EFFICIENCY AND FINANCING OF HEALTH SECTOR: A STUDY OF SECONDARY LEVEL HEALTH SERVICES IN ANDHRA PRADESH

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DECEMBER
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DEDICATED

TO

The memory of my father

Krishna Chandra Dash

DECLARATION

This is to state that the thesis entitled **"Efficiency and Financing of Health Sector: A Study of Secondary Level Health Services in Andhra Pradesh"** submitted to the Department of Economics, University of Hyderabad for the award of degree of Doctor of Philosophy in Economics, is the original work carried out by me under the supervision of Dr. K N. Murty, Reader, Department of Economics, University of Hyderabad, and the same has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or any other similar title of recognition.

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CERTIFICATE

I certify that the thesis entitled "**Efficiency and Financing of Health Sector: A Study of Secondary Level Health Services in Andhra Pradesh**" submitted by Mr Puma Chandra Dash, to fulfil the requirement for the award of the degree of Doctor of Philosophy in Economics, has been carried out under my supervision and no part of the thesis has been submitted for any degree or diploma of any other university

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LIST OF ABBREVIATIONS

AC	Average Cost
ALS	Average Length of Stay
APVVP	Andhra Pradesh Vaidya Vidhana Parishad
BOR	Bed Occupancy Rate
BTR	Bed Turnover Rate
CBR	Crude Birth Rate
CDR	Crude Death Rate
CES	Constant Elasticity of Substitution
CHV	Community Health Volunteers
CUP	Combined Utilisation and Productivity
CV	Coefficient of Variation
DHA	District Health Authority
DHS	Directorate of Health Services
DRG	Diagnostic Related Groupings
EOS	Economics of Scale
FTE	Full Time Equivalent
FW	Family Welfare
ICD	International Classification of Disease
IHO	Intermediate Health Unit
IMR	Infant Mortality Rate
LER	Life Expectancy Rate
MAPE	Mean Absolute Percentage Error
MC	Marginal Cost
MCH	Maternity and Child Health
MNP	Minimum Needs Programme
MPW	Multi Purpose Workers
NHP	National Health Policy
OLS	Ordinary Least Squares
PHC	Primary Health Center
RMPE	Root Mean Percentage Error
ST	Scheduled Tribe
TC	Total Cost
VES	Variable Elasticity of Substitution
WHO	World Health Organization
WLS	Weighted Least Squares

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CHAPTER I
HEALTH SECTOR IN INDIA: AN OVERVIEW

1.0. Introduction:

Health is a fundamental human right and a world wide social goal Health is necessary for the realization of basic human needs and to attain the status of a better quality of life In 1977, the 30th World Health Assembly decided that the main social target of governments and World Health Organization (WHO) in the coming decades should be " the attainment by all the citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life" (WHO 1979)

Such a declaration has led most of the governments in western countries to give much more priority to their health care systems through higher allocation and better utilization of resources in order to improve the quality of health care Less developed countries are in the process of improving it and some among them are yet to start India also has been attempting towards this end The major hindrances on its way could be attributed to inadequate allocation of resources for the health sector, rapid population growth, inefficient use of the resources allocated and above all lack of public consciousness about their own health status Health being a State subject in the Indian federal system, different states in the country have been trying to meet the WHO health goal through mobilization of both internal and external resources including the funds from foreign agencies Specifically, the state of Andhra Pradesh has been in the forefront in this regard and somewhat successful in developing a better public health care delivery system. However, the achievement of the goal of "health for all" for the state is perhaps still a distant dream Here a major point that needs to be understood is that the country needs to give emphasis on the rural health services where nearly 70% of total Indian Population still lives. Despite repeated pronouncements by the policy makers about the need for rural emphasis, health services provided to the people have continued to be urban oriented where a major chunk of the resources allocated to the health sector are spent In this chapter we attempt to give an outline of the functioning of the health care delivery system of India in general and Andhra Pradesh in particular Before going into detailed debate on the issues involved it may be useful to clarify certain baste concepts that are frequently used in health care research

1.1. Definition of health:

Different professional groups define the concept of health in different ways Medical professionals define health in terms of illness, which, in turn is expressed in terms of mental or physical disorders This concept of health is predominantly based on pathology and is concerned with the presence or absence of disease and the stage of its invasiveness Some others define illness through giving emphasis to the amount of pain suffered or the degree to which individuals are restricted in undertaking their normal day to day activities For some, the maintenance of health is also linked to social aspects such as unemployment and wealth. The broadest definition of health appears to accept anything and everything that can affect health status The most widely accepted definition of health given by World Health Organization (WHO 1948), quoted in FRCH (1987) is as follows

"Health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity".

Having defined health in the above fashion, WHO developed the following indicators of health

(a) **Health policy indicators:** Political commitment to health for all, resource allocation, the degree of equity of distribution of health services, community involvement, and organizational framework and management process

(b) **Social and economic indicators: Rate** of population increase, GNP or GDP, income distribution, work conditions, adult literacy rate, housing and food availability.

(c) **Health care indicators:** Availability, accessibility, utilization and quality of care

(d) **Health status indicators:** Birth weight, nutritional status and psychological development of children, infant mortality rate, child mortality rate, life expectancy at birth, maternal mortality rate, disease specific mortality, morbidity incidence and prevalence, disability prevalence (WHO 1981b)

Given these indicators of health, the achievement of the goal 'health for all' is not only the responsibility of the individuals seeking health care, but also of the community, state and international agencies as well The role of the individual differs from country to country depending upon the social, economic, cultural and environmental conditions The indicators given above bring out the multidimensional nature of health All the above indicators are inter linked and the improvement of health status and health care is emphasized in all of them (World Development Report, 1993) [1]

1.1.1. Health status and health care:

These two concepts differ in their basic nature. Health status has a value in use,

[1] Using these indicators as measures of health status, it is argued that, in case of underdeveloped countries health status is low compared to developed countries The reasons cited are, low income level and higher population growth, which characterize developing countries Also growing industrialization is another

but contains no value in exchange A detailed discussion about the measurement of health status such as disease specific mortality, morbidity, incidence and prevalence of different diseases and disability caused by different diseases requires a separate study and is not within our scope. This study aims at establishing a relationship between cost of health care and health output The latter includes outpatient care, inpatient care, emergency care etc, which are provided through different health care institutions at various levels This study however focuses on secondary (curative) health care institutions only As a background for our study, in the next section, we attempt to give a brief historical overview of the health status indicators for India and Andhra Pradesh

1.2. Health status in India:

1.2.1. Pre-Independence period:

The earliest indigenous system of medicine can be traced back to the development of Vedic medicine following the Aryan migration to the Indus Valley "The Vedic Samhitas which were religious texts, contain the concepts of anatomy, physiology and pathology which were quite impressive" (Banerji 1974) Ashok Maurya (279 - 236 B C) was responsible for the spread of social medicine, manifested in a public health care system that included hospitals and Sanitaria for men, women and children (FRCH 1987)

During the medieval period, physicians from west Asia who were trained in Unani system, compiled and translated Ayurvedic texts Hakim Yooufi (16th century) a physician in the court of Baber and Humayun is said to have synthesized Arabian, Persian and Ayurvedic thought and produced a composite and integrated medical system (Leslie 1974). The late 19th and 20th century saw the method of Ayurvedic Physicians

important reason. Industrialization is a major cause of environmental pollution, which in turn leads to chronic diseases.

who " were radically different from the classical texts and were deeply influenced by the Galenic (Unani) traditions in Islamic Medicine" (FRCH 1987)

Western system of medicine was introduced in India in the latter half of the 18th century mainly to serve the needs of the colonial settlers and their armed forces that came to rule India [2] These facilities were extended to a small segment of people, mostly elite masses, living in urban areas. Those people could get better western medical facilities including health-related services such as sanitation and water supply A larger segment of people who were staying in the rural areas was neglected except in periods of incidence of massive epidemic diseases such as plague, cholera and small pox Therefore, the rural population relied upon the indigenous medical system

The report of the health survey and planning committee (Bhore Committee) submitted to the Government in 1946, gave the following health status of the country on the eve of Indian Independence (Table 1 1)

Also the committee pointed out that " high morbidity and mortality were largely preventable and were mainly due to the absence of safe drinking water, sanitation, waste disposal, poor nutrition, lack of preventive and curative health services and poor health consciousness among the people themselves" (Govt of India, 1946)

In addition, the committee pointed out the severe shortage of medical personnel Independent India inherited a limited infrastructure of modern health services from the British. The medical training was oriented towards the needs of the army medical personnel It was expanded and institutionalized in the licentiate course offered by the

[2] The emergence of an organized public health system, m fact, dates back to the appointment of an inquiry committee. 'Royal Commission[1] in 1859 in order to investigate the causes of poor physical condition in the British Indian army.

Table 1.1: General health statistics in British India*, 1944

Statistic	Value
General death rate per 1000	22.4
Infant mortality rate /1000	162
Life expectancy at birth (Years) Females	265
Males	269
Death rate of children under 10 years /1 000	4
Disease	Incidence (%)
Cholera	24
Small Pox	11
Plague	05
Fever Including Malaria	584
Dysentery	42
Respiratory diseases	76
Others	258
Total	100

* Figures do not include the princely states

Source Health Status of Indian People, FRCH, 1987

Universities of Madras, Calcutta and Bombay Looking at the circumstances Bhore committee recommended that at least 15% of total public expenditure should be devoted towards health sector

1.2.2. Post-Independence period (1951-1997):

In contrast to the recommendations of Bhore Committee (1946), it could be seen from various plan documents that the expenditure on health sector has been declining during post-independence period The outlay has decreased from 3 3% in the first plan (1950-56) to 3% in the second plan (1956-61), 2 6% in the third plan (1961-66), 2.1% in the fourth plan (1969-74), 1.9% ir the fifth plan (1974-79), 1 8% in the sixth plan (1980-85) and seventh plan (1985-90) (Health Statistics of India, 1984)

However, with 3 3% of the total allocation for health sector, the first plan (1951-56) aimed at providing safe drinking water to the people, controlling the communicable diseases like malaria, cholera, tuberculosis etc, opening smaller health units for providing health services to the rural masses and providing basic family planning services Since mere opening of health units does not mean better provision of services, the plan also aimed at equipping the health units with trained personnel along with adequate provision of drugs and equipment

One spectacular achievement of the first plan was launching a program to control communicable diseases like malaria, small pox, tuberculosis, leprosy, filariasis, trachoma and cholera In addition, 725 smaller health units, known as primary health centers (PHC) were also opened during the first plan The All India Institute of Medical Sciences (AIIMS), various research centers to study the major diseases and a few training centers for paramedical workers were also established

Though various programs were launched and various institutions were opened during the first plan, the benefits of such programs could not be realized during first plan itself Therefore, the second plan (1956-61) re-emphasized on the same set of objectives with special attention on the implementation of the already existing programs

The Health Survey and Planning Committee (196la) under the chairmanship of Sir Laksmanswami Mudaliar made an evaluation of the progress in health conditions and health services from the period after the submission of Bhore Committee (1946) report The committee pointed out that there was a significant progress in controlling the communicable diseases and establishing various institutional facilities during first two five-year plans The deaths due to cholera, malaria and small-pox were found to be halved and institutional facilities in the form of hospitals and dispensaries had increased from 9068 in 1950 to 13875 in 1960 and the number of hospital beds increased from 112,000 to 200,000 during the same period The report, however, revealed that" almost one third of the total number of beds are to be found in 125 teaching hospitals, 47% of the total number of beds are provided by 6 6% of the hospitals with 200 beds and above " The vast majority of these institutions were situated in urban areas "Hospitals with a bed strength of less than 50 form over 70% of the total number of hospitals and only 19% of the total beds are to be found in them" The committee admitted that the basic health facilities had not reached at least half the nation In addition, the committee also reported the non-availability of adequate manpower and infrastructure facilities in the already established health care institutions Therefore, the committee recommended consolidation, rather than expansion, of the existing PHCs and their phased upgrading, achieving the norm of 40,000 population per PHC instead of 60,000, discontinuation of the establishment of new PHCs in the absence of full employment of staff, and equipping of district hospitals with "Mobile Clinics" for the non-PHC population

In view of the drawbacks of first and second five year plans, as pointed out by Mudaliar Committee (196la), the third and fourth five year plans (1961-66, 1969-74) gave more emphasis on the training of health manpower that were required for smooth running of already established institutions The third plan aimed at providing "increased facilities" for linking health and social education

The fourth plan with regard to the PHC program, took up the immediate objective of establishing "an effective machinery for the speedy construction of building, taff, drugs and equipment" which was to become the minimum needs program (MNP) It emphasized on both curative as well as preventive services in rural areas as a base for the control and eradication of communicable diseases Towards the end of fourth plan, in February 1973, in addition to the preventive and promotive health services, the government announced its intention of providing "specialized services" in medicine, surgery, obstetrics and gynecology For the first time, substantial amounts were allocated for the training of paramedical cadre (Rsl293 Crores) Further, 10 more medical colleges were opened during plan period, bringing anticipated doctor population ratio to 1 1510 in 1968 compared to 1 6100 in 1961 This is in sharp contrast to the rural situation where each PHC with maximum 2 doctors served a population of nearly 120,000

In spite of various attempts made during third and fourth plan in order to reduce regional disparities, the provision of health services were found to be urban oriented Therefore, the fifth plan (1974-79) aimed at correcting these problems through providing better accessibility to the health services to the rural masses In addition, the plan also emphasized on developing referral services, improving the quality of medical education and training of health professionals, and above all, integrating the health and family welfare components in order to provide minimum public health services in the country. The chief instruments for achieving these goals were the MNP, the multi purpose worker (MPW) training scheme, and the priority treatment of backward and tribal areas The MNP which was a package of inputs in the field of health, nutrition, environmental improvement and water supply, elementary adult education, roads and electrification in rural areas and housing for land-less laborers received a large outlay of Rs 2,291 crores and the MPW training scheme received Rs 8 crores In addition, the plan targeted the opening of 101 PHCs, 11,036 sub-centers and 1,293 rural hospitals for rural and remote areas Further, in 1977 the GOI introduced a major innovation in the nation's health strategy by launching a program for training village based health auxiliaries and the community health volunteers (CHV) scheme[3]

Though various attempts were made during last five plans in order to make the health services accessible to rural masses, the actual beneficiaries of health services were found well-to-do urban households It was felt that, heavy emphasis on hospitals, specialization and super specialization and highly trained doctors are the major reasons for making the health services urban oriented

The sixth five-year plan (1980-85) took these drawbacks as major points and re-emphasized on the community based health care system with special objective of providing health services in rural areas on a priority basis In order to facilitate this it was

[3] The CHVs were part-time workers selected from villages and trained for three months in simple preventive and curative skills both allopathic and indigenous. MPWs supported them, and the program was started in 777 selected *PHCs* where MPWs were already in place

planned to train the larger cadre of first level health workers selected from communities No further expansion of urban and curative health services was emphasized

The seventh plan (1985-90) re-emphasized on the rural health services and laid out its objectives keeping in view the goal of "health for all" by 2000 AD as mentioned in national health policy (NHP), 1983. The plan emphasized on strengthening the rural health services through the consolidation of the health infrastructure, the strengthening of the three-tier system of sub centers, primary health centers and community health centers, the extension of the MPW scheme with emphasis on training for attitudinal changes, the promotion of community participation, and the involvement of voluntary agencies in the delivery of health services

Despite the rural emphasis, the rural health services for delivery of primary health care were still not operationalized fully Urban health services, specifically urban slums required immediate attention due to changing urban morphology Also it was observed that most of the health care institutions that were established in rural and urban areas in different plan periods were lacking basic facilities such as manpower, drugs and equipment In addition, lack of proper monitoring of the progress of various programs was found a major hindrance on the way of implementation of different schemes Accordingly, the eighth plan (1992-97) aimed at correcting these shortcomings through special emphasis on rural and urban health services For rural areas, the plan aimed at equipping the hospitals with better physical facilities, manpower, materials, equipment and drugs The urban health services were given due importance with reference to the urban poor and slump dwellers Under this scheme the urban hospitals were entrusted with the task of running primary health care centers and treat them as their extension counters for providing basic health services to the urban poor communities Along with the emphasis on rural health services, the plan also aimed at strengthening the secondary and tertiary health care services

1.2.3. Present health status:

From the above analysis, it can be inferred that during the post independence period significant effort is being made in India for improving the health status of her population Therefore, the life expectancy of the population has increased from 44 years in 1960 to 58 years in 1990. The crude birth rate (CBR) as well as the crude death rate has declined from 34 to 32 and 10 to 6 persons during the same period (Table 1 2 and 13)

It is to be noted that, the current levels of effort and resource allocation are not sufficient to meet the future needs of the people The higher incidence of chronic diseases like AIDS, hepatitis B and diabetes, and the problems due to new drug resistance for diseases like tuberculosis and malaria adds a new dimension to current health problems Although provision of these services requires adequate government funding, the degree of government involvement is still relatively limited Under the present system, India spends 6% of her GDP (US $ 13 per capita per year) on health care annually While the private households pay 75% of this total health expenditure, the public sector (central and state governments) contribute 22%, which amounts to only 1 3% of GDP (US $ 2 7 per capita) Out of this meager amount, the share of central government is only 10% A larger share (87%) is paid by state governments, with the third party insurance contributing to the remaining 3% (Krishna Kumar 1993) In addition, the internal allocation of health funding shows that, a major chunk of the government expenditure is being spent on

Table 1.2: Health indicators of India, 1961-96

Year	CBR			CDR			IMR			LER
	R	U	T	R	U	T	R	U	T	T
1961-70	NA	412	NA	NA	NA	190	NA	NA	1460*	46.4
1971-80	33 14	28.6	34.7	162	9.4	148	1385	796	128.8	54.0
1981-89	34.3	27.3	327	126	77	11.5	108.4	623	99.6	NA
1990-93	310	239	294	106	65	97	850	503	783	NA
1996	293	21.6	275	96	6.5	90	77	46	72	61

* Correspond; to 1951-61
CBR Crude birth rate, CDR Crude death rate
LER Life expectancy rate, IMR Infant mortality rate, R Rural, U Urban, T Total,
NA Not Available
Source SRS Bulletins, reproduced in Health Monitor, 1995

Table 1,3: Life expectancy at birth (years) by sex and residence

Year	Rural		Urban		Total	
	Male	Female	Male	Female	Male	Female
1970-75	489	471	588	592	505	490
1976-80	51.0	503	596	608	525	521
1980-85	540	536	616	641	554	557
1985-90	567	562	620	649	577	581
1991-96*	NA	NA	NA	NA	606	617

* Source India's Social Sector (1996), CMIE, Bombay
Source SRS Bulletins, 1970-75,1976-80,1981 - 85,1986-90

salaries The expenditure on salaries grow at about 10% in real terms while the other health care inputs grow at about 5% rate Since much of the health care funding is spent on salaries, there is deficiency of funds for non-salary recurrent costs Expenditure on maintenance of existing infrastructure (including replacement cost) has declined from 30% to less than 20% in the past thirty years Therefore, infrastructures are not always maintained at an operable level (Dugeal et al, 1995) Two policy measures are generally suggested in this regard First, using the available resources more efficiently, second, exploring the possibility of alternative sources of funding the health services The present study aims at analyzing these two points in the context of secondary level health care system in Andhra Pradesh

1.3. Health status in Andhra Pradesh:

The health care delivery system in the state of Andhra Pradesh (AP) is little better in comparison to some other states of India This is true when we look at the health status indicators for the state In 1996, AP had a birth rate of 22 8, death rate of 8 4, infant mortality rate of 65 per 1000 live births as compared to the corresponding national figures of 27 5, 9 0 and 72 respectively Life expectancy for AP in 1991-96 was 62 4 as compared to 61 0 for India as a whole Nearly forty one percent of the births in AP takes place in health institutions or were attended by health personnel which is very close to the corresponding national figure of 41 2 % The decennial growth rate of 24 2% of AP population during 1981-91 compares favorably with India's figure of 23 8% At the same time, the total fertility rate of AP in 1994 at 2 5% was slightly less than that of 2 7% for the country as a whole (Table 1.4)

Table 1.4: Health indicators of Andhra Pradesh and India

Health indicator	Location	AP	India
Annual birth rate per 1000 population , 1996	R	23 5	29.3
	U	20.6	21 6
	T	22.8	27 5
Annual death rate per 1000 population, 1996	R	9.2	96
	U	59	65
	T	84	90
Infant mortality rate per 1000 live births, 1996	R	73	77
	U	38	46
	T	65	72
Estimated death rate for children aged (0-4) years, 1993	R	19	26 6
	U	119	13 4
	T	17	23 7
Life expectancy, 1991-96	T	62 4	61 0
Attended births (%) by qualified personnel / institution (per lakh population), 1993	R	56 2	43 5
	U	90.6	88 1
	T	62 9	48 8
Decennial growth rate, 1981-91	R	18 4	20 0
	U	43 2	36 5
	T	24 2	23 8
Total fertility rate, 1994	R	NA	NA
	U	NA	NA
	T	2 5	2 7

R Rural, U Urban, T Total

Source

1 SRS Bulletins, 1988, 1994, 1998
2 Final population totals Brief analysis of primary census abstract (1991, 1992), Census of India, Series -1, Paper -2
3 Heath Information of India (1992), New Delhi
4 India's Social Sector (1996), CMIE, Bombay

Among the common causes of death in AP are nervous and circulatory system disorders (20%), respiratory disorders (16%), maternity and infancy related causes (11%), accidents and injuries (10%), digestive disorders (7%), and various types of fevers (6%) The records from primary health centers (PHCs) show that common illnesses treated were respiratory infections, malaria, alimentary diseases, and aches and pains Gastroenteritis, respiratory infection, malaria, scabies, and skin infections are among the most frequently treated diseases among children (Mahapatra and Ramana, 1995) Socio-economic variables, which impinge on health development, are given in Table 1.5.

The improved health status of AP is closely linked to its well-developed health care delivery system The public health care system in AP is divided into three levels Primary care facilities, which provide the people with preventive and promotive care for minor health problems, maternal and child health (MCH), and family planning (FP) The Directorate of Health Services (DHS) manages this section of health services, with the exception of family planning, which is under the control of Directorate of Family Welfare (FW) The referral hospitals and secondary level hospitals make up the second level of public health care These facilities provide both inpatient and outpatient care for illness that are too complicated to be treated at the primary level These facilities are under the control of the Andhra Pradesh Vaidya Vidhana Parishad (APWP), an autonomous governmental body, which was created in 1986 Tertiary hospitals, which include teaching hospitals, are the third and final level of public health system Managed by the Directorate of Medical Education (DME), the tertiary hospitals provide more technical and specialized care

Table 1,5: Socio economic indicators of Andbra Pradesh and India

Indicator	Reference period	AP	India
Real per capita income (Rs)	1990-93	1829	2219
Relative index of development	1992-93	99	100
Index of infrastructural development	1992-93	103	100
Total non-agricultural workers in labor force (%)	1981	30.5	NA
	1991	314	NA
Female non-agricultural workers in labor force (%)	1981	171	NA
	1991	17.3	NA
Urban population (%)	1991	26.9	257
Rate of literacy (%)	1991	441	521
Rate of female literacy (%)	1991	327	393
Drop-out rate from classes I - IV (%)	1989-90	562	488
Average size of operational holdings (ha)	1985-86	172	NA
Road length per 1000 sq km	1987-88	500	544
Electrified villages (%)	1991	100	84

Source
Basic Statistics States (1994), CMIE, Bombay
Profile of Districts (1993), CMIE, Bombay
Final population totals Census of India 1991, Series-1, Paper-2

Apart from the directorates that manage the individual levels of the public heath system, there are five smaller directorates that manage the AIDS program, Preventive Medicine, Employees State Insurance, and the Indian System of Medicine and Drug Control. The Department of Health, Medical, and Family Welfare is responsible for these smaller directorates

As of 1994, AP's public health infrastructure includes 10,555 sub-centers (SCs), 1,306 primary health centers (PHCs), 175 community heath centers (CHCs), and 45 mobile units at the primary level At the secondary level, there are 162 hospitals and dispmsaries of which 107 are community hospitals, 8 are area hospitals, 17 district hospitals, 6 specialty hospitals and 24 dispensaries While the community hospitals have 30 or 50 beds and are in rural areas, area hospitals have 100 beds and are found in smaller towns District hospitals located in district headquarters have nearly 200 beds or more All dispensaries are situated in urban areas For tertiary care, 38 tertiary hospitals affiliated with 9 medical schools, and 2 super-specialized hospitals are available In addition to these facilities, there are 23 district TB centers, 25 TB clinics, and 194 leprosy control units at the primary and secondary levels

Apart from use of government health care facilities, utilization of private health care facilities happens to be higher for the state of AP According to the national sample survey (NSS) utilization data from the 42nd round (1986-87), there seems to be a relatively higher utilization of private hospitals and private doctors as far as outpatient (OP) care was concerned Private health care caters to a higher extent of OP cases (74.9%) in the rural areas of AP than in the urban areas (71.9 %) In OP care at all India level, private health care institutions are the main providers of care, attending to 69 2% of cases in rural areas and 69 *9%* cases in urban areas In AP, 69 6% of inpatient (IP) cases in rural areas and 61 6% in urban areas are treated in the private health care institutions Public health care utilization for IP care in rural AP is only around 30% and in urban AP around 38% The very high utilization of health care in the private sector in AP is in contrast to the national picture In India, in the rural areas 59 7% of IP cases were treated in public hospitals or PHCs and an almost similar percentage (60%) in urban areas Lack of access to public health care facilities, low quality and non-availability of staff, drugs, and essential supplies make public facilities an unattractive choice for general population Scheduled Tribe (ST) households and the lower-income groups are the major users of public health facilities Since 98% of the public health services are free, as opposed to only 7% in the private sector, it is rational for the poorer people to use more government facilities Two-thirds of the people who prefer public health care to private care are in the lowest 25 % of the income bracket (Mahapatra and Ramana, 1995)

1.4. Allocation of funds to health sector in AP:

In the past couple of years, the amount allocated to health care in AP has declined Public health care spending in AP constitutes only 5 6% of the total state revenue and 5 1% of the total state revenue and capital budget, which represents 1 3% of the State Domestic Product The pattern of allocation of funds within the health care system has also changed over the past 10 years While expenditure allocated to primary health care has increased from 46% to 49% between financial year 1981 and 1990, funding to hospital services has declined from 41% to 34% In the amount allocated to hospital care, most of it goes to tertiary care, leaving very little resources to the secondary care despite the planning commission norm of 33 67 The ratio is as high as 49 51 between tertiary and secondary care respectively With only 32% of its public hospital beds at the secondary level, AP public health system does not meet even half of the Planning Commission norm of having 70% of all public hospital beds at secondary level Moreover, shortage of diagnostic facilities, repair and maintenance service for equipment, transport facilities, and trained personnel are very often a feature of secondary level health care Inadequate beds and technical equipment has hindered the secondary level's capacity to support primary level health care when needed

Overall, shortage of hospital beds can also be observed in AP According to the Planning Commission norm, 67 beds should be available for every 100,000 people in the population Based on this norm, there is a shortage of approximately 12,000 beds However, this is not always the best indicator of the needs of the society A better way to assess the need for hospital beds is by analyzing the epidemiological profile Based on this analysis, 90,000 beds are needed to maintain a minimal level of clinical service in AP Even after the private sector provides 42,000 beds, there will still be a shortage of 17,000 beds (Mahapatra and Ramana 1995)

The above paragraphs suggest that, in spite of better health care facilities in AP, the usual problem of low quality, lack of access, non-availability of required staff and essential drugs still persist Since these problems stem mainly from lack of efficiency and inadequate availability of public finance, there is a need for looking at these two aspects in detail

1.5. Motivation for the present study;

The secondary level health care system in the state of AP gives an unique opportunity for a detailed study of these two aspects The uniqueness lies in the fact that, a separate governmental autonomous body manages the secondary level hospitals in the state of AP, called Andhra Pradesh Vaidya Vidhana Parishad (APWP) The autonomy status to the secondary level hospitals is a first of this kind in India The aim of granting this autonomy status was to provide the health services with greater efficiency, quality and improvement in financial sustainability, thereby minimizing the inherent problems that are associated with other health care delivery system The major policy question here is, how far these objectives have been useful in improving the delivery of secondary level health services in AP Are the secondary level hospitals running efficiently[9] Are the hospitals self sufficient in funds in order to maintain better quality of care? The present study aims at examining these issues from an economist's point of view Explicitly, the present study has two broad objectives

1.6. Broad objectives of the study:

(a) To evaluate the performance and efficiency of secondary level hospitals in Andhra Pradesh

(b) To examine the issue of health financing in developing countries in general and AP in particular, with a view to suggest some policy measures in this regard

1.7. Chapter outline:

As a background of this study, in this Chapter, we made an attempt to give a brief outline of the health care delivery system of India as well as Andhra Pradesh Based on the problems identified with the health-care delivery system in Andhra Pradesh, the broad objectives of the study are also specified here In Chapter II, a selected review of the studies on evaluating hospital performance and efficiency that are conducted in developed and developing countries is presented Chapter III deals with the methodology of past studies on the subject. We also try to identify the appropriate methodology for this study. Based on the review and methodology, detailed objectives of our study are listed. In Chapter IV, an attempt is made to evaluate the performance of secondary level hospitals in Andhra Pradesh through the use of combined utilization and productivity (CUP) analysis. Chapter V is devoted to evaluate the efficiency of secondary level district hospitals in Andhra Pradesh using cost functions approach. Chapter VI deals with financing aspects of health services. Here, we give a brief outline of different methods of financing the health services in underdeveloped countries with a focus on the government financing, its inadequacy, and the need for additional resources. Further, the possibility of charging the user fees for curative services is tested based on a field survey in one of the AP secondary level district hospitals. Chapter VII gives the summary of the main findings of this study, its drawbacks and the scope for further research.

CHAPTER II
REVIEW OF LITERATURE

2.0. Introduction:

This chapter gives a brief over view of selected studies on efficiency of health services and health sector financing with a view to understand the issues involved and identify the appropriate methodology for this study The review is made non-technical, keeping the technical details to the next chapter The studies relating to health sector efficiency are reviewed separately for developed and developing countries This is followed by studies on Andhra Pradesh In the penultimate section, we give a brief review of the health financing issues and studies that stress on user charges The last section contains conclusions of the chapter

2.1. Studies on hospital efficiency:

2.1.1. Studies using performance indicators:

Lasso (1986) analyzed the performance of 73 Colombian hospitals for the period 1977-80 Hospitals are categorized into different groups on the basis of their bed strength Using combined utilization and productivity (CUP) analysis for assessing their performance, the author found that hospitals with larger bed strength have higher BOR and ALS followed by other groups with smaller bed size

Sear (1991) conducted a study of efficiency of investor owned and non-profit hospitals by using a sample of 142 hospitals in the State of Florida, USA in 1988 Three indicators (ratios), namely total number of full time equivalent (FTE) personnel per active bed, number of man hours per adjusted patient day, and the total wages paid per adjusted patient day are used for the purpose The author found that investor owned hospitals used significantly fewer FTE staff per bed, fewer man hours per adjusted patient day and paid significantly less in wages

2.1.2. Econometric studies:

There are a number of studies, which used econometric models for studying hospital efficiency. The problems addressed here include, quality and case mix heterogeneity, uncertainty, and input price variations The nature of these problems and the way they can be tackled are briefly discussed below in the context of developed country. The review of studies for both developed and developing countries follows there after.

