a percentage increase in the labour time of the support staff of *Woldiya* hospital would produce a less proportionate decrease (0.02%) in the number of outpatient visits. The corresponding figures for *Finote Selam* and *Debre Zeit* hospitals are 0.24% and 0.34%, respectively. This may be perhaps due to diminishing marginal returns to scale, which in turn implies the presence of already large number of administrative workers in these hospitals (Appendix I).

(b.2) Technically inefficient hospitals

The preliminary tests also identified *Dessie, Dilla* and *Debre Markos* hospitals as showing significant level of technical inefficiency in their outpatient health care provisions. In addition, the production process of these health care units is found to be adequately and well represented using the MLE method. The regression estimates of the parameters β_1 and β_2, on the other hand, reveal that the activities of both the technical and non-technical staff significantly determine the provision of outpatient health care services.

Hence, for *Dessie* hospital the estimated parameters (-1.069 and -1.214) denote that the responsiveness of outpatient visits to the change in the labour time of technicians and support staff is nearly proportional (i.e., it is almost unitary elastic) but opposite in direction. That means a unit increase in each of these variables would result in decreasing the number of outpatient visit approximately by unity. The case is different for *Dilla* and *Debre Markos* hospitals. As shown, a certain percentage increase in the time spent by health professionals and support staff is likely to induce, respectively, about six and three fold increases in the volume of outpatient visits for *Dilla* hospital, signifying increasing marginal returns to scale. But for *Debre Markos* hospital outpatient services show close to unitary elastic responsiveness (0.994) to the change in labour time of the technical staff as compared to a very small proportionate change (0.026) due to that of the non-technical staff.

Finally, the estimated parameter for 'other' inputs (β_3), comprising the values attached to depreciation and costs of drugs, is significant enough to affect the production process of only two of the efficiently operating health care providing units (*Shashemene* and *Yekatit 12* hospitals) and one of the inefficient one (*Dessie* hospital). For all these hospitals, a unit increase in costs associated with depreciation and drugs is estimated to more than double the production of outpatient services.

However, for the rest of the sample hospitals this factor is found to produce no significant influence on the production of outpatient health care services.

Table 4.5: Efficiency levels of sample hospitals for outpatient visits

Sample Hospitals	Method of estimation[+]	Coefficients β_0	β_1	β_2	β_3	σ_s^{2} [++]	γ [+++]	Log Likelihood	Mean Efficiency Level (%)
Finote Selam	OLS	-3.105 (-3.541)	0.822 (7.161)*	-0.239 (-0.756)*	0.322 (1.039)	0.006	-	17.23	
Woldiya	OLS	-2.531 (-7.613)	0.706 (3.123)*	-0.022 (-4.580)*	0.690 (0.926)	0.019	-	8.83	
Shashemene	OLS	-5.132 (-4.858)*	0.704 (7.343)*	-0.024 (-1.790)	0.777 (2.917)*	0.002	-	25.52	
Debre Zeit	OLS	-3.656 (-2.805)*	0.927 (8.992)*	-0.335 (-2.010)*	0.499 (1.169)	0.017	-	10.40	
Yekatit 12	OLS	-8.876 (-8.277)	1.814 (23.718)*	-0.001 (-0.049)	1.700 (8.623)*	0.002	-	24.76	
Dessie	OLS	-8.452 (-7.099)	0.115 (1.084)	0.226 (0.350)	2.365 (7.948)	0.068	-	1.43	
	MLE	-8.243 (-7.368)*	-1.069 (-7.378)*	-1.214 (-1.961)*	2.392 (8.517) *	0.1018	0.999	6.04	82.43
Dilla	OLS	-13.23 (-0.616)	6.372 (0.768)	2.724 (0.364)	-1.244 (-0.272)	13.93	-	-38.18	
	MLE	-13.22 (-0.591)	6.372 (9.276)*	2.724 (4.419)*	-1.244 (-0.331)	9.65	0.855	-33.18	90.94
Debre Markos	OLS	-0.536 (-0.133)	1.013 (5.472)	0.022 (1.140)	-0.494 (-0.508)	0.014	-	11.54	
	MLE	-1.782 (-0.740)	0.994 (11.281)*	0.026 (3.025)*	-0.214 (-0.390)	0.025	0.999	16.19	91.24

Note: Figures in parentheses denote t-ratios.
*Significant at 5% level of significance.

Table 4.5 also exhibits the mean technical efficiency levels for those hospitals identified to perform at significant level of inefficiencies. The 82.43% mean technical efficiency level of *Dessie* hospital may represent the less prudent utilization of the available resources. This would logically mean that given the available technology,

[+] For the technically efficient hospitals (Finote Selam, Woldiya, Shashemene, Debre Zeit and Yekatit 12) the coefficients of the production function are best represented by OLS estimates. Whereas, for those identified to have certain degree of inefficiency the frontier estimation that uses MLE method is found appropriate.

[++] $\sigma_s^2 = \sigma_u^2 + \sigma_v^2$

[+++] $\gamma = \dfrac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$

the level of inputs may be reduced at least by 17.57 percent so that the level of outpatient services delivery can be improved without incurring additional cost. The mean technical efficiency levels of *Dilla* (90.94%) and *Debre Markos* (91.24%) hospitals could imply that by using the available resources and technology, the technical efficiencies of these hospitals can be raised at least by 9 and 8%, respectively, without resorting to additional resources in the short run.

(c)The inefficiency model

The results obtained under *(a)* above would permit one to conduct further investigation to determine the factors affecting the inefficiency levels. Hence, regressing equation *(3.5)*[+] would help identify the major factors causing inefficiencies in the sample hospitals that were found to perform under significant levels of inefficiencies. As discussed above, the two main variables identified as important determinants of the level of outpatient health care provisions were the labour time of the health professionals and that of the administrative and support staff. This part of the paper, therefore, tries to investigate how the remuneration provided to these two groups of personnel contributes to the inefficiency levels of *Dessie, Dilla* and *Debre Markos* hospitals.

As one may clearly observe (Table 4.6) the incentive associated with the remuneration that goes to the technical staff is the main cause for the variation in the inefficient provision of outpatient health care services in all the three inefficiently operating hospitals. In all cases, the salary paid to the professional staff is observed to negatively influence the service delivery of the hospitals under consideration. However, the estimated parameter (δ_1) reveals that the capacity of the salary variable in reducing the inefficiency level is very small. For instance, a 100% increase in the salary of the technical staff is likely to reduce the inefficiency level of *Dessie, Dilla* and *Debre Markos* hospitals only by approximately 4, 0.3 and 0.2%, respectively.

[+] $U_i = \delta_0 + \delta_1 PS_i + \delta_2 AS_i + \omega_i$, where U_i is the inefficiency level for each health care unit, δ_0 a constant, δ_1 coefficient of salary paid to the professional staff (PS), δ_2 coefficient of salary paid to the non-professional (administrative) staff (AS), and ω_i the disturbance term that may capture other influencing factors.

Table 4.6: OLS estimates for technical inefficiency model for outpatient visits

Name of Hospital	Variable	Coefficient	OLS Estimates	p-value
Dessie	Constant	δ_0	-0.2095 (-2.433) *	0.024
	Salary to PS	δ_1	-0.0417 (-14.67)*	0.0015
	Salary to AS	δ_2	-0.0057 (-7.93) *	0.079
Dilla	Constant	δ_0	0.0982 (12.473) *	0.000
	Salary to PS	δ_1	-0.003 (-8.256) *	0.043
	Salary to AS	δ_2	-0.001 (-0.68)	0.512
Debre Markos	Constant	δ_0	0.049 (0.977)	0.162
	Salary to PS	δ_1	-0.00197 (11.70) *	0.027
	Salary to AS	δ_2	-0.001 (-0.186)	0.860

* Statistically significant at 5% level of significance

The salary paid to the non-technical staff, on the other hand, is observed to have no significant influence on the inefficiency level, except for Dessie hospital where it generates infinitely small proportionate change.

The far less responsiveness of the level of inefficiency to changes in the salary variables would, therefore, indicate that there are other factors rather than remuneration causing inefficiencies in these hospitals. That is, the contributions of other influencing factors would seem to be more important in reducing inefficiency levels than the direct monetary rewards. Thus, in order to curb the inefficiency problems in public hospitals the concerned government bodies need to take various measures including providing opportunities for further training as a form of incentive.

4.2.2. Inpatient services

(a) Preliminary tests

By making two restrictions on μ and γ one may determine the statistical significance of the specified model (*3.4*) in determining whether there is a certain degree of technical inefficiency in the provision of inpatient services by the hospitals under

investigation. In this regard, the tests conducted on the production function for each health care unit using OLS and ML estimation methods show significantly different outcomes only for Debre Markos hospital. Accordingly, the test results revealed the existence of a reasonable degree of inefficiency in this hospital which may not be captured by using the OLS method of estimation. It is, therefore, appropriate to use the frontier estimation for these hospitals so as to have robust estimates for the parameters of the production function. In contrast, the production functions for the remaining sample hospitals are found to be best represented by OLS estimation, implying the absence of significant level of technical inefficiencies in them. Hence, if any technical inefficiency arises in these hospitals it might be due to statistical noises.

Table 4.7: Hypothesis testing for parameters on deciding the existence of inefficiency in the inpatient service

Name of Hospital	Log-likelihood for		χ^2_{cal}**	$\chi^2_{2,0.95}$
	OLS ($H_0: \mu = \gamma = 0$)	MLE ($H_1: \mu \neq \gamma \neq 0$)		
Finote Selam	8.06	9.41	2.7	5.99
Dessie	29.87	30.07	0.4	5.99
Woldiya	12.96	14.74	3.56	5.99
Shashemene	10.93	10.93	0	5.99
Dilla	7.58	7.58	0	5.99
Debre Markos	-20.26	14.05	*12.42	5.99
Debre Zeit	12.38	14.41	4.06	5.99
Yekatit	25.55	25.55	0	5.99

Note: The degree of freedom for the χ^2 test is 2, denoting the number of restrictions

* Significant at 5 percent level of significance

** $LR = -2[L(H_0) - L(H_1)]$

(b) Production frontier analyses

Similar to the case of outpatient services, regression analyses is carried out for the production function specified in equation (*3.4*), by letting output to be the level of inpatient services this time (Table 4.8). Also similar to the previous case, as the negative value obtained for the intercept term (β_0) for the majority of the sample hospitals lacks theoretical backup, it is dropped from the analysis. But unlike for the outpatient visits, OLS estimates for the efficiently operating health care units reveal

that the labour time of health professionals and values attached to depreciation and costs of drug are important inputs in the production of inpatient health care services.[+]

For this group of hospitals, the activities of the health professionals are found to positively contribute to the production of inpatient services. One exception is, of course, the case of Finote Selam hospital where inpatient services seem to decline with the increase in the number of the technical staff. Considering the fact that this hospital is one with the highest inpatient-physician ratio (Table 4.1), one may not come up with an outright explanation for such negative association. With regards to the size of the impact, the parameter estimates indicate that a percentage change in the labour time of the technical staff would yield approximately an equal proportionate change in inpatient days in *Dessie, Woldiya* and *Shashemene* hospitals. Whereas, the proportionate change in the number of inpatient days is much more lower than that of the technical staff in *Dilla, Debre Zeit* and *Yekatit 12* hospitals.

The study also revealed that depreciation and drug costs are significant determinants of the delivery of inpatient services in all the seven efficiently operating health care units. Except at *Shashemene* hospital, where inpatient days fall with the increase in expenditure on depreciation and drugs, positive relationships are observed between these variables in the rest of the hospitals. Particularly, changes in these two cost items are observed to produce more than proportionate changes in the levels of inpatient services provided in *Dilla* and *Debre Zeit* hospitals. Moreover, while the responsiveness of inpatient days to costs of depreciation and drugs is nearly unitary elastic for *Woldiya* and Finote Selam hospitals, it is inelastic for *Dessie, Shashemene* and *Yekatit 12* hospitals.