(0 Quality heterogeneity:

Most studies on health services ignore the problem of quality heterogeneity Quality variations in health services hinder efficiency comparisons between providers Failure to control quality differences may ascribe higher efficiency to lower quality producers and vice-versa The next question is what is health care quality and how it can be measured and controlled for?

There are alternative definitions for health care quality Wyszewianski et al (1987), for example, adopted a conventional, technical definition of health care quality It is based on both the extents to which health care providers comply with technical norms of care and the service's ability to improve the patient's health status According to them, " quality is higher for care A than for care B, if for the same patient, care A is likely to make a greater net contribution to the patient's health and wellbeing than is care B "

Barnum and Kutzin (1993) recognize that the quality of health care has two dimensions, the medical or technical and the consumer's dimension "Quality has both supply and demand characterastics The critical demand issue is 'perceived' quality the consumer assessment of the relative quality of different health care providers . Adequate staff and supplies are obvious supply side factors affecting 'actual' quality of services that are important in affecting perceived quality" (Chapter 3, p 17)

The notion of quality that we adopt for our study is demand side one This includes the demand side dimensions such as attitude of medical personnel, cleanliness of premises, and other measures of the degree to which patients' preferences are met Because of the multi-dimensional nature of quality, it is not possible to infer the estimates of efficiency by combining quality information with cost of care To do so, knowledge about the weights of different dimensions of quality would be required That, however, is beyond the scope of this study

It is sometimes argued that perceived and technical quality may or may not be in agreement with one another Discrepancy in these viewpoints can be greater in developing countries where poor, uneducated populations may have a more limited ability to discern the technical merits of health services Barnum and Kutzin (1993) suggest that quality perceptions by patients are in some cases related with technical quality measures, such as the availability of drugs and medical supplies Thus, the policy measures aimed at improving technical quality through increase in supplies can also improve quality perceptions

To sum up, the quality of care can be assessed and controlled for in various ways when measuring efficiency of health services These include measuring quality according to (1) degree of compliance of medical norms of practice, (2) clinical outcomes and (3) various measures of patient's satisfaction

(ii) **Casemix:**

Comparative studies of health facility cost and efficiency have to overcome the difficult methodological problems arising from the wide diversity of health care activities produced by alternative providers and the effects that such heterogeneity has on resource use, cost, and efficiency.

A patient-day care may differ between hospitals, between different departments of the same hospital and over time According to Tatchell (1983), these differences may arise due to differences in (a) technology, (b) quality of care, (c) case-mix, (d) case complexity and severity, and (e) institutional characteristics (size, teaching status, location, composition, ownership etc) So the output of the hospitals need to be standardized in order to bring it to a comparable form for measuring efficiency Among the different methods of standardising the output, service mix is the foremost Service mix may be defined as the type of services available or the services and the procedures actually performed Cohen (1967), Anderson (1976), Kouner (1969) have used the method of service-mix, taking the actual procedures performed in the hospital

Another method of standardizing hospital output is to derive a measure of hospital case-mix using the case types treated in the hospital One of the early attempts to standardize hospital output for case mix was based on specialty mix Feldstein (1967) made an attempt to standardize the hospital output by dividing the various specialties into 8 mutually exclusive groups Another approach to deal with case mix is diagnostic mix The studies related to this latter method have used either international classification of disease (ICD) groupings or diagnostic related groupings (DRG) for standardizing the output Evans (1971) and Evans and Walker (1972) have used ICD groupings for dividing the diagnosis into different homogenous categories Fetter et al (1980) and Barer (1982) have used DRG for standardising hospital output Other methods of standardising hospital output are found in Lave and Lave (1970), Lave, Lave and Silverman (1972) However, Tatchell (1983) gave a detailed review of the studies related to the issue of case mix and service mix He identifies two methods of standardizing hospital output, namely service mix and case mix

The service mix approach uses information about the type of services offered by the hospital (pediatrics, gynecology, etc) as a basis for standardising hospital output Tatchell (1983) argues that the existence of common services among providers doe not imply that the mix and complexity of cases, as well as quality of care are similar among providers He also points out that whether or not certain services are offered by a provider is not sufficient to characterise its output, due to lack of information about the extent to which these services are actually used

The case mix approach attempts to standardise hospital output according to the mix of cases actually treated in the hospital Vitaliano (1987) calls this method as demand-side one In fact, both methods reflect demand and supply forces since the services offered by hospital generally respond to a demand The case mix approach, however, captures supply as well demand relations better because it is based on utilisation information Under the case mix approach, Tatchell distinguishes several methods They are, specialty mix, diagnostic related groupings, information theory, case severity, and others The reminder of this section focuses on the use of the case mix approach to standardize output when measuring heath facility efficiency

The case mix denotes composition as well as complexity of cases While measuring hospital cost, these two aspects are of utmost importance and need to be considered For example, if only composition is taken into account, then wards in two hospitals would appear identical if both of them treat same number of diabetic cases over a given period of time If information on case complexity is also taken into consideration, it could be that the two facilities differ in terms of the proportion of complicated cases Also it is to be noted that the facilities, which treat more number of complex cases consume more resources resulting in higher cost per treatment Thus, study of health facility efficiency, technical or economic, requires knowledge about the case mix This information can be used to control for case mix variability while estimating cost

However, while it is possible to obtain data about composition of output, it is usually difficult to get information on output complexity Complementary techniques must then be used Some of these are given below

Register and Bruning (1987) in their comparative study of efficiency between profit and non-profit oriented U S hospitals have used an alternative method for dealing with case mix, since the information on case mix of individual hospitals was not available Case mix proxies are used to limit the confounding effects of case heterogeneity on efficiency measures They assumed that rural and urban hospitals differ in their case mix and therefore confined to only urban hospitals in their study All long-term (older) federal hospitals are also eliminated from the sample to reduce heterogeneity Hospitals that provide a specified set of services are retained, thus eliminating all hospitals, which are too 'basic' or 'high tech' It is posited that hospital size, measured by the number of beds, is also associated with the case mix Therefore, they limited their sample to hospitals within the range of 100 to 200 beds

To verify their hypothesis that hospital size is associated with case-mix, the authors group the sample hospitals by size and compare the groups on the basis of bed-to-doctor and bed-to-nurse ratios The differences in ratios are interpreted as differences in case mix However, it should be noted that the above procedure might introduce a bias in their analysis because bed-to-labor ratios may reflect not only case mix but also efficiency differences The authors have also estimated technical efficiency using multiple-output production function approach This estimation method allowed them to control case mix composition, while the previous procedure of restricting the sample could control the case complexity as well

Eakin and Knieser (1988) in their study of economic efficiency of US hospitals also confronted the problem of case mix differences among facilities To quote them

'The output data indicate that hospitals are a heterogeneous group with respect to mix of cases treated Consequently, we adopt a multiple output specification in this study In particular we use four categories of outputs - general medicine, obstetrics, gynecology, Weighted surgeries and outpatient visits" (p 587)

The above procedure controls for case mix composition In order to control for case severity and factors other than case mix the authors proceeded as below

"Three additional variables - TEACH, a dummy variable indicating medical school affiliation, ALOH, the average over all length of hospitalisation and the average overall occupancy rate - are included in the list of repressers to control for case severity and capacity utilisation" (p 587)

The variable TEACH is used to capture the (positive) effect on hospital costs of teaching activities The length of stay variable is used to control for severity However, this variable may represent differences in medical practice, not attributable to severity but to efficiency The occupancy rate variable is introduced to discriminate between technical and economic efficiency, a useful distinction A hospital may be technically efficient (it can be on its production possibility frontier) but, due to low occupancy it may be economically inefficient

Vitaliano (1987) adopted a service mix approach to control for case mix and its effect on hospital efficiency For each hospital in the sample, an un-weighted index of 11 available hospital facilities or services is constructed and used as an independent variable to estimate a total cost function He finds that the service-mix variable is statistically significant and has a positive effect on total cost

To sum up, there are several methods available to control case mix when evaluating health services efficiency These include.

(a) limiting the sample of providers to those that provide a similar case mix,

(b) in econometric studies of efficiency, include indicators of case mix such as type and volume of services produced, measures of output complexity etc as explanatory variables and

(c) limiting the comparison of efficiency to a few, well defined medical services (e g appendectomies, hernia repair, etc)

The author has also mentioned several other methods under case mix approach, such as specialty mix, DRGs, information theory, case severity and others

(iii) Uncertainty:

The uncertainty in the hospital care arises from different dimensions These are uncertainty with respect to (a) the timing of an illness and hence the demand for hospital services, (b) physician's diagnosis, and (c) the final out-come of the treatment Since demand uncertainty in particular is likely to have important consequences on hospital costs, it is necessary to understand the cost and uncertain demand

If one views the hospital, in addition to providing direct or anticipated patient care, as also providing sufficient capacity to assure that hospital services are available at the time of unexpected demand, this insurance or option demand of the community at large should be treated as yet another service provided by the hospital. Failure to take this standby service into account in econometric cost models may result in specification error

Cowing et al (1983) suggest the following formula for measuring the level of standby services

$$k=\frac{\text{(Beds-AverageDailyCensus)}}{\text{(Average Daily Census)}^{1/2}}$$

Here, larger the 'k', there is less chance that services will not be available for yet another patient (Jaskow, 1980) Although this issue has been recognised by various authors, it could not be incorporated in hospital costs in a more formal manner A detailed review of the studies dealing with this issue is given in Cowing et al (1983) In brief, it suggests that demand or output uncertainty accounts for some portion of the observed excess capacity of hospitals and it had lead to decreasing cost with increase in hospital utilisation

(iv) Input price variation:

Input price variation across providers complicates the interpretation of differentials in efficiency For example, let there be two providers who operate with equal technical efficiency, but facing different input prices An analysis of efficiency that focussed on technical efficiency alone would conclude that both the providers are equally efficient. This would contrast with the outcome of a study on economic efficiency for the following reasons If the technology and input mix were similar between providers, the provider facing higher input prices would exhibit the lower economic efficiency

Furthermore, if factor prices vary among providers, no inferences can be drawn about economic efficiency, unless a more careful analysis is conducted Social cost of resources, instead of factor prices, may have to be considered in such cases

There are numerous studies which examined some of the above mentioned issues in detail. These include, Bays (1980), Pauly (1978), Baron (1978), Elnicki (1974), Lee Wallace (1973), Lave, Lave and Silverman (1972), Hu (1971)7 Francisco (1970), Cohen (1967), Cowing and Holtman (1983), Watts and Klastonin (1980), Luke (1979), Feldstein and Shutting (1977), Bays (1977), Thompson, Fetter and Mross (1975), Rafferty (1971), and Berry (1970)

2.1.3. Studies for developed countries:

During the past two and half decades, estimation of cost function for hospitals has become a common place for industrialised countries Reviews by Cowing, Holtman and Powers (1983), Wagstaff (1989), and Ricardo (1992) have documented this literature. The initial attempts to estimate cost functions using data from hospitals in industrialised countries employed composite measures of hospital output (eg Cohen 1967) They used average or unit cost of inpatient day or admission as the dependent variable, and a variety of interrelated explanatory variables such as occupancy rates, patient flow, length of stay, and capacity as explanatory variables (Mann and Yett 1968)

Most of the early empirical studies [Feldstein (1967), Berry (1967), Carr and Feldstein (1967), Ingbar and Tayler (1968), Fransisco (1970)] were concerned with the effect of size on hospital costs - that is, the existence of scale effects and the related questions of optimal size Authors of these studies estimated rather restricted versions of the general cost function, usually without recognizing many of the implicit assumptions involved For example, most of the models did not include input prices in the estimated cost function, an omission which is equivalent to assuming zero input substitutability, that is, a fixed proportions technology for producing hospital care

In addition, many of these studies typically include two types of variables in the cost function The first one is a flow type variable, number of patient days of service provided, to account for variations across hospitals in actual or current output The second variable is a stock type variable, the total number of beds, to account for variations in size or capacity Some models have used other measures of output and the ratio of output to capacity The basic purpose of these latter models appeared to be that of relating cost changes caused by output changes, holding capacity constant, to the short-run cost structure, and cost changes caused by changes in capacity, holding output constant to the long-run cost structure This in turn is related to the existence of economies of scale The general conclusion of these studies was that there was evidence of significant economies of scale, at least up to moderate sized hospitals of around 500 beds

Later studies have specified cost functional forms and included variables that are consistent with a theoretical production structure (eg Cowing and Holtman 1983, Grannemann et al 1986, and Vita 1990) They have used total cost (rather than average cost) functions with multiple outputs and have employed flexible functional forms The data used were mostly from USA or UK We discuss briefly some of these studies

Granemann et al (1986) departs from previous studies of hospital cost by introducing a more flexible functional form for total cost They combined a translog form with a conventional cubic cost function where outputs enter directly, not in the logarithmic form, to permit zero output levels Capital is included as an independent variable, reflecting their assumption that capital is not a fully fixed cost to the hospital. This allows exogenous variations in the hospital's capital cost even in the short-run. They also included various hospital outputs, like emergency care, home visits, and two measures of inpatient care, to account for differences among hospitals in average length of stay Due to data limitations, they have not included the interaction terms between input prices and output levels in their model The authors estimated various measures of hospital performance such as marginal cost, product specific economies of scale and scope Data on hospital costs, inputs and outputs are taken from American Hospital Association's annual survey for 1981 Ordinary least squares estimation method was used for estimating the cost function

Vitaliano (1987) argued that econometric studies of efficiency, which use multiple outputs in a cost function are plagued by the problem of multicollinearity among outputs He, therefore, used a total cost function with a single output to conduct a comparative study of economic efficiency using a sample of 166 New York State hospitals Instead of using output measure as an explanatory variable, the author used the number of beds Other explanatory variables used in the model include, condition of hospital, index of case mix of services provided in the hospital, regional dummy, and a measure of hospital's monopoly and monopsony power The latter variable is measured by hospitals' share of the total supply of beds in the country Vitaliano argued that monopsony or oligopsony hospital might exert downward pressure on factor prices The estimation technique was weighted least squares A quadratic U-shaped average cost function was obtained from the estimated total cost function As expected from a U-shaped average cost curve, the hospital costs have exhibited economies of scale in certain range of output He attributed this to presence of high fixed cost such as specialised personnel and equipment

Eakin and Kniesner (1988) proposed a general methodology for estimating hospital cost functions, which allows for the possibility that hospitals may not be cost minimisers. They point out that "erroneously assuming cost minimisation leads to inaccurate estimates of factor substitution possibilities" (p 584) The authors estimated a system of equations which include observed cost function and three observed factor share equations They specify a 'hybrid' translog total cost function to accommodate zero output levels instead of their logarithm

The model included four outputs and four inputs and was estimated using the method of seemingly unrelated non-linear regressions The sample consisted of 331 US short-term hospitals, both profit and non-profit oriented Allen elasticities of factor substitution and economies of scale are estimated The empirical results show that hospitals undervalue the cost of capital and over value the price of physicians Hospitals thus tend to over employ capital and under employ physicians This resulted in allocative inefficiency, which equals to 5 percent of the total observed cost They also found that elasticities of substitution and factor demands are sensitive to model specification

Frank and Taube (1987) studied technical and allocative efficiency in the production of outpatient mental health clinics using data from 755 clinics obtained through a survey by the US National Institute of Mental Health in 1982 The study focussed on estimation of production functions for mental health visits Like Eakin and Kniesner (1988), this study was also interested in exploring provider departures from cost minimisation behavior The method consists of verifying marginal productivity theory, i e , equality between the factor price ratio and the ratio of marginal products for each pair of inputs Differences between the above two ratios are attributed to either over or under utilization of inputs The authors also estimated the economies of scale and scope in the production of mental health visits Finally, the study looked into the determinants of efficiency by focussing on differences in productivity between government-run and private clinics

In the empirical analysis, Cobb-Douglas and Transcendental functional forms are used for specifying a production function Ordinary least squares estimation was user Both the forms indicated decreasing returns to scale and greater productivity of private clinics, as evidenced by an ownership dummy included in the production functions The study also has shown violation of marginal productivity theory, i e, factor price ratio between physicians and other clinical staff differed from the corresponding ratio of marginal products, with physicians being over employed This also signaled a departure from cost minimization in the production of outpatient mental health services in the USA

Eakin (1991) used the results from Eakin and Kniesner (1988) to study the determinants of economic efficiency in hospitals For this purpose, the estimated values of allocative inefficiency are regressed on several hospital and market-related characteristics considered to be the determinants of efficiency based on economic theory The independent variables included ownership, regulatory factors, competitive factors, factors characterizing the sources of hospital revenue, measures of hospital size, and regional dummy variables Estimation was done using generalised least squares h was found that the regulatory environment is a critical determinant of economic efficiency

Economic inefficiency was greater in larger hospitals with a larger market share He does not find statistically significant differences in hospital efficiency between non-profit and profit-oriented hospitals and like-wise between church operated and other hospitals.

2.1.4. Studies for developing countries:

Initial studies on hospital cost and performance in developing countries have made use of accounting information and hospital service records A detailed review of the Indian studies on cost accounting method prior to 1974 can be found in Srivastava and Gupta (1974) Sharma and Timmappaya (1974) attempted to develop a suitable method of measuring the performance of smaller hospitals

Ramlingas-wami (1984) estimated the cost of medical education in 17 medical colleges in India and found that the recurrent cost of educating a medical graduate varied between Rs 55,000 to 1,34,000 in the year 1981 among different medical colleges Thus, most of the earlier studies have concentrated in developing a suitable methodology for costing rather than evaluating hospital performance

Rodriguez and Jimenez (1985) conducted a comparative study of productivity between private and (decentralized) public Chilean hospitals They measure the productivity in terms of inverse average length of stay (ALS), namely shorter the ALS, higher the productivity The authors divided ALS into three components, namely diagnosis (D), medical treatment (T) and recovery (R) respectively It was argued that while T must be performed within the hospital, D and R can partially be accomplished on outpatient basis For a given patient-case-mix, the authors hypothesized that a series of individual specific variables, such as age and income can influence D and R, It was assumed that a patient's income is a close proxy of the type of health insurance or coverage he / she has Thus, income was assumed to closely correlated with out-of-pocket price of the services and it influenced individual behavior, as measured by D and R. The type and severity of illness, and the amount of medical inputs provided to the patients, were also assumed to affect the D, T and R.

Using a sample of 5 hospitals (3 private and 2 public) and 369 patients, the authors used OLS to regress length of stay on patient age and income, medical inputs and facility specific dummy variables Three separate equations were estimated for obstetrics and gynaecology. surgery and internal medicine The authors conclude that, other things being equal, private hospitals had lower length of stay and were more productive than public institutions They cautioned, however, that their analysis was subjective to the accuracy of information about diagnosis, case mix and severity of the illness etc

Lewis, Suletta and Forgia (1990) used cost accounting method to measure efficiency and quality of care at Aybara hospital, which is a 271-beded government-run facility in the Dominican Republic To estimate costs, the authors monitored a selected sample of patients during their treatment in the hospital, recording the cost of services provided to them The sample consisted of three sets of patients, (i) emergency patients, (ii) people consulting in an ambulatory basis, and (iii) inpatients admitted to five departments (3 surgical and 2 ophthalmology) of the hospital during a one-week reference period The sample patients underwent 23 surgical interventions consisting of wounds, appendicitis, cataract, hysterectomy and hernia during that week The prices of non-labor inputs were obtained directly from supplier wherever possible Labor costs were computed by measuring actual staff time devoted to medical procedures and multiplying it by workers actual wage (converted to an hourly basis) The total cost of procedures was the sum of the variable and allocated fixed cost The variable cost included cost of labor, drugs, ancillary services and consumables Cost of overheads, depreciation of buildings, equipment and other fixed assets constituted the fixed cost. The quality of care was measured in two ways, (a) assessing the appropriateness of the qualifications of the medical staff involved in care and (b) comparing the actual diagnosis and treatment practices and services delivered with medical norms of care

By extrapolating the percentage of labor used from the sample to all patient services in the hospital, the authors concluded that only 12% of the medical labor contracted by the hospital could actually be counted for Although no allowances were made for down time by the medical staff, this unexpected result signaled a major inefficiency in operations of Aybara hospital With regard to quality of care, major departures were found between the expected cost of meeting norms of diagnosis and treatment and the cost of such services actually provided The cost of drugs dispensed and the tests performed represented about 10% of the costs implied by the norms

Anderson (1980) studied the behavior of hospital costs in Kenya using a sample of 51 hospitals during 1975-76 The dependent variable was average cost per patient day The explanatory' variables were, capacity as measured alternatively by available and used beds, occupancy rate, average length of stay, number of outpatient visits per inpatient day, number of satellite ambulatory facilities operating under the hospital and the nature of hospital, provincial or non-provincial

Four alternative specifications of the model were estimated using alternative dependent and independent variables It was found that the hospitals were operating with increasing returns to scale, as evidenced by negative and statistically significant coefficients associated with scale variables Further, higher occupancy levels resulted in lower average costs implying that greater demand should be accommodated within the existing hospitals rather than through new ones. Outpatient activity was found to increase average cost. In contrast, length of stay did not come out statistically significant Because the cost of hospital and its satellites are intertwined, the average cost used as dependent variable also included the cost of satellite facilities The regression results showed that a greater level of satellite activity had a positive impact on aggregate average cost Finally, the provincial hospitals were found to have higher average cost than district and sub-district hospitals

Dor (1987) has estimated average cost function for 19 urban hospitals in Peru The hospitals included were some from the ministry of health and others from social security ministry/department Using the average cost function, Dor obtained an analytical expression for the optimal patient flow, i e , the flow at which hospital average cost was a minimum Using OLS and WLS methods, he estimated separate average cost functions for each of the three cost categories (labor, goods and services) as well as combined He found that hospital average cost decreased with service intensity This means, the average cost of hospitalization decreased either with increase in number of hospitalizations or decrease in the number of beds or both The calculated optimal flow was 3 2 admissions per bed per month This value was above the sample mean but below the actual flow of several hospitals in the sample Thus, the study concluded that the average cost curve was 'U'shaped

Bitran and Dunlop (1990) studied the determinants of hospital costs using a sample of 15 government hospitals for Ethiopia, with one to three annual observations for each hospital and total of 38 observations Flexible functional form as in Grannemann et al (1986) was estimated using the OLS method Several parameters of interest such as the marginal cost of inpatient care and outpatient care, average incremental cost, product specific economies of scale, and economies of scope measures were calculated from the estimated cost function

The authors found that the hospitals in the sample were operating under constant returns to scale for patient days, laboratory tests, and deliveries Economies of scope were found between first outpatient visit and inpatient days, signaling an economic advantage (reduction in cost) in joint production of impatient and outpatient care The limitation of the study was to use ' planned' hospital expenditure by the Ethiopian government to represent cost This may differ substantially from the actual expenditure

Wouters (1990) studied the cost and efficiency of a sample of 42 private and public health facilities in Ogun State, Nigeria She analysed efficiency and cost by estimating production and cost functions respectively Technical efficiency was assessed using the estimated production function and the associated measure of marginal product of health workers She found that the efficiency variable was insignificant and thus concluded that departures from cost minimisation have little effect on expenditures She also found that the marginal costs are less than average costs and thus concluded that facilities in her sample exhibit increasing returns to scale both for admissions and outpatient visits Based on the estimated economies of scope, it was concluded that there were no advantages in the joint production of inpatient and outpatient care

Shephard et al (1991) conducted a cost effectiveness study of surgery in intermediate health units (IHU) in Cali, Columbia In order to reduce the high cost of treatment, IHUs were set up as an intermediate unit between PHCs and hospitals The study showed that surgical anesthesia complications were higher in the hospital than in IHU, patient's satisfaction as measured by the time taken to return to their work after surgery, was higher at IHU The average cost was much higher at the hospital than in IHU

Barnum and Kutzin (1993) computed the same indicators as in Lasso (1986) for measuring the performance of public hospitals in some of the developing and industrialized countries The data used by them was either average of all hospitals in the selected countries or average of sample hospitals in respective countries. They found that the industrialized countries perform better in terms of their utilisation as well as productivity compared to developing countries like Turkey, Ethiopia and Korea

Bernum and Kutzin (1993) have also conducted an evaluation study of financial management of 8 Class I and Class II hospitals distributed throughout Columbia The costs were evaluated at 1975 constant pesos, and service data correspond to each year during 1975-78, thus providing a pooled time series of cross sections Using a total cost function, the authors found that at the sample average, the marginal costs for inpatients and outpatients were approximately equal to the respective average costs, implying short-run constant returns to scale with respect to both the variable factors

Another study was conducted in 1993 by the same authors for China A short-run variable cost function was used for the purpose The sample included cost and service data for three years, 1984-86 The authors found diseconomies of scale and only mild economies of scope, implying thereby short-run inefficiency in the level of operation with respect to bed days and outpatient visits

2.1.5. Studies for Andhn Pradesh:

Mahapatra and Herman (1991) used the method of ratio analysis for evaluating the performance of secondary level hospitals in Andhra Pradesh, India. Due to heterogeneity in the hospitals covered, the authors grouped the hospitals on the basis of available number of beds and the type of service provided The hospitals providing similar type of service are grouped into one category The authors found differences in the performance of different categories of hospitals

Mahapatra and Herman (1994) applied the combined utilization and productivity (CUP) analysis for evaluating the performance of secondary level hospitals in the state of Andhra Pradesh (AP) Based on a sample of 108-109 hospitals for the years 1989-90, the authors computed bed occupancy rate, bed turnover rate and average length of stay for each hospital in the sample Using the graphical method suggested by Lasso (1986), the authors found that a sizable proportion of hospitals, namely, 407 percent in 1989 and 394 percent in 1990, were associated with low productivity and low utilisation Similarly, an estimated 31 5 percent of hospitals in 1989 and 33 9 percent in 1990 were associated with high utilisation and high productivity

After the study by Mahapatra and Herman (1994), there were no published works, to our knowledge, that measured hospital performance in AP Since there has been a substantial change in policies relating to secondary level hospitals, there is a need to re-examine the performance indicators of the secondary level hospitals in AP This is being attempted in this study Thus, although there are a large number of studies relating to hospital cost in developed countries using the cost function approach, there are only a very few studies for developing countries To the best of our knowledge, there are no published studies in India using cost function approach for measuring the hospital performance and efficiency The present study aims at filling this gap by using data on secondary level district hospitals in AP

2.2. **Financing of health services:**

Government intervention in the provision of health care services is supported on the grounds of externality, equity and efficiency Several economists like Arrow (1963), Newhouse (1970), and Cuyler (1971) gave sufficient justification for the government provision of health services They argue that private providers can not supply the health services due to market failure Si ice health services are basic and they help in improving the quality of human capital and thereby economic development, there is a need for the government provision of these services World development report (1993) reiterates this view Further, the report states that the government provision of health services helps in reducing poverty, inequity and inefficiency

As already discussed in Chapter I, World Health Organizations' Alma-Ata declaration of 1978 outlined a global strategy for 'health for all by 2000' through the primary health care system WHO estimated that the implementation of this strategy-requires annual per capita health expenditure of US $15 in 1981 prices for most of the developing countries Since per capita public spending on health is currently only US $2 3, there is an annual resource gap of US $50 billion for all the developing countries Even if developing countries could fund as much as 50% of this amount, they would have to seek external funding of about seven times the present level of international transfers The growth of per capita domestic public spending on health, therefore, is not anywhere near the levels required to meet the goals of the global strategy [WHO (1981c), World

Bank(1980b)]

Because of this reason and others (discussed in Chapter VT), various researchers and policy makers suggest alternative method of generating funds to finance health services (Jimanez 1986a, 1986b) Among the suggested measures are, user fees, development of suitable insurance system etc It is in this context that the present study aims at examining the issue of financing the health services in developing countries in general and AP in particular The study aims at reviewing the traditional arguments in favor of government intervention and the current arguments for introducing the user fees for health services by examining the resource allocation pattern in the state of AP In order to examine the feasibility and its impact of introducing the user fees, the study aims at conducting a field study on government-run hospitals in AP

2.3. Conclusion:

The purpose of this chapter was to review the past studies on hospital performance and efficiency with a view to identify the broad issues that were addressed in the literature From the above review, we notice that earlier researchers have dealt with the issues of case mix, quality heterogeneity, uncertainty, and input price variations while analyzing hospital performance and efficiency However, most of the above studies were for developed countries and we could find only a few studies for underdeveloped countries Further, even the few studies that were done for developing countries could not address the above issues One of the reasons could be non-availability of appropriate and detailed data The next chapter tries to look into the alternative approaches that were used for evaluating hospital performance and efficiency The objective is to identify an appropriate methodology, which can be used for evaluating hospital services in the state of Andhra Pradesh.

CHAPTER III
HOSPITAL PERFORMANCE AND EFFICIENCY: ALTERNATIVE APPROACHES

3.0.Introduction:

This chapter gives a brief outline of different approaches that are used to measure hospital efficiency We discuss basically four approaches, viz, cost accounting, ratio analysis, combined utilization and productivity (CUP) analysis and statistical production and cost functions that are used to measure hospital performance/efficiency These approaches have varying data requirements The first one uses the accounting information of different hospitals and analyzes the hospital service records in order to examine hospital costs and performance It can be applied usefully to a single hospital and involves a labor-intensive detailed examination of hospital accounts, staffing pattern, and admissions The second and third approaches are relatively simple and less data demanding They use hospital census data on the number of beds available in the hospital, and number of inpatients and outpatients treated On the other hand, the fourth approach requires detailed data on hospital functioning and could be used for evaluating the efficiency of many hospitals at a time This method, based on micro economic theory, provides insight into cost issues- the relation between marginal and average cost the degree to which hospitals exhibit economies of scale and scope The first two approaches do not focus on these aspects

3.1. Cost accounting method:

The accounting method requires more detailed information on the components of hospital cost. Bamum and Kutzin (1993) have grouped cost accounting studies into two categories The first category consists of studies which use detailed cost information in a 'step down procedure' to describe aggregate costs across departments and functions The second category makes a less detailed estimate of hospital average cost based on ^Sgregate central ministry information or hospital statistics and accounting records

3.1,1, Step down procedure:

Step down cost accounting is a dis-aggregate method of analyzing the cost associated with specific hospital outputs It is based on the scrutiny of the hospital production process to enable the best assignment of costs to outputs to which they are related Total hospital expenditure is apportioned to specific departments (cost centers), and criteria such as 'time use' are employed to distribute all costs (including overhead and cost of intermediate outputs) to final service categories Steps involved in a step down cost analysis are given below

The first step in the estimation process is to get a complete picture of total hospital recurrent cost This means combining hospital line item expenditure (typical line items are salaries, drugs, other supplies, public utilities etc) with data on resources used that do not appear in the hospitals budget or financial statement Next step is to attribute line item costs to cost centers in specific hospital departments The cost centers may differ across studies Three typical cost centers used in Barnum and Kutzin (1993) are overhead, intermediate and final costs The services produced by overhead cost centers are consumed by other departments (cost centers) of the hospital, not directly by patients The cost of administration, housekeeping, and maintenance are included in this The intermediate cost-centers generate services, which are not only consumed by various departments but also by patients directly Examples of such costs are x-ray, laboratory tests, operation theatre etc The final cost centers provide the services, which are directly consumed by the patients, not by other departments. These include outpatients and inpatients Some studies dis-aggregate these services among different departments, e g , medicine, surgery, orthopedics etc

However, there are data related problems associated with this step down cost analysis. First, cost data may not be directly available for individual hospitals. Second, multiple sources of budgeting, (e.g, central as opposed to district level) and assorted ways of making payments for different line items (e g, the salaries of physicians and nurses may be paid by health ministry, othe salaries may be paid by district authorities or by the hospital) make the reconstruction of actual expenditure tedious Third, cost information may be available only on aggregate basis for the hospital The advantage, however, is the need to reconstruct hospital cost data from multiple sources provides some insight into the problems of resource allocation that confront hospital managers

3.1.2. Other accounting methods:

An alternative to step down method is to use aggregate data either for individual hospital or for a group of hospitals The method relates cost and service information to time and institutional and geographical coverage Studies based on this method require less time and less detailed information in comparison to step down procedure (Barnum and Kutzin 1993)

The above procedures provide data on average cost of different services rendered by the hospitals Though the average cost data are useful for assessing hospital performance, they are not sufficient for reaching definitive conclusions regarding hospital efficiency Further, the above cost studies underlie the following assumptions

(a) The quality of service is uniform across facilities so that the cost per an equivalent unit of output could be compared

(b) The clinical composition of patients, i e , case mix is the same at each facility

It must be emphasized that without an understanding of quality of service and case mix, the efficiency implications of variations in average cost can not be properly interpreted For example, high average cost may reflect high quality, but low efficiency. On the other hand, low average cost may be a reflection of low quality and thereby low-efficiency Thus, in the absence of information on quality and case mix, it is difficult to draw meaningful conclusions from cost accounting studies

3.2. Ratio **analysis:**

Another method that requires less detailed data and yet provides useful information on hospital performance is the ratio analysis Three inter-related indicators of hospital services called average length of stay (ALS), bed occupancy rate (BOR), and bed turnover rate (BTR) are used for this purpose These indicators are called performance indicators and are computed based on data from three basic hospital censuses, namely, bed capacity (B) of the hospital, cumulative inpatient days (IP) during a specified time interval, year in our case, and admissions (A) during the same time interval Based on this data, the performance indicators are defined as below

(a) Bed turnover rate or flow, $BTR = \frac{A}{B}$

(b) Bed occupancy rate, $BOR = \frac{IP}{B \times \text{Time interval}} \times 100$

(c) Average length of stay, ALS = $\frac{\mathbf{IP}}{\text{A}}$

It is to be noted that bed capacity is in the denominator of two of these three indicators, implying that bed capacity is a global surrogate for inputs As the staffing pattern, budget etc , are broadly linked to the bed strength through norms for provision of staff and budget, it is not inappropriate to use bed capacity as a surrogate of inputs. In addition, it is to be noted that these three indicators are interdependent and based on all the three hospital censuses (B, IP, and A) Knowledge of any two can give the value for the third [1]. Hence, for the purpose of measurement of performance, any two indicators, say, BOA and BTR are sufficient

3.3. Combined utilization and productivity analysis:

Lasso (1986) argued that the use of BOR, BTR and ALS individually do not provide adequate information and sometimes may give misleading results on hospital performance The bed occupancy and turn over rates (BOR and BTR) may vary from country to country and between hospitals at different levels, namely primary (low), secondary (middle) and tertiary (high) Bed occupancy rate decreases as the level of hospital decreases Further, a low BOR increases the average cost of services Even if hospital inputs are being used with technical efficiency, low bed occupancy implies economic inefficiency On the other hand, a high BOR does not necessarily indicate better hospital performance A high BOR brings down the average cost but may be associated with low quality Thus, the implication of high BOR for average cost and hospital efficiency is ambiguous without information on other service indicators A high

[1] Annual bed occupancy measures the percentage of total availabk beds that are occupied by patients in a year and is calculated by the formula. BOR. = IP / (B * 365) Annual turnover ate is calculated by the

BOR with modest ALS may reflect an efficient situation (i e BTR is also high) or an inefficient situation when a large proportion of beds are occupied due to high ALS. Thus, explanatory power of a single indicator becomes clearer when information on other indicators is also available and used for the purpose (Barmm and Kutzirt, 1993)

Therefore, instead of using these indicators individually for measuring hospital performance, he developed a graphical technique for using the indicators together[2]. Implementation of CUP analysis involves three steps First, basic data on hospital censuses, namely inpatient days, admissions, and number of available beds need to be collected. Second, performance indicators such as bed occupancy rate (BOR), bed turnover rate (BTR), and average length of stay (ALS) are computed Third, BOR and BTR are plotted on a chart, where average bed occupancy (also referred to as utilization) per year and the average annual number of discharges per bed (i e , BTR, also known as productivity) are shown on the x- and y-axis respectively

The chart is then divided into four sectors (regions) using two intersecting lines drawn at the mean values of BOR and BTR, which in turn identify the mean value of ALS Each of the regions thus obtained has the following features Sector I (lower left) indicates relatively low levels of bed occupancy and productivity, the least desirable situation Sector II (upper left) indicates relatively low level of bed occupancy, but high productivity and short hospital stay Sector III (upper right) indicates high level of bed occupancy and productivity, the most desirable situation Sector IV (lower right) indicates relatively high level of bed occupancy, but low productivity and long hospital

formula, BTR = A / B. Average length of stay is determined by ALS = IP / A By simple manipulation we get, ALS = *(BOR. x* 365) / BTR. Thus, once BOR and BTR are known, we can calculate ALS easily

[2] The technique of using these indicators together is called combed utilization and productivity (CUP) analysis Lasso (1986) defines BOR as utilization and BTR as the productivity of a hospital When these

stays (Lasso 1986)

It is to be noted that CUP analysis can give a broad picture about the performance of hospitals This serves as an operational/benchmark tool for the hospital administrators in order to make policy decisions. The policy maker can identify the low performing hospitals on the basis of the performance indicators for further investigation on the causes of their low performance It is obvious that hospital performance depends very much on the quality and clinical composition of cases treated Comparison of different hospitals about their performance is therefore problematic CUP analysis can partly mitigate this problem by grouping the hospitals into different categories Apart from performance indicators, there are other aspects of a hospital such as multi-product nature, organizational structure, economies of scale and scope, which are of prime importance to the researchers as well as policy makers These could not be analyzed through any of the three techniques just described Such issues can better be addressed using multi-product cost functions

3.4. Statistical/econometric approaches:

Health economists have used statistical and econometric approaches for various purposes, namely to evaluate the efficiency of hospitals, examine the determinants of hospital costs, address the issues relating to economies of scale and scope, and to find out the relationship between marginal and average cost These approaches are generally based on micro economic theory of production and cost In micro economic theory of production, we come across two concepts of efficiency, namely technical and economic efficiency

two indicators are plotted together in a chart it shows the productivity as well as the utilization let els of the hospital under study.

3.4.1. Technical and economic efficiency:

A production process is said to be technically efficient if there is no way to produce more output with the same inputs or to produce same output with fewer inputs (Varian 1987, p 9) In the context of medical care, a process is technically efficient if production inputs (labor, drugs, equipment) are combined in a way that yields the maximum feasible output (outpatient visits, hospitalizations etc) In theory of the firm terminology, it means that any point on the production possibility frontier is technically efficient A production process will be technically efficient only in the presence of scale effects i e., when economies of scale exists In other words, disecor omies of scale may arise due to managerial, technological and socio-economic inefficiencies (Sherman 1981) Technical inefficiency in case of hospitals may arise due to inefficiency in the use of staff, supplies and equipment (Barnum and Kutzin 1993)

Economic efficiency extends the concept of technical efficiency to take into account the relative costs of alternative inputs as well A production process is called economically efficient, if inputs are combined to produce given level of output at minimum cost Wyszewianski et al (1987) apply this concept in relative terms, arguing that efficiency improvement requires reducing the total cost of inputs used to produce a given output In other words, if the total cost of inputs used by process X to produce a given level of output is less than the cost of inputs required by another process Y to produce the same output, then the process X is said to be more economically efficient than the process Y The optimal input combination is given by the tangency point between an isoquant and an iso-cost (price) line Thus, economic efficiency describes a specific subset of technically efficient choices In fact, for a given set of input prices and output levels, there can be only one economically efficient combination of inputs, although many technically efficient alternatives might be possible

The statistical approaches make use of the production function in order to estimate (or otherwise characterize) the input-output relationships in health care sector. The shape of the production function is usually specified a-priori, on the basis of economic theory and practical considerations of simplicity and plausibility Often some experimentation with alternative functional forms is required to obtain a 'best' fit or a suitable match between the data and the requirements of microeconomic theory

Similar procedure is followed for cost function estimation Often cost function approaches are used, in lieu of a production function to deal with multiple outputs and inputs Thus, production function is used to deal explicitly with multiple inputs (and single output), whereas cost function deals with multiple outputs and inputs, the latter considered implicitly (Sherman 1981)

For instance, let us assume that the production function is specified as

$$Y = F(X_{1,} X_2 \; .X_m) \qquad (31)$$

where $X_1, X_2, \; X_m$ represent the quantity/value of each of m inputs and Y the corresponding output The functional form F is assumed to be known and each output value, Y, is *maximal* in order that equation (3 1) represents a production function

Given this situation, we may distinguish the observed input amounts for some firm by indexing them as $X_{1j}, X_{2j}, \; , X_{mj}$ so that X_{ij} represents the amount of i^{th} input used by firm j Using these inputs, the j^{th} firm produces the output Y_j which satisfies

$$0 \leq Y_j, \leq Y_j, \qquad (32)$$

where,

$$Y_j \qquad = F(X_{1j}, X_{2j}, \qquad , X_{mj}) \qquad (3.3)$$

In other words, Y_j is the (maximal) output, which would have been achieved if the firm had used these inputs efficiently. Equation (3.2) can be re-written in the ratio form

$$0 \le \frac{Y_j}{\hat{Y}_j} \le 1 \qquad (34)$$

with an efficiency ratio of unity being achieved only if production process is fully efficient Failure to achieve a ratio of unity would then represents what might be termed as 'managerial or technical inefficiency' irrespective of the prices paid for these inputs and without regard to the prices received for the output, provided that all prices are positive

Of course, a management, which achieves Y_j,but paid excessive prices for the inputs, would simultaneously be economically inefficient This represents price inefficiency. Closely related to the concept of price inefficiency is 'allocative inefficiency' Such allocative inefficiency can arise, even if the prices paid are minimal, when the firm does not respond to the opportunities the market allows for substituting between factors in order to achieve a given (maximal) output level Y^ In other words, the wrong (inefficient) mix of inputs is used to achieve this output

3.4.2. Evaluation of hospital **efficiency:**

Regression analysis approaches to estimating input-output relationship are widely used, but these are subject to serious limitations when applied to non-profit oriented sectors and their efficiency evaluations Such limitations arise from the assumption that the relationship estimated by the regression techniques reflects efficient input-output relationships This could only be true if the observations were all generated from the hospitals that are known to be efficient Such an assumption is questionable, to say the least, in a sector like hospital services where, clearly, pure competition in the sense of market price economics may not hold

Another set of problems which affects most of the existing regression based studies of health care organizations is, the need to aggregate multiple outputs into a single output measure However, we will not be dealing with the studies, which convert multiple outputs to single output Hence, we confine to statistical approaches which deal with multiple output situations such as (a) simultaneous equation models including the recursive type and (b) single equation models, which utilize flexible functional forms to deal explicitly with multiple outputs and inputs together

The first of these alternatives relates to causal identification via the way equations are modified relative to each other The problem of causal identification, which occurs in simultaneous equation models, has not been addressed in most of hospital services literature, except Feldstein (1967) The translog function, a representative of the flexible functional forms, has been receiving increased attention in the study of health services efficiency We shall examine the usefulness of this and other functional forms in analyzing hospital efficiency

Our treatment of these statistical/econometric approaches for evaluating hospital efficiency will proceed as follows In the following section, we will review the translog function as applied to the health sector This is our primary interest because, (a) it explicitly allows for simultaneous evaluation of multiple outputs and inputs which is an important attribute for hospital evaluation, and (b) it does not require that specific functional form be specified a-priori which is a critical feature of hospitals since the production and cost function of hospitals are not known with any reasonable degree of precision Next we consider the set of hospital production and cost functions with emphasis on the study by Feldstein (1967)

3.4.3. Production and cost functions:

Production functions:

We want to consider certain background materials that are necessary for understanding flexible functional forms The easiest way is to consider the case of an ordinary Cobb-Douglas function involving one output (Y) and two inputs (X_1 and X_2) The function has the form

$$Y = \gamma X_1^{\alpha} X_2^{\beta} \qquad (35)$$

Where $\alpha, \beta \geq 0$ and y X) are constants and represent output elasticities write factor inputs X_1 and X_2 respectively The production process exhibits increasing, constant or decreasing returns to scale when $a + \beta > = < 1$ respectively The function (3 5) can also be written as

$$\ln Y = \ln \gamma + \alpha \ln X_1 + \beta \ln X_2 \qquad (36)$$

Equation (3 6) is the usual form for fitting the Cobb-Douglas function by the method of least squares to determine the values of γ, α and β Statistical tests of significance can be applied to determine, among other things, whether $\alpha + \beta > = < 1$ applies The above functional form can be extended to the case of more than two inputs, say m, as below

$$\ln Y = \ln \gamma + \sum_{i=1}^{m} \alpha_i \qquad \text{taX}, \qquad (37)$$

It is well known that the Cobb-Douglas production function implied in both the equations (3 6) and (3 7) exhibits unitary elasticity of substitution, which is considered an unrealistic property To avoid this, other functional forms like constant elasticity of substitution (CES), variable elasticity of substitution (VES) and a host of others are proposed in the empirical literature Empirical analysis usualh involves in specifying alternative functional forms, estimating them with the data on hand and choosing the 'best' functional form, keeping the statistical and economic criteria in mind

Christensen, Jorgenson and Lau (1973) have proposed a general functional form known as Transcendental logarithmic form, Translog for short, to represent a second order approximation of Taylor's series expansion for any production function This functional form has become instantaneously very popular and extended to utility, cost and profit functions as well The advantage of this flexible functional form is that the neoclassical properties of a production function can easily be imposed as parametric restrictions and their empirical validity can be tested using data Further, translog form allows the implementation and empirical testing of a priori restrictions of additivity/separability of factor inputs The general translog production function can *be* specified as below:

$$\ln Y = \alpha_0 + \sum_{i=1}^{m} \alpha_i \ln X_i + (1/2) \sum_{i=1}^{m} \sum_{j=1}^{m} \beta_{ij} \ln X_i \ln X_j \qquad (3\ 8)$$

It may be noted that (3 8) can be estimated using single equation or systems approach The latter is necessary when we are interested in estimating the output supply and factor demand equations corresponding to the translog production function

Advanced econometric techniques like Zellner's seemingly unrelated regression estimation (SURE) are used in this case Production functions such as (3 8) along with neoclassical restrictions imposed on the parameters are sometimes referred to as 'structural' models A number of empirical studies, as already listed in Chapter II, have estimated such structural models for health sector in developed countries. Useful discussions about efficiency (technical and economic) are carried out using the estimated production function.

Researchers have worked out the expressions for returns to scale, factor demand elasticities and Allen-Uzawa partial elasticities of substitution underlying *(3* 8) An additional advantage of (3.8) is that the Cobb-Douglas function given in (3 7) as well as few other functional forms such as log-quadratic can be obtained as special cases by restricting the β_{ij} parameters appropriately It is clear that (3 8) deals with a single output (Y) and several inputs (X), m in number here Unfortunately, the multi-product generalization of the production function in (3 8) is not easy to conceive or specify However, as we shall show shortly, the single and multi-product parallels of translog cost function are relatively easier to specify

Recursive models:

Feldstein (1967) has proposed a recursive model to represent the production behavior of hospital services in Great Britain The model has the ability to handle both multiple outputs and inputs, albeit in somewhat a special way The recursive model by Feldstein (1967) is as follows

(i) $D = B^{\alpha_1} M^{\alpha_2} \exp(p'\beta)$

(ii) $W = B^{\alpha_3} M^{\alpha_4} \tilde{D}^{\alpha_5}$

(iii) $R = B^{\alpha_6} M^{\alpha_7} \exp(p'\beta)$ (3 9)

(iv) $N = B^{\alpha_8} \hat{R}^{\alpha_9} \exp(p'\beta)$

(v) $H = B^{\alpha_{10}} \hat{R}^{\alpha_{11}} \exp(p'\beta)$

where D drugs and dressing expenditures, B number of beds, M number of medical staff, W patient outputs in physical units, R proportion of occupancy, N. nursing expenditures, H housekeeping expenditures and the bracketed term is the vector of case mix proportions weighted by a vector β.

The model has the following assumptions

(a) No hospital output is constrained by exogenously determined levels of nursing (N) and house keeping (H) expenditures Rather, these variables are determined by the hospital, based on its level of operation

(b) Output, measured in number of patients treated, depends only on number of beds (B), medical staff (M), drugs and dressings (D) and case mix

(c) Beds (B), medical staff (M) and the vector of proportion of patient case types (p) are exogenously determined

It can be seen that in the model, each equation specifies a Cobb-Douglas type of function of the inputs and an exponential component to handle case mix variations, e g proportion of severe vs normal cases and ambulatory- or outpatient treatments, etc Closure inspection of (3 9) shows that the model is recursive with two sub-systems, namely equations (i) and (ii), and equations (iii), (iv) and (v) In the first sub-system, the drugs (D), which are the outputs in equation (i) becomes input to equation (ii), but do not appear anywhere else in the system The second sub-system has proportion of occupancy (R) as an output in equation (iii) and as an input to equations (iv) and (v) The two sub-systems are tied together by common (exogenous) input factor beds (B)

Since the above model is recursive, ordinary least squares estimation was used to estimate it in the following log-linear form

$$\ln D = \alpha_1 \ln B + \alpha_2 \ln M + \sum_{j=1}^{k} p_j B$$

$$\ln W = \alpha_3 \ln B + \alpha_4 \ln M + \alpha_5 \ln \hat{D}$$

$$\ln R = \alpha_6 \ln B + \alpha_7 \ln M + \sum_{j=1}^{k} p_j \beta_j \qquad (3\ 10)$$

$$\ln N - \alpha_8 \ln B + tt9 \ln \hat{R} + \sum_{j=1}^{k} p_j P.$$

$$\ln H = \alpha_{10} \ln B + \alpha_{11} \ln \hat{R} + \sum_{j=1}^{k} p_j \beta_j$$

Feldstein (1967) compared the results of this recursive model with a similar set of single equation regressions, also in Cobb-Douglas form The comparison favored the recursive model The results also indicate, rather weakly, the presence of decreasing returns to scale in hospital services

Cost functions:

For a variety of reasons, it is easier to study the aspect returns to scale using cost functions (Cowing, Holtman and Powers, 1983) and this in any case, is the way most of the studies in health economics have approached this topic In addition, many hospital studies are primarily concerned with cost behavior rather than input-output relationships addressed directly by production functions A simple cost function may be represented as

$$\mathbf{C\text{-}C(Y,p)} \tag{311}$$

where total cost (C) is a function of the output vector Y and the vector of input prices (p) The cost function has the ability to consider the effect of multiple outputs on total cost On the other hand, it deals with inputs only implicitly although, provided technical efficiency can be assumed, modern theories of Shephard-Samuelson duality permit one to move between cost and production functions to remedy this deficiency In any case. 'p' serves as a vector of parameters with (under optimising behavior) the vector of outputs (Y) resulting from input mixes and magnitudes selected under whatever technology (Baumol, Panzar and Willig 1982)

Shephard [reproduced in Baumol, Panzar and Willig (1982)] used equation (311) for his duality relations between cost and production functions, which inter alia makes it possible to move in a relatively easy manner between cost and production functions Shephard lemma (see for example, Bothwell and Cooley 1978) states

$$\frac{\partial C(Y;p)}{\partial p_j} = X_j^* \tag{3 12}$$

where Xj represents the optimal amount of the j^{th} input Therefore, at any specified level of output and prices, the optimal inputs, X_j^* (j=1,2, ,n), are directly determmable from the cost function

The duality theory, which relates outputs to input in the above-indicated manner, assumes that 'technical efficiency' has already been attained in both cost and production With this assumption, rt is possible to move from cost to production functions and vice versa, so that the analyst is free to use either of the two approaches

A specific case of equation (3 11) is the translog cost function, which can be represented as

$$\ln C = \alpha_0 + \sum_{i=1}^{m} \alpha_i \ln Y_i + \sum_{j=1}^{n} \beta_j \ln p_j + \frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{m} \delta_{ij} \ln Y_i \ln Y_j + \frac{1}{2}\sum_{j=1}^{n}\sum_{k=1}^{n} \gamma_{jk} \ln p_j \ln p_k + \frac{1}{2}\sum_{j=1}\sum_{k=1} \rho_{jk} \ln Y_j \ln p_k \tag{3.13}$$

where. C total cost, p_j unit price of j^{th} input and Y_i, amount of i^{th} output A number of studies have used the translog cost function for measuring hospital efficiency and other related aspects

In addition to the pure translog cost function given above, some researchers have addressed the topic of efficiency as well as economies of scale and scope through hybrid functional forms In these functional forms, the independent variables, particularly the price variables, enter the equation in logarithmic form The output and other variables appear in actual scale without the logarithm The translog hybrid cost function can be specified as

$$\ln C = \alpha_0 + \sum_{i=1}^{m} \alpha_i Y_i + \sum_{j=1}^{n} \beta_j \ln p_j + \frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{m} \delta_{ij} Y_i Y_j + \frac{1}{2}\sum_{j=1}^{n}\sum_{k=1}^{n} \gamma_{jk} \ln p_j \ln p_k + \frac{1}{2}\sum_{j=1}^{m}\sum_{k=1}^{n} \rho_{jk} Y_j \ln p_k \tag{3.14}$$

The definition of 'Y', 'p' and 'C' remains the same as above In the following section, we give a brief review of some of the selected functional forms that are widely used in hospital cost function studies

Hospital Cost Functions:

Feldstein (1967) approached the topic 'returns to scale' from the standpoint of cost functions He began by examining the cost per case as a function of number of beds (B), which is a measure of scale Two simple average cost functions were estimated with number of beds (B) in linear and quadratic form separately as below:

$$AC = a + pB \qquad (315)$$

$$AC = a + \beta_1 B + \beta_2 B^2 \qquad (316)$$

where AC is the average cost per patient, a and P are parameters to be estimated Though the goodness of fit was poor using the above functional forms, the results indicated increasing average cost in certain range of hospital size (number of beds) Average cost regression was re-run with a case mix variable reflecting the nine specialties (e g , pediatrics, general surgery, general medicine etc) added

$$AC = \alpha + frB + \beta_2 B^{?} + \sum_{i=1}^{9} \delta_i p_i \qquad (3\ 17)$$

where p_i (i = 1,2, ,9) is the proportion of case mix types in relation to all cases treated in a hospital In addition to substantial increase in explanatory power, the case mix variable became significant in the regression Likewise, inclusion of case flow rate variable (average number of cases treated per bed year, F) also improved the results further

$$AC = \alpha + \text{frB-hfo^+ZTiPi+oF}_{i=1}^{9} + \rho F^2 \qquad (3\ 18)$$

In equation (3 18), the average cost per patient was found to decrease as hospital bed size increases implying increasing returns to scale In contrast, as noted earlier, the production function estimates reflected slight decreasing returns to scale for hospitals of certain size

Different authors used similar cost functions[3] These studies on hospital cost concentrated largely upon determining the shape of the average cost curve, effects of case mix on hospital cost, and optimal hospital size by using cross sectional data on various hospitals In addition, these studies also focus on estimating the possibility of scale economies, which implied increased efficiency for larger hospitals However, most of these studies did not pay adequate attention to the multiple output, or input price issues as discussed in the previous chapter Although some of these studies (particularly in 70's) gave more attention towards the case mix problems, they failed to link the empirical models used to the theoretical concept of multiple-output firm and the related cost structure Thus, their work is considered "less regorous, even rather ad-hoc at times, than might be desired, a weakness which severely limits its interpretation and usefulness for policy analysis" (Cowing et al 1983)

More recent studies on hospital cost use theoretically consistent models of hospital cost These studies specify the total cost to be a function of multiple categories of outputs and inputs In addition, various measures of capital stock (e g number of beds, number of admitting physicians etc), and case mix are also included in these models These studies have used either translog or hybrid functional forms in order to estimate the relationship between the cost and output One of the early applications of translog cost function was by Cowing and Holtman (1983)

The authors used a functional form similar to that given in equation (3 13) They

[3] For example, see Carr and Feldstein (1967), New house (1970), Bays (977). Pauly (1978). Lave and Lave (1970). and Rafferty (1971).

used five outputs (emergency room care, medical surgical care, pediatric care, maternity care and other care), prices of six inputs (nursing labor, auxiliary labor, professional labor, general labor, and materials and supplies), and two measures of fixed variables (number of admitting physicians and fixed capital) in their model The model is specified as follows:

$$\ln C = \alpha_0 + \sum_{i=1} \alpha_i \ln Y_i + \sum_{j=1} \beta_j \ln p_j + \frac{1}{2} \sum_{i=1} \sum_{j=1} \delta_{ij} \ln Y_i \ln Y_j +$$

$$\frac{1}{2} \sum_{j=1} \sum_{k=1} \gamma_{jk} \ln p_j \ln p_k + \sum_{i=1} \sum_{j=1} \rho_{ij} \ln Y_i \ln p_j + \sum_{i=1} \psi_i \ln Y_i \ln S +$$

$$\sum_{j=1}^{n} \pi_j \ln p_j \ln S + \varphi_{sd} \ln S \ln D + \varphi_s \ln S + \varphi_{ss} (\ln S)^2 +$$

$$\theta_d \log D + \theta_{dd} (\log D)^2 \qquad (3.19)$$

where, C: variable cost, D: number of admitting physicians (assumed to be fixed in the short run), S: measure of fixed capital stock. Using Shephard lemma, the authors derived the cost share equations for all the variable inputs. Thus, the actual model has seven equations, namely six share equations and the cost function itself. By using cross-section data from 138 non-federal, short-term, general-care hospitals in USA, the above model with six equations[4] was estimated by using the method of maximum likelihood

Probably, the most frequently used functional form in recent times is the hybrid cost function originally proposed by Grannemann et al (1986) The functional form is given below:

[4] Since cost shares add-up to unity, out of the six dare equations only five are linearly independent and can be estimated The parameters of the sixth equation can be obtained using all other parameters.

$$C = A \prod_{1=1}^{n} p_1^{\beta_1} \exp(f(Y, D, CM, R, Z)) \qquad (3\ 20)$$

or

$$\ln C = \ln A + \sum_{1=1}^{n} \beta_1 \text{ to } p_1 + f(Y, D, CM, R, Z) \qquad (3.21)$$

where A: vector of various factors that are assumed to affect the level of cost, but not the shape of the cost function with respect to outputs, P_J price of j^{th} production input. Y vector of hospital primary outputs (Y_1, Y_2, Y_3 are inpatient days by type, Y_4 is outpatient visits, Y_5 emergency department visits), D vector of inpatient discharges by type, CM matrix of case mix variables, R vector of various sources of revenue of the hospital, Z vector of other miscellaneous outputs produced by the hospital The outputs enter the equation in linear, quadratic as well as cubic forms and other variables such as CM and R enter with interaction terms

Functional forms similar to Grannemann et al (1986) have been used in Bitran and Dunlop (1989), Vita (1990), Barnum and Kutzin (1993) and various other studies

Mixed models:

The above models are primarily used for examining the determinants of hospital costs, estimating the extent of scale and scope of hospitals However, in studies where the primary focus is to examine the efficiency of the hospital production process, use somewhat different approach These studies, in addition to the use of cost functions, use the production function approach in order to calculate the efficiency index Goldman and Grossman (1983) have used this approach for estimating the inefficiency of community health centers in the U S Similar approach was followed by Wouters (1990) in her study of cost and efficiency of a sample of 42 private and public hospitals in Nigeria

Technical efficiency was estimated using a production function Measures of marginal product of health workers are also obtained. The following production function was used

$$\ln V = a_0 + a_1 \frac{(IN^{\lambda} - 1)}{\lambda} + a_2 \ln DRUGNUM86 + a_3 \ln HHW + a_4 \ln LHW +$$

$$a_5 BEDSDUMMY + a_6 \frac{(BEDS^{\lambda} - 1)}{\lambda} BEDSDUMMY$$

(3 22)

where λ is a parameter of the Box-Cox transformation In the above production function, (logarithm of) the number of outpatient visits (V) is the dependent variable Independent variables are, the number of inpatient admissions (IN), the number of patients receiving drugs (DRUGNUM86), the proportion of high and low level health workers (HHW, LHW) and the presence of number of beds (BEDSDUMMY and BEDS)

To examine whether the cost minimization was taking place, estimates of marginal product of high and low level worker were compared with relative category of labor in private and public facilities She found that pubic facilities employed too many low-level workers compared to private hospitals In contrast, private providers were found to be using a near optimal (cost minimizing) mix of high and low level of health workers The estimated cost function is as follows

$$\ln RCOST = b_0 + b_1 \ln V + b_2 \frac{(IN^{\lambda} - 1)}{\lambda} + b_3 \ln DRUGPCT86 + b_4 \ln INDEX +$$

$$b_5 \ln WAGHHW + b_6 \ln WAGLHW + b_7 BEDSDUMMY +$$

$$b_8 \frac{(BEDS^{\lambda} - 1)}{\lambda} BEDSDUMMY \quad (3\ 23)$$

where RCOST recurrent expenditure of the facility, DRGPCT86 proportion of patients obtaining drugs, WAGHHW and WAGLHW wages of high and low level health workers and INDEX efficiency index defined as,

$$INDEX = \frac{\dfrac{MP_{LHW}}{MP_{HHW}}}{\dfrac{WAGE_{LHW}}{WAGE_{HHW}}} - 1 \qquad (3\ 24)$$

The other variables are as defined in equation (3 23) The equation (3 23) was estimated using OLS method

Thus, in this chapter, we have reviewed the alternative approaches that were used in the literature for evaluation of hospital performance and efficiency We notice that the method of combined utilization and productivity (CUP) was used for evaluating hospital performance and statistical cost functions for hospital (economic/allocative) efficiency CUP analysis is a managerial technique that could be used for quick identification of low performing hospitals. This method does not require detailed data on the hospital production process and depends mostly on hospital census data such as inpatient days, outpatient visits, admissions, beds etc However this method does not take certain critical issues such as economies of scale and scope, marginal and average costs, elasticity of substitution etc , which are of prime importance to the economists and policy makers These issues are well handled by the statistical cost functions We therefore, attempt to use the CUP analysis for evaluating hospital performance and cost functions for efficiency in Andhra Pradesh The specific objectives of this study are listed below

3.5. Specific objectives of the study:

1. Evaluate the performance and efficiency of secondary level hospitals in the state of Andhra Pradesh. This is attempted through:
   (a) Combined utilization and productivity (CUP) analysis for evaluating hospital performance.
   (b) Cost functions for evaluating hospital efficiency.
2. Examining the issue of health financing in developing countries in general and AP in particular, with a view to suggest some policy measures in this regard. This is done through:
   (a) Review the methods of financing the health sector as suggested by various international agencies.
   (b) Assessing the resource allocation pattern in the health sector in AP.
   (c) Examine the feasibility of user fees as a source of financing in Andhra Pradesh district hospitals using a field study.