On the other hand, the regression analysis shows that the administrative and support staff have no significant contribution to the delivery of inpatient services in almost all the sample hospitals. However, this variable is observed to positively and negatively affect, though with smaller magnitude, the level of inpatient services at *Dilla* and *Debre Zeit* hospitals, respectively, at 10% level of significance.

As described above, the only hospital operating with significant level of technical inefficiency is *Debre Markos* hospital, its mean efficiency level being about 90%. Not only that, as revealed by the estimated parameters of its production function, neither

[+] Note that both are significant at 5% level of significance.

the technical staff nor the values associated with depreciation and costs of drugs seem to significantly determine the delivery of inpatient services in this hospital. Only one input, time spent by the administrative and support staff, is turned out to be a significant determinant of the production of inpatient services.

According to the parameter estimate of this variable, the level of inpatient days is highly and negatively responsive to changes in the level of employment of the non-technical staff. That is, the volume of services to be provided to inpatients could be increased by about 12 fold by cutting the time spent by the administrative and support staff only by a unity. Such a high level of marginal diminishing returns to every additional unit of time spent by the administrative staff in the production process, however, is an indication for the presence of overstaffing of the non-technical staff in this particular health care providing unit.

Finally, based on the mean technical efficiency obtained, it can be concluded that, given the available technology, the technical efficiency of *Debre Markos* hospital could be raised at least by 10% without committing additional inputs.

Table 4.8: The efficiency level of selected public hospitals for inpatient services

Sample Hospitals	Method of Estimation	Coefficients				σ_s^2	γ	Log Likelihood	Mean Efficiency Level (%)
		β_0	β_1	β_2	β_3				
Finote Selam	OLS	-11.300 (1.264)	-0.446 (-.2.81)*	6.00 (0.618)	0.965 (2.511)*	0.022	-	8.062	
Dessie	OLS	-3.968 (-25.69)*	1.02 (15.762)*	0.018 (0.838)	0.072 (2.37)*	0.003	-	29.87	
Woldiya	OLS	-9.023 (-5.62)*	0.970 (17.32)*	-0.177 (-1.094)	1.08 (2.84)*	0.008	-	12.96	
Shashemene	OLS	-3.266 (-6.401)*	1.024 (20.465)*	-0.057 (-0.207)	-0.127 (-2.31) *	0.019	-	10.93	
Dilla	OLS	-20.756 (-4.093)*	0.032 (0.121)	-0.388 (-1.576)* *	3.62 (3.215)*	0.05	-	7.67	
Debre Zeit	OLS	-9.168 (-6.753)*	0.487 (4.566)*	0.051 (1.545)**	1.411 (3.823)*	0.241	-		
Yekatit 12	OLS	0.478 (6.440)*	0.0453 (2.370)*	0.018 (0.805)	0.177 (13.08)*	3.478	-	25.55	
Debre Markos	OLS	6.88 (0.001)	0.158 (0.051)	-12.53 (-0.001)	0.762 (0.002)	3.48	-	-20.26	
	MLE	7.16 (7.25)*	0.112 (0.301)	-12.569 (-12.64)*	0.459 (1.09)	3.47	0.999	14.05	90.08

Note: Figures in parentheses denote t-ratios.
Significant at *5% and ** 10% levels of significance.

5. Summary and conclusions

With the major objective of investigating the level of efficiency at which public hospitals are operating in Ethiopia, this study was conducted on eight sample hospitals purposely selected from Amhara (4), Oromiya (2), Addis Ababa (1) and from SNNPs (1) regions based on the contributions they are making in the provision of public health care in selected health programs.

Generally, two major approaches were employed in this study: qualitative and quantitative analyses. In the former part, emphasis was given to the description of the general profiles of the health institutions under investigation, and also the relationships among the various characteristics comprised in the general profiles. And for the latter case regression analyses were carried out on the production frontier functions developed for this purpose.

1. Descriptive analysis

Viewed in general terms, the number of the technical staff (that comprises specialist doctors, general practitioners, nurses, laboratory and X-ray technicians, health assistants and pharmacists) exceeded that of the non-technical (administrative and support) staff in the majority of the sample hospitals. However, compared to the other health staff the number of specialist doctors was found to be very low in almost all the sample hospitals.

Though variations were observed between the different hospitals, the majority of them provided health care services for an average of 192 and 91 outpatients and inpatients per day, respectively. Despite the much talked scarcity of hospital beds, only about two-third of the hospital beds on average were occupied each day. On the other hand, the physicians in the sample hospitals were observed to have been overburdened as each of them were forced to treat 18 outpatients and 8 inpatients each day. The high workload of the physicians in the surveyed hospitals was further reflected by a higher bed-physician ratio observed. Thus, it may be possible to conclude that such a large coverage of outpatient and inpatient services per day can only be attained at the expense of quality health care services.

The majority of the sample hospitals were also observed to have very low daily budget, the good proportion (39%) of which was being taken up by the salaries of the

professional and administrative staff. The average percentage share of the amount allocated for drug supplies was close to 30% of the total daily budget.

The analysis made by focusing on selected health care services common to all health care institutions under consideration showed that nearly 15 outpatients are treated each day per an intervention area, and an inpatient was admitted on average for about 8 days in any one hospital. It was also observed all the medical staff to have devoted much of their time to inpatient services than to outpatient services. Hence, measured in terms of the time spent per each intervention, significant variations were observed in the contributions made by the different technical health staff. For the outpatient services, for instance, the maximum time spent was registered by nurses, followed by health assistants, medical doctors, laboratory and X-ray technicians, in that order. While physicians were found to contribute more to the provision of inpatient health care services by spending closer to 3 hours on average on each of the ten intervention areas, the order in which the other technical staff contributed remained unchanged.

The attempt made to investigate the factors that are likely to influence the provision of outpatient services indicated that outpatient visits were negatively correlated with distance from Addis Ababa, absolute poverty and relative poverty. In contrast, in-referral and out-referral services were found to have positive association with the number of outpatient visits. However, the low correlation coefficient observed between outpatient visits and the poverty levels and the referral services would imply that there are other factors than these predominantly influencing outpatient services. In this regard, the investigation undertaken to find out the contributions made by individual segments of labour revealed the number of technical staff to have a strong correlation with outpatient visits as compared to the non-technical staff. This, therefore, would emphasize the significant role being played by the professional staff in the provision of the health care services. Particularly, the availability of physicians, health assistants and nurses were observed to strongly affect the number of outpatient visits, in that order. This would in general imply the need for appropriate allocation of health personnel, particularly the skilled ones, in order to enable hospitals extend their services efficiently and in the standard required.

2. Regression analysis

In order to investigate the level of technical efficiency at which the sample hospitals are operating, production frontier analyses were carried out on two major service categories: outpatient and inpatient services.

(a) Outpatient services

The preliminary tests undergone revealed that while the majority of the sample hospitals were performing without showing any significant level of inefficiency, some degree of inefficiency was observed in the provision of outpatient services in three of the sample hospitals (*Dessie, Dilla* and *Debre Markos*).

The two main variables identified by the production frontier analysis as important determinants of the level of outpatient health care provisions were the labour time of the health professionals and that of the administrative and support staff. Thus, the coefficient estimates indicated that the outpatient visits in the efficiently operating hospitals tend to increase with the increase in the labour input of the technical staff and decrease with that of the non-technical staff. But for those inefficiently operating health care units, the activities of both the technical and non-technical staff were seen to produce a positive impact on the outpatient visits. On the other hand, the estimated parameter for values attached to depreciation and costs of drugs was found to strongly and directly affect the production process of only two of the efficiently operating health care providing units and one of the inefficient ones.

From these it can be concluded that the availability of physicians, nurses, health assistants, laboratory and X-ray technicians, and pharmacists is more important than the administrative and support staff for the provision of outpatient services. Hence, this would imply the emphasis to be placed on resource allocation and strengthening the capacity of the technical staff.

Attempt was also made to investigate the source of inefficiency in the three inefficiently operating hospitals. While the remuneration provided to the technical staff seemed to have a negative but small influence on the delivery of outpatient services, the salary paid to the non-technical staff was observed to have no significant influence on the inefficiency level. This, would, therefore, indicate that there are other factors rather than the direct monetary rewards causing inefficiencies in these hospitals. Therefore, in order to curb the inefficiency problems in public hospitals the concerned government bodies need to take various measures, including providing opportunities for further training as one form of incentive mechanism.

(b) Inpatient services

With regards to inpatient services, the preliminary tests revealed only one sample hospital (*Debre Markos* hospital) to have been operating under significant level of inefficiency. The parameter estimates of the production function also showed that

neither the technical staff nor the values associated with depreciation and costs of drugs seemed to affect the delivery of inpatient services in this hospital. Only the labour time of the non-technical staff was found to highly and negatively affect the production of inpatient services.

It can thus be concluded that such a high level of negative association between inpatient days and the number of non-technical staff is an indication for overstaffing of the administrative and support staff in this particular hospital. Moreover, as the mean efficiency level of this hospital is 90%, its technical efficiency could be raised at least by 10% without committing any additional inputs.

The parameter estimates of the production function for the seven sample hospitals operating without showing significant level of inefficiency revealed that the labour time of health professionals and values attached to depreciation and costs of drugs were important inputs for the production of inpatient health care services. Hence, both the activities of the technical staff and depreciation and drug costs were found to positively contribute to the number of inpatient days in the majority of this group of hospitals. The regression analysis, on the other hand, showed the administrative and support staff to have no important contribution to the delivery of inpatient services in almost all this hospitals.

The above results would imply that improving the number and quality of the professional health staff and upgrading the physical and technical capabilities of health care units increases the efficiency with which the units are producing inpatient health care services.

Based on both the qualitative and quantitative analyses, the following general conclusions may be drawn. The utilization levels of health services are influenced by many factors ranging from individual choice to the proximity of the health care facility. The performance of the public health care delivery is mainly reflected by the level of health coverage, the availability of health facilities and the finance required to run them. Though the delivery of health care services is a team work, it is observed to have been primarily determined by the availability of skilled health personnel. The number of highly skilled medical personnel determines the number and type of patients as visitors of the health care providing unit.

The ongoing effort for improving organization and management of the health system at all levels should be strengthened so that the provision of health care services

would be efficient and its quality be maintained. The management of each hospital in each area would be of great importance to improving the proper use of the available resources.

Finally, it can be suggested that further policy measures should be taken in order to reduce the burden of public hospitals and improve the quality of the health care services in the country.