In the next chapter, we take up the empirical analysis of evaluating hospital performance in the state of Andhra Pradesh using CUP analysis.

CHAPTER IV
HOSPITAL PERFORMANCE: AN EVALUATION

4.0. Introduction:

As mentioned in the previous chapter, the application of cost accounting methods for measuring hospital performance and efficiency is fraught with difficulties because of their inherent assumptions of single measure of output, identical quality of care and case mix across hospitals An alternative method that is often used for evaluating hospital performance is the ratio analysis The ratios used in this method do not necessarily depend on average cost data It is also not required that different outputs be converted into a single output unit Further, the problem of case mix is handled in a tactful way by grouping the hospitals into a few homogenous groups The ratios used here are bed occupancy rate (BOR), bed turnover rate (BTR), and average length of stay (ALS)[1] These ratios are computed from various basic service statistics of the hospitals

An earlier attempt to measure the performance of secondary level hospitals by using these ratios in AP was made by Mahapatra and Berman (1991, 1994) Basic hospital statistics for 1989 and 1990 were used They have concluded that most of the secondary level hospitals in AP are either associated with low bed occupancy and low turn over or high bed occupancy and high turnover Since then there are no published studies to our knowledge, which have used this method for India / AP As the evaluation of hospital performance is a continuous process, and there have been substantial changes in hospital policy in the subsequent period, there is a need to re-examine the issue afresh

[1]The definition of these ratios are given in the previous chapter and reproduced in Section 4 42 for convenience

This study makes an attempt to evaluate the hospital performance for the period 1991-96 Details about the sampling and methodology are given below

4.1. Sampling and methodology:

4.1.1. Sampling:

As already mentioned in Chapter I, APWP a special autonomous body, was created in 1986 and the hospitals that are presently under the jurisdiction of APWP, were initially under the control of Directorate of Health (DOH) Prior to creation of APWP, no hospital level data on performance indicators were available In 1989, the then commissioner of APWP developed a special data collection format The hospitals were requested to supply monthly data on various performance indicators as per the format supplied to them During course of time there have been several changes in the data collection format In 1997 the format was modified and certain additional variables were included in the original format As a result of change in data collection format, the available hospital performance data has also changed over the years

The secondary level health care in A P is delivered through various categories of health care institutions (district hospitals, area hospitals, community hospitals, speciality hospitals, and dispensaries) These institutions are managed by Andhra Pradesh Vaidya Vidhana Parishad (APWP) and are called first referral centers This division of secondary level hospitals into different categories, which is based on the types of services provided by them, was made before APWP came into existence [2]

[2] Before the creation of APWP the secondan level hospitals were managed by Directorate of Health *(DOH).* With the creation of APWP in 1987, these hospitals were transferred from DOH to APVVP But the norne-nclature of the hospitals was primarily made by DOH

As per 1998 records, there were 17 district hospitals, 8 area hospitals, 108 community hospitals, 6 speciality hospitals, and 24 dispensaries, which were included under the category of secondary hospitals and managed by APWP It can be hoped that the above classification of hospitals has brought about uniformity within each category in terms of hospital size, services rendered, case mix etc If this is so, the ratio analysis can then suitably be applied to each category of hospital separately Under the above assumption, we carried out the analysis for each of three categories of hospitals separately, viz district, area, and community hospitals Speciality hospitals and dispensaries were excluded from our sample due to the following reasons

(a) The specialty hospitals are few in numbers and are not homogenous in the sense that these hospitals do not provide similar type of services Therefore, it was not possible to treat them as a single category for our purpose

(b) The dispensaries are intended to provide only outpatient care Since the ratio analysis requires the variable, number of beds, and dispensaries do not have any beds, we excluded the dispensaries from our sample

The basic data required for computation of hospital performance indicators were not available for some hospitals in specific years Therefore, the number of hospitals used in our analysis differs from year to year Table 4 1 gives the number of hospitals (category and year wise) for which the data are available

Computation of the three ratios requires data on three basic hospital statistics viz , annual number of admissions, cumulative inpatient days, and number of available beds These data were collected from the commissionerate of secondary level hospitals (APWP) Data on basic hospital statistics were available on monthly basis We armed

Table 4.1: Number of hospitals for which data are available

Hospital category	1991	1992	1993	1994	1995	1996
District	17	17	17	17	17	17
Area	8	8	8	7	8	8
Community	86	95	97	97	98	99
Total	111	120	122	121	123	124

Table 4.2: Summary statistics on bed capacity of APWP hospitals during 1996

Hospital category	Number of hospitals	Bed capacity				
		Min	Max	Mean	S.D.	C.V.(%)
District	17	150	352	256 1	60 1	235
Area	8	80	105	979	712	73
Community	99	25	100	374	143	382
Total	124	25	352	720	80 1	111 31

at the annual figures by aggregating the monthly data[2] It may be noted that there has been no change in bed capacity during 1991-96 in any of the hospitals Accordingly, we confine to 1996 data on bed capacity Table 4 2 gives the summary statistics of APVVP institutions that are covered in this study

It can be seen from the above table that the average bed capacity is 256 for district hospitals, 98 for area hospitals and 37 for community hospitals in AP Thus, district, area and community hospitals can be described as large, medium and small in size at secondary hospital level in AP Although the bed capacity remained constant within each hospital over the study period, it varied somewhat between hospitals in each category

[2]For some hospitals, there were no data for certain months during a year Since we aim at analysing the performance indicators year wise, it is obvious that the hospitals, which did not report the data for all the months, will have distorted values of the indicators for such year(s) Therefore, suitable adjustment was made in the formulae by taking the number of days for which the data were reported

The variability in bed capacity is the largest (38 2%) in community hospitals and the least (7 3%) in area hospitals

Table 4 3 gives the various summary statistics on hospital manpower across different hospital categories Since manpower is sanctioned according to hospital size (bed strength), we notice that district, area and community hospitals have staff strength declining by hospital size District hospitals on an average have the largest manpower with 30 doctors, 94 nurses and 123 supporting staff including other staff A typical community hospital has only 5 doctors, 14 nurses and 18 other staff Area hospitals have intermediate staff strength Interestingly, except in case of nurses, district hospitals show-least variability in staff strength (manpower) despite largest size compared to other two categories of hospitals Not withstanding the lowest size, community hospitals show-almost similar variability in manpower as that of area hospitals

There can be several socio-economic reasons for the lowest variability in staff strength of district hospitals These include probably, public awareness, closure monitoring by APVVP and district hospital administration in taking timely decisions about manpower needs and above all preference of staff to work in urban based hospitals due to a host of socio-economic reasons All these reasons act negatively as we move on to area and community hospitals Government apathy towards these two latter categories also may play a significant role Geographical location is another important aspect

4.1.2. Methodology:

For convenience and easy reference, let us reproduce the essential aspects of the CUP analysis methodology given in Chapter III As mentioned earlier, the compulation of hospital performance indicators requires information on three basic hospital statistics Those are bed capacity (B) of the hospital, cumulative inpatient days (IP) during a

Table 4.3: Summary statistics on hospital manpower in 19%

Staff category	Summary statistic	Hospital category		
		District	Area	Community
Doctors	Min	27.0	7.0	30
	Max	360	26.0	110
	Mean	298	161	50
	SD	25	65	12
	C.V. (%)	8.4	40.4	240
Nurses	Min	31.0	17.0	50
	Max	83.0	25.0	230
	Mean	578	209	84
	SD	159	31	3 1
	C V (%)	275	148	369
Paramedical staff	Min	140	40	20
	Max	270	11 0	80
	Mean	21 2	91	49
	SD.	35	25	1 1
	C V. (%)	165	275	224
Support staff	Min	360	160	00
	Max	840	310	240
	Mean	609	216	77
	SD	136	46	34
	C V (%)	223	213	442
Other staff	Min	530	220	00
	Max	1050	410	260
	Mean	770	284	108
	SD	136	61	37
	C V (%)	177	215	343
Total manpower	Min	1670	710	160
	Max	3220	1340	840
	Mean	2467	961	368
	SD	446	203	104
	C V (%)	181	21 1	283

Note The approved staff position has not changed during 1991-%

specified time interval, year in our case, and admissions (A) during the same time interval The hospital performance indicators are

1 Bed turnover rate or flow, $BTR = \frac{A}{B}$

2 Bed occupancy rate, $BOR = \frac{IP}{B \times Time\ interval} \times 100$

3 Average length of stay, $ALS = \frac{IP}{A}$

CUP analysis is carried out by plotting the BOR and BTR on a chart as described by Lasso (1986). In contrast to the sample mean values of BOR and BTR used as the norms by Lasso (1986) and Mahapatra and Berman (1994), we use the norms proposed by APVVP for dividing the CUP chart into four sectors According to these norms for any district hospital to be efficient[3] the following conditions are to be met

- ALS should be around 8 days
- BOR should be around 75% and
- BTR should lie within ± 10 % of the state mean

Similarly for an efficient area hospital, the ALS, BOR and BTR need to be respectively around 7 days, 70%, and ±10% from the state mean For an efficient community hospital, the norms are ALS 6 days, BOR 65% and BTR ± 10% from the state mean The efficiency of each hospital is evaluated on the basis of these benchmarks However, for the purpose of our analysis, the above benchmarks are used as the cut off points for BOR and ALS But, for BTR, instead of state mean, we use the

[3] The word 'efficiency' is being used in a loose (non-economic) sense here Specifically hospitals which fulfill the norms are classified to be 'efficient' and others as 'inefficient' Efficient hospitals are those with BOR and BTR values located in Sector III Thus the phrase best performance is being used synonymously

hospital category mean over the years as benchmark because, state mean may not be representative in the presence of large heterogeneity in hospital characteristics

4.2. Empirical results:

4.2.1. District hospitals:

Table 4 4 gives the summary statistics of hospital activity indicators for district hospitals The indicators are presented year wise and for the sample period as a whole From Table 4 4 it could be observed that there are some hospitals for which the value of BOR and BTR (in case of area and community hospitals) are more than 100 which has serious implications on the quality of care We need to understand the phenomenon of "extra beds" and "floor beds" in Andhra Pradesh hospitals in order to know why these values are so high

As the total number of available beds is very low, some hospitals do face situation of high demand, much excess of their capacity Most of the hospitals maintain some stock of folding cots The hospitals usually respond to higher demand by putting extra beds using folding cot stock These are called extra beds When such beds are not available or are exhausted, patients are housed on the floor These are called floor beds This is the reason for which some hospitals can have bed occupancies in excess of 100% and turnover rates of more than 50, even with average length of stay of around 8 days Such a practice within limits can help the hospital achieve full utilisation of its capacity and are inevitable due to overall shortage of hospital stock If a hospital permits itself the option of a few extra / floor beds, it will not have to maintain empty beds to meet unforeseen situations However, excessive reliance on "extra beds" or "floor beds" has serious implications on

with the word 'efficient'. However, we exam me the economic concept of efficiency from cost minimization angle in the next chapter

Table 4.4: Summary statistics of hospital performance indicators for district hospitals

Indicator	Statistic	1991	1992	1993	1994	1995	1996	1991-96*
BOR	Max	131.1	135 1	115 1	105 1	110 8	92 5	111 0
	Min	33.5	42.5	54 8	50 7	43 2	42 5	45 5
	Mean	83.2	86 9	83 0	79 6	73 3	68 4	79 2
	SD	22 1	22.5	14 0	15 7	20 5	17 2	170
	CV (%)	26 6	25 9	16 9	19 7	27 9	25 1	21 5
BTR	Max	78 9	63 6	97 3	92 9	81 5	82 2	86 1
	Min	14.6	18 2	23 2	21 7	156	24 2	20 8
	Mean	44.7	46 6	52 0	47 6	43 2	47 2	46 3
	SD	16 4	18 2	19 9	18 2	17 9	18 0	17 1
	CV,(%)	36 7	39 0	38 3	38 2	38 2	41 1	38 1
ATS	Max	10 5	10 5	96	9 1	17 7	79	88
	Min	3 1	33	25	25	27	3 3	29
	Mean	73	73	65	67	70	57	66
	SD	1 8	1 8	1 9	1 8	3 1	1 3	1 6
	C V (%)	24 6	24 6	29 2	26 8	44 3	22 8	24 2

* Average

quality of care First, with increasing number of patients, the chance of hospital acquired infection, inadequate nursing and professional attention increases Second, the scope for discrimination in allocating the regular / extra / floor beds will creep into the picture

During the sample period 1991-96, there is considerable variation in the BOR, BTR and ALS values across district hospitals A typical district hospital seems to record a bed occupancy rate of 79 2%, which is marginally higher than the norm of 75% However, the average bed turnover rate is only 46 3, which do not reflect a very good performance Likewise, ALS value of 6 6 days, much below the norm of 8 days per patient, will indicate probably quick disposal (discharge) of cases, not a desirable feature of health care The relatively large values of coefficient of variation for these performance indicators show that there is considerable variation in performance across district hospitals There could be several reasons for this Since BOR, BTR and ALS are considered to represent hospital utilisation, productivity and quality of care respectively, we notice a considerable variation in these characteristics across hospitals Productivity differentials seem to be relatively larger than differences in hospital utilisation and quality of care

The performance indicators show some variation o\er time However, there is no secular trend in any of these indicators In particular, BOR seem to decline, probably due to lesser use of public health care facilities Though we do not have supporting data, it may be assumed that private health care might be increasingly available and patronised by affordable sections of population On the other hand, the bed turnover rate, BTR, an indicator of hospital productivity, shows fluctuations over time The average utilisation and productivity indicators have touched the maxima in 1992 and 1993 respectively The quality of heath care (ALS) also shows fluctuations with maximum and minimum occurring in 1991-92 and 1996 respectively It must be pointed out that high ALS may also indicate high complexity of cases treated or insufficient attention being paid to patients or wrong diagnosis and delay in cure Thus, its interpretation effect is somewhat ambiguous

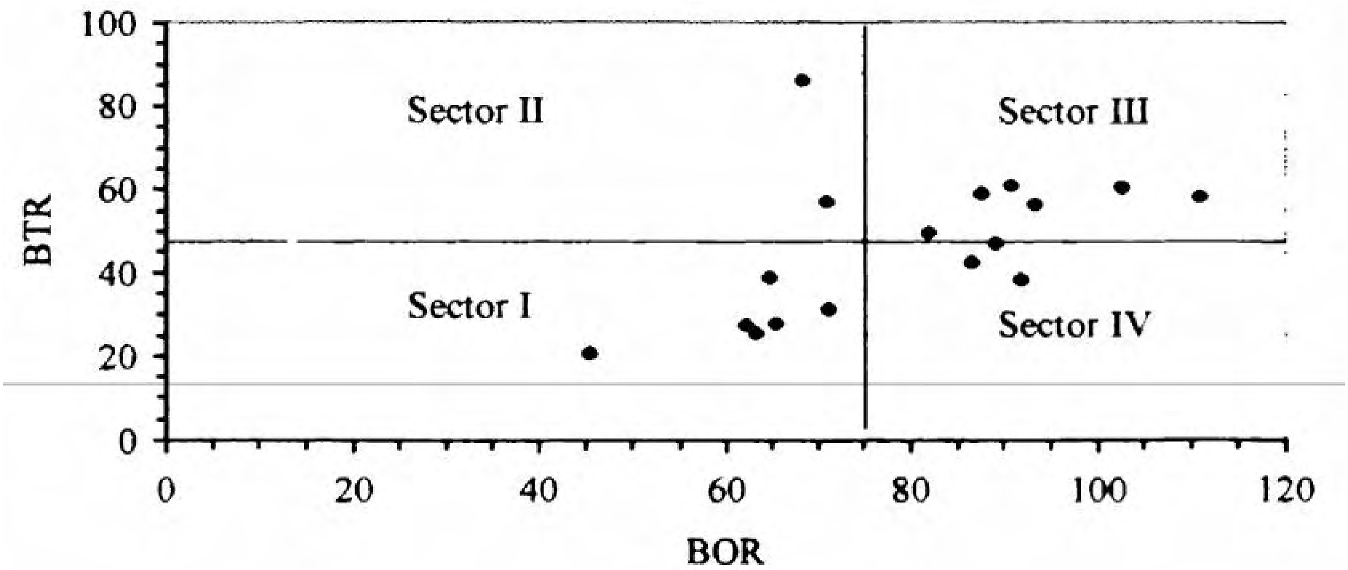
For CUP analysis, we plot the BOR and BTR for each year and the six-year average Each graph is divided into four sectors on the basis of norms for BOR (75%) and BTR, the mean values of bed turnover rate across district level hospitals for the respective years Sector I shows the hospitals which have low turnover (productivity) and low occupancy (utilisation) rate, an undesirable situation The hospitals, which fall in

Sector II, are characterized by high BTR and low BOR and the hospitals within the Sector III are characterized by high BOR and BTR. Sector IV comprises of hospitals with high BOR and low BTR We first discuss the results for six-year average and then comment on annual patterns.

Six-year average values of BOR and BTR along with their norms (norm for BOR. 75% and BTR 46 3) are plotted and shown in Chart 4 1 To facilitate discussion, the number of district level hospitals (with percentage in parenthesis) falling in each sector is shown in Table 4 5 The sectoral percentages are also depicted in a multiple bar diagram (Chart 4 2) The year-wise CUP charts are shown in Appendix Charts 4 1 to 4 6 For the sample period 1991-96 as a whole, out of the total 17 district hospitals, 6 hospitals (35 2%) have both BOR and BTR values less than the prescribed norms These hospitals located in Karimnagar, Machlipatnam, Nellore, Ongole, Rajamundry, and Srikakulam therefore belong to Sector I, the least 'efficient' category based on hospital performance indicators

Likewise, 7 hospitals (41 2%) have shown both BOR and BTR values larger than the norms set by APVAT These hospitals situated at Anantpur, Chittore Cuddapah, Nalgonda, Nizamabad, Sangareddy, and Vizianagaram can be called as most 'efficient' and fall in Sector III .Another two hospitals each (11 8%) belong to Sectors II and Sector IV, which have one of the indicators exceeding the norm and the other indicator below the norm Thus, on an a\erage, during the sample period, 47% (including the one with equal BTR norm) of the district hospitals seem to perform satisfactorily and fulfil the efficiency norms set by APVVP Looking at Sectors II and IV of Chan 4 1, we note that another handful of hospitals (5) are close to the performance norms and perhaps can be improved This leaves us with 4 hospitals (Adilabad, Eluru, Khammarn and Mehboobnagar) which need closer look into their functioning and necessary steps for improvement

Chart 4.1: CUP Sector wise location of district level hospitals based on average BOR and BTR values for 1991-96



Looking at year wise values of BOR and BTR, we notice no systematic pattern for any of the sectors The number and composition of hospitals belonging to each sector kept changing over the years The number of low performing hospitals (i c , low BOR and BTR hospitals) were minimum at 3 in 1992 and maximum at 7 in 1995 They constituted 17 7% and 41 2% of the total number of district hospitals existing in 1992 and 1995 respectively The best performing hospitals i e , those belonging to Sector III, have touched a maximum of 8 in 1992 and a minimum of 5 in 1995 as well as 1996 These hospitals accounted for 47 1% in 1992 and 29 4% in 1995 as well as 1996

A closer look at the specific hospitals in each sector shows that the hospitals lying in Sector l i e , least efficient, have either remained in the same sector over the years or have moved to Sector IV or Sector II No hospital has moved to Sector III This shoves that such hospitals could improve either utilisation or productivity but not both over the years This indicates competition / trade off between BOR and BTR. On the other hand, the hospitals falling within Sector III have either moved to Sector IV or have remained in the same sector over the years They have never moved towards the Sector I Hospitals falling within Sector II and IV have either moved towards Sector III or I Thus, simultaneous improvement in both BOR and BTR is possible and may require a conscious effort on the part of the hospitals as well as their administrators

Since some of these hospitals have moved to Sector IV over the years, the bed occupancy rate for these hospitals is obviously high This high occupancy might have been due to longer hospital stay, which implies that these hospitals treat more complicated cases This result is on expected lines in a sense that the district hospitals are higher level facilities and therefore handle the complicated cases requiring longer hospitalisation, which leads to higher occupancy One might argue that the longer stay- might be due to poor diagnostic scheduling and poor attention by the doctors Thus, no concrete conclusion regarding the performance implications of these Sectors could be drawn without consideration of other factors

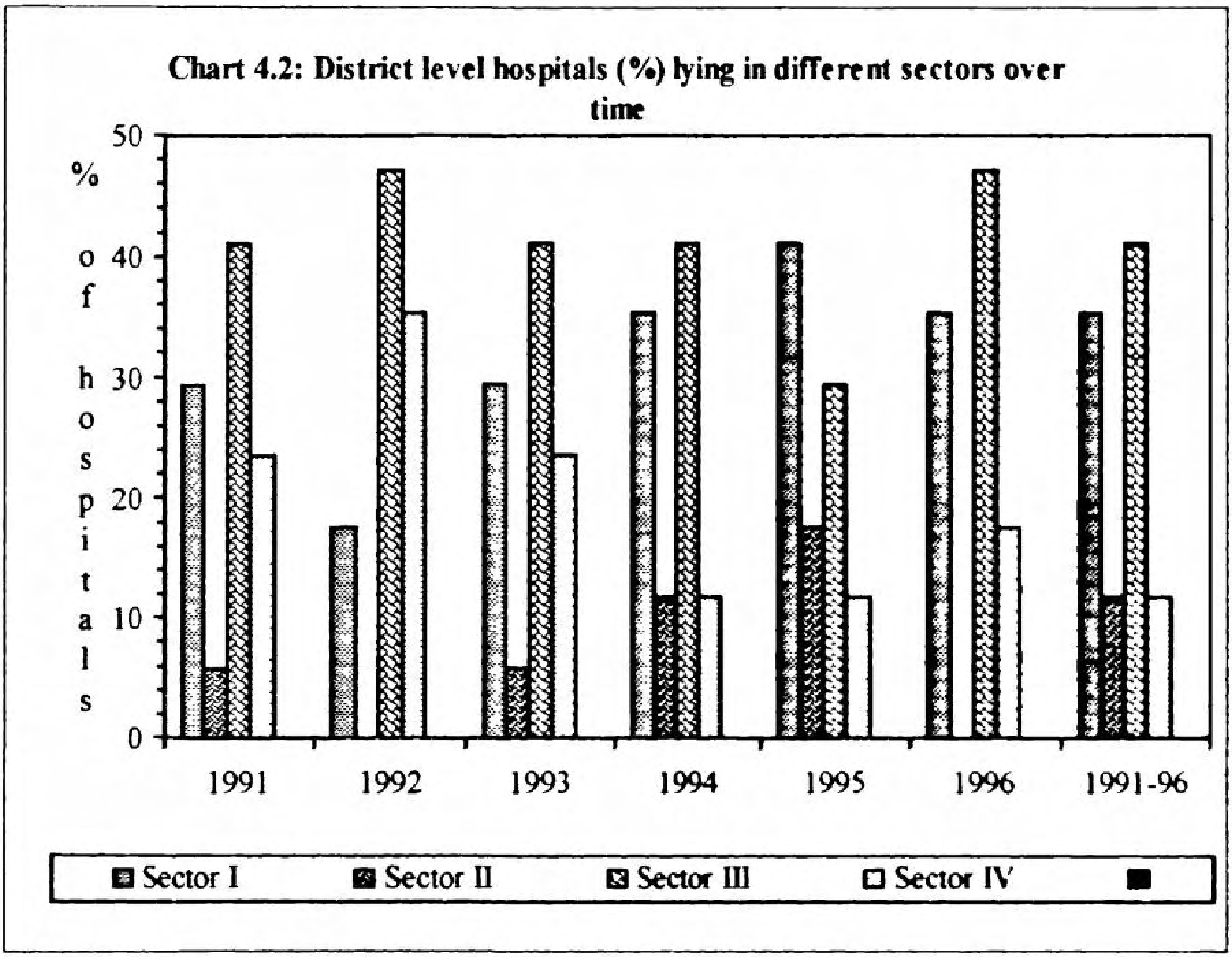
4.2.2. Area hospitals:

Summary statistics of hospital activity indicators for area hospitals are given in Table 4 6 The problem of BOR and BTR exceeding the value 100 seems to exist in case of area hospitals in a bigger way than in district hospitals As argued earlier, this would mean 'low' quality of hospital care and the associated negative consequences One can not rule out the possibility of erroneous record keeping and data management systems Given these limitations, we try to analyze the data and make broad inferences

Table 4.5: CUP Sector wise distribution of district level hospitals*

Sector No.	Sector Description	1991	1992	1993	1994	1995	19%	1991-96*
I	Low BOR and low BTR	5 (294)	3 (177)	5 (294)	6 (35.3)	7 (412)	6 (353)	6 (352)
II	High BTR and low BOR	1 (59)	0 (00)	1 (5.9)	2 (118)	3 (176)	3 (176)	2 (118)
III	High BTR and high BOR	7 (412)	8 (471)	7 (41.2)	7 (41.2)	5 (294)	5 (29.4)	7 (412)
IV	High BOR and low BTR	4 (235)	6 (353)	4 (23.5)	2 (118)	2 (118)	3 (176)	2 (118)
Total		17 (100)	17 (100)	17 (100)	17 (100)	17 (100)	17 (100)	17 (100)

Figures within the parenthesis show the percentage values to the total
* Based on CUP Chart 4 1 and Appendix Chars 41-46



about performance of area hospitals in AP During the sample period 1991-96, the variation in BTR is the highest (54%) compared to BOR (47 9%) and ALS (25.8%) The mean bed occupancy rate (72%) is only marginally higher than the prescribed norm of 70% for area hospitals The mean value of ALS is 6 2 days, which is lower than the prescribed norm of 7 days The mean BTR (43 5 per bed) also does not indicate an impressive performance.

It is interesting to compare these performance indicators with those of district hospitals Although we expect the average levels be lower here, it is puzzling to notice greater variability despite fewer number of area hospital (8) One wanders about the possible reasons for this. Why are the area hospitals less utilized as well as less productive compared to district hospitals? Why does the performance vary more than the district hospitals? Have the location of these hospitals and the nature of services provided by them anything to do with such performance? These are some of the questions, which should bother the hospital management and policy maker

The year wise values of these indicators do not show any systematic trend over the sample period However, the average bed occupancy rate (BOR) seems to decline over time The bed turnover rate (BTR) appears to become more volatile These two trends are indicative of declining performance of area hospitals in AP over time Looking at ALS figures (Table 4 7), it can be said that the higher BTR in 1996 was due to low length of stay (5 7 days)

The number of area hospitals falling in each sector is shown in Table 4 7 The percentage of hospitals falling in each sector in different years is shown in a multiple bar diagram (Chart 4 4) For the sample period 1991-96 as a whole, out of the total 8 area hospitals, 4 hospitals (50%) have both BOR and BTR values less than the prescribed norm of 70% These hospitals are located in Golkonda, Jagityal, Gudivada and King Koti therefore belong to Sector I, the least 'efficient' category On the other hand, there were only 2 hospitals (25%) which have BOR and BTR values larger than or equal to the prescribed norm and therefore lie in Sector III These hospitals are located in Malakpet and Hindupur There are two hospitals, one with BOR higher and BTR lower and other with BOR lower and BTR higher falling in Sector IV and Sector II respectively These hospitals are located in Tenali and Nampaly

Looking at year-wise values of BOR and BTR, ft could be observed that the number of hospitals with high BOR and high BTR have declined from 3 to 2 during 1991 to 1996 Likewise, the number of low performing hospitals (low BOR and BTR hospitals) have increased from 4 in 1991 to 6 in 1995-96 (Appendix Charts 4 7 to 4 12)

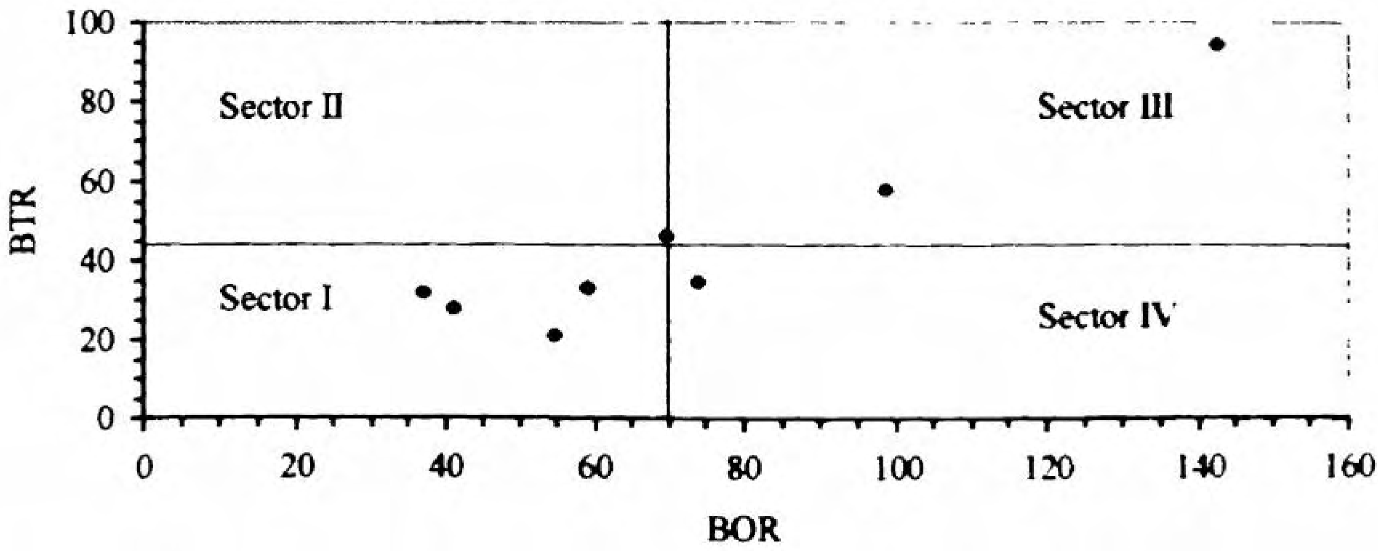
When we study the movement of hospitals from one Sector to the other, it was observed that the area hospitals lying in the Sector I in 1991 have either remained in the same sector or moved to Sector IV or n No movements have taken place from Sector I to Sector in Unfortunately, some hospitals, which were in Sector III, have moved Sector I (i e , low performing sector) Also, some of the hospitals, which were in Sector IV, have moved to Sector I over the years This kind of trend among the hospitals is certainly disappointing and brings us to the conclusion that the performance of area hospitals have not improved over the years, rather the facilities are being underutilised, and working inefficiently

Table 4.6: Summary statistics of hospital performance indicators for area hospitals

Indicator	Statistic	1991	1992	1993	1994	1995	19%	1991-96*
BOR	Max	1405	121 6	154.9	1454	1493	143.1	1424
	Min.	380	42.2	28.7	426	350	27.2	37.0
	Mean	79.0	734	753	796	582	661	720
	SD	345	259	402	336	377	373	34.5
	C.V. (%)	436	353	534	422	648	564	479
BTR	Max	808	81 2	1002	979	107 1	101 5	945
	Min	180	185	176	223	233	184	21 1
	Mean	421	450	454	440	398	463	43 5
	SD	190	210	248	262	277	339	235
	C.V (%)	45 1	467	546	595	696	73 2	540
ALS	Max	126	11 0	89	11 5	64	79	95
	Min	42	39	28	54	50	36	42
	Mean	72	66	63	72	54	5 7	62
	SD	26	23	20	2 1	05	1 3	1 6
	C V. (%)	36 1	348	31 7	292	93	228	258

* Average

Chart 4.3: CUP Sector wise location of area hospitals based on average BOR and BTR values for 1991-96



The percentage of hospitals lying in each sector and their year-wise performance is given in Table 4 7 and also shown in Chart 4.4 It could be observed that for the first three years i e , 1991, 1992, and 1993 the number of hospitals lying in Sector III remains constant and then falls for other years The percentage of hospitals in Sector I has increased over the years

4.2.3. Community hospitals:

This category of hospitals are most populous i e , has the largest number (99) compared to other two categories in AP These hospitals arc located in nook and corner of the state and expected to provide the basic health care facilities to rural people It would be interesting to see whether these hospitals deliver the health care services efficiently, both in absolute and relative sense Table 4 8 gives the summary statistics of community-level hospital activity indicators At the outset, from the table we notice that the maximum value of BOR exceeds the value 300, at the beginning of the sample period Likewise, BTR values are close to 200 This gives the impression that the record

Table 4.7: CUP Sector wise distribution of area level hospitals

Sector		1991	1992	1993	1994	1995	1996	1991-96*
No.	Description							
I	Low BOR and low BTR	4 (500)	3 (375)	3 375)	4 (571)	6 (750)	6 (750)	4 (500)
II	High BTR and low BOR	0 (00)	0 (000)	0 (000)	0 (000)	0 (000)	0 (000)	0 (000)
III	High BTR and high BOR	3 (375)	3 (375)	3 (375)	2 (286)	2 (250)	2 (250)	2 (375)
IV	High BOR and low BTR	1 (125)	2 (250)	2 (250)	1 (143)	0 (000)	0 (000)	2 (125)
Total		8 (100)	8 (100)	8 (100)	7 (100)	8 (100)	8 (100)	8 (100)

Figures within parenthesis show the percentage values to the total
*Based on CUP Chart 4 3 and Appendix Chans 47-412

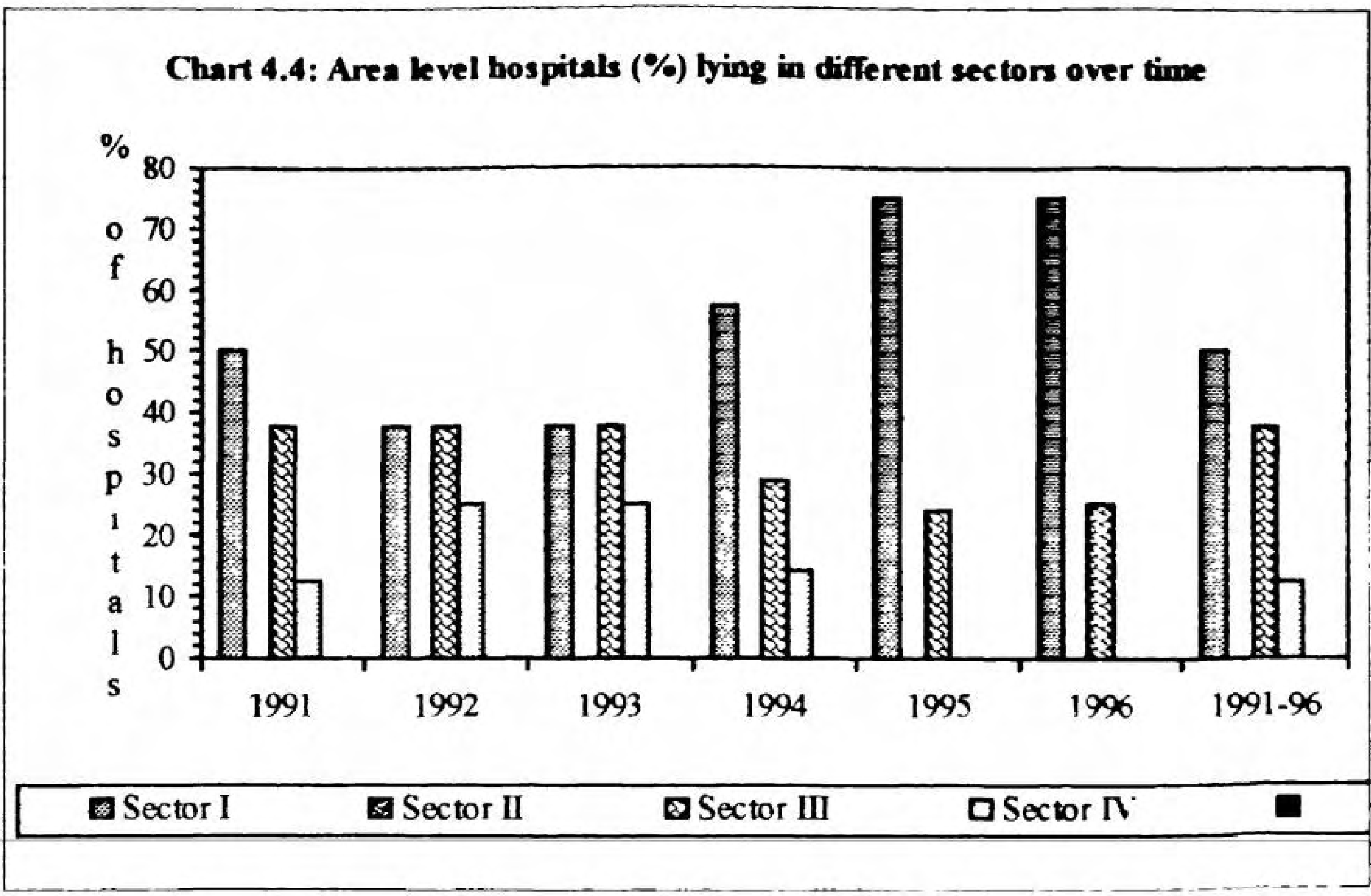


Table 4.8: Summary statistics of hospital performance indicators for community hospitals

Indicator	Statistic	1991	1992	1993	1994	1995	1996	1991-96*
BOR	Max	3346	2409	2467	2180	1670	2053	1938
	Min	11 2	52	13 3	11 0	54	49	142
	Mean	972	91 2	91 5	81 5	723	759	847
	SD	53 7	492	487	41 5	39 1	400	393
	C V. (%)	552	539	532	509	54 1	527	464
BTR	Max	1344	1728	1883	1277	1366	1477	1424
	Min	11 0	28	743	49	3 3	4 1	72
	Mean	602	58 1	634	577	579	569	587
	SD	299	328	35 1	305	33 5	313	293
	CV (%)	496	544	553	528	578	550	499
ALS	Max	16 1	148	100	113	84	124	90
	Min	28	1 9	30	24	23	277	3 5
	Mean	6 1	62	56	5	48	5 1	55
	SD	2 1	22	15	16	12	12	35
	C V (%)	344	344	268	290	250	12 235	236

*Average for 1991-96

keeping may be faulty and unreliable The following analysis is therefore conditioned by the quality of data available

The mean bed occupancy rate and bed turnover rate for community hospitals are much higher compared to district and area hospitals The coefficients of variation for both these indicators are high indicating large variation of BOR and BTR across the community level hospitals The average length of stay is consistently low over the years and has a declining tendency This suggests that high bed occupancy and bed turnover rate for these hospitals is due to shorter length of stay It is disappointing to note that there are some community hospitals whose bed occupancy is as low as 4 9% These hospitals are mostly located in remote areas and are having the known problems of non-availability of medical personnel

Six-year average values of BOR and BTR for community hospitals are plotted on the Chart 4 5 It could be observed that a majority of the hospitals (45) fall within Sector III (i e, the region indicating high bed occupancy and high bed turnover), thereby implying that the community hospitals are performing almost in par with district hospitals

The percentage of hospitals lying in each sector in different years is given in Table 4 9 Year wise results from the CUP analysis show that the percentage of hospitals in Sector III (high utilization and high productivity region) has remained consistently high On the other hand, the number of hospitals in Sector I (km productive and low. utilization region) also seems to increase over the years (Appendix Chans 4 13 to 4 18)

Chart 4.5: CUP Sector wise location of community hospitals based on BOR and BTR values for 1991-96

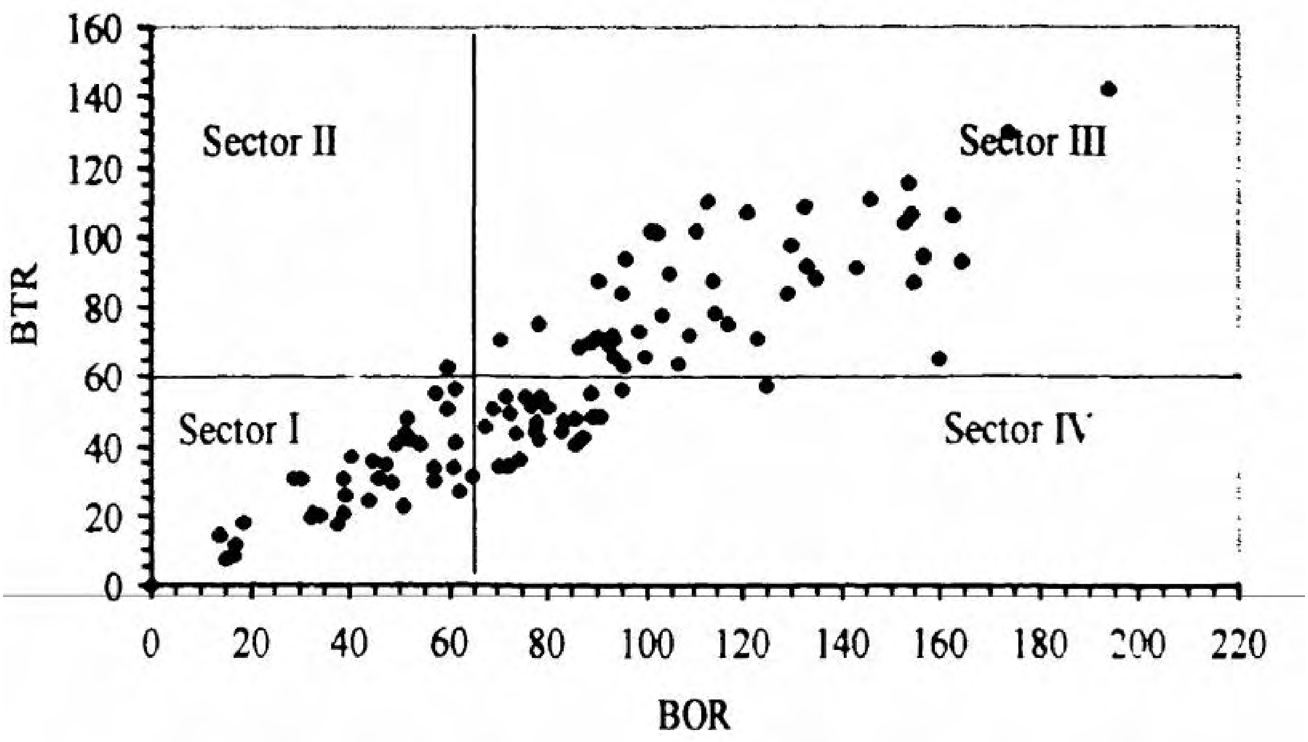
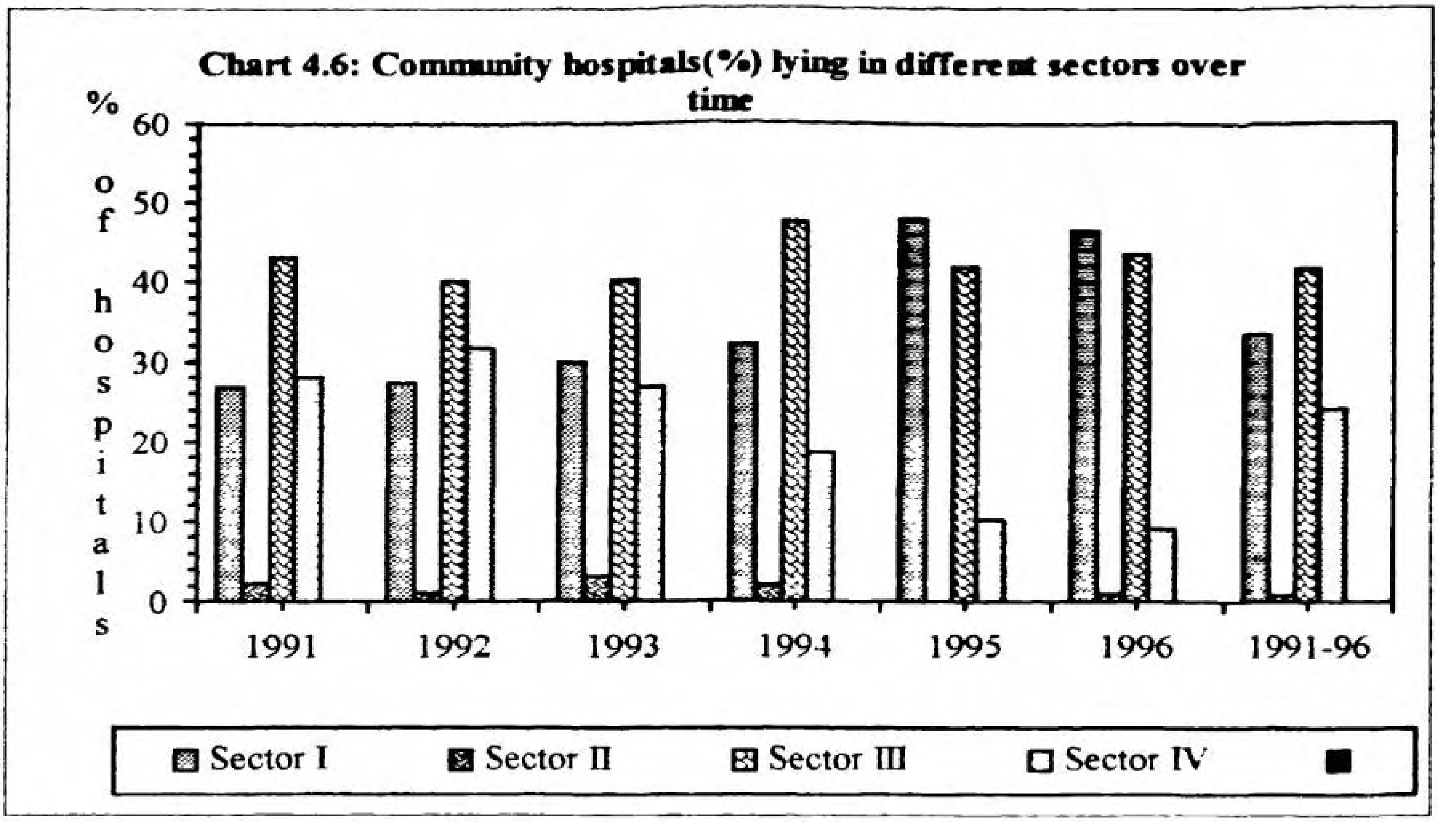


Table 4.9: CUP Sector wise distribution of community level hospitals

Sector No	Sector Description	1991	1992	1993	1994	1995	1996	1991-96*
I	Low BOR and low BTR	23 (267)	26 (274)	29 (299)	31 (319)	47 (480)	46 (465)	36 (333)
II	High BTR and low BOR	2 (23)	1 (10)	3 (31)	2 (21)	' O (00)	(10)	1 (09)
III	High BTR and high BOR	37 (431)	38 (400)	39 (402)	46 (474)	41 (418)	43 (434)	45 (417)
IV	High BOR and low BTR	24 (279)	30 (316)	26 (268)	18 (186)	10 (102)	9 (91)	26 (241)
Total		86 (100)	95 (100)	97 (100)	97 (100)	98 (100)	99 (100)	108 (100)

figures within the parenthesis are percentage values to the total
'Based on CUP Chart 4 5 and Appendix Charts 413-418



When we look at the detailed data, it is observed that there is a bi-directional movement between Sector I, and Sector III Some hospitals that were in Sector I in 1991 have moved to Sector III via Sector IV or they have moved directly from Sector I to Sector III The increasing number of hospitals in Sector I over the years is due to the movement of hospitals from Sector IV to Sector I or from Sector III to Sector I Sometimes it is also observed that the movement has taken place from Sector I to Sector III However, over all, there has always been a tendency of moving from higher sectors to Sector I

4.3. Determinants of hospital performance indicators:

4.3.1. Model:

In the earlier section, we have seen how the hospital performance indicators, bed occupancy rate (BOR), bed turnover rate (BTR) and average length of stay (ALS) can be used in the framework of combined utilization and productivity analysis It was noted that the three indicators are interdependent and use only three hospital censuses viz IP days, admissions and number of beds Other data are also available from hospital records, which contain useful information about hospital functioning This includes data on hospital inputs like number of doctors, nurses, other medical and non-medical personnel, drugs and equipment etc In this section, an attempt is made to find out the effect of some of these other variables on bed occupancy and bed turnover rate In other words, we would like to find out the determinants of BOR and BTR using multiple regression technique The major drawback of this approach is that the same explanatory variables are used as determinants of BOR (supposed to represent hospital utilization / demand factors) and BTR (representing hospital productivity supply factors) Separate data on the demand and supply sides of hospital services are not available The regression equations used for this purpose are as follows

$$BOR_{it} = a_0 + a_1 DB_{it} + a_2 NB_{it} + a_3 PB_{it} + a_4 SB_{it} + a_5 OB_{it} + a_6 ALS_{it} + a_7 D_{1t}$$
$$+ a_8 D_{2t} + a_9 D_{3t} + a_{10} D_{4t} + a_{11} D_{5t} + u_t$$

$$BTR_{it} = b_0 + b_1 DB_{it} + b\ \ NB_{it} + b_3 PB_{it} + b_4 SB_{it} + b_5 OB_{it} + b_6 ALS_{it} + b_7 D_{1t}$$
$$+ b_8 D_{2t} + b_9 D_{3t} + b_{10} D_{4t} + b_{11} D_{5t} + v_t$$

$$(1 = 1, 2, \ \ , N, t = 1, 2, \ \ , T)$$

where, DB Doctors per bed (includes specialist and other doctors), NB Nurses per bed, PB Paramedical persons per bed, SB Supporting staff per bed (apart from doctors and nurses those who are engaged in-patient care directly), OB Other staff per bed, ALS Average length of stay, N Number of hospitals, T Number of years, u and v random error terms D_1, D_2, D_3, D_4, D_5 indicate the year dummies for 1991, 1992 and 1993, 1994, 1995 respectively The year 1996 is used as control / reference year In the above regressions, the independent variables are defined on per bed basis to match the dependent variables BOR and BTR[4]

4.3.2. Data:

The basic data required for estimating the above regressions are collected from APVVP headquarters The variables DB, NB, SB, OB were computed by dividing each category of staff by the number of beds available in each hospital Six-year pooled time series of cross sections data was used for each category of hospitals separately As already indicated earlier, there are 17 district hospitals, 8 area hospitals and 107 community hospitals, which are managed by APVVP and included in our sample Unfortunately, there were some hospitals under each category that did not report the data for some years Therefore, the number of observations is somewhat less than what it should be (Table 4 10) Regression analysis is done for each category of hospitals separately In addition, for each category of hospital an alternative specification, which includes the actual number of each category of staff (instead of per bed basis) as regressors, is estimated

4.3.3. Empirical results:

Table 4 10 gives the summary statistics of all the variables used in the regressions From this table, it can be seen that the average (over the six-year sample period) bed occupancy rate (BOR) is the highest in community level hospitals (84 9% and the lowest in area level hospitals (72 7%), with district level hospitals falling in

[4] Multiple regression using the total number of doctors, nurses, etc as independent variables are also used These latter regressions ga\e poor results in terms of signs of coefficients, explanatory power etc Hence these results are given in Appendix Table 4 1 but not discussed here

Table 4.10: Summary- statistics **of the variables in BOR and BTR regressions**

Variables	Sample	Mean	SD	C.V. (%)	Min	Max
District hospitals						
BOR	102	7906	1952	2469	3355	13614
BTR	102	4688	1789	38 16	1461	97.3
ALS	102	6.74	207	3071	25	177
BEDS	102	256.1	601	2347	150	352
DOCT/BD	102	0.12	003	2500	009	018
NURS/BD	102	022	002	909	0 16	0.27
PARA/BD	102	085	0 13	1529	006	0 11
OTH/BD	102	031	005	16 13	023	046
SLTBD	102	024	003	1250	0 19	031
DOCTOR	102	2976	243	8 17	27	36
NURSE	102	5752	1548	2691	31	83
PARA	102	21 24	3.42	16 10	14	27
OTHER	102	77	1323	17 18	53	105
SUPORT	102	609	1326	21 77	36	84
Area hospitals						
BOR	47	727	3393	4667	272	15488
BTR	47	4444	2463	5542	1761	107 14
ALS	47	639	193	3020	277	1262
BED	47	97 1	7 1	731	80	105
DOCT/BD	47	0 16	006	3750	007	026
NURS/BD	47	021	003	1429	0 16	025
PARA/BD	47	0 1	003	3000	004	0 13
OTH/BD	47	029	006	2069	022	041
SUP/BD	47	022	004	18 18	0 16	031
DOCTOR	47	16 13	624	3869	7	26
NURSE	47	2009	29	1444	17	25
PARA	47	923	224	2427	4	11
OTHER	47	2849	579	2032	22	41
SUPORT	47	2162	442	2044	16	31
Community hospitals						
BOR	579	8491	4708	5545	4 89	33623
BTR	579	5927	3277	5529	28	22343
ALS	579	5 5	1 76	3200	1 92	1663
BED	579	3744	1438	3841	25	100
DOCT/BD	579	0 14	003	21 43	0 1	02
NURS/BD	579	023	006	2609	007	076
PARA/BD	579	014	003	21 43	004	0 13
OTH/BD	579	031	0 1	3226	0	086
SUPBD	579	022	008	3636	0	08
DOCTOR	579	505	1 2	23 76	3	11
NURSE	579	846	3 1	3664	5	23
PARA	579	494	1 05	21 26	4	11
OTHER	579	11 18	372	3327	0	26
SUPORT	579	79	347	4392	0	24

between (79 1%) The same pattern applies to bed turnover rate (BTR) as well The opposite pattern is true for ALS variable The coefficient of variability (C V) in hospital utilization (i e, BOR) is however the least for district hospitals (24 7%) and the greatest for community level hospitals (55 4%) The coefficient of variations for productivity and length of stay do not follow this pattern It is interesting to note that the average values of staff strength per bed i.e , doctors per bed, nurses per bed etc are almost identical across hospital categories This shows that the bed strength is the principal guiding factor for resource allocation in secondary level hospitals in AP However, inter hospital variability exists in allocated resources due to variability in bed strength itself It goes without saying that the staff strength follows the order district hospital (highest), area hospital (middle) and community hospital (lowest), same as the bed strength

(a) Community hospitals:

The regression results are given below

$$BOR_{it} = \underset{(-3\ 83)}{-46\ 60} + \underset{(668)}{459\ 69\ DB_{it}} + \underset{(092)}{40\ 85\ NB_{it}} + \underset{(0\ 24)}{15\ 39\ PB_{it}} + \underset{(3\ 05)}{115\ 40\ SB.} - \underset{(-1\ 26)}{38\ 92\ OB.}$$

$$+ \underset{(637)}{6\ 67 ALS_{it}} + \underset{(2\ 55)}{13\ 48\ D_1} + \underset{(1\ 14)}{5\ 84\ D_2} + \underset{(2\ 52)}{12\ 46\ D_3}$$

Sample size = 579, $R\text{-bar}^2 = 0\ 19$, $F(90, 569) = 16\ 58$, $DW = 1\ 51$

$$BTR_{it} = \underset{(2\ 54)}{21\ 34} + \underset{(648)}{307\ 40\ DB_{it}} + \underset{(063)}{19\ 20\ NB_{it}} + \underset{(0\ 37)}{16\ 52\ PB.} - \underset{(2\ 89)}{75\ 48\ SB_{it}} - \underset{(-0\ 92)}{19\ 61\ OB_{it}}$$

$$\underset{(-6\ 55)}{-4\ 72\ ALS.} + \underset{(1\ 94)}{7\ 09\ D_1} + \underset{(1\ 30)}{4\ 61\ D_2} + \underset{(2\ 54)}{8\ 67\ D_3}$$

Sample size = 579, $R\text{-bar}^2 = 0\ 21$, $F(9, 569) = 18\ 16$, $DW = 1\ 56$

Figures in the parenthesis are estimated t-ratios

The overall goodness of fit represented by R-bar^2 is not bad, taking into consideration the pooled time series of cross section nature of the two regressions The F-statistic is highly significant at 1% level of significance A good number of individual coefficients are also statistically significant either at 1% or 5% significance level Due to pooled nature of data, the Durbin-Watson statistic is difficult to interpret (reported for completeness only) Although some of the explanatory variables have insignificant coefficients, they are retained in the regressions because of their appropriate (expected) signs The relatively low R-bar ^{2} values show that several other (unknown) determinants of BOR and BTR have not been included in the regressions

Based on the t-ratios, it follows that bed occupancy rate is explained by number of doctors per bed (DB), average length of stay (ALS) and support staff per bed (SB) in that order The year dummies (intercepts) for 1994 and 1995 are not significantly different from zero and hence have been omitted from the regressions The non-zero year dummy coefficients for 1991, '92, and '93 show that the intercepts of the regressions are different for different years

Parameter estimates of ALS show that an additional day of stay in the hospital increases BOR by 6 67% The increase in hospital staff strength per bed contributes positively to utilization of hospital services Specifically, an additional doctor per bed is likely to increase the bed occupancy rate by more than 4 5 times, an additional nurse per bed can increase the BOR by 41% Due to the exclusion of other (unknown) determinants, some of these responses are probably overestimated The positive coefficients for 1991, '92 and '93 year dummies show that the average BOR is higher for these years compared to 1996 (control/reference year) This conclusion confirms the earlier result of declining BOR over the years (Table 4 8)

From the BTR regression, based on t-ratios, the bed turnover rate (BTR) is explained by average length of stay, doctors per bed, and support staff per bed in that order There are significant differences in BTR over the years 1991, '92 and '93 compared to 1996 The BTR seems to decline over time. In contrast to BOR regression, an additional day of stay in the hospital seem to decrease the bed turnover rate by 4 72% - a longer hospital stay per se may result in lower productivity in terms of hospital output although it may increase the quality of care Increase in hospital staff contributes positively to hospital productivity One additional doctor per bed is expected to triple the hospital productivity (output), an additional nurse per bed is likely to increase productivity by 19.2% The medical and non-medical supporting staff, also help in increasing hospital output significantly

Thus, in the case of community level hospitals, which are located in remote rural areas of AP, we could identify the determinants of BOR and BTR with reasonable success Due to the large and richness of this data set, multiple regression could separate out the marginal contribution of medical and non-medical staff which are found to be positive and significant As we shall notice shortly, the smaller data sets of area and district hospitals could not succeed to the same extent At the community hospital level, a closer relationship (understanding) may exist between patient and hospital staff, which enables an accurate quantification of individual effects Such possibilities are less it district and area level hospitals Apparently, in the case of area hospitals, the marginal contributions of doctors per bed are negative (although statistically not significant) for both BOR and BTR Among other things, this perverse effect may be due to the complexity of cases treated in these hospitals which require a team effort from all categories of staff, leading to confounding of individual effects

(b) Area hospitals:

The same set of regressions was run separately for area hospitals The results are given below.