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Appendix I: General profile of the sample hospitals

Profiles	Finote Selam	Dessie	Woldiya	Shashemene	Dilla	Debre Markos	Debre Zeit	Yekatit 12	Mean
Distance from A/Ababa (km)	380	401	500	251	370	299	45	Within A/A	
Population served (million)	0.9	2.3	1.3	> 0.11	0.66	1.2	0.97	na*	
Total Health Staff									
Specialists	-	4	1	6	1	2	1	23	4.8
General practitioners (MDs)	6	6	6	12	11	5	12	5	7.9
Nurses	13	25	10	34	12	25	26	26	21.4
Lab and X-ray technicians	7	13	7	9	7	7	5	7	7.8
Health assistants	24	60	26	46	33	36	22	74	36.4
Pharmacists	1	1	1	2	1	1	2	4	1.6
Administrative & support staff	33	33	56	153	65	89	58	279	95.8
Outpatient visits (per day)	165	200	100+	200	144	210	208+	305	191.5
In-referrals (per day)	2.3	3	na	8	na	2	2.5	23	6.8
Out-referrals (per day)	3.1	3	na	1	na	~0	2	3	2.1
Value of building (million Birr)	1.46	na	na	1	5	1.85	na	1.5	2.16
Number of beds	105	185	93	160	81	68	66	305	132.88
Occupancy rate (%)	74	78	68	61	31	87	53	75	65.88
Number of beds occupied#	78	144	63	98	25	59	35	229	91.4
Total daily budget (Birr per day)	3,708.5	7,944.3	3,646.17+	20,838.9	13,344.4	5,808.22+	3,616.44	15,397.26	7637.90
Allocation for drugs (Birr per day)	1,297.98+	2,470.60	1,681.90	1,890.40	1,479.50	3,178.10	908.85	3,178.10	2,010.68
Average daily salary expenditures									
Professional staff	1,161.92	2,383.29	1,213.70	2,333.10	1,381.70	1,696.93	1,696.93	4,861.20	2,223.84
Administrative & support staff	806.80	905.65	419.10	987.40	419.30	809.10	140.90	2,059.50	820.14

** As a zonal hospital it provides services to patients coming from Addis Ababa and the surrounding areas.*

+Estimated figures (editor)

#Occupancy rate is converted to number of beds occupied to serve as a proxy for number of inpatient per day (editor) na: data not available

Appendix II: Average time spent (in minutes) by total health staff on outpatient visits at sample hospitals

	Finote Selam	Dessie	Woldiya	Shashemene	Dilla	Debre Markos	Debre Zeit	Yekatit 12
Number of interventions*	13	13	13	13	13	13	13	13
Outpatient visits **	12.7	15.4	7.7	15.4	11.1	14.4	16	23.5
Time spent by MDs	28.2	48.2	51.5	32.5	29.3	41.5	15.9	35.9
Time spent by nurses	76.2	61.5	61.6	42	58.9	100.6	37.5	152.6
Time spent by lab technicians	24.4	40	41.9	20.9	8.9	16.2	42.8	43.5
Time spent by X-ray technicians	14.5	12	16.7	4.8	51.7	10	31.6	11.5
Time spent by health assistants	14.5	21.8	27.1	53.1	51.7	142.9	24.6	96.2
Labour time spent by the registrar	2.5	3.8	4	4.2	4	13	2.5	25.3
Value attached to depreciation & supply of drugs (Birr per day)	65.3	105.2	78	69.4	163.7	167.6	70	344.4

** Refer to the types of outpatient services on the basis of which the average time spent on each patient is computed.*

*** Mean outpatient visits registered for the given number of interventions.*

Appendix III: Average time spent (in minutes) by total health staff on inpatient visits at sample hospitals

	Finote Selam	Dessie	Woldiya	Shashemene	Dilla	Debre Markos	Debre Zeit	Yekatit 12
Number of interventions*	10	10	10	10	10	10	10	10
Inpatient days**	7.8	14.4	6.3	9.8	2.5	5.9	3.5	13.3
Time spent by MDs	327.7	121.9	135.4	119.1	139.1	256.7	127.5	181
Time spent by nurses	222	137.7	160.3	228.4	247.4	151.3	46.5	139.3
Time spent by lab technicians	24.8	55.8	54.1	35.1	40.4	28.9	52.5	95.9
Time spent by X-ray technicians	19.5	40.5	37	16	22	36.2	52.5	60
Time spent by health assistants	69.1	93.7	86	181.8	199.4	29.1	55.5	57.3
Labour time spent by the registrar	1.6	4.4	4.3	5.8	5.4	1.4	10.8	6.2
Value attached to depreciation & supply of drugs (Birr per day)	180.8	160.2	108.2	1062.6	427.4	340.9	183.7	712

** Refer to the types of inpatient services on the basis of which the average time spent on each patient is computed.*

*** Mean number of inpatient days registered for the given number of interventions.*

Determinants of Demand for Health Care Services and their Implication on Health Care Financing: The Case of Bure Town[1]

Nahu Asteraye[2]

Abstract

This study attempts to identify the factors that determine the medical treatment seeking behaviour during illness and the demand for health care services by employing a maximum likelihood estimation technique and using primary data collected from a small woreda town in western Gojjam. The factors that are expected to have an influential impact are categorized as individual and/or household specific variables and choice specific variables.

According to the estimated results of the two logit models employed in the study, individual and/or household specific variables such as sex of the patient, severity of illness, monthly income of the household and family size, and distance to reach the nearest health facility (a choice specific variable) are found to significantly affect whether treatment was sought at times of illness. On the other hand, patients' choices of health care service providers are found to be influenced by the age of the patient, sex of the household head and education level of the patient (from the category of individual and/or household specific variables) and by medical cost of treatment per visit and waiting time for treatment (from the choice specific category). All these, therefore, call for the intervention of the government in devising mechanisms that would help reduce the discrepancies observed in terms of sex, age, level of education and income, on the one hand, and in introducing appropriate policy measures that would facilitate the expansion of health facilities that provide best quality health care services at a cost affordable to the majority of the population, on the other.

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1. Introduction

1.1. Background

Health is a major target of all households and governments in all countries. In addition to its direct importance to individual welfare, health indirectly affects the development of a country through its influence on the efficiency of human capital and on the productivity of work. In Zweifel and Breyer (1997), the dual property of health is stated as: "Health is not everything in life, but without health, life is nothing". According to these authors,

- health is a highly valued asset (i.e., other values and goals do exist in life, yet compared to health, they ranked lower on the preference scale of most people).
- health is a prerequisite for success in other activities (i.e., poor health limits the production capabilities of the affected person, including his or her ability to enjoy the good things of life (apart from health)).

The nature and level of a country's economic development are believed to be the major determinants of the health status of its inhabitants. But at the same time, the health of the population can also influence economic progress (Mills, et al, 1988). Hence, the two are interdependent as people are both the driving forces and final targets of socio-economic development. Consequently, the provision of health services becomes an important aspect of the socio-economic development of a country. It was this fact and the view that health is a basic human right which forced most governments to accept the declarations of Alma Ata that aimed to attain "Health for all" by the year 2000 (WDR, 1993).

Due to its low per capita income, food insecurity, recurrent famines, huge overseas aid, high infant mortality, and low life expectancy, Ethiopia is one of the poorest countries of the LDCs. The latter indicates that not only the health status of the population is very low but also diseases are widespread in the country (Kloos, 1998). According to the Ethiopian Social Sector Note (WB, 1998), the low health status of the population is characterized by vulnerability to largely preventable infectious diseases and nutritional deficiencies, high rate of population growth, low per capita income, low education level and high rates of illiteracy, inadequate access to clean water and sanitation facilities, and poor access to health services.

For instance, in 1995 life expectancy was 49 years and infant mortality was 112 out of 1,000 live births (compared to 52 years and 92 in SSA, respectively). Moreover, Table

1.1 shows how poor the health status of Ethiopia is as compared to the sub-Saharan African and other low-income countries.

Table 1.1: Basic health status indicators

Indicators	Ethiopia	Eritrea	Kenya	Tanzania	Uganda	Africa
Crude Death Rate (per 1,000)	18	15	9	14	19	**15**
Life Expectancy (years)	49	46	59	51	42	**52**
Infant Mortality (per, 1000)	120	135	59	84	122	**92**
Child Mortality (per 1000)	240	204	94	167	185	**172**
Maternal Mortality (Per 1,000,000)	452-1528[a]	...	510-646	200-748	550	**573**
Immunization Coverage (percent)						
DPT	28	...	82	82	73	**50**
Polio	28	...	81	81	74	**50**
Measles	22	...	79	79	73	**51**
Access to Proper Sanitation (%)	10	...	86	86	67	**26**[b]
Access to Safe Water (%)	18-26	...	52	52	...	**37**[b]
Access to Health Care (%)	55	...	93	93	...	**54**[b]
Attended Births (%)	10	...	60	60	...	**34**[b]

Source: WB, 1998

Note: (a) Maternal Mortality Estimates for Ethiopia vary widely depending on sources used.
(b) Excludes South Africa

As can be seen in the table, Ethiopia stands low in all health indicators compared to some of its neighbouring countries and Africa in general. These, therefore, indicate the tremendous efforts the country should make in order to alleviate the prevailing problems and thereby improve the health status of the people.

One aspect which guarantees the effectiveness and sustainability of the programmes and policies in the health sector would be the involvement of households. For instance, identifying the factors that determine households' demands for health care services could be of paramount importance in assisting the formulation of rational strategies. To this end, an econometric analysis is a tool at our disposal that allows making inferences, with known statistical confidence, how demand is affected by each of its multiple determinants. This case study is an exercise in this regard.

The study is concerned with determining empirically the factors that are associated with the decision of seeking medical treatment and the choice of health service providers in times of illness. It also tries to indicate the implications of these demand determinants on health care financing in a rural area setting. Hence, the study was conducted in Bure, a town of Bure-Womberma Woreda in West Gojjam Administrative Zone of the Amhara Regional State. Bure is located along Addis Ababa – Bahir Dar road 410 km away from Addis Ababa and 160 km from Bahir Dar, the regional capital. At the time when the survey was conducted (between February and March 1999), there were one health center, two private clinics and three pharmacies providing health services to 13,437 people of the town and the whole population of the woreda, estimated to have been more than 200,000 based on the 1994 CSA census.

1.2. Objectives of the study

Assurance of accessibility of health care for all segments of the population and promotion of participation of the private sector and non-governmental organizations in health care are among the main policies of the government of Ethiopia. The policies seem to have facilitated the provision of modern health care services by various health facilities (hospitals, health centers, clinics, etc.) owned by the government, private-for-profit providers and other NGOs. The service fees of most private-for-profit providers are observed to be higher compared to other providers, particularly to the subsidised provision of government health services since "their service fees are not structured on a full cost recovery basis" (MOH/WB, 1995).

Nevertheless, various health status indicators show that the health status of the Ethiopian population is still very low. As the government priority area is improving the health status of the population, it would be essential to investigate in detail the different factors that directly and indirectly influence the provision and demand of the health care services. That is, it is necessary to know what makes people seek medical care in times of illness, the kind of health care services people need to use and which facility to use.

In other words, demand analysis should be conducted in order to identify the factors that affect individuals' decisions to seek health care and to choose from among different providers. Moreover, an understanding of the determinants of demand would enable health policy makers to introduce and implement appropriate incentive schemes that could be used to encourage certain patterns of service uses and discourage others. Demand analysis would also help investigate the implications different health related policies have on health care financing.

Therefore, the broad objective of this study is to conduct demand analysis for health care services and show the implications on health care financing. More specifically, the study tries to assess the utilization patterns of the sample households using a series of variables; to identify the determinants of demand for health care services being provided by different providers; and to look into the policy implications of the results obtained, including the implications on health care financing.

2. Theoretical and empirical perspectives

2.1. Theoretical background

Generally, demand for a particular type of health care service produced by a given type of supplier is the quantity of that service people are willing to obtain as a function of the characteristics attributed to consumers and all the providers. Consumers consider their demand for health care services both as consumption and investment commodity (Grossman, 1972).

As consumption commodity, health care makes consumers feel better so that it directly enters their preference function; and as investment commodity the state of health determines the amount of work and leisure time available to consumers. The lower the number of sick days the larger is the time available for work and leisure. Hence, the return to investment in health is the monetary value of the decrease in the number of sick days. It can thus be concluded that the demand for medical services is not for the services per se; rather it is the demand for "good health" (ibid.)

In this regard, analyzing the demand for health care services as being derived from the individuals' demand for good health provides a sound basis for determining which factors to be included in the model specifying the demand for health care services and for hypothesizing their effects.

Hence, a utility maximization problem, an indirect utility function or minimization of expenditure function (Deaton and Muelbauer, 1980; Varian, 1992) can be employed as a tool of demand analysis. Let's consider the usual utility function employed by scholars such as Gertler and Van der Gaag (1990) to show the behaviour of medical service users.

Consider individual i seeking medical treatment from health care service provider j. The direct utility derived by the individual could be formulated as a function of improvement in health status attained after treatment and consumption of consumer goods as:

$$U_{ij} = U_{ij}(H_{ij}, C_{ij}) \qquad (2.1)$$

where U_{ij} is the expected utility individual i derives by receiving health care services from provider j; H_{ij} the expected improvement in health status of individual i after receiving treatment from provider j; and C_{ij} is the consumption of all other goods and services other than the health care services. The amount of C_{ij} is assumed to depend upon the choice of provider j because of the associated monetary and non-monetary treatment costs.

Since H_{ij} and C_{ij} are not directly observable it becomes necessary to introduce new functions that relate them with observable variables. Following Behrman and Deolaikar (1988) and Senauer and Garcia (1991) with some modifications (i.e. by picking out those variables that are not observable, for instance, genetic endowment, nutrient intake, etc.) the health care production function for the i^{th} individual can be expressed as:

$$H_{ij} = H(I_i, F_{ij}) \qquad (2.2)$$

where I_i is a vector of observable socio-economic characteristics of individual i and his households (e.g., their age, gender, education, household size, etc); and F_{ij} is a vector of characteristics that individual i faces at the health care service provider j (e.g., the quality of treatment obtained, treatment costs, etc.).

Moreover, along with this production function the individual is constrained by the following usual full-income constraint, which combines both time and income into one total resource constraint:

$$Y_i = P_h H_{ij} + P_c C_{ij} + W_i T_H \qquad (2.3)$$

where Y_i is the total monthly income of individual i; P_h and P_c are prices associated with the consumption of health care services and all other goods and services, respectively; W_i the opportunity cost of time for individual i; and T_H is total time spent by individual i for treatment (i.e., in travelling to and waiting for treatment) at the health care service provider j.

Then, maximizing the utility function (2.1) subject to the health care production function (2.2) and the full-budget constraint (2.3) yields a system of demand equations for health care services that can be expressed as a function of the health care service prices, income and other exogenous variables.

Generally, the demand functions for health care services that can be derived based on this theoretical framework and by taking into account all the other factors that are expected to affect demand, can have the following functional form involving individual/household specific and choice specific variables:

$$D_{ij} = f(Z_i, X_{ij}) \qquad (2.4)$$

where D_{ij} is individual $i's$ demand for health care service of type j; Z_i a vector of individual and household specific variables, such as education, age, income, etc; and X_{ij} is a vector of choice specific variables individual i faces when choosing provider j, such as treatment cost, waiting and travel time for treatment, distance, perceived quality, etc.

2.2. Empirical literature review

A study done in Kenya to evaluate the effects of health service pricing reform revealed that following the introduction of user charges, the utilization of health services dropped by some 38 percent. But after the abolition of registration fees, the use of health services increased, though it is insufficient to reverse the overall downward trend in demand (Mwabu, et al, 1995). As patients were observed to be more sensitive to fees paid for diagnostic services than to registration, the study recommended that while introducing or adjusting fees the proportional increase in charges for diagnostic services should in general be smaller than that for outpatient services.

Based on a utility maximization model, Acton (1975) analysed the role of money price, time prices, and income in determining the demand for medical services in New York City by using data obtained from a 1965 survey of users of the outpatient departments of the same city. The result of the study supported the prediction that travel time functions as price in determining the demand for medical services when free care is available. Further, the study showed that individuals with higher income are more likely to use the private sector, which is relatively less time intensive, than the public sector.

Hay, et al. (1982) evaluated the determinants of demand for dental health by developing an econometric model. The result indicated that the number of annual dental visits were significantly and positively related to total annual dental expenses and negatively related to out of pocket expenses. Moreover, while age was significantly and negatively related to dental visits, variables representing income, other family demographic characteristics, and past oral health status were not found to be significantly related to the number of dental visits.

Using data from one of the low income rural areas of Kenya, Mwabu et al. (1995) employed a logit model to analyze the quality of medical care and choice of medical treatment. The estimation revealed that income exerted a strong positive effect on the probability of seeking medical care from a mission or private provider compared to self-treatment. More schooling made patients to consult a government health facility than resorting to self-treatment. Though the signs on the coefficients for user fees and distance were negative as expected, they were not significant. In addition, the quality variables that reflect drug scarcity were found to be significant determinants of demand.

These same authors' earlier study tried to examine the efficiency and equity effects of introducing user fees on Kenya's public facilities (Mwabu et al., 1986). The study predicted demands (or probabilities of seeking treatment) in various health facilities when user fees are charged for health services in government clinics. Accordingly, the results obtained showed that the demand for health services in government and mission clinics and pharmacies (shops) is highly sensitive to changes in relative money prices, while it is quite inelastic in government hospitals, private clinics and traditional clinics.
These results were obtained when demand prediction was made by assuming the government uses the revenue obtained from user fees for purposes other than the improvement of health services in its clinics. On the other hand, when the government was assumed to use the revenue from its clinics to upgrade the quality of health services, government-owned clinics were chosen over mission clinics at all levels of user fees (ibid.)

Viewed in general, the study showed the net welfare effect of user charges on medical services to be ambiguous. Because, if user fees were imposed across the board in all government health facilities, the equity trade-offs would be large so that the user fees would be socially and politically unacceptable. But if user charges were restricted to only government hospitals, the attendant equity problem would not be too difficult to manage (i.e., they would promote equity) because they would benefit the poor more than the rich.

Hotchkiss (1998) examined the trade-off that consumers make between price and quality in the demand for health care in the Philippines. In this paper, a discrete choice model was used to estimate the effects of quality, price, distance and individual characteristics on the choice of obstetric care providers. The estimation result suggested that such facility attributes that influence quality of care as crowding, practitioner training and drug availability are significant determinants of the choice of obstetric care provider. Price effects for both the poor and non-poor households were negative, but were statistically significant only for the former.

Moreover, distance to the health facility had a negative and highly significant effect on facility choice. Assets were found to be positively and significantly associated with choosing alternatives that are associated with higher quality. Having health insurance has also the same effect. Regarding the trade-off between price and quality among women in the Philippines, the policy simulations indicated that when prices and quality were simultaneously increased in government health care facilities, the mean probability of using public facilities would increase for both the poor and non-poor households (ibid).

A study conducted in Nigeria showed that price and quality of care are significant determinants of health care choices (Akin et al., 1995). It was observed that higher prices at either type of facility tend to reduce usage of that type, and that usage tends to increase for each type of care as the quality of the care is increased. The result also indicated that there is no difference in the price responsiveness of different income groups.

In studying the household demand for health care services in Ethiopia, KUAWAB (1996) consultants, using a logistic regression model, tried to identify the factors determining the choice for health providers (i.e., government, private, religious and individual health facilities) for those individuals obtaining medical treatment. The regression analysis revealed that distance to the nearest health facility has strong impact on the choice of all health providers. Income, proxied by per capita household expenditure, was also

observed to have a stronger positive effect on the choice of all health facilities, except those run by religious institutions.

The above study further indicated that mothers' education positively influences the choice for private, individual and missionary health facilities, implying the greater role mothers' education could play in determining the household demand for health care. On the other hand, while age produces a positive influence on the choice of government and private facilities, age square has negative and positive effects on the choices of private and individual facilities, respectively. The latter relationships depict the tendency of older people to obtain treatment from individual health providers.

However, the major limitation of this study is its failure to take into consideration the non-monetary costs of treatment (i.e. time spent in travelling to reach a facility and waiting for treatment) and the monetary cost (i.e. medical cost) that would have their own effects on the choice of providers.

In an attempt to identify the main socio-economic factors that determine access to and utilization of health care services in urban Ethiopia, Abdulhamid and Alem (1996) employed binomial probit models and applied multinomial (conditional) logit models for the analysis of the choice of facility types. On the one hand the probit models identified income as the major determinant of whether treatment was sought or not and also generated interesting results regarding utilization of health care services on the other. Accordingly, residents of most of the towns (Bahir Dar, Awassa, Dessie, and Jimma) were more likely to seek treatment than residents of Addis Ababa. But residents of Dire Dawa were observed to have a lower probability of seeking medical treatment, while residents of Mekele were as likely as those of Addis Ababa in seeking treatment.

On the other hand, the regression analysis performed on the choice of providers (multinomial logit models) showed that richer households were the most utilizers of private facilities than the poorer households. In addition, older people were also found to use private facilities more often, the rate ultimately falling with an increase in age. Sex of the household head was found to significantly determine the choice of private and public service providers while it was insignificant in all other cases. Moreover, mothers' education has a significant effect in determining the choice of service providers and type of facilities, favouring private services in the first case and hospital treatment in the other case. Fathers' education was not significant in any of the cases.

The major limitation of this study was that certain choice specific variables, such as distance, waiting time for treatment, time spent to reach the facility and medical cost, were not included in the estimated models due to the paucity of the available data set. This might have some impact on the reliability of the estimated results.

In estimating willingness to pay for health care in Ethiopia, the Health Care Financing Secretariat conducted a survey in 2001 to generate data and relevant information from surveys at household level and at the gate of health facilities and by convening focus groups.

The results obtained from the three components all supported the conclusion that perceived quality was a very important determinant for both patients' choices of provider and of their willingness to pay for services and drugs. Moreover, the cost of medical care was the second most important determinant of provider choice. But some complaints were registered by respondents about the high prices charged by private for profit medical practitioners. However, it was clear, particularly from the household survey, that patients do pay considerable amounts for medical care, and are willing to pay even higher amounts than they now do if they obtain higher quality care in return.

3. Methodology

3.1. Methods of analysis and data sources

Given the theoretical framework under which a demand function for any type of good or service is derived, an empirical analysis that employs a logit model through a maximum likelihood estimation technique, supplemented by a descriptive analysis, is used in this study.

The data used for this study are primary data collected through structured questionnaire from the residents of Bure town, a small woreda town in western Gojjam Administrative Zone. Bure town is selected mainly because no study on demand for health care services has been done not only in this area but also in similar rural towns at national level. Therefore, as Bure is the most populated rural town with heterogeneous population in terms of socio-cultural conditions, it is hoped to represent the conditions prevailing in Amhara Region in particular and those of other similar rural towns of the country in general.

The sampling frame included all the 2019 households in the survey area from which 400 households (20%) are selected using a systematic random sampling method. Then the designed questionnaires were administered to the sample households that experienced illness or injury over the four weeks immediately preceding the date of the interview. At times when no one was found to have been sick in the specified period of time in the sample household, the next door household was visited as a replacement. In this way, detailed data on individual's illness and utilization of health care services, including many socio-economic variables specific to the respondent and to the choice of health facilities made, and all other information relevant to the estimation of the demand for health care services were collected.

In this regard, the first question presented to the respondents was whether they have been ill in the past four weeks. Based on the reply to this question, respondents were grouped into two: those who were sick and not sick in the specified period of time. Two follow up questions were posed to those who were sick to elicit what they did first and second in terms of seeking medical treatment, and categorized based on their responses. Accordingly, while those who replied 'no consultation' to the two questions were grouped as ‘not seeking treatment’, those who reported to have visited any one health facility were classified as utilizers of a given facility.

Therefore, respondents were grouped as utilizers of public health facilities if they went to a government-owned facility first or if they went to a government facility second after responding `no consultation' to the first question. On the other hand, if the respondents replied a combination of government and private facility use, what they did first was considered to be vital to group them and define the dependent variable. Utilizers of ‘private facilities’ were also categorized in a similar fashion. In addition, patients that sought treatment from traditional healers were grouped as utilizers of ‘traditional health care services’, while those that bought medicine from drug shops and pharmacies without consulting a physician were taken as utilizers of ‘self treatment’.

The rest of the questions in the questionnaire tried to assess the quality of treatment patients received and also prompted them to evaluate the behaviour of the staff members at the times of treatment, because these factors were regarded as important variables which affect decisions as to where to seek treatment.