$$BOR_{it} = -11\ 37 - 180.73\ DB_{it} + 1069\ 81\ NB_{it} - 1064\ OPB_{it} - 1346\ 51\ SB^{*}$$
$$(-0\ 24) \quad (-1\ 14) \quad (3\ 96) \quad (-2\ 08) \quad (-2\ 26)$$

$$+ 1097\ 13\ OB_{it} - 7\ 80\ ALS_{it} + 26\ 76\ D_1 + 16\ 10\ D_2 + 15\ 99\ D_3 + 19\ 08\ D_4$$
$$(2\ 02) \quad (-2\ 53) \quad (2\ 22) \quad (1\ 42) \quad (1\ 43) \quad (1\ 54)$$

Sample size = 47, R-bar^2 = 0.44, F(10, 36) =4 69*, DW= 2 20

$$BTR_{it} = 17\ 28 - 141\ 75\ DB_{it} + 667\ 64\ NB_{it} - 817\ 73\ PB_{it} - 913\ 51\ SB_{it} + 865\ 0\ OB_{it}$$
$$(053) \quad (-130) \quad (357) \quad (-231) \quad (-222) \quad (231)$$

$$-11\ 46\ ALS_{it} + 15\ 79\ D_1 + 11\ 18\ D_2 + 8\ 60\ D_3 + 1\ 1\ 77\ D_4$$
$$(-539) \quad (1\ 90) \quad (1\ 42) \quad (1\ 1\ 1) \quad (1\ 38)$$

Sample size = 47, R-bar^2 = 0 49, F(10, 36) =5 55, DW= 2 26
Figures in the parenthesis are estimated t-ratios

In the regression for BOR, parameter estimates for doctors per bed (although statistically not significant), paramedical staff per bed and support staff per bed are found to be negative, which is unexpected and difficult to explain The coefficients of nurses per bed and other medical personnel per bed are positive and significant Above all, ALS, which is likely to be highly correlated with BOR, turned out to have a wrong and significant coefficient For the BTR regression, the ALS variable has expected sign and turned out significant as well In both the regressions, the year dummies were found to be insignificant

(c) District hospitals:

The estimated regressions for the district hospitals are as follows

$$BOR_{it} = 2696 - 24806 DB_{it} + 17641\ NB_{it} + 487\ 64\ PB_{it} - 64\ 34\ SB_{it} + 3947 OB_{it}$$
(1 24) (-2 40) (1 80) (2 05) (-0 47) (0 48)

$$-\ 1\ 07\ ALS_{it} + 16\ 50\ D_1 + 20\ 26\ D_2 + 15.44\ D_3 + 12\ 24\ D_4 + 6.26\ D_5$$
(-108) (263) (322) (252) (199) (1.01)

Sample size = 102, R-bar^2= 0 18, F(l 1, 90) =3 01, DW = 2 01

$$BTR_{it} = 64\ 35 - 56\ 94\ DB_{it} - 7\ 01\ NB_{it} + 277.92\ PB_{it} + 147\ 65\ SB_{it} - 100\ 54\ OB_{it}$$
(4 74) (-0 88) (-0 11) (1.86) (1 73) (-1 97)

$$-\ 6\ 48\ ALS_{it} + 7\ 99\ D_1 + 10\ 38\ D_2 + 10\ OS\ D_3 + 7\ 18\ D_4 + 4\ 74\ D_5$$
(1043) (203) (264) (263) (186) (122)

Sample size = 102, R-bar^2- 0 62, F(l 1 , 90) = 15 83, DW - 1 63

Figures in the parenthesis are estimated t-ratios

The results show that the marginal contribution of doctors per bed (in the BOR regression) are of wrong (unexpected) sign and statistically significant The observations made in case of area hospitals are also applicable here to a lesser extent In a contrasting way, some of the year dummies are found to be significant and positive This reiterates the declining trend of both BOR and BTR over time

4.4. Summary and conclusion:

We may recall Lasso (1986) noted that due to the proportionality between BOR, BTR, and ALS, a ray drawn from the origin represents a fixed length of stay In our case, the scatter is fairly tightly distributed around a ray from the origin passing through the intersection of values of BOR and BTR Obviously, the deviation of length of stay within each category of hospitals is much lower than the deviations in BTR and BOR However, it is to be noted that the CUP sectorisation of the hospitals gives a broad description about their BOR, BTR, and .ALS Therefore, it would not be appropnate to give Performance status to a hospital simply on the basis of CUP sector location CUT sector status would help in describing an individual hospital and can be a good starting point for further discussions This analysis can be used by the state level managers as indicators of hospital performance to focus managerial attention on them. However, appropriate interpretation of the results pre-requisrtes the study of other factors affecting the performance indicators

Bernum and Kutzin (1993) have discussed the possible determinants of these indicators and relevance of these determinants for an appropriate interpretation of the values for any hospital Factors considered by them include underlying morbidity pattern of the population in catchment area, availability of drugs and supplies, scheduling of diagnostic tests and therapeutic procedures, hospital re-imbursement policy etc The health care situation in Andhra Pradesh is characterised by low hospital stock (i e , lower availability of bed capacity) compared to its population The hospitals considered for this study are government owned and their budgets are not linked to ALS or BTR levels The problem of scheduling of diagnostic tests and operating facility and case mix may be more dominant factors affecting ALS and BTR of AP district hospitals Poor maintenance of equipment and vacancy of professional staff positions as well **as** sub-optimal efficiency in operation may also be responsible (Mahapatra and Berman, 1991)

A high BOR need not necessarily indicate better hospital performance The implication of high occupancy for average cost and hospital efficiency is ambiguous without information on other service indicators The reasons are obvious A high BOR may indicate an efficient situation, when many patients with modest lengths of **stay** are served (i e , the hospital will have high turnover rate), or an inefficient situation, as when the high proportion of filled bed largely results from long length of stay A low average cost per bed day, but a relatively high cost of admission, signal the later situation (Bernum and Kutzin, 1993)

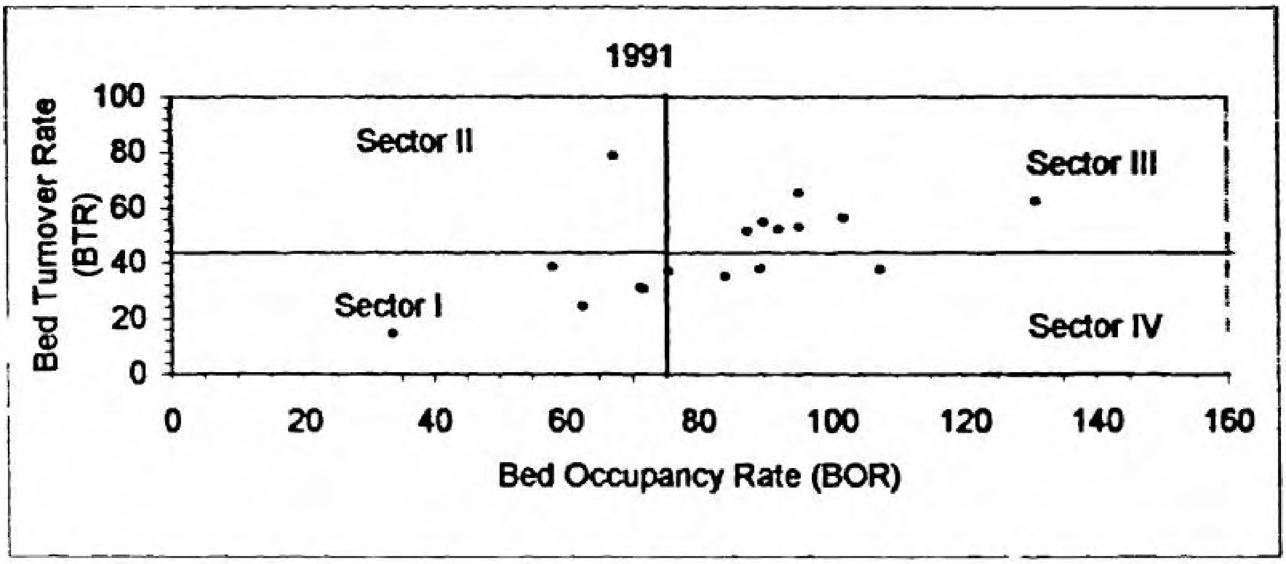
An attempt was made to evaluate the Performance of secondary level hospitals for the state of Andhra Pradesh (AP.) by using combined utilisation and productivity analysis Study of the indicators of global activity (BOR, BTR, and ALS are called global activity indicators) of the secondary level hospitals in A.P shows wide variability among hospitals Variability of BOR and BTR is much higher than ALS Combined utilisation and productivity analysis shows that a sizable proportion of the hospitals are either in low-turnover and low occupancy group (about 30-35%) or high turnover and high occupancy group (about 42%) Although the trends are not systematic, there is a tendency of the hospitals moving towards low productivity region over the years This indicates that the secondary level hospitals in the state of A P are associated with low performance and facilities This result is similar to the one observed by Mahapatra and Berman (1994), who have studied the secondary level health care system in AP during 1989-90

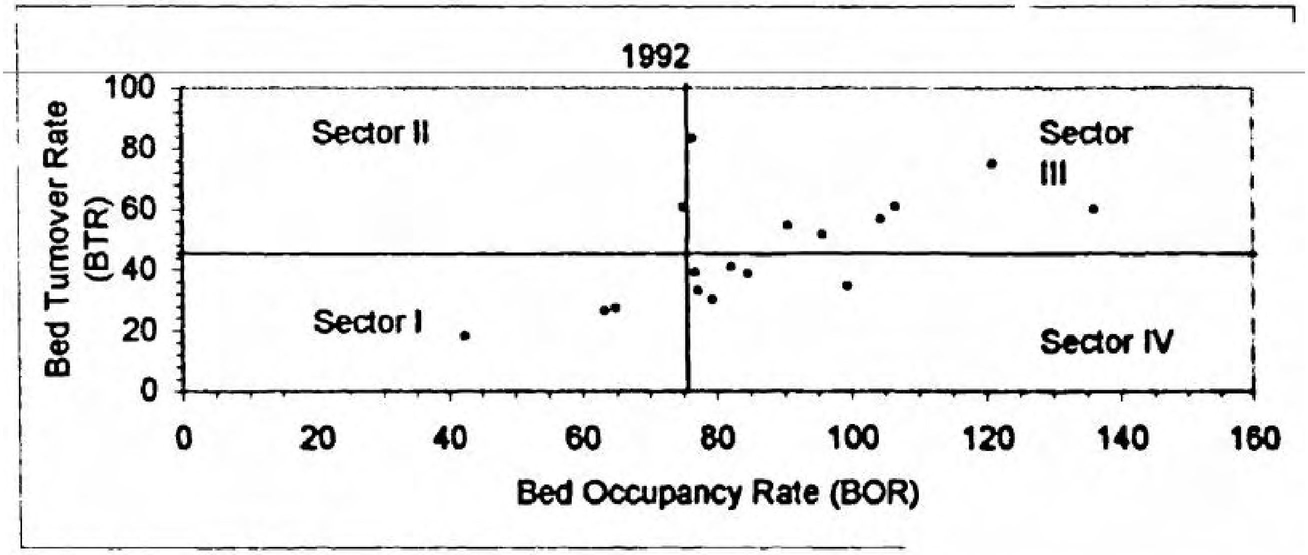
As an extension of CUP analysis, an attempt was made to identify the possible determinants of hospital performance indicators (BOR and BTR) using multiple regression In the absence of appropriate data on the demand and supply sides of hospital services (output), we treated BOR and BTR to represent these forces Further, we used the same set of determinants for both BOR and BTR These include the data on number of doctors, nurses, paramedical staff, support staff, other category of staff all on per bed basis, and average length of stay It was found that, in the case of community level hospitals, where the data is rich enough these determinants have played a significant and expected role in explaining the variation in both BOR and BTR Due to limited data available for area and district hospitals, some perverse responses were also noticed. Among other things, factors such as; geographical location, socio-economic conditions of the people surrounding the hospital, proximity of the hospital to the locality etc. play an important role in determining the utilization as well as the productivity of the secondary hospitals. These factors seem to play a larger role in the case of district and area hospitals compared to community hospitals.

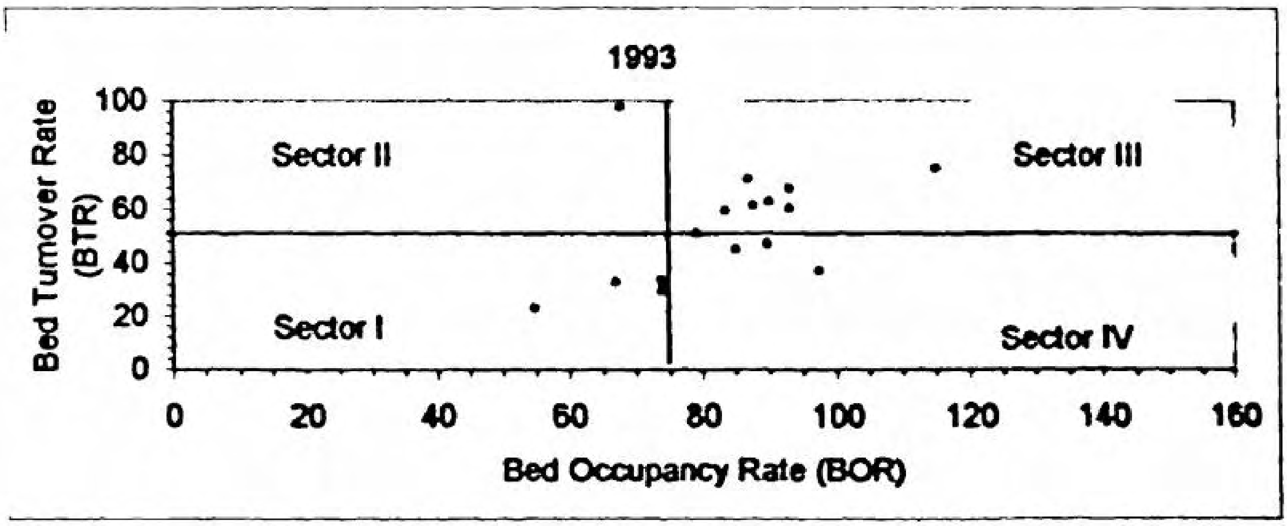
Appendix Table 4.1: Results using total number of doctors, nurses, paramedical, support and other staff as <u>independent variables</u>

	Community hospitals				Area hospitals				District hospitals			
Variable	Coeff	Std Err	T-Stat	Signif	Coeff	Std Err	T-Stat	Signif	Coeff	Std Err	T-Stat	Signif
Constant	56.37	12.89	4.37	0.00	18.64	32.82	0.57	0.574	-63.80	30.87	-2.07	0.04
DOCT	1.71	2.09	0.82	0.41	-0.39	1.35	-0.29	0.776	2.03	0.81	2.50	0.01
NURS	-3.53	1.12	-3.15	0.00	10.16	2.43	4.18	0.000	-0.52	0.33	-1.55	0.12
PARA	-3.26	2.36	-1.38	0.17	-11.96	4.77	-2.51	0.017	3.92	1.07	3.65	0.0004
SUPORT	3.98	1.26	3.17	0.00	-18.51	4.89	-3.78	0001	0.08	0.45	0.17	0.86
OTH	-0.21	1.01	-0.21	0.83	14.00	4.85	2.89	0.007	0.10	0.26	0.39	0.70
ALOS	5.76	1.11	5.17	0.00	-8.48	3.00	-2.83	0.008	1.32	1.00	1.32	0.19
Dl	13.45	5.66	2.38	0.02	27.87	11.66	2.39	0.022	11.14	4.92	2.26	0.03
D2	6.94	5.47	1.27	0.20	16.77	10.98	1.53	0.135	14.72	4.94	2.98	0.004
D3	11.60	5.29	2.19	0.03	16.49	10.80	1.53	0.136	11.99	4.84	2.48	0.02
D4					19.64	11.93	1.65	0.108	8.23	4.85	1.70	0.09
N=579, R-bar2=0.08, F=18.16, DW=1.56					N=47, R-bar2=0.48, F=5.27, DW=2.27				N=102, R-bar2=0.30, F=5.44, DW-1.74			
Constant	86.83	8.88	9.78	0.00	41.80	22.69	1.84	0.074	14.85	20.15	0.74	0.46
DOCT	1.54	1.44	1.07	0.29	-0.32	0.93	-0.35	0.732	1.33	0.53	2.52	0.01
NURS	-2.42	0.77	-3.14	0.00	6.19	1.68	3.69	0.001	-0.53	0.22	-2.44	0.02
PARA	-168	1.62	-1.04	0.30	-9.25	3.30	-2.80	0.008	2.10	0.70	3.01	0.00
SUPORT	2.41	0.87	2.78	0.01	-13.09	3.38	-3.87	0.000	0.54	0.30	1.81	0.07
OTH	0.06	0.69	0.08	0.93	11.04	3.35	3.29	0.002	-0.29	0.17	-1.70	0.09
ALOS	-5.35	0.77	-6.99	0.00	-11.92	2.07	-5.75	0.000	-5.36	0.65	-8.23	0.000
Dl	7.00	3.89	1.80	0.07	16.54	8.06	2.05	0.047	4.57	3.21	1.42	0.16
D2	5.33	3.76	1.42	0.16	11.63	7.59	1.53	0.134	6.87	3.22	2.13	0.04
D3	808	3.64	2.22	0.03	8.94	7.47	1.20	0.239	7.56	3.16	2.39	0.02
D4					12.15	8.25	1.47	0.149	4.39	3.16	1.39	0.17
N=579, R-bar^2=0.10, F=8.31, DW=1.53					N=47, R-bar^2=0.53, F=6. 1 8, DW=233				N=102, R-bar^2=0.64, F=19.54, DW= 1.62			

Appendix Charts 4.1 to 4.3: Sectoral location of district level hospitals based on BOR and BTR Values

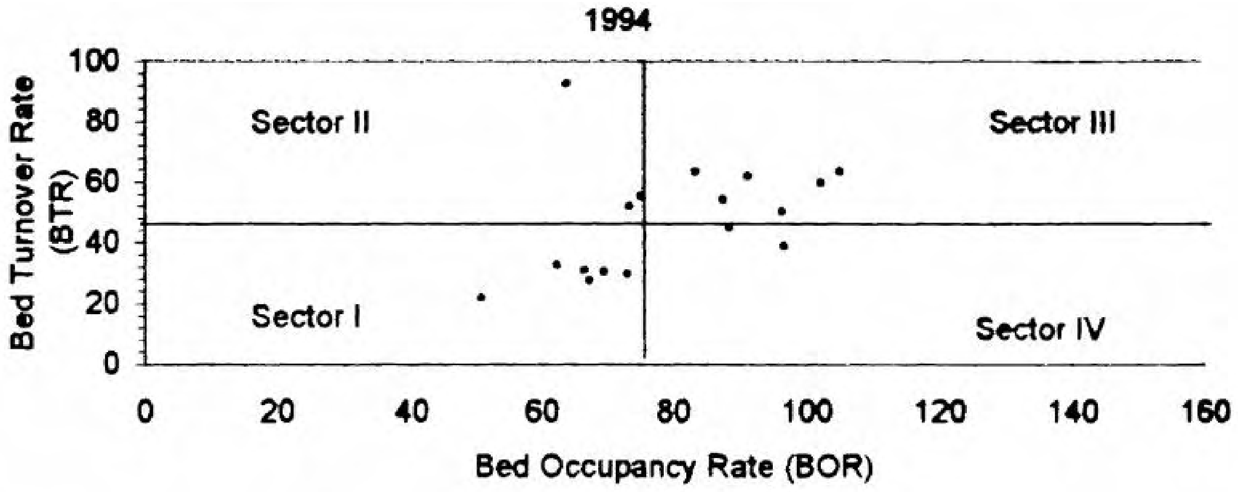


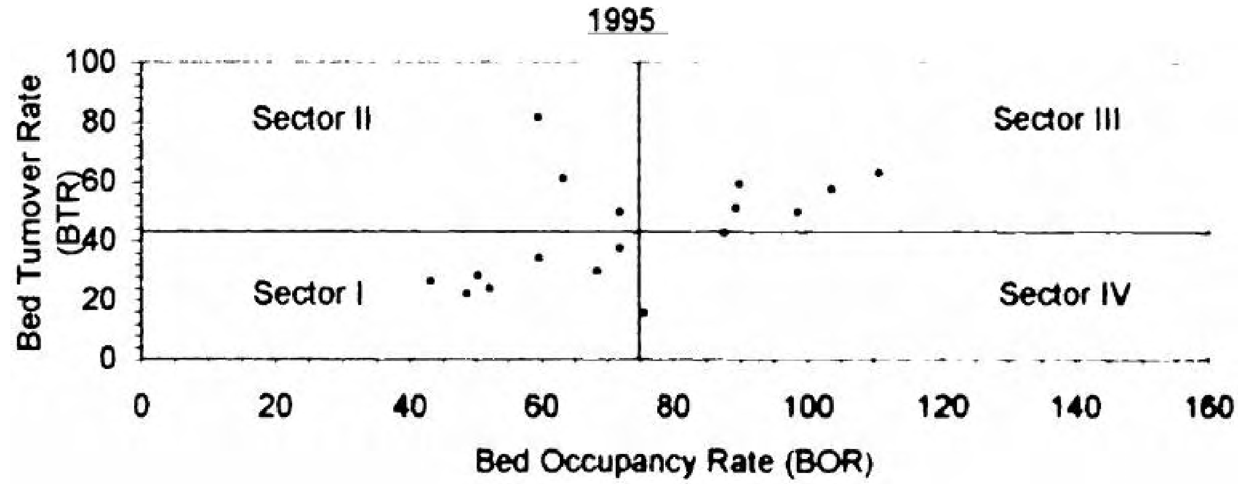


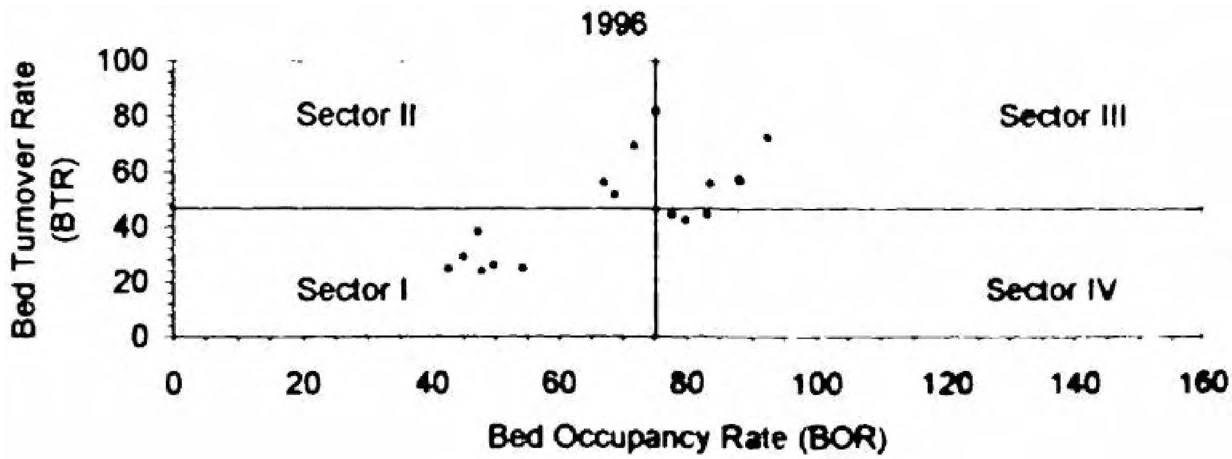


Sector I Low BOR and low BTR Sector II. Low BOR and high BTR. Sector III. High BOR and high BTR Seector IV. High BOR and low BTR

Appendix Charts 4.4 to 4.6 : Sectoral location of district level hospitals based on BOR and BTR Values

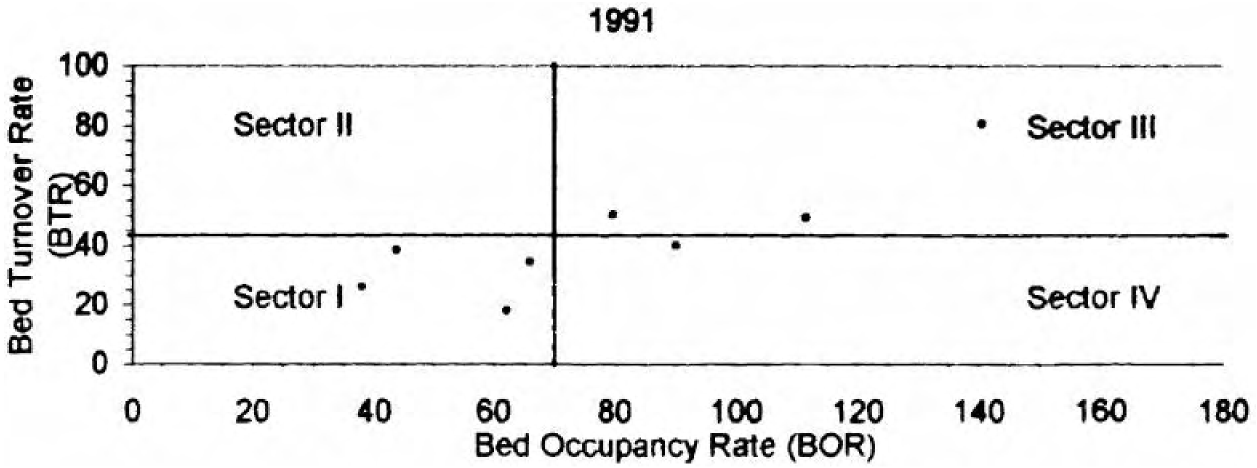


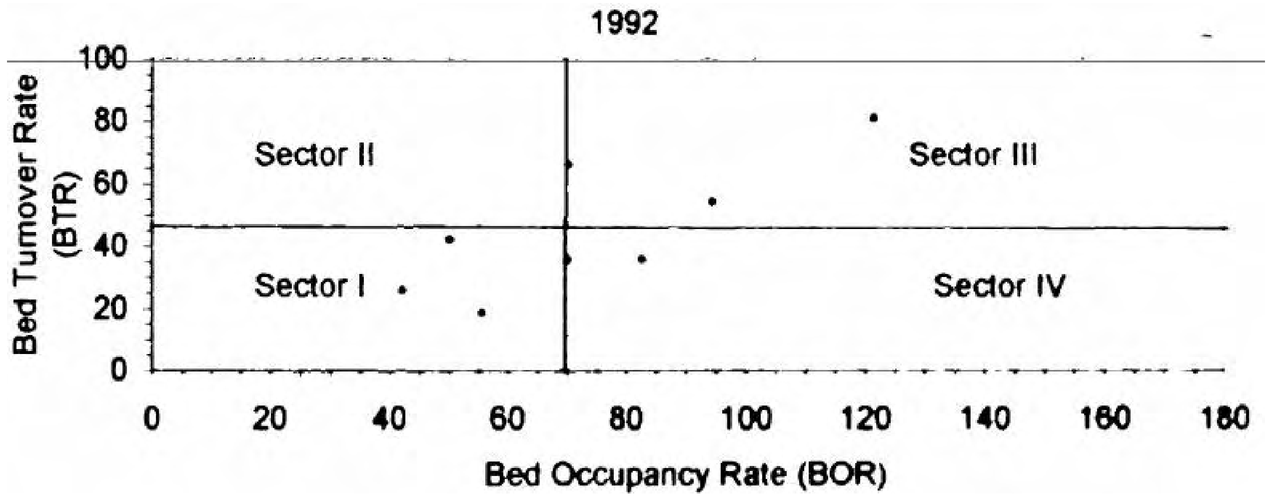


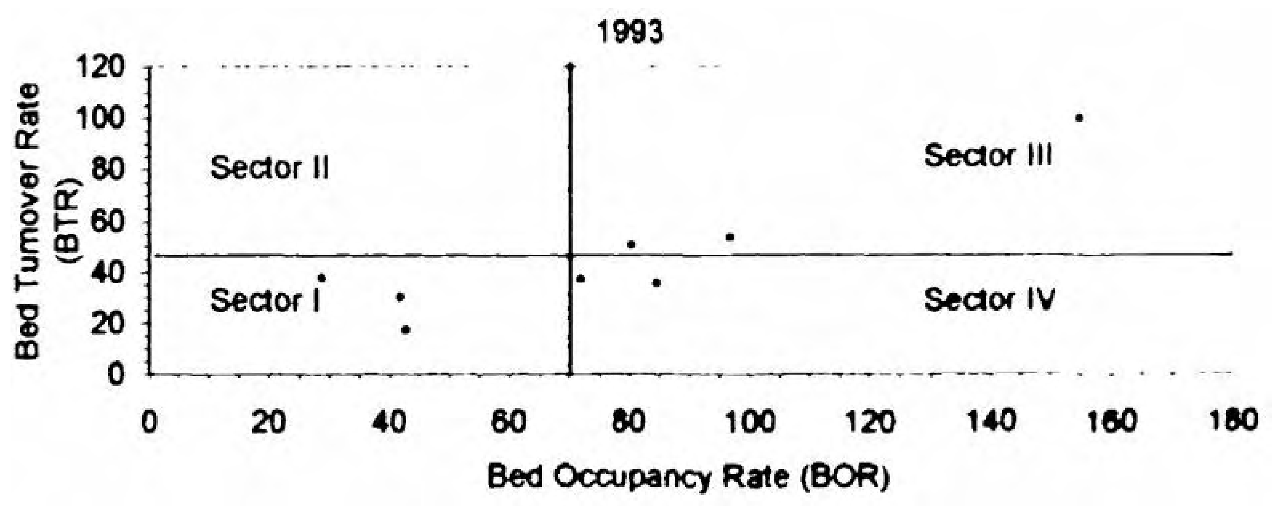


Sector I Low BOR and low BTR, Sector II Low BOR and high BTR. Sector III High BOR and high BTR
Sector IV High High BOR and low BTR

Appendix Charts 4.7 to 4.9 : Sectoral location of area level hospitals based on BOR and BTR Values

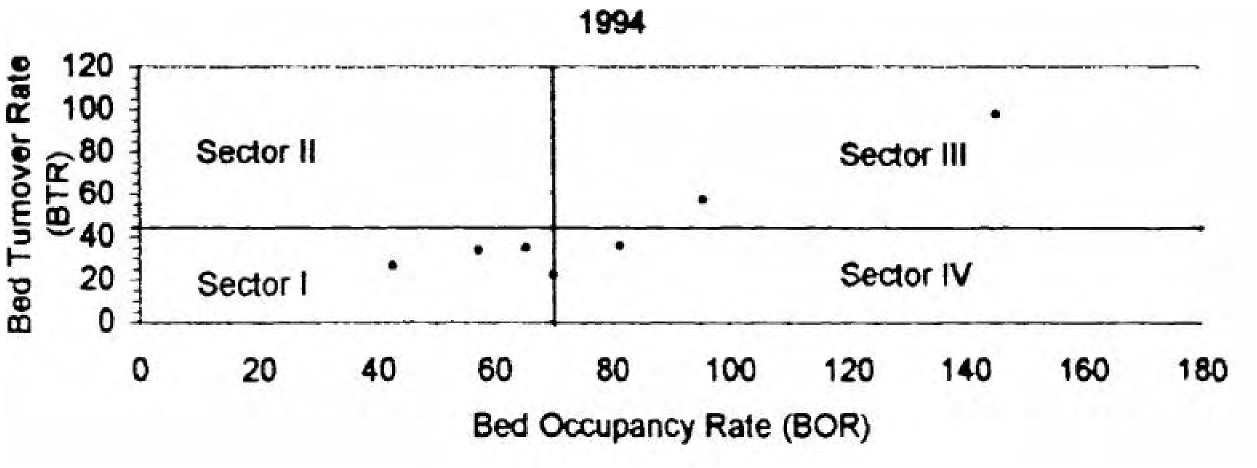


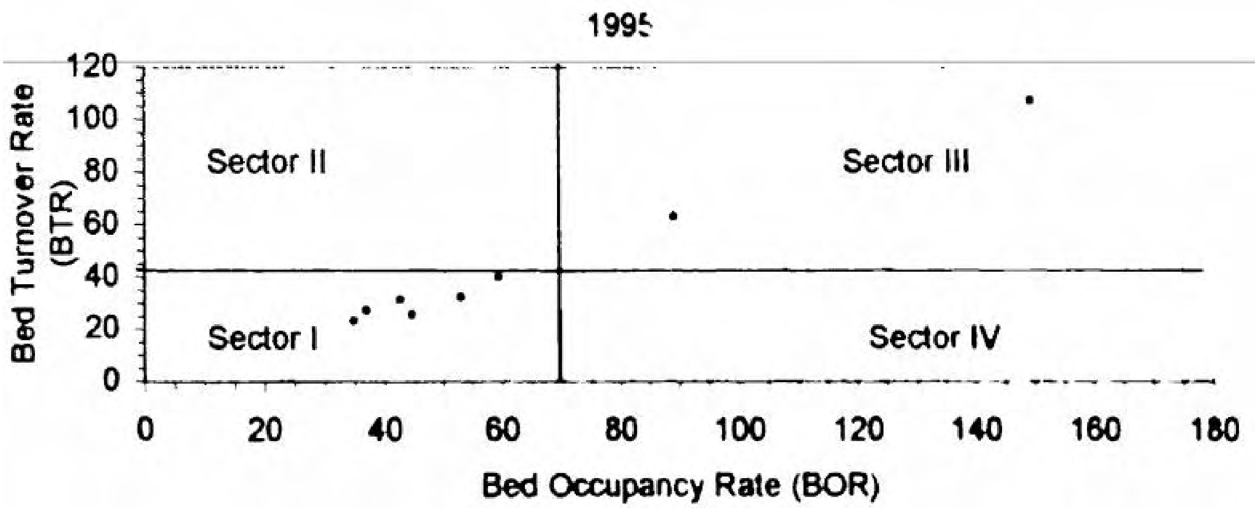


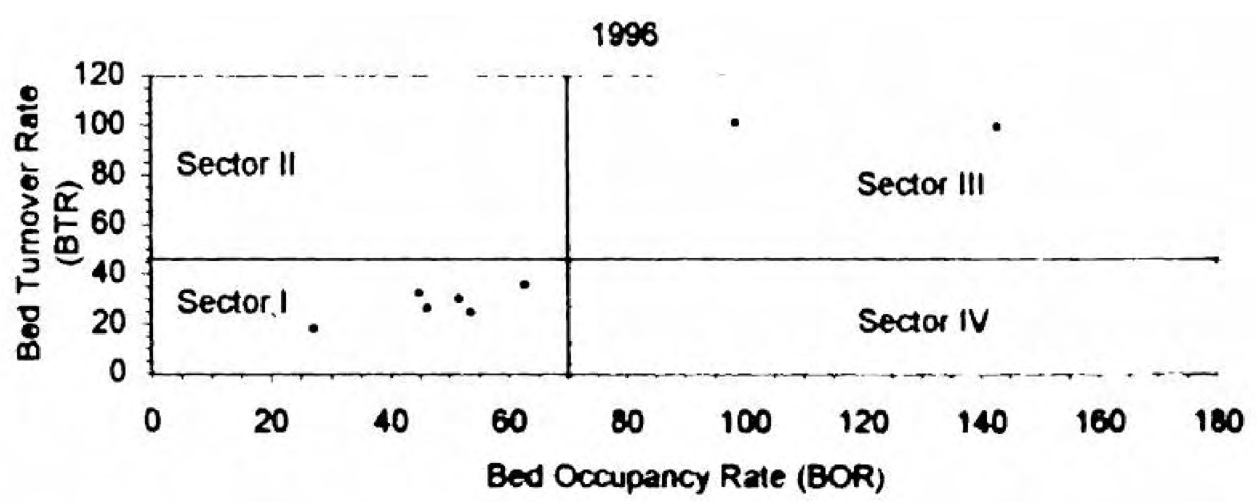


Sector Low BOR and low BTR Sector II Low BOR and high BTR
Sector IV High BOR and low BTR

Appendix Charts 4.10 to 4.12 : Sectoral location of area level hospitals based on BOR and BTR Values

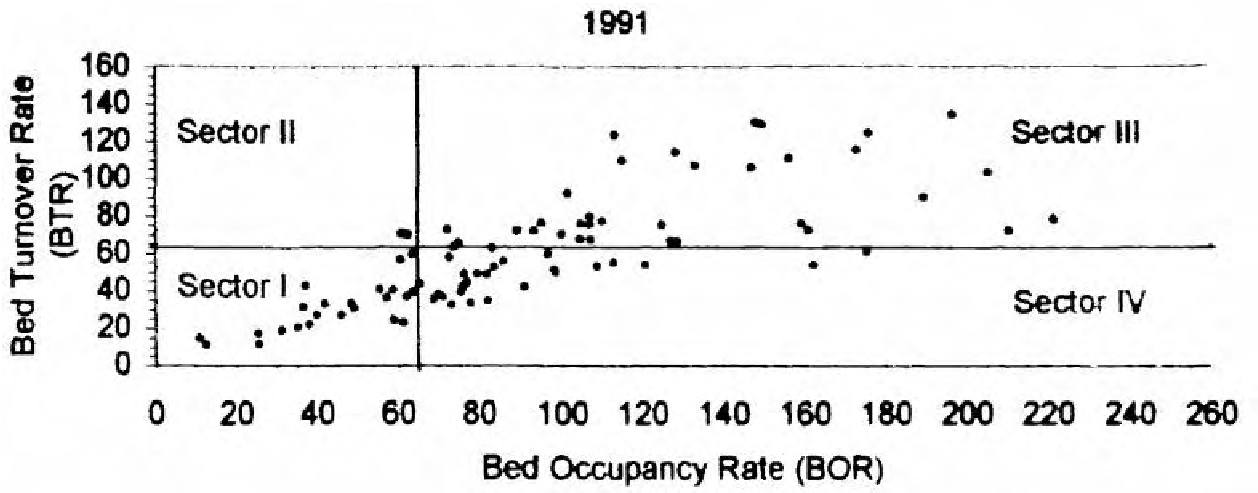


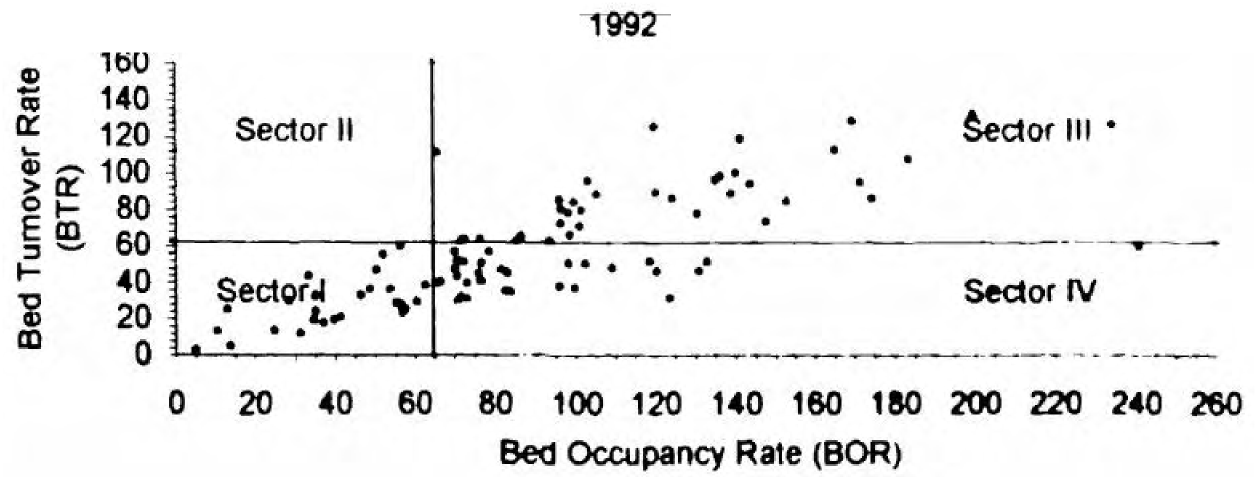


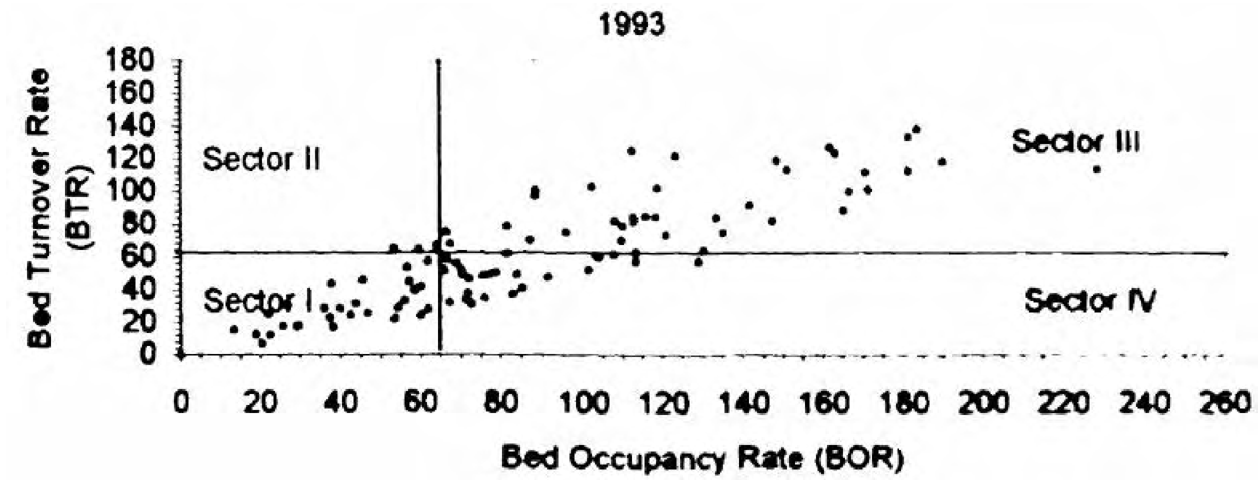


Sector Low BOR and low BTR, Sector II Low BOR and high BTR,
Sector IV High BOR and low BTR

Appendix Charts 4.13 to 4.15 : Sectoral location of community level hospitals based on BOR and BTR Values

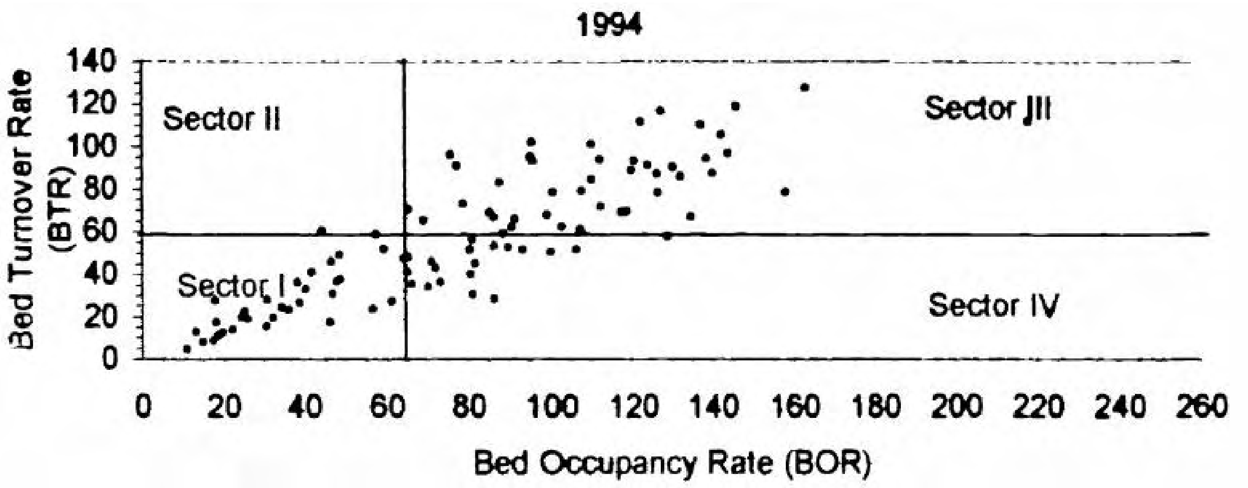


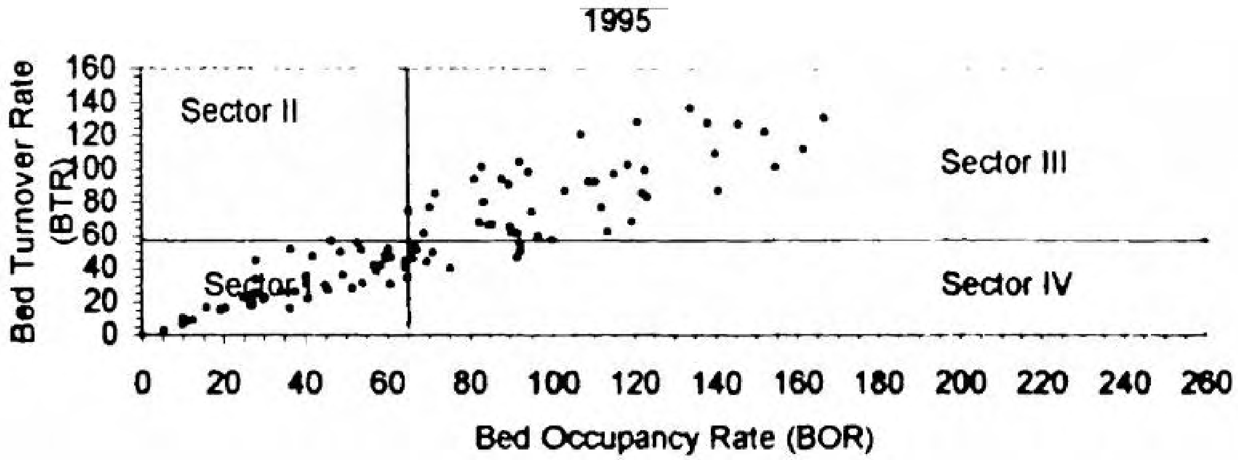


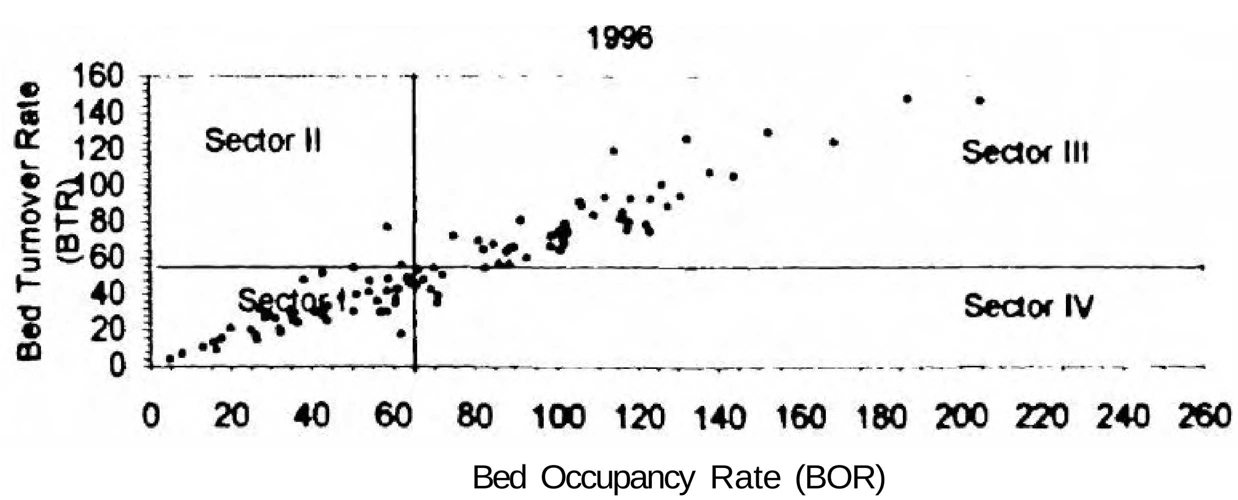


Sector Low BOR and tow BTR. Sector II Low BOR and high BTR Sector III high BOR and high BTR Sector IV High BOR and low BTR

Appendix Charts 4.16 to 4.18 : Sectoral location of community level hospitals based on BOR and BTR Values







Sector Low BOR and low BTR, **Sector II** low BOR **and high** BTR **Sector III High** BOR **and high** BTR **Sector** IV High BOR and low BTR

CHAPTER V
HOSPITAL EFFICIENCY: AN ANALYSIS

5.0. Introduction:

In Chapter III, we have discussed various methods for measuring hospital efficiency and mentioned their drawbacks In Chapter IV, we evaluated the performance of APVVP hospitals by using combined utilisation and productivity (CUP) analysis Although CUP analysis could be used as a managerial tool for quick identification of low-performance hospitals, it is inadequate as an economic tool for studying hospital as a multiproduct firm and its decision making process In this chapter, we try to analyse the efficiency of APVVP hospitals from a neoclassical viewpoint The specific tool used is a neoclassical cost function for reasons mentioned in the previous chapters

The first section of this chapter describes the database on hospital costs and outputs Section 2 deals with the estimation of multi-product cubic total cost function from which we obtain the average and marginal cost curves, under certain simplifying assumptions The total cost function seems to violate the monotomcity property Further, we estimate the conversion factor between IPs and OPs, which enable us to trace the average cost curve In Section 3, we estimate a hybrid multi-product cost function Since these ad-hoc cost functions do not satisfy the theoretical properties of neoclassical cost function, in Section 4 we estimate three variants of a flexible translog cost function with theoretical properties imposed as restrictions Some authors refer to these as "structural' cost functions The three variants considered here are the familiar Cobb-Douglas, Log-quadratic and the translog For these models, we also estimate the parameters of interest to economists such as product-specific cost elasticities, economies of scale and scope

Here again, the estimated functions seem to violate monotomcity property for all the variants. We attempt to draw some inferences about the allocative efficiency of APVVP hospitals.

5.1. Data on hospital costs and outputs:

The data used in this chapter are primarily from two sources; (a) data on basic hospital statistics maintained at APVVP and (b) audit reports of APVVP for various years. Basic hospital statistics comprises of monthly data on several variables such as number of new and repeated outpatients, admissions, discharges, deaths, cumulative inpatient (IP) days, major surgeries, and minor surgeries. Such data are available for each year during 1990-96 For 1996, data on some more variables like emergency major, minor operations etc are also available

Cost (outlay / expenditure) data on salaries and non-salaries are collected from audit reports of APVVP The expenditure data on different items are available for the years 1990, 1995 and 1996 Due to the non-availability of cost data for the years 1991-94, we confined our analysis to 1995-96 data only.

Although, data on hospital costs and outputs are available at community, area and district hospital levels, the major reasons for selecting district hospitals for this analysis on cost functions are as follows. In 1986, at the first phase of APVVP activity, all the district hospitals came under the control of APVVP The main objective of including the district hospitals in the first phase was that, these hospitals are basically referral hospitals providing specialised care with better medical and surgical facilities, compared to area and community hospitals The latter group came under the jurisdiction of APVVP from 19S7 onwards. Second, the district hospitals provide similar facilities and therefore it was thought appropriate to study them as a single group of hospital. The same is not true with area and community hospitals. Third, due to the large heterogeneity in costs and outputs of area and community hospitals, it may not be appropriate to dub them along with a more homogeneous group. Accordingly, only district hospitals are chosen for estimating cost functions.

Total cost:

In this study, we have used total outlay (variable cost) as a proxy for total cost, in the absence of data on fixed costs The variable costs include salary of different categories of staff, non-salary expenditure tike diet charges for patients, expenditure on consumables, medicines etc. The fixed cost consists of cost of building, equipment etc. In APVVP, the allocation of fixed cost is based on the equipment and building norms developed by APVVP itself on per bed basis. In practice, however, such equipment are not available as per the norm. In other words, though the norms exist on paper, the same is not followed while providing the equipment and other materials to hospitals Further, it was not possible even to make a list of available equipment because of lack of data As a result, it is not possible to estimate hospital wise capital expenditure Thus, we decided to use the total salary and non-salary expenditure data, which gives a fairly good picture of hospital recurring (variable) cost Therefore, we have implicitly assumed the capital cost to be constant during the study period This assumption is not unreasonable while estimating a short run cost function

Hospital outputs:

The data on different outputs such as IP days, OP visits, major surgeries, minor surgeries (measured in numbers) are collected from APVVP hospital performance database. The data on other hospital outputs such as deliveries, laboratory tests etc. is incomplete and hence not used here.

Hospital inputs and input prices:

From the data on basic hospital statistics, it is possible to identify five categories of hospital manpower inputs - doctors, nurses, paramedical staff, support staff, other staff and one monetary input called non-salary In addition, data on one fixed input, namely number of hospital beds, is also available This fixed input will be treated as capital input in the short run cost function Corresponding to each of the five variable inputs, which are in physical quantity (number), we can identify the annual salary expenditure (Rs) from the audit reports Using these quantity and expenditure data, we obtain the implicit price (annual salary) for each factor input In the case of non-salary input, it is not possible to get the corresponding physical quantity Hence, we assume that the expenditure itself as input price implying thereby a unit quantity for this variable Thus, in all, we have seven factor inputs - five physical quantities, one non-salary (monetary) and one fixed input (beds) It must be mentioned that the variation in factor prices is primarily of cross section in nature (across district hospitals) in addition to the limited variation between 1995 and 1996 This may imply confounding of price and quality variation in factor prices The data set has 2 annual observations each from 17 hospitals for 1995 and 1996 The data is presented in Appendix Tables 5 A 1 and 5 A *2* Summary statistics of this data set is presented in Table 5 1

In the actual estimation of the cost functions, we however use 'mean scaled' data instead of levels For this purpose, data on each variable is divided with its mean value so that the data are in an index number form The data are thus unit free and the estimated parameters of the cost function will correspond to the 'average' hospital The hospital specific parameters can be obtained by appropriate multiplication or division with mean value of variables It has been found that this procedure of mean scaling improves the signs and significance levels of estimated parameters

Table 5.1: Summary statistics of hospital costs, outputs, and inputs for district hospitals in AP.

Variable	Mean	SD	C.V. (%)	Minimum	Maximum
1. Input prices (Rs)					
Annual salary					
Doctor	92779.4	115766	125	715024	1282124
Nurse	680453	110638	163	442634	86752 1
Paramedical staff	543189	63670	117	409560	699% 4
Support staff	482102	73944	153	28521 2	645481
Other staff	12826 0	29254	228	82237	19361 4
Non-salary (Rs)	37131080	9351495	252	2296976 0	58068100
2. Fixed factor (No.)					
Beds	2561	607	237	1500	3520
3. Outputs (No.)					
Outpatients	265572 2	781564	294	1463960	4577760
Inpatients	668980	27840 1	41 6	29491 0	1415980
Major surgeries	14676	5478	373	6440	31220
Minor surgeries	10863	9878	909	2250	43690
4. Input quantities (No.)					
Doctor	298	24	82	270	360
Nurse	578	156	270	310	810
Paramedical staff	212	35	163	140	270
Support staff	609	134	220	360	840
Other staff	770	134	174	530	1050
5. Total cost (Rs)	154694860	32158759	208	97591500	219730490

The next section presents the empirical results on simple multi-product cost function Further, we attempt to estimate the conversion factor[1] and trace the shapes of the average and marginal cost curves

5.2. Simple short-run cost function:

In this section, a preliminary analysis of cost minimizing behavior of AP district hospitals is made by estimating a simple short-run total cost function, where total cost is expressed as a function of four outputs, six factor prices and one fixed factor input Explicitly, the estimated cost function is of the following form

$$C^v = a_0 + \sum_{i=1}^{6} b_i w_i + \sum_{i=1}^{4} a_i y_i + \sum_{i=1}^{4} \sum_{j=1}^{4} a_{ij} y_i y_j + \sum_{i=1}^{4} c_i y_i^3$$

$$+ d_0 k + d_{00} k^2 \qquad (5\ 1)$$

where C' is variable hospital costs, y is a set of four hospital services- outpatient, inpatient, major surgery and minor surgery, w is a set of six variable input prices (salaries) for doctor, nurse, paramedical support personnel, other staff and non-salary expenditure, and k is a single measure of fixed factor in the form of hospital beds

In a single-product cubic cost function, with increase in output, we expect the total cost to initially increase at a decreasing rate, then to stabilize and thereafter to increase at an increasing rate This shape implies increasing returns to scale in the beginning when fixed inputs are exploited, constant returns to scale momentarily when the cost function changes its curvature, and decreasing returns to scale thereafter The last phase corresponds to the situation when fixed factors are fully utilized

The conversion factor refers to the number used for converting IPs into OPs and vice versa Such a **factor** was necessary for finding out the average cost of IPs and OPs which are used for determining the shape of the average cost curve

The short-run total cost function in (5 1) is a Musi-product generalization of single-product cubic cost function Using pooled time series of cross sections data, we estimated the total cost faction given in (5.1) From Shephard lemma, the coefficient of each factor price is equal to the corresponding optimal factor level Given factor prices, in order that the estimated factor levels are consistent with the total cost, a linear restriction is placed on the coefficients of price variables This restriction implies that, at the sample mean, the sum of the factor costs is equal to the average total cost The unrestricted cost function may not satisfy this restriction automatically The parameter estimates satisfying the above cost restriction are given in Table 5 2

The estimated cost function has several significant coefficients for linear, quadratic, and cubic output terms in equation (5 1) The signs of these coefficients are positive, negative and positive for linear, quadratic and cubic terms respectively The only exception was the coefficient of squared output term for minor surgeries The overall goodness of fit of the regression is high (0 99), and many coefficients arc statistically significant implying good explanatory power All the input price variables have correct sign and statistically significant coefficient Since the data are mean-scaled, we adjust the parameters by suitable multiplication / division with actual mean to get the relevant hospital wise parameters

Using Shephard lemma for this simple short-run cost function, the estimated optimum factor levels (obtained from coefficients of input price variables) are, doctors 66 7, nurses 44 0, paramedical staff 42 3, supporting staff 37 8, other staff 13 1 and non-salary 8 0 (Rs lacs) We may compare these optimum factor levels with the observed factor levels (Table 53) and judge the degree of allocative efficiency in hospital

Tible 5.2: Parameter estimates and related measures of simple total cost function for district hospitals in AP.

Input related parameters:

Coefficient of	Price (salary) of					Non-salary
	Doctor	Nurse	Parame-dical staff	Support staff	Other staff	
Linear terra	2240 (280)	0,761 (140)	1990 (310)	0620 (200)	0170 (064)	0216 (055)

Output related parameters:

Output variable	Out-paticnts	In patients	Major surgeries	Minor surgeries	Linear term	Cubic term
Outpatieits	-12000 (-25)	1850 (250)	-1310 (-1 80)	-1090 (-160)	13600 (240)	3250 (230)
Inpatients	1850 (250)	-6120 (-190)	0974 (130)	-0985 (-2 50)	7020 (210)	1350 (160)
Majorsurgeries	-1310 (-1 80)	0974 (130)	-3970 (-190)	0138 (061)	5210 (240)	0865 (150)
Minor surgeries	-1090 (-160)	-0985 (-2 50)	0138 (061)	0156 (040)	0806 (075)	0072 (086)

Three other parameters:

Overall intercept	Coefficient of	
	Beds	Beds square
-15000 (-4 93)	9350 (285)	-3720 (-2 19)

R^2 - 0 99, R-bar^2 = 0 98, D-W = 138
Figures in parenthesis are t-ratios

Table 5.3: Observed and estimated factor input levels (No.) using sample *cost function for district hospitals in AP*, 1995

District hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Eit.	P.E.	Obs.	Est.	P.E.	Obs..	Est.	P.F.	Ota.	Est.	P.F.
Srikakulam	280	66.7	-580	490	440	11 3	160	423	-622	500	378	324	71 0	131	441 5	305	80	2798
Vizianagaram	270	66.7	-595	34 0	440	-228	170	423	-598	360	378	-4 7	530	131	304 2	156	80	141 1
Rajamundry	290	667	-565	680	440	545	21 0	423	-503	600	378	589	770	131	4871	378	80	1701
Eluru	31 0	667	-53 5	81 0	440	840	270	423	-36 1	840	378	122 5	940	131	6169	530	80	5591
Machilipalnam	31.0	667	-53 5	690	440	568	22 0	423	-480	640	378	695	850	13 1	548 3	44 1	80	4497
Ongolc	28.0	66.7	-580	31 0	440	-296	14 0	423	-669	420	378	11 2	590	131	1500	230	80	1860
Nellore	27.0	66.7	-595	640	440	454	22 0	423	-480	670	378	774	790	13 1	5025	444	80	4529
Chittoor	28.0	66.7	-580	640	440	454	25 0	423	-409	650	378	72 1	730	13 1	4568	367	80	357 1
Cuddapah	31.0	66.7	-535	830	440	886	24 0	423	-432	820	378	1172	81 0	131	5178	296	80	268 5
Anantapur	320	66.7	-52.0	81 0	440	840	26 0	423	-38 5	780	378	1066	1050	13 1	7008	479	80	4958
Mahboobnagar	30.0	66.7	-550	470	440	68	200	423	-527	530	378	401	61 0	13 1	3652	31 7	80	295 1
Sangareddy	34.0	66.7	-49.0	49.0	440	11.3	2C 0	423	-527	470	378	245	620	13 1	3729	250	80	211 0
Nizamabad	28.0	66.7	-58.0	650	440	477	24 0	423	-43 2	760	37 8	10l 3	950	13 1	6245	41 3	80	4147
Adilabad	36.0	66.7	-460	55 0	440	250	I? 0	423	-55 1	590	37 8	563	750	131	4720	248	80	208 8
Karimnagar	29.0	66.7	-565	53.0	440	204	23 0	423	-456	570	378	51 0	780	13 1	4949	329	80	3100
Chammam	28.0	66.7	-580	50.0	44.0	136	21 0	423	-503	590	378	563	790	13 1	5025	285	80	2552
Nalgonda	29.0	66.7	-565	40.0	440	-9 1	2C 0	423	-527	560	378	483	820	13 1	5254	234	80	191 9
Average	29.8	66.7	-55.3	57.8	44.0	31 4	21 2	423	-498	609	378	61 2	770	13 1	4873	347	8 0	332 3

Obs Observed number, Est.. Estimated number, P E Percentage error

Cntd.