In addition, in order to determine the monetary cost of treatment, respondents were asked to state the amount of medical expenditure (comprising fees paid for registration, treatment, laboratory test, drug cost, etc.) they incurred per visit. And to capture the non-

monetary costs of treatment, questions relating to travel time to and from health care centers and waiting time for treatment were included. Envisaging the influence household income has on the choice of a health facility, respondents were also asked to state their households' total monthly incomes from all sources.

3.2. Specification of the empirical model

When individuals are faced with an accident, illness or injury, they would decide whether to seek a medical treatment or not, and those who are seeking would also decide which health care unit to use (i.e., the modern or the traditional services). Moreover, from the modern health care services that are available to them, individual users would choose from among governmentally or privately provided services that would enable them to maximize their utility.

Hence, in order to determine the probability of individuals seeking treatment at times of illness and/or the probability of choosing any one health care unit, the following logit model is employed:

$$P_r(D_i = 1) = P_i = F(\beta X_i) = \frac{\exp(\beta X_i)}{1+\exp(\beta X_i)} = \frac{1}{1+\exp(\beta X_i)} = \lambda(\beta X_i) \qquad (3.1)$$

And hence,

$$P_r(D_i = 0) = 1 - P_i = 1 - F(\beta X_i) = \frac{\exp(-\beta X_i)}{1+\exp(-\beta X_i)} = 1 - \lambda(\beta X_i) \qquad (3.2)$$

where $P_r(D_i = 1) = P_i$ is the probability of individuals seeking a medical treatment, or the probability of choosing a certain health service provider in times of illness.

β 's are vector of parameters to be estimated,

X_i 's are vector of explanatory variables that are defined in Exhibit 1 for the first outcome and in Exhibit 2 for the second outcome.

$\lambda(\cdot)$ denotes the logistic distribution function.

Exhibit 1: Vector of explanatory variables included in the first outcome (i.e., seeking treatment or not)

Variable	Description of the variable
SX/SXH	Dummy variable, one if the sex of the patient/head of the household is male and zero otherwise.
AG	Age of the patient in years.
LDAY	Length of days that the patient has been ill.
HHS	Household size in number.
INCH	Households' monthly income in Birr.
OH	Dummy variable, one if the patient's household owns its own house and zero otherwise.
DMS	Dummy variable, one if the patient is married and zero otherwise.
DOCCP	Dummy variable, one if the patient is employed and zero otherwise.
AGESQ	Age square.
DIST1	Distance to reach the nearest health facility in km.
DSCCUH/ DSCCU	Dummy variable, one if the head of the household/the patient's level of education is secondary & above and zero otherwise.
CONS	Constant term

Exhibit 2: Vector of explanatory variables included in the second outcome (i.e., the choice of private versus public health facilities)

Variable	Description of the variable
SX/SXH	Dummy variable, one if the sex of the patient/head of the household is male and zero otherwise.
AG	Age of the patient in years.
LUW	Length of days that the patient was unable to perform his/her regular activities.
MEDC	Medical cost that includes all monetary expenses incurred per visit.
WAIT	Waiting time for treatment in minutes.
DIST2	Distance to reach the health facility attended in km.
HHS	Size of the household in number.
INCH	Total income of the household per month in Birr.
DMS	Dummy variable, one if the patient is married and zero otherwise.
DPQUAL	Dummy variable, one if perceived quality of treatment is excellent or very good and zero if good or poor.
DBSTAF	Dummy variable, one if the behaviour of the staff members at times of treatment is excellent or very good and zero otherwise (as evaluated by the patient).
DSCCU	Dummy variable, one if the patient's level of education is secondary & above and zero otherwise.
AGESQ	Age square
CONS	Constant term

4. Findings of the study

The analyses carried out on the determinants of demand for health care are presented in two subsections. The first reviews the descriptive statistical results and the second presents the empirical results obtained from the estimation of the specified econometrics models.

4.1. Descriptive statistics results

In this subsection the level of utilization of the different health care providing establishments by the sample households is assessed vis-à-vis some demographic factors as well as the important determinants of demand, such as economic factors (e.g., income and medical cost), and access variables (e.g., time spent by waiting for treatment), and subjective factors (e.g., perceived quality of treatment and behaviour of the staff members while providing treatment).

Generally, the survey revealed that out of the total 400 respondents (58 and 42% females and males, respectively) included in this study, nearly 14% of them reported that they did not seek any medical treatment at all though they were sick in the four weeks preceding the date of the interview. Of the remaining 86% of the respondents, who sought medical treatment, 53.6, 43.1 and 1.5% visited government, private and traditional health services providers, respectively, while the rest 1.7% treated themselves without consulting any health care practitioner (Table 4.1).

Table 4.1: Medical care seeking behaviour and facilities choices by sex of respondents

Sex	Seeking treatment				Total		Facilities chosen*			
	No		Yes				Government	Private	Traditional	Self treatment
	Count	Row %	Count	Row %	Count	Column %	Row %	Row %	Row %	Row %
Female	36	15.5	197	84.5	233	58.3	53.3	43.1	2.0	1.0
Male	21	12.6	146	87.4	167	41.8	54.1	43.2	0.7	2.7
Total	**57 (14.3)**		**343 (85.7)**		**400**	**100**	**(53.6)**	**(43.1)**	**(1.5)**	**(1.7)**

** The figures in parentheses under these columns indicate the proportion of respondents that chose the various facilities out of those who sought medical treatment.*

Table 4.1 further reveals that females are not only the ones who encountered illness most (57.4) in the period of analysis, but also account for the largest proportion (63.2%) of those who declined to take any form of medical treatment. However, with regards to the utilization of the different health care services, no significant difference is observed between females and males.

Asked as to why they did not seek medical treatment, the majority identified incapability to cover the cost of treatment (50%) and long distance of the health facilities (38%) to have been the main reasons for not seeking treatment in the specified period of time (Table 4.2).

Table 4.2: Pooled reasons for not seeking treatment

Reasons	Percentage of responses
Incapability to cover cost of treatment	50.0
Distance to reach the nearest health facility	37.5
Non seriousness of the illness	4.7
Religious case	4.7
Other reasons	3.1
Total	**100**

On the other hand, those who sought medical treatment from different health service providers have also indicated their reasons for choosing a particular provider. Accordingly, the large majority of the respondents (84%) who attended government owned health facilities did so mainly because the cost of treatment was lower. But 11% of the users chose government facilities because they provided best quality treatment with sufficient medical inputs. For about 77% of the respondents who attended private health care units, best quality of treatment together with their availability for providing urgent services were the major reasons for choosing them. Eighty percent of the traditional facility users thought that the diseases they faced could not be treated by modern health care units. And close to 67% of those who treated themselves without consulting health care practitioners on their parts gave the frequent occurrence of an illness as the main reason for their choice (Table 4.3).

In order to identify those factors that might determine the treatment seeking behaviour and the choice of health care providers, the responses of the sample households are cross tabulated against some demographic, economic, access and subjective factors as depicted below.

Table 4.3: Pooled reasons for attending the chosen facility

Reasons	Government %	Private %	Traditional %	Self Care %
Lower cost of treatment	83.69	0	0	0
Best quality of treatment with sufficient instruments	10.87	55.41	0	0
Availability of Services	0	21.62	0	0
Nearness of the facility	1.09	9.45	0	0
Off working day/time	0	6.76	0	0
Frequent occurrence of illness	0	0	0	66.67
Not treated by modern treatment	0	0	80.00	0
Others*	4.35	6.76	20.00	33.33
Total	100%	100%	100%	100%

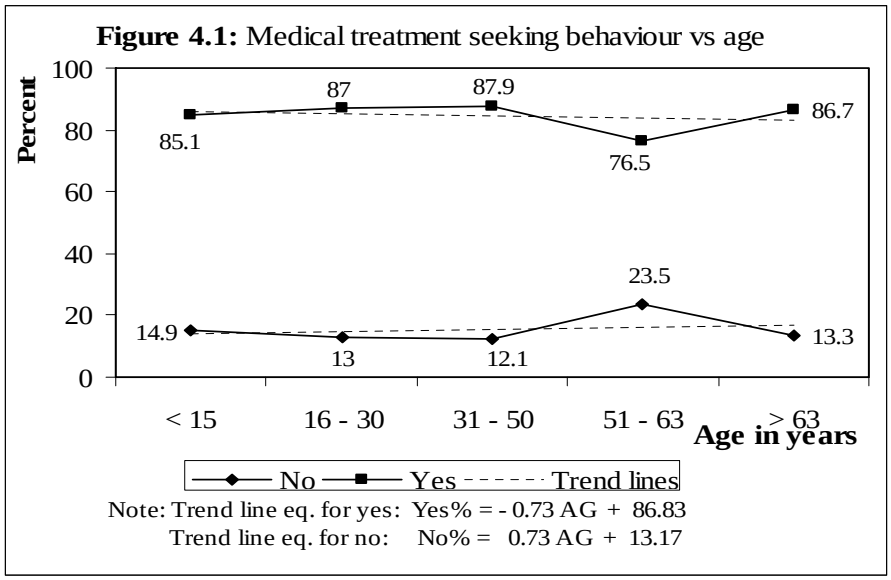
** Others include: others' advice, treatment is free, and missing cases.*

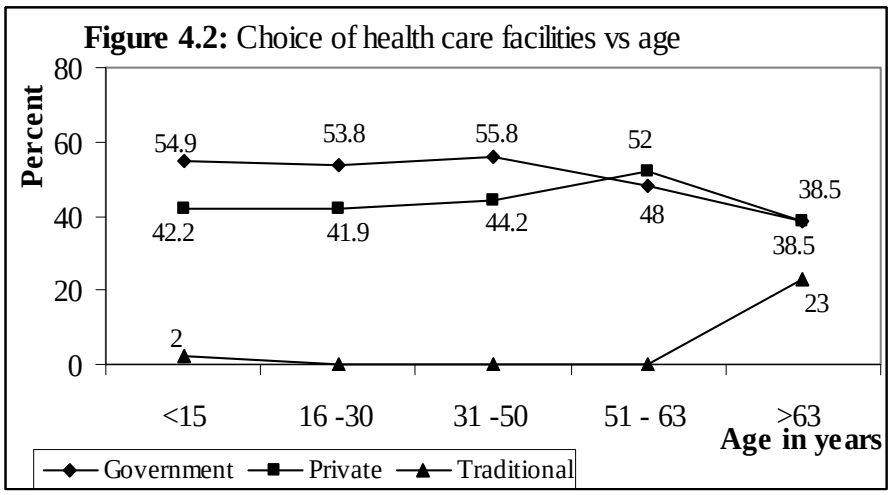
a) Age:

Viewed in terms of age groups, medical treatment seeking behaviour of respondents seems to show no association with an increase in age. However, close examination of the curves drawn for 'yes' and 'no' responses using trend lines indicates that:

(1) the percentage of those seeking treatment shows a slight decline with an increase in the age of respondents; and

(2) the respondents' behaviour of not seeking medical treatment tends to rise with age (Figure 4.1). On the other hand, the rate of utilization of public and private health care units appear to rise with an increase in age up to the mid fifties, beyond which not only the rate declines but also the use of traditional healers starts to increase from its low level (Figure 4.2). Hence, traditional health care services seem to be frequented more by older people than their younger counterparts.





b) Marital status:

The married and unmarried groups of respondents account for the largest proportion (with 35 and 48%, respectively) (Table 4.4). However, the majority of the respondents in all groups seem to show similar behaviour both in seeking medical treatment and

utilizing the various health care services. That is, marital status is observed not to markedly influence the demand for medical services, as opposed to the assertion of Feildstein (1988).

Table 4.4: Medical care seeking behaviour and facility choices vs marital status of respondents

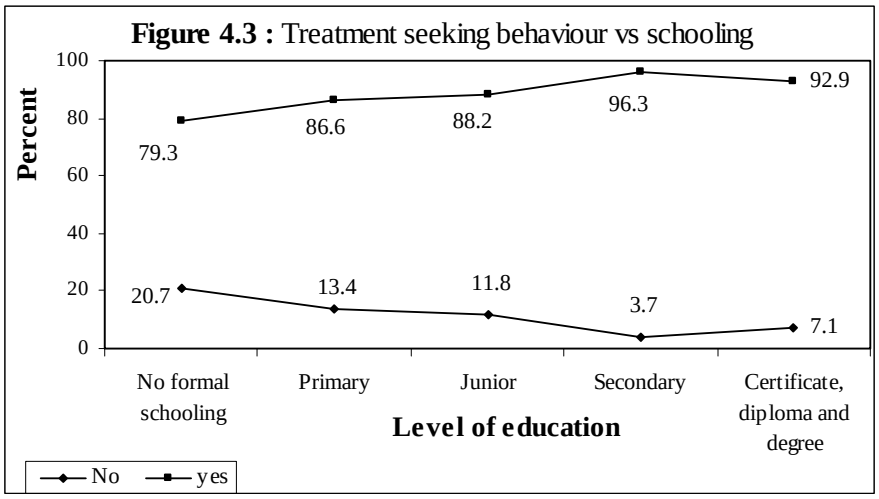
Marital Status	Seeking treatment		Total		Facilities chosen*			
	No	Yes			Government	Private	Traditional	Self treatment
	Row %	Row %	Count	Column %	Row %	Row %	Row %	Row %
Married	9.2	90.8	141	35.3	50.8	47.7	0.8	0.8
Unmarried	15.6	84.4	192	48.0	56.8	38.9	1.2	3.1
Divorced	20.0	80.0	45	11.2	55.6	44.4	0	0
Widowed	22.7	77.3	22	5.5	41.2	47.1	11.8	0
		Total	**400**	**100**	**(53.6)**	**(43.1)**	**(1.5)**	**(1.7)**

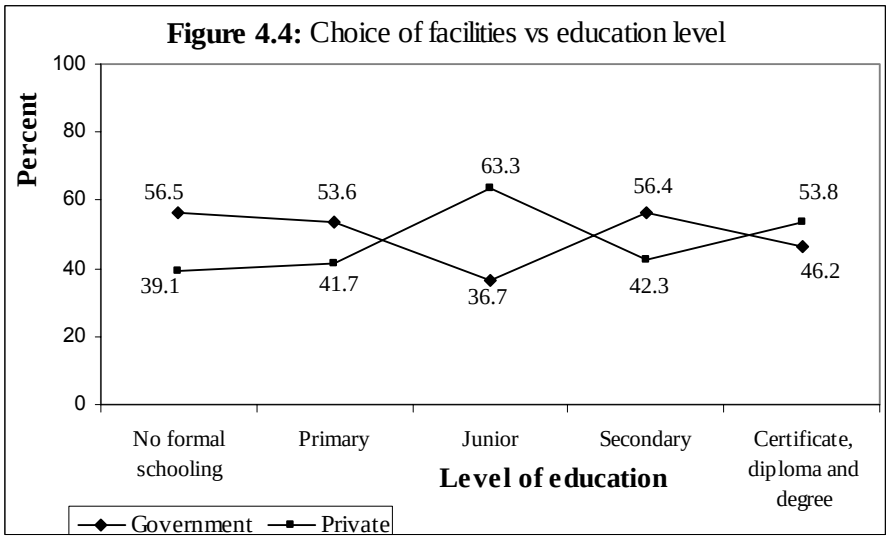
* *The figures in parentheses indicate the proportion of respondents who chose the various facilities out of those sought medical treatment.*

c) Education level:

Disaggregated by the level of education, variations are observed in the medical treatment seeking behaviour of respondents. As depicted by Figure 4.3 the percentage of those who sought medical treatment at times of illness is increasing with the level of schooling. On the contrary, the higher the level of education of the respondents the lower is the tendency not to seek medical treatment at time of illness. It can thus be concluded that education positively influences the decisions of individuals whether or not to seek medical treatment at times of illness.

On the other hand, education seems to have no impact on the choice of health care service providers. However, it can in general be observed that (1) private and public health care units are the most widely utilized facilities by the majority of the respondents irrespective of the level of education (as opposed to the traditional and self treatment which are used only by a very small proportion of respondent, and so not shown in the figure), (2) the choices of government and private health care facilities, respectively, show a slight tendency of decreasing and increasing with the level of education (Figure 4.4).





d) Income:

Based on the stated monthly income that the household of the patient obtained, households are divided into four quartiles representing income groups ranging from lowest to highest: quartile one (poorest), quartile two (lower-middle), quartile three (upper-middle) and quartile four (richest). Cross tabulation of the responses against

the level of income revealed that the higher the household income the higher will be the tendency to seek medical treatment. That is, as expected, income is observed to have an influential effect on the decision to seek treatment in times of illness. Thus, the richer the household of the patient, the more likely would be the probability of seeking treatment.

Table 4.5: Medical care seeking behaviour by income groups

Income Quartiles	Seeking treatment		Total		Facilities chosen*			
	No	Yes			Government	Private	Traditional	Self treatment
	Row %	Row %	Count	Column %	Row %	Row %	Row %	Row %
Quartile 1 (poorest)	23.0	77.0	113	28.3	63.2	28.7	3.4	4.6
Quartile 2 (Lower middle)	17.8	82.2	90	22.5	55.4	40.5	1.4	2.7
Quartile 3 (Upper middle)	14.4	85.6	97	24.3	56.6	42.2	1.2	0
Quartile 4 (richest)	1.0	99.0	100	25.0	41.4	58.6	0	0
	Total		**400**	**100**	**(53.6)**	**(43.1)**	**(1.5)**	**(1.7)**

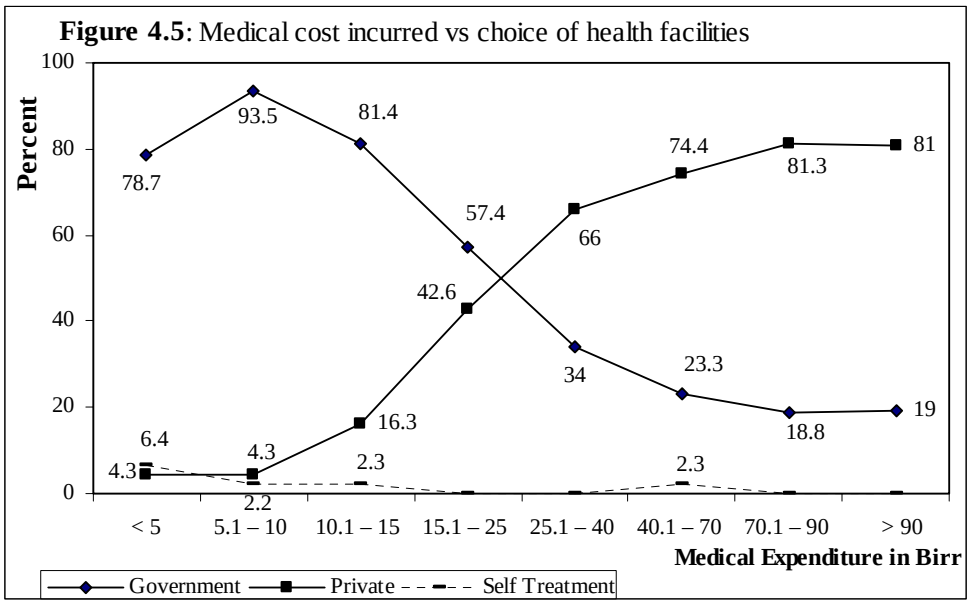
** The figures in parentheses indicate the proportion of respondents who chose the various facilities out of those sought medical treatment.*

With regards to the choice of a provider of health care services, on the average the majority (54%) of all the income groups frequent government facilities followed by private health care units (43%). The proportion of those using traditional health services and self treatment are significantly low, with a share of only 3% (Table 4.5). However, households' preferences seem to shift from government facilities to those of private ones as their income level rises, because the choice of government health care units tends to fall with the increase in the level of income while it rises in the case of private facilities. Moreover, lower income group households are observed to frequent traditional health services and self treatment, though the proportion is low.

e) Medical cost:

Generally, viewed in terms of cost of treatment, government health care units are the most utilized (54%) as compared to private health care facilities (43%). It was also

found that public and private providers on average charge Birr 24 and 83 per visit per patient, respectively. But close examination of the responses indicates that, given the types of illnesses that made patients visit a physician, with the rising medical cost of treatment, the percentage of patients visiting the government health care services declines while it is rising in the case of private health facilities (Figure 4.5). For instance, about 94% of the respondents reported to have paid Birr 5 – 10 for medical treatment at public health care units while the proportion of those who paid more than Birr 90 were only 19%. For private health care providers the corresponding response rates were 4.3 and 81%, respectively.



It can thus be safely deduced that, assuming all other factors to be constant, as the cost of medical treatment rises the probability of choosing the services being provided by the governmental health facilities falls while the reverse takes place for the private health care units. This means that at higher cost of treatment, private health care provisions are preferred to government ones. This may probably be due to the fact that, on the one hand, respondents associate quality with higher charges to medical treatment, and on the other, a larger portion of the private health care services are being utilized by the higher income groups in which case higher medical cost does not preclude them from using the private services. If these could be supported by an empirical analysis, they

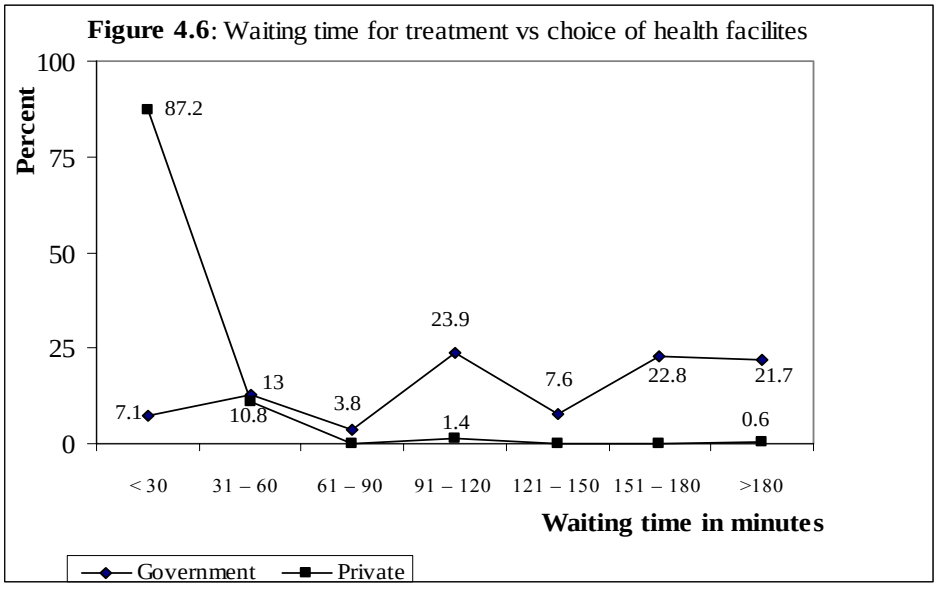
would have significant policy implications regarding the relationship between the medical cost and quality of services. Finally, it should be noted that the proportions of responses on expenditure for traditional and self treatment are significantly low.

f) Waiting time:

Generally, close to 97% of the respondents indicated the associations between waiting time and the choice of government and private health facilities. The responses of the rest 3% of the respondents failed to show any clear relationship between waiting time and choosing traditional health care services and self treatment. Moreover, the average waiting time for treatment at the public health care units was found to be about 148 minutes while it was only about 23 minutes in the private ones.

Figure 4.6 shows the relationship between waiting time for treatment in minutes and the choice of the two major health care providers: government and private facilities. As can be seen, the majority (87%) of those who attended private health facilities get treatment on average within less than 30 minutes. It is only a small proportion (11%) of the respondents that reported to have waited up to an hour before they get treatment. It should be noted that the percentage of the respondents that waited for treatment longer than an hour is insignificantly small.

Figure 4.6: Waiting time for treatment vs choice of health facilites



In the case of government health care units, the picture is different. While only about 24% of those who visited government health facilities obtained treatment within an hour and half, about half (54%) of the respondents had to wait for 1.5 to 3 hours to get medical attention. The remaining respondents (22%) reported to have waited for longer than 3 hours before receiving any medical attention.

Based on these observations, it appears that waiting time for treatment and choice of government and private facilities, respectively, are positively and negatively related. Thus, one might expect that when waiting time for treatment at the private facilities rises, the probability of choosing those facilities would decline, and the reverse would be true for the choice of government facilities. But from the point of view of economic theory, the latter case seems to give apparently less sense, because waiting time and demand for health care services are inversely related as waiting time involves an opportunity cost. However, the possible explanations for such an observation could be (1) the lower cost of treatment prevailing at government health care units; and (2) the inability of the majority of the households to afford the medical cost of treatment private providers are charging. Further the opportunity cost is less pronounced here because respondents are ill and are not able to work. In both cases, patients had no choice but wait as long as they get the required treatment at government health facilities.

g) Perceived quality of treatment and evaluation of the behaviour of staff members:
Table 4.6 presents the perceived quality of treatment and evaluation of the behaviour of the staff members of the various health care facilities under consideration. According to 78 to 88% of the respondents, the perceived quality of treatment as well as the behaviour of the staff members of government health care units fall on the scale of poor to good. On the other hand, more than 60% of the respondents valued the quality of treatment and the behaviour of the staff members of private facilities to be in the range of very good to excellent. These may indicate that private facilities are more preferred to those owned by the government. The latter observation could probably be one of the reasons for individuals to choose the private providers at a higher cost of treatment than the government ones.

Thus, one might conclude that not only offering better quality of treatment but also improving the way staff members treat their customers raise the probability of choosing a particular health care unit. It is also necessary to note that traditional health care services and self treatment are low quality options for medical treatment.

Table 4.6: Subjective factors and choice of health facilities

Facility Type	Perceived Quality of Treatment				Evaluation of the Behaviour of Staff Members			
	Poor to Good		Very Good to Excellent		Poor to Good		Very Good to Excellent	
	Count	%	Count	%	Count	%	Count	%
Government	112	78.3	72	36.0	128	88.2	56	29.2
Private	23	16.1	125	62.5	14	9.7	134	69.8
Traditional	3	2.1	2	1.0	3	2.1	2	1.0
Self treatment	5	3.5	1	0.5	-	-	-	-
Total	**143**	**100**	**200**	**100**	**145**	**100**	**192**	**100**

Finally, it is important to note that the statistical significances of the relationships depicted above by cross tabulation would be further examined and tested using the regression models developed for the two-stage analyses of medical treatment seeking behaviour and choice of health care service providers. The ensuing section is a follow-up to these general observations.

4.2. Empirical results

In this subsection, the regression results obtained from the estimation of the two empirical models discussed in section 3 are analyzed in the light of the objectives of the study. Hence, the analyses would be carried out in two stages. First, attempt would be made to identify the factors that influence the decisions of individual patients to seek medical treatment at times of illness. In the second stage, the factors that determine the probability of choosing a health care service provider (i.e., the factors that affect the demand for health care services) would be analyzed for those who sought medical care. For such analyses binomial logit models are employed as the dependent variables are discrete choice (dummy) variables.

Furthermore, to check for multicollinearity (i.e., whether the independent variables are correlated to one another), a correlation matrix of the independent variables is established. The correlation analysis revealed that distance travelled to reach the chosen health facility (DIST) and time spent in travelling to reach to that health facility (TRAT) are highly correlated. In addition, the length of days the patient has been ill (LDAY) and the length of days the patient was not able to perform his/her regular activity due to the illness (LUW) are also found to be highly correlated (Annex). Consequently, only one of them from each group of correlated variables is included in the regression

analysis. In addition, variables that have little or no contribution to the improvement of the adjusted R^2 are excluded from the regression analysis.

The coefficients obtained in Logit models are not directly interpreted as the change in the probability of occurrence caused by a unit change in the independent variables. But the signs of these coefficients, as usual, indicate the directions of association between the explanatory variables and the probability of occurrence. To capture the marginal effects (i.e., the magnitude of the change in the probability of occurrence) caused by the changes in the explanatory variables, the odds ratios are calculated. Hence, an odds ratio greater than one indicates the increase in the probability of an event occurring compared for it not occurring, while the reverse holds when the ratio is less than one.

Taking the value of the pseudo R^2 to be similar to R^2 in the regression analysis, it can be concluded that almost in 83 percent of the cases the explanatory variables included in the model explain the variation in the probability of seeking treatment in times of illnesses. However, examining each variable included in the model reveals that only five variables (SX, LDAY, HHS, INCH and DIST1) significantly influence the decisions of patients in seeking or not seeking treatment (Table 4.7).

Accordingly, sex of the patients (SX) is one of the variables having significant effect on the patients' decision whether or not to seek medical treatment outside from home. Noting that a unit change in the dummy variable SX indicates the switch from female to male, the odds ratio indicates that, other things being equal, the probability of male patients to consult a physician at times of illness is nearly 12 times as high as that of females. In addition, the positive sign of the parameter depicts the direct relationship between the probability of seeking treatment and sex of the individual. That is, compared to females, males are more inclined to seek medical treatment at times of illness. This result is consistent with the findings of KUWAB Consultants (1996).

The second variable that has a fairly significant effect (with the expected sign) is the length of days that the patient has been ill (LDAY) in the last four weeks prior to the survey date. This variable can be taken as a proxy for the severity of the illness. Thus, other things being equal, additional days of illness of the patient are estimated to raise the odds of consulting a physician by a factor of 1.14.

The other variable that has a fairly significant effect on the patients' probability of seeking treatment is the size of the household (HHS). The negative value of this coefficient shows that the larger the household size the lower would be the probability of seeking

treatment, other things held constant. This could probably be due to lower income per capita associated with large family households. Observe also that an additional member in the patients' family would reduce the odds of consulting a physician by a factor of 0.72. This finding is also consistent with that of KUAWAB Consultants (1996).

Table 4.7: Decisions whether treatment was sought or not

Binomial Logit Model: Maximum Likelihood Estimates (seeking treatment = 1, not seeking = 0)				
Variable	**Coefficient**	**Odds ratio**	**t-ratio**	**Significance level**
SX	2.443887	11.51772	2.088**	.037
AG	-.0501915	.9510473	-0.695	.487
LDAY	.1278142	1.136342	1.845*	.065
HHS	-.3333731	.7165028	-1.751*	.080
INCH	.0076866	1.007716	2.005**	.045
SXH	-.5583246	.5721669	-0.562	.574
OH	.9941459	2.702415	1.085	.278
DMS	1.427257	4.167253	1.099	.272
DOCCP	-.4584896	.6322379	-0.423	.672
AGESQ	.0003575	1.000358	0.417	.677
DIST1	-3.953213	.0191929	-5.578***	.000
DSCCUH	.023129	1.023399	0.015	.988
DSCCU	.952921	2.593274	0.640	.522
CONS	7.23342		3.413	.001
LR Chi^2 (13) = 255.85 [3]	Prob > chi^2 = 0.0000		Pseudo R^2 = 0.8307[4]	

*Note: The estimates are significantly different from zero at * 10%, ** 5% and *** 1% significance levels.*

Monthly income of the household (INCH) is the fourth variable found to produce a significant effect (with the expected sign) on the probability of seeking medical treatment. The regression result indicates that the higher the monthly income of the household, the higher would be the probability of the household seeking treatment. More specifically, the increase in the income of a household is estimated to raise the probability or the odds of consulting a physician by the same proportion. Abdulhamid and Alem (1996) and KUAWAB Consultants (1996) have also arrived at the same conclusion.

[3] Using the chi square test with 13 degrees of freedom, the likelihood ratio (LR) statistic 255.85 describes the result of the joint significance hypothesis tests about the coefficients involved indicating that the model is significantly different from the intercept-only model.

[4] The pseudo R^2 measures the proportion of the "uncertainty" involved in the data as explained by the empirical results.

The last variable observed to strongly and negatively influence the medical seeking behaviour of households is the distance between the patients' homes and the nearest health facility (DIST1). Accordingly, if the distance to the nearest health care unit increases by one kilometre, the odds of consulting a physician fall by a factor of 0.02. The same result was found by KUAWAB Consultants (1996).

By way of winding up the discussion on the regression results obtained by the first model, it should also be noted that variables such as the education level of the household head (DSCCUH) and that of the patient (DSCCU), and age (AG) and marital status (DMS) of the patient were found to have no statistically significant impact on the decisions households are taking to seek or not to seek medical treatment.

With regards to the second binomial logit model set to identify the factors that contribute to the probability of choosing health care service providers, it is generally observed that close to 73 percent of the variation in the probability of choosing a health care facility for treatment is explained by the explanatory variables included in the specified regression analysis. Moreover, the likelihood ratio statistic 315.78 (estimated by a chi square test with 14 degrees of freedom) shows that the result obtained by the regression analysis using the specified model is significantly different from the intercept-only model. Note that as the proportion of those choosing traditional health care services and self treatment are relatively small, the regression analysis was carried out only for those who chose private and public health care units.

Table 4.8 shows that, among the 14 variables included in the logit model, only 8 variables (AG, MEDC, WAIT, SXH, DPQUAL, DBSTAF, DSCCU and AGESQ) are found to have significant impact in determining the choice of health car facilities at 1 to 10% significance levels. Hence, age (AG) and the square of age (AGESQ) of the patient are found to influence the probability of choosing a private health facility positively and negatively, respectively, at 10% significance level (i.e., the probability of this being not the case is only 10%). The former result indicates that younger patients tend to utilize private health facilities more often as compared to their older counterparts. But this tendency falls as the age of the individual increases (as depicted by the negative coefficient of the AGESQ term).

More specifically, assuming all other factors to be constant the odds ratios depict that a one year rise in the age of the patient at the early stage would raise the probability of choosing private health care facilities by a factor of 1.13 while at the latter stage it would reduce it by a factor of 0.998.

Table 4.8: Choice of health care service providers (private versus public)

Binomial Logit Model: Maximum Likelihood Estimates (private = 1, public = 0)

Variable	Coefficient	Odds ratio	t-ratio	Significance Level
SX	.7622588	2.143112	1.363	.173
AG	.1221595	1.129934	1.880*	.060
LUW	.0255233	1.025852	.650	.156
MEDC	.0168779	1.017021	2.525***	.012
WAIT	-.0466857	.9543874	-6.257***	.000
DIST2	.2372199	1.26772	.501	.617
HHS	-.075606	.9271814	-.663	.507
INCH	-.0002718	.9997283	-.224	.823
SXH	1.663938	5.280065	2.234**	.025
DMS	-1.167203	.3112362	-1.464	.143
DPQUAL	1.698189	5.46404	2.680***	.007
DBSTAF	1.727149	5.624597	2.726***	.006
DSCCU	-1.433797	.2384019	-2.038**	.042
AGESQ	-.0015787	.9984225	-1.683*	.092
CONS	-2.483857		-2.008	.045

LR chi^2 (14) = 315.78 Prob > chi^2 = 0.0000 Pseudo R^2=0.7330

*Note: The estimates are significantly different from zero at * 10%, ** 5% and *** 1% significance levels.*

The other two variables that are defined as dummy, namely SXH and DSCCU have positive and negative significant influence on the probability of choosing private health care units respectively. Thus, other things being equal, male headed households have higher tendencies to use private health care units for treatment at times of illness as compared to female headed households; the males' probability of choosing private facilities being 5.28 times as high as those of females'. The result obtained on the level of education, on the other hand, shows that the more a patient is educated, the less likely would be private facilities to be chosen for medical treatment. Ceteris paribus as the odds for choosing private facilities by those with education level of secondary and above is 0.24 times those of below secondary level, it means that there is a decreased chance of choosing private health care units by relatively educated patients.

Among the economic variables included in the model, while medical cost of treatment per visit (MEDC), which represents the monetary cost aspect, becomes significant determinant of the probability of choosing the private health facility for treatment, income of the patient failed to show any significant impact on the choice of health care facilities

as opposed to the general expectation and the cross-tabulation result. Based on the sign of the estimated coefficient and the odds ratio, it can be concluded that a unit rise in the medical cost of treatment increases the probability of choosing private health care units by a little more proportionately than that of public facilities (as the odds ratio is 1.02). This result, however, is not expected from the point of view of economic theory because it implies that raising medical cost of treatment raises the probability of choosing health facilities. The fact that more individuals utilize private facilities at higher cost of treatment can be attributed to the quality of health care services being provided by these facilities and their availability for urgent services.

Waiting time for treatment, i.e. the access variable that denotes the non-monetary cost of treatment, on the other hand, is observed to reduce the probability of choosing private health care facilities by a factor of 0.95 as compared to those of public facilities. That is, the higher the time patients spend at private health facilities before they get treatment, the lower would be the probability of choosing them for medical treatment.

The last two variables that are found to significantly and positively influence one's choice of where to get treatment are the subjective factors, defined as the perceived quality of treatment obtained (DPQUAL) and the behaviour of the medical staff while giving treatment (DBSTAF). In this regard, a unit change in the perceived quality of treatment and in the patients' evaluation of the behaviour of the staff members (from 0 to 1) indicates shifts in patients' ratings of the dummy quality variables from "poor to good" to "very good to excellent". Therefore, as a result of a unit change in these two subjective variables, the chances for choosing private health facilities are estimated to be more than five times as high as choosing public facilities, if all other factors are kept constant. This indicates that there is a higher chance of choosing the private than the public health service providers because of the effect of these quality variables. The study conducted in Kenya by Mwabu, et al. (1995b) also arrived at the same result.

5. Conclusions and policy implications

5.1. Conclusions

The provision of proper health care services is discussed as a major component of the drive to improve both the health status of the people and the level of economic development of a country. This paper, using primary data collected from households in Bure town, tried to examine the factors that determine the medical treatment seeking

behaviour at times of illness and the choice of health care service providers (i.e. the demand for health care services) through both descriptive and empirical analyses.

The descriptive statistics showed that out of the 400 patients that have been addressed by this study, only about 14% of them did not seek treatment while 86% sought medical treatment mainly from public and private health care units (54 and 43%, respectively). The proportions of those who attended traditional healers and practiced self treatment were very small (3%). High cost of treatment and long distance to the nearest health care facility were found to be the main reasons for not seeking treatment. But for those who sought treatment, while low cost of treatment was the principal factor for choosing public health care units, private health facilities were chosen primarily for the best quality of treatment they were providing.

Cross tabulations of households' responses against demographic, economic, access and subjective variables and analyses of the estimated empirical results generated the following major findings and conclusions.

First, the sex of the patient (being male), the length of time that the patient had been ill (which is a proxy for the severity of the illness), and the monthly income of the household were found to have a strong positive effect on medical treatment seeking behaviour but not on the choice of health care service providers. That is, males compared to females, those who have been ill for longer days and those with higher monthly income per household have higher tendency to seek treatment whenever they fall ill. However, these same factors do not seem to help in the decisions patient are taking as to which health care service provider to choose for medical treatment. It can thus be concluded that the gender of the patient and the monthly income of the family have significant roles in medical treatment seeking decisions. Females and those with low monthly income are less likely to take any medical treatment when they fall ill.

Second, the size of the household and distance to the nearest health facilities were also found to have a strong negative effect on whether or not treatment was sought but not on the choice of health facilities. According to the results obtained, the higher the number of family members in the household and the longer the distance a patient has to travel to reach the nearest health care unit, the larger will be the probability of not seeking medical treatment at all. Thus, at such small tendency for medical treatment, it would not be surprising to observe these two factors having no impact on the choice of health care facilities.

The conclusions that can be drawn form these observations are: (a) in households with larger family size the per capita income is likely to be low so that a patient in such family is less likely to seek treatment at times of illness; and (b) due to the longer distance of a health care facility from a household, the higher would be the opportunity cost incurred by other family members in transporting the patient so that the lesser would be the chance to get medical treatment.

Third, age level of the patient in years and sex of the household head (i.e. being male) were found to have a positive influence on choosing the private health facilities but not on whether treatment was sought at times of illness. Moreover, the square of the age level of the patient was also found to have a negative effect in choosing the private health facilities but not on whether treatment was sought. The same result was also found by cross tabulation. These results indicate that the probability of choosing private health care facilities increases with the increase in the age of the patient up to a certain level and then it starts to decrease afterwards. Thus, based on the results obtained for age and age square, it can be concluded that private health care services are utilized more by younger and adult patients than the older patients.

Fourth, the regression result revealed that both the level of education of the patient and the household head (i.e. being secondary level and above) have no significant impact on treatment seeking behaviour, though cross tabulation established a positive relationship. However, the education level of the patient was found to significantly and negatively affect the choice of private health facilities. Accordingly, the more the patient is educated the less likely would he be to prefer private to public health care units for medical treatment at times of illness. In this connection, one would be prompted to conclude that (a) compared to other factors the level of education plays an insignificant role in determining the treatment seeking behaviour of patients; and (b) education does not necessarily make patients choose private facilities.

Fifth, the results of the quality variables that denote the perceived quality of treatment obtained and the behaviour of the staff members while providing treatment (i.e. being very good and excellent) were found to positively affect the choice of privately provided health care services. That is, viewed in terms of the perceived quality of medical treatment and the welcoming reception of the staff, patients prefer more private health care units to government ones. It can, therefore, be noted that the quality of medical services being provided and the attitudes and behaviour of the medical team towards the patients are important factors to attract patients to a particular health care unit.

Sixth, both cross tabulation and regression analysis produced unexpected result by establishing the per visit cost of medical treatment to have significant positive impact on the choice of private health care provisions. This means that an increase in the medical cost of treatment per visit would increase the probability of choosing private health facilities. This being contrary to economic theory, one can conclude that this is a grey area which warrants more research before the result can be relied on.

Lastly, waiting time for treatment was found to have a strong negative effect on the probability of choosing private health facilities as expected. Hence, the probability of choosing private health care service providers would fall as the time patient are expected to wait before they get medical treatment increases. Hence, reducing the time patients are to stay at health care units is likely to improve the rate at which the facilities are utilized.

5.2. Policy implications

On the basis of the descriptive and analytical findings of this study, some policy implications can be drawn.

The age and sex of the patient and of the household head, the monthly household income, and the family size of the household are observed to significantly influence the decisions individuals are making whether to seek treatment and/or which health care facility to choose. These imply that, as the elderly and women are the most vulnerable to diseases (due to age and maternity related cases), mechanisms should be devised to enable the provision of special health care services to both these groups. In addition, the much lower treatment seeking behaviour of females than that of males implies the need to raise the awareness of women in particular and the community at large in seeking medical treatment at times of illness. Introducing appropriate family planning strategies would also be of indispensable importance in improving the general health status of the family.

Moreover, creating additional income generating opportunities that improve family income (particularly that of women), which of course is a general macroeconomic policy of most governments, is likely to raise the demand for health care services from the formal health sector, thereby improving the health status of the population at large, which in turn is the basis for the economic development of a country. However, the fact that raising the income of the people is not a task that can be achieved within a short period of time would require the supply side interventions a necessary measure to prevent the poor, the aged and the women from not being marginalized.

Reducing the distance to the nearest health care facilities, irrespective of the type of the provider, is likely to raise demand for health care services. But increasing access by constructing new health facilities alone cannot be a panacea to increase utilization because both the quality of treatment being provided (i.e., availability of sufficient medical inputs of all sorts) and the way the staff members deliver the treatment were found to be important determinants of demand for health care services. Particularly, most patients perceived public health care services to be not only of poor quality compared to their private counterparts, but also the way the medical staff at government owned health care units attend the patients are evaluated to be below the expected standard. Hence, increasing the availability of public health care facilities must be accompanied by the necessary medical inputs (such as essential drugs and medical equipment) and well trained personnel. This seems to have an important implication on the MOH's future plan to operate on cost-recovery basis. Therefore, if the Ministry at all wants to capture a greater share of patients and secure higher revenues by introducing higher user charges, it should necessarily have to improve first the quality of health care services being provided by the facilities under its control.

The average waiting time for treatment at the public health facilities was found to be about 148 minutes while it was only 23 minutes at the private ones. On the other hand, the average medical costs of treatment per visit were about Birr 24 and 83, respectively. Thus, any public policy to be structured with regards to such issues must take these discrepancies into consideration.

The contributions of the private health care service providers could not be overlooked as they are utilized by relatively large proportion (43%) of the respondents. Hence, the policy of the Ministry of Health aimed at promoting the participation of the private sector in the provision of health care services should further be strengthened by introducing various incentive schemes that would enable private facilities to expand. Not only that, the Ministry should devise mechanisms that ensure the provision of best quality health care services to the users.

To sum up, though it is difficult to generalize based on findings obtained using data from a single sample area, what looms out of this preliminary study is the need for the intervention of the government in improving the quality of health care services being provided and reducing the waiting time for medical treatment before any attempt is made to raise user fees at government health facilities, as these variables are the main determinants of demand for health care services.

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Annex: ***Correlation Matrix of Independent Variables***

	sx	ag	1day	luw	medc	trat	wait
sx	1.0000						
ag	-0.0110	1.0000					
1day	-0.0250	0.2074	1.0000				
luw	-0.0420	0.2288	0.8435	1.0000			
medc	-0.0731	0.1835	0.2597	0.3280	1.0000		
trat	0.0525	0.0387	0.1065	0.0914	-0.1122	1.0000	
wait	0.0316	-0.0064	-0.0069	-0.0624	-0.3015	0.1813	1.0000
dist	0.1540	-0.0016	0.1922	0.1276	-0.0055	0.6878	0.0845
hhs	0.0519	-0.1029	-0.0315	-0.0368	-0.0164	-0.1007	0.0333
inch	0.0800	-0.1266	-0.1606	0.1030	0.0618	-0.0831	-0.1146
sxh	0.2203	-0.1391	-0.0794	-0.0081	-0.0279	0.0027	-0.0360
doccp	0.2081	0.4642	0.0620	0.0218	0.1318	-0.0392	-0.0454
dpqua1	-0.0798	0.0461	-0.0808	-0.0445	0.1940	-0.0901	-0.3096
dbstaf	-0.0548	0.0454	-0.0178	0.0143	0.2377	-0.1570	-0.4846
dsccu	0.1787	-0.0063	-0.0641	0.0002	0.0798	-0.0688	-0.0228
dsccuh	0.0893	-0.2643	-0.1936	-0.1433	0.0478	-0.1225	-0.0185

	dist	hhs	inch	sxh	doccp	dpqual	dbstaf	dsccu	dsccuh
dist	1.0000								
hhs	-0.0939	1.0000							
inch	-0.0085	0.4095	1.0000						
sxh	0.1198	0.2709	0.3292	1.0000					
doccp	-0.0565	-0.0327	0.0330	-0.0974	1.0000				
dpqual	-0.1678	-0.0745	0.0373	-0.0665	0.0341	1.0000			
dbstaf	-0.1618	-0.0832	0.0211	-0.0413	0.0280	0.4065	1.0000		
dsccu	-0.1045	-0.0863	0.0563	0.0588	0.1362	0.0531	0.0210	1.0000	
dsccuh	-0.0230	-0.0383	0.4270	0.2521	-0.0714	-0.0614	0.0119	0.3849	1.0000