Table 5.3: Observed and estimated factor input levels (No.) using simple cost function for district hospitals in AP, 1996

District hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P E
Srikakulam	28.0	66.7	-580	490	440	11 3	150	423	-622	500	378	324	71 0	13 1	441 5	288	80	2587
Vizianagaram	27.0	66.7	-595	340	440	-228	170	423	-598	360	378	-47	530	13 1	3042	35 1	80	3374
Rajamundry	29.0	66.7	-565	680	440	545	21 0	423	-503	600	378	589	770	13 1	4873	492	80	512 1
Eluru	31.0	66.7	-53.5	81 0	440	840	270	423	-36 1	840	378	1225	940	13 t	6169	41 7	80	4195
Machilipatnam	31.0	66.7	-53.5	690	440	568	220	423	-480	640	378	695	850	13 1	5483	552	80	5873
Ongole	28.0	66.7	-58.0	31.0	440	-296	140	423	-669	420	378	11 2	590	13 1	3500	324	80	3035
Nellore	27.0	66.7	-59.5	640	44.0	454	220	423	-480	670	378	774	790	13 1	5025	446	80	4547
Chittore	28.0	66.7	-58.0	64.0	44.0	45.4	250	42.3	-40.9	650	378	72 1	730	13 1	4568	403	80	402 1
Cuddapah	31.0	66.7	-53.5	83.0	44.0	88.6	24.0	42.3	-432	82.0	378	1172	81 0	13 1	5178	445	80	4540
Anantapur	32.0	66.7	-52.0	81.0	44.0	84.0	25.0	42.3	-38.5	780	378	1066	1050	13 1	7008	56 1	80	598 1
Mahboobnagar	30.0	66.7	-55.0	47.0	44.0	6.8	20.0	42.3	-52.7	530	37.8	404	61 0	13 1	3652	367	80	3565
Sangareddy	34.0	66.7	-49.0	49.0	44.0	113	20.0	42.3	-52.7	47.0	378	24.5	62.0	13 1	3729	286	80	2567
Nizamabad	28.0	66.7	-58.0	65.0	440	47.7	24.0	42.3	-43.2	760	378	101 3	95.0	13 1	6245	48 1	80	4992
Adilabad	36.0	66.7	-46.0	55.0	44.0	25.0	19.0	42.3	-55 1	590	378	563	750	13 1	4720	322	80	301 2
Karimnngar	29.0	66.7	-56.5	530	440	204	23.0	42.3	-456	570	378	51 0	780	13 1	494 9	41 5	80	4164
Khammam	28.0	66.7	-58.0	50.0	44.0	13.6	21.0	42.3	-50.3	590	378	563	790	13.1	5025	330	80	311.4
Nalgonda	29.0	66.7	-56.5	40.0	44.0	-9.1	20.0	42.3	-52.7	560	37.8	48.3	82.0	13.1	5254	24.1	8.0	200.2
Average	29.8	66.7	-55.3	57.8	44.0	31.4	21.2	42.3	-49.8	60.9	378	61.2	770	13 1	487.3	395	80	3923

Obs: Observed number, Est.: Estimated number, P.E.: Percentage error performance The observed average factor levels are, doctors 29 8, nurses 57 8, paramedical staff 21 2, support staff 61 9, other staff 770, and non-salary 37 1 (Rs lacs) It is clear that these actual factor levels, which vary across hospitals, are quite different from the optimum factor levels (the same across hospitals) implied by this simple cost function Thus, though the cost function gave very high goodness of fit, the estimated factor levels (and therefore factor shares) are quite away from the observed levels This shows the limitation of estimating only a cost function, leaving out factor shares / levels

Optimum bed size:

As indicated earlier, the beds in the cost function are taken as the measure of fixed factor An estimate of optimum bed size (also treated as optimum hospital size) can be obtained by imposing first order condition for cost minimization Differentiating the hospital total cost with respect to k, number of beds, and equating the derivative to zero. we have,

$$\frac{\partial C^{v}}{\partial k} = d_0 + 2\, d_{00}\, k = 0$$

Solving this equation for k and putting the parameter values from the estimated cost function, we get the optimum bed size

It may be noted that the fixed factor (beds) as well as its square has wrong sign and significant coefficients (Table 5 2) According to neoclassical theory, long-run total cost will be minimized provided the coefficient of k is equal to the negative of price of capital However, empirical studies do show a positive sign for this parameter This is interpreted as 'excessive' capital investment and long-run disequilibrium for capital input Thus, AP district hospitals seem to over invest in fixed capital input, represented by number of beds here

From the coefficients of k and k^2, it is possible to estimate the optimum bed size that minimises the total short-run variable cost The estimated optimum bed strength is 322, which is somewhat closer to the maximum bed strength (352) It may be mentioned that the non-salary input constitutes less than 25% in total variable costs of secondary level district hospitals in AP Such a low share for this vita! input is often cited as a reason for low performance of these public health care institutions

Average and marginal cost **curves:**

In the case of a single product, it is easy to derive the AC and MC curves from total cost curve For a cubic total cost function, the AC and MC curves will be quadratic and satisfy the neoclassical properties provided the estimated total cost function itself satisfies the required properties, including monotonicity

But, in a multi-product situation, this is not so easy particularly with AC curve We need to make further assumption of converting one output into another such **as** OP ~ mlP, where, 'm' is a known value Fortunately, as shown in the Appendix-5B, it is possible to estimate the value of 'm' along with other parameters from the data itself In our case, the value of 'm' is found to be 3 98 This means one IP day equals 1 98 OP visits or alternatively one OP visit equals (1 / 3 98) IP days This estimated value of 'm' compares very closely with the value 4 suggested by APVVP (APBD Report, 1995) Using this conversion factor, we convened all OP visits into IP days In other words, the four-output situation is reduced to three outputs Further, assuming that the two outputs major and minor surgeries do not affect the average cost of inpatients outpatients, we attempted to construct the total, average and marginal cost curves for one (single) output, IP days

The estimated total cost function for IP days (Graph 5 1) seems to violate the monotonicity property both at the beginning and end of the IP variable It is inconceivable how total cost can decrease with increase in output Partly, the problem may be due to the cross-section nature of the data It is also possible that costs are not fully taken into account More importantly, since the hospitals are geographically spread all over the state of Andhra Pradesh, demand for hospital services also may vary widely across the hospitals The quality of service, case mix and disease pattern also varies across hospitals / regions These factors may limit the utilization and hence supply of hospital services across hospitals These may be the reasons for perverse shape of total cost curve We will notice that this has adversely affected the sign and magnitude of other parameters such as marginal cost of this output as well as others Despite this drawback with the estimated total cost function, we attempt to use it for tracing the AC and MC curves for IP days

From the total cost function in *(5* 1), the marginal cost of the output can be obtained by substituting the values of parameters and variables in the following expression

$$MC_i = \frac{\partial C}{\partial y_i} = a_i + a_{ii} y_i + \sum_{j \neq i} a_{ij} y_j + 3 c_i y_i^2 \qquad (5\ 2)$$

$$(i = 1, 2, \ldots, 4)$$

Using (5 2), the estimated marginal costs are found to be negative for several hospitals for each of the output category (Table 5 4) For inpatients, however, the negative values were found to be relatively few To trace a smooch MC curvefortotalIPIP

Graph 5.1: Estimated total cost curve of IP days using simple cost function for secondary level district hospitals in AP.

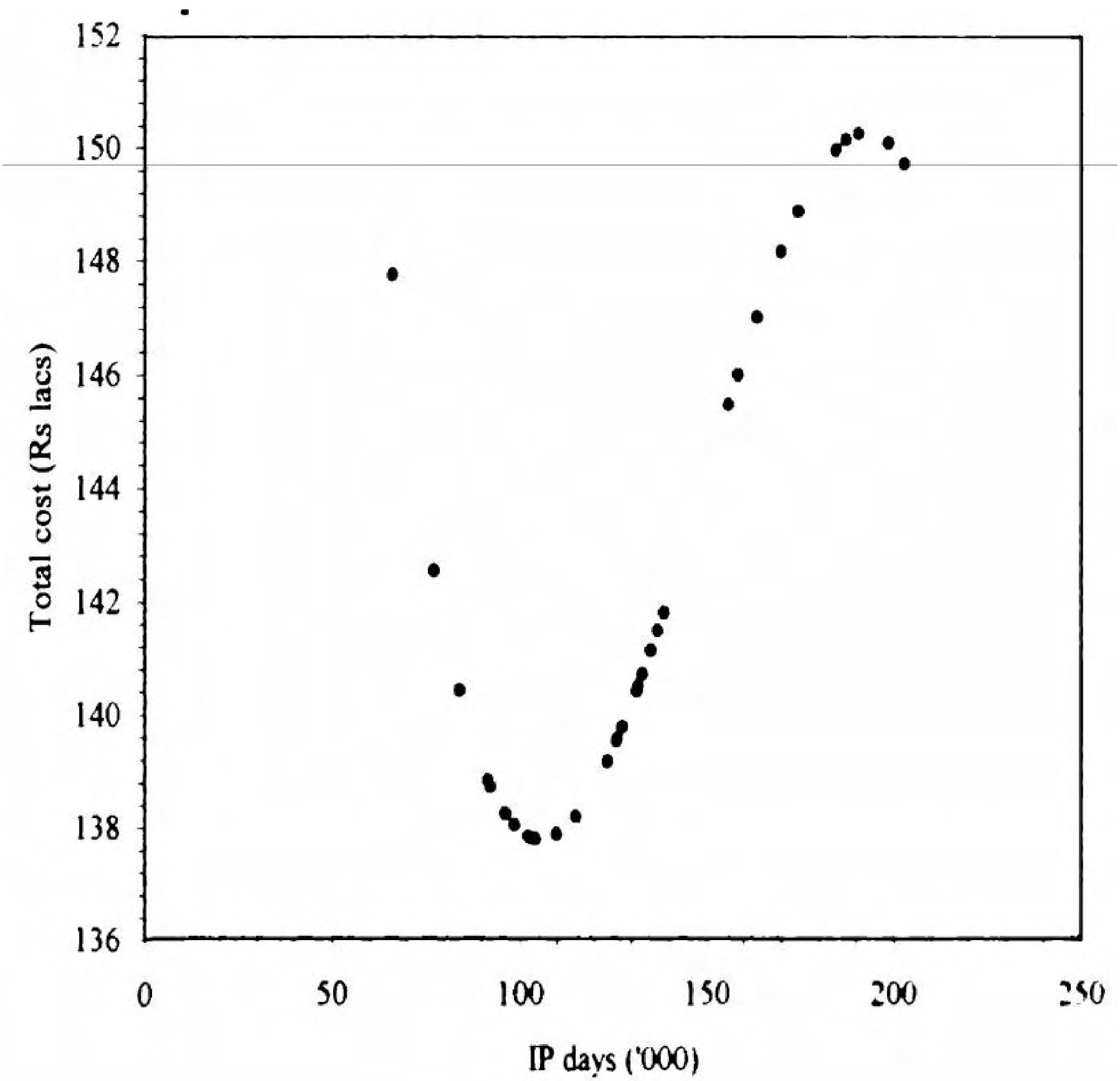


Table 5.4: Estimated marginal cost (Rs) for each output category using simple cost function for district hospitals in AP.

District Hospital	Out-patients	In-patients	Major surge-ries	Minor surge-ries	Out-patients	In-Patknts	Major surge-ries	Minor surge-ries
	1995				19%			
Srikakulam	-24.6	971	-82	-1481 9	-273	979	-17776	-14640
Vizianagaram	59	81.5	-2502 9	-5206	145	977	-2563 8	-1603
Rajamundry	-426	151	2495	87410	-52	637	-4808	-4854
Eluru	-34	543	-14073	-18991	-64	471	-15976	-18707
Machilipatnam	-70	241	-3054	-15247	-1 1	316	2823	-6349
Ongole	175	909	20955	-2526	166	812	-889	202
Nellore	100	-58	16164	-8774	-47	233	12601	2833 7
Chittore	-93	458	13615	-15107	-162	875	-398 2	-6908
Cuddapah	108	503	14709	-24003	127	-11 1	14560	-12021
Anantapur	101	933	8292	-2438 3	-47	323	-10825	-15408
Mahboobnagar	-570	436	-4102 4	79768	-321	392	-30485	-8938
Sangareddy	-248	845	-4031 1	-18258	-21 3	-189	-81 1	5565
Nizamabad	-560	-653	-2529 9	25891 7	-426	-61 5	-3595	128634
Adilabad	-71	265	12305	773	63	188	9827	-2390
Karimnagar	33	881	-11621	-2797	-30	605	10655	-7065
Khammam	-121	506	11207	-14690	135	991	-2402 0	-2248 1
Nalgonda	175	172	4021	-350	136	435	-19222	-3367
Average	-127	164	-2033	-15524	-103	319	-8492	.11694

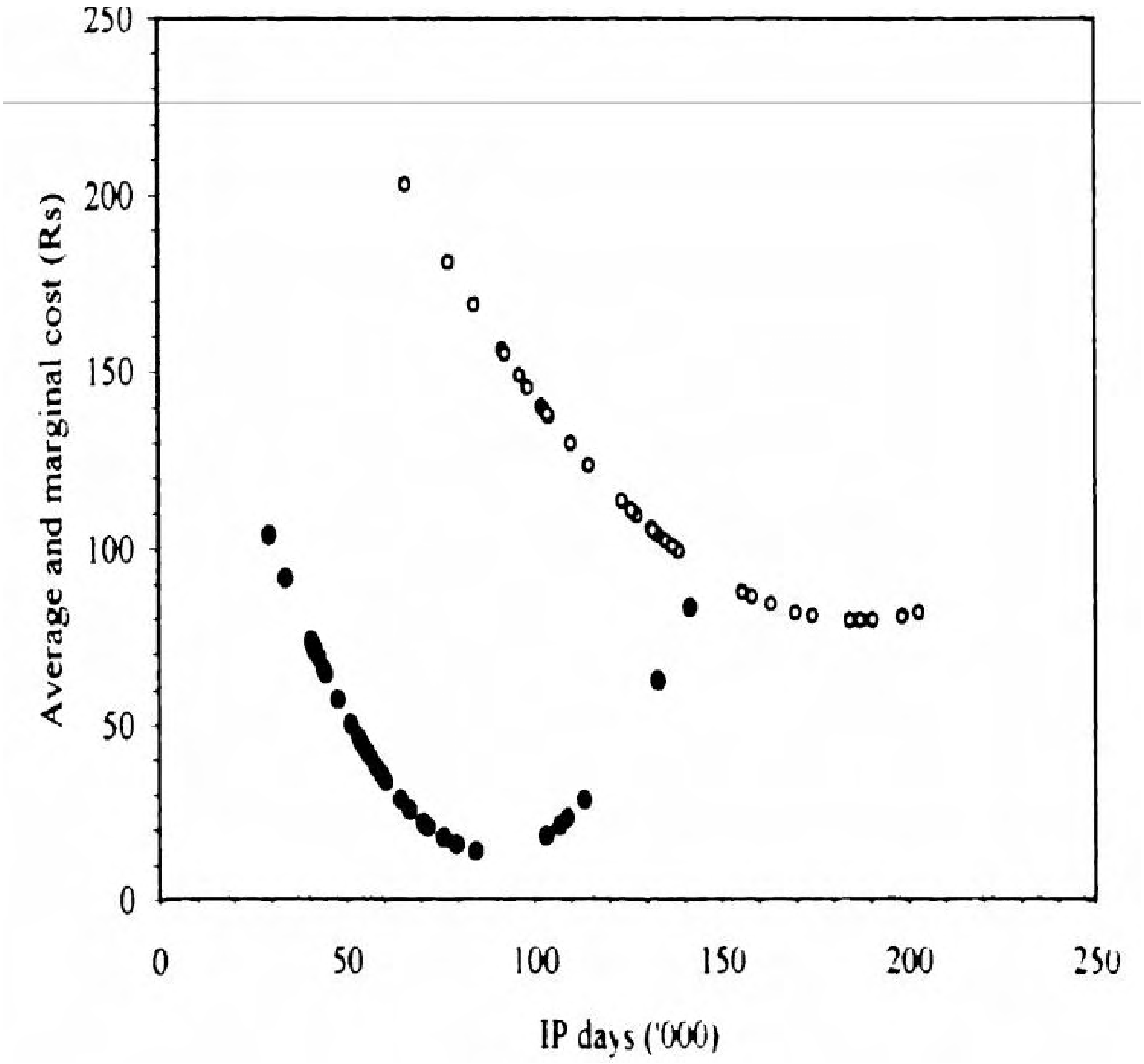
days, we estimated a quadratic MC curve afresh, which incidentally remained in the 1* quadrant The AC curve for IP days is also estimated in a similar way to get it smooth rather than zigzag

The predicted values of MC and AC using these quadratic functions are plotted in Graph 5 2 In the observed range of output variable (total CP days), the two short-run cost curves do not seem to intersect at the minimum of AC curve as required by the neoclassical theory of firm[2] However, the shape and location of AC and MC curves seem to be consistent with economic theory, i e , both curves are 'U' shaped and the MC curve is below the AC curve From this short-run AC curve, we obtained the optimum level of output as 190558 total IP days per annum and the associated average cost corresponding to this optimum output, i e , the minimum point on the AC curve as Rs 98 - per IP day

Thus, alt hospitals whose total IP output and average cost are close to these optimum values can be called 'efficient' Using this criterion, in 1995, the district hospitals at Eluru (IP days 198743, AC Rs 98 5), Cuddapah (IP days 198571. AC Rs 98 5), Anantpur (IP days 202972, AC Rs 98 9) and Nizamabad (IP days 187418, AC 98 2) and Eluru (IP days 190779, AC Rs 98 1) in 1996 may be classified as 'nearly efficient' All the four hospitals are large in size, with bed strength exceeding 300 We may therefore, infer that economies of scale must be a contributing factor for 'efficiency' in four of the secondary level district hospitals in AP

[2] This problem partly may be due to not estimating such conversion factors for other two output categories major and minor surgeries Since the cos attributable to these outputs is also getting included in the cost of IP without adding output equivalent, the average cost of IP is likely to be over estimated. Thus, the curves shown in Graph 5 2 are very crude approximations. They may serve only an illustration purpose

Graph 5.2: Estimated average and marginal cost curves of IP days for secondary level district hospitals in AP using simple cost function.



• Average cost ° Marginal cost

5.3. Flexible hybrid cost function:

In the empirical literature on cost functions for health services, quite often we come across the following hybrid cost function As the name indicates, it combines the qualities of a popular flexible functional form called transcendental logarithmic, of translog in short, with a conventional cubic cost function Accordingly, the name flexible hybrid cost function Following Grannemann et al (1986). this cost function can be specified as,

$$C^{v} = e^{(a_0 + d_0 k + d_{00} k^2)} . \prod_{i=1}^{6} w_i^{b_i} . e^{F(Y)} \qquad (5\ 3)$$

where, C total hospital variable cost, 'e' is the base of the natural exponential function. k number of beds, a proxy measure of capital stock. w_1 price of i^{th} input. F(Y) a cubic function of output levels and a_0, b_1, d_0, and d_{00} are coefficients to be estimated By taking logarithm on both sides of equation (5 3), the outlay> function can be re-written as,

$$\ln C^{v} = a_0 + d_0 k + d_{00} k^2 + \sum_{i=1}^{6} b_i \ln w_i + F(Y) \qquad (5\ 4)$$

where,

$$F(Y) = \sum_{i=1}^{4} a_i y_i + \sum_{i=1}^{4} \sum_{j=1}^{4} a_{ij} y_i y_j + \sum_{i=1}^{4} c_i y_i^{3} \qquad (5.5)$$

The definitions of variables are as previously given In (5 3), all the four hospital outputs appear in linear, quadratic and cubic power as well as cross product, the six factor prices appear in logarithmic form, and the lone fixed factor, beds, appear in quadrance form

Quite similar to the simple cost function, we imposed a linear restriction on the coefficients of the price variables Since the cost function is log-linear in factor price by Shephard lemma, the coefficients of price variables represent optimum factor shares They should add up to unity This ma> not happen unless imposed as a restriction

Empirical results:

Table 5 5 gives the parameter estimates and related measures for the hybrid cost function Broadly, despite the change in functional form, the results here are similar to those of simple cost function Since the dependent variables are different, we can not compare goodness of fit and other measures For a log-linear model, in an absolute sense, the R^2 value here is not high From Shephard lemma, the coefficients of price variables give average optimum factor shares directly The short-run total cost is inelastic to prices of all inputs As mentioned before, the prices here may contain some quality component as well For the average hospital, among the input prices, the salary of doctor and paramedical staff seems to have a larger effect on short-run hospital costs A 10% increase in price of these inputs increases the hospital cost by 39% and 3 6% respectively The price of support staff also has a significant positive effect on hospital costs

Based on this model, the estimated optimum factor shares are. doctors 46 5%, nurses 13 4%, paramedical staff 17 7%, supporting staff 11 4V other staff 0 8% and non-salary 8 2% Since the model underlies constant factor shares for all hospitals, the above values apply to each hospital in the sample (Table 5 6) It goes without saying that the hospital wise observed factor shares differ from these optimal levels, implying high degree of allocative inefficiency As before, positive sign for k, fixed factor, implies over investment The optimum bed strength is estimated using the coefficients of k and k^2 The optimum bed size is equal to 309, which is slightly lower than the one obtained using the simple cost function

Table 5,5: Parameter estimates and related measures of hybrid cost function for district hospitals in AP.

Input related parameters:

Coefficient of	Price(salary) of					
	Doctor	Nurse	Parame-dicil staff	Support stiff	Other stiff	Non-salary
Linear term	0391 (2.80)	0079 (092)	0355 (310)	0106 (210)	00182 (040)	0051 (088)

Output related parameters:

Output variable	Out-patients	Inpatients	Major surgeries	Minor surgeries	Linear term	Cubic term
Outpatient	-2250	0419	-0244	-0140	2460	0610
	(-2 80)	(360)	(-2 10)	(-1 30)	(270)	(260)
Inpatient	0419	-1050	0017	-0138	1 140	0244
	(360)	(-200)	(015)	(-2 20)	(200)	(180)
Major surgeries	-0244	0017	-0619	-016	1000	0139
	(-2 10)	(015)	{-1 80)	(-043)	(290)	(150)
Minor surgeries	-0140	-0138	-016	-016	0195	0016
	(-1 30)	(-2 20)	(-043)	(-025)	(1 10)	(120)

Three other parameters:

Overall intercept	Coefficient of	
	Beds	Beds Square
-1030 (-2 10)	1890 (359)	-0784 (-2 89)

R^2 = 0 99, R-bar^2 = 0 98, D-W = 1 4 1

Figures in parenthesis are t-ratios

Table 5.6: Observed and estimated factor input shares(percent) using hybrid cost function for district hospitals in AP, 1995

District Hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs..	Est.	P.E.	Obs.	Eat.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.
Srikakulam	183	465	-607	260	134	937	64	177	-64 1	18 7	134	393	68	08	797 3	238	82	1916
Vizianagaram	194	465	-583	24 1	134	79 4	68	177	-61 4	135	134	06	62	08	7101	300	82	2668
Rajamundry	168	465	-638	292	134	117 1	74	177	-582	170	134	272	67	08	776 0	229	82	1798
Eluru	156	465	-664	280	134	1085	79	177	-554	180	13 4	342	39	08	4100	266	82	2254
Machilipatnam	163	465	-650	23 5	134	750	70	177	-607	202	134	504	8 3	08	986 4	24 8	8 2	203 5
Ongole	21 9	465	-528	21 7	134	61 3	76	177	-57 1	158	134	180	94	08	11386	235	82	1879
Nellore	15.3	465	-67 1	26 1	134	946	73	177	-586	21 4	134	595	44	08	473 9	255	82	211 7
Chittore	17,6	465	-621	294	134	1184	80	177	-550	14 7	134	94	59	08	668 7	24 5	82	200 0
Cuddapah	161	46.5	-655	355	134	1639	65	177	-63 5	204	134	524	53	08	597 8	163	82	993
Anantapur	17.3	46.5	-628	280	134	1087	63	177	-643	196	134	460	49	08	548 4	23 8	82	191 5
Mahboobnagar	20.5	46.5	-560	24 1	134	792	71	177	-598	175	134	304	55	08	625 2	25 3	82	209 9
Sangareddy	232	465	-500	19 1	134	425	81	177	-542	208	134	55 1	84	08	1009 1	203	82	1479
Nizamabad	148	46.5	-682	230	134	714	83	177	-533	203	134	51 6	71	08	834 2	265	82	2239
Adilabad	20.3	46.5	-56.4	192	134	427	79	177	-555	243	134	81 5	88	08	10537	195	82	1390
Karimnagar	16.7	46.5	-64.1	247	13.4	836	70	177	-603	21 8	134	625	53	08	590 0	246	82	2005
Khammam	18.4	46.5	-60.5	23.2	13.4	728	91	177	-484	190	134	420	85	08	10145	21 8	82	166 1
Nalgonda	20,8	46.5	-552	18.8	134	397	90	177	-493	242	134	803	65	08	7512	208	82	1542
Average	198	46.5	-574	27.1	134	101 6	63	177	-643	197	134	472	67	08	785 1	201	82	1486

Obs. Observed factor share, Est: Estimated factor share, P E Percentage error

Contd

Table **5.6: Observed** and estimated **factor input** shares (percent) using **hybrid cost function for district hospitals in AP, 1996**

District Hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.
Srikakulam	206	465	-557	239	134	78 1	69	17 7	-613	139	134	40	61	0 8	700 6	28 5	8 2	249 2
Vizianagaram	167	465	-642	274	114	1016	62	177	-648	176	134	312	59	08	674 1	26 3	82	2213
Rajamundry	1 5 6	46 5	-66 5	314	13 4	1334	76	177	-57 1	196	134	463	47	08	52 15	2 1 1	8 2	1 5 8 5
Eluru	163	465	-649	227	134	687	63	177	-644	188	134	40 4	182	0 8	982 8	277	82	238 3
Machilipatnam	225	465	-51 6	21 8	134	62 1	66	177	-62 9	146	134	89	83	08	98999	263	82	221 1
Ongole	150	465	-678	275	134	1045	73	177	-587	228	134	698	40	08	4276	23 5	82	1869
Nellorc	169	465	-63 7	31 1	134	131 2	81	177	-54 1	119	134	-113	62	08	711 7	259	82	2164
Chittore	153	465	-67 1	311	13 4	131 6	76	177	-570	192	134	436	50	08	561 3	21 7	82	165 1
Cuddapah	186	465	-599	269	13 4	1002	77	177	-566	167	134	248	46	08	503 1	25 5	82	211 4
Anantapur	214	465	-540	243	134	807	66	177	-626	174	134	298	53	08	599 1	250	82	2055
Mahboobnagar	203	465	-563	21 3	13 4	586	77	177	-568	20 9	114	55 5	82	08	970 7	21 7	82	1656
Sangareddy	14.1	46,5	-697	23 7	134	767	80	177	-548	196	134	460	71	08	8359	27 5	8 2	236 1
Nizamabad	20.9	46.5	-55 1	177	134	31 6	89	177	-499	206	134	537	88	08	1058	23 1	82	181 1
Adilabad	16.8	46.5	-63.9	236	134	759	71	177	-60 1	209	134	562	46	08	508 1	270	82	2297
Karimnagar	17.9	465	-61 4	249	134	856	99	177	-43 9	183	134	362	66	08	763 4	224	82	1734
Khammam	21.2	46.5	-545	19 1	134	423	92	177	-48 1	235	134	756	68	08	789 5	202	82	147 1
Nalgonda	178	465	-61 7	255	134	897	75	177	-579	193	134	438	64	08	7383	236	82	1886
Average	17.9	465	-61 6	255	134	897	75	177	-577	186	134	390	62	08	7100	244	82	1981

Obs: Observed factor share, Est Estimated factor share, P E Percentage error

5.4 Structural cost functions:

Model:

Having discussed two simple ad hoc cost functions, we move on to structural cost functions[3], which satisfy the neoclassical properties either by specification or imposed **as** parametric restrictions Further, in these models, cost function is estimated jointly with either factor levels or factor shares This approach is known to yield efficient estimates We confine our analysis to one particular class of structural cost functions, namely the transcendental logarithmic, translog for short, family Three members of this family are analyzed here The general translog cost function has the following specification

$$\ln C^{V} = a_0 + \sum_{i=1}^{4} a_i \ln y_i + (1/2)\sum_{i=1}^{4}\sum_{j=1}^{4} a_{ij} \ln y_i \ln y_j + \sum_{i=1}^{6} b_i \ln w_i +$$

$$(1/2)\sum_{i=1}\sum_{j=1} b_{ij} \ln w_i \ln w_j + \sum_{i=1}\sum_{j=1} c_{ij} \ln w_i \ln y_j + d_0 \ln k +$$

$$d_{00} (\ln k)^2 + \sum_{i=1} d_i \ln k \ln w_i + \sum_{i=1} e_i \ln k \ln y_i + e_0 \, dum \qquad (5.6)$$

where, C^v is variable hospital costs, y is a set of four hospital services- outpatient inpatient, major surgery and minor surgery, w is a set of six variable input prices (salaries) for doctor, nurse, paramedical staff, support personnel, other staff and non-salary expenditure, k is a single measure of fixed input m the form of hospitals beds, and dum is a dummy variable representing year (=1 for 1995 and 0 for 1996)

Although (5 6) involves a large number of parameters, it can be estimated within a system of equations framework given adequate number of observations Moreover estimating the cost function along with the associated factor share equations can enhance the efficiency of the resulting parameter estimates By using Shephard's lemma, the variable translog cost function yields the cost shares (s_i^y) associated with each variable input as,

$$S_i^v = b_i + \sum_{j=1}^{6} b_{ij} \ln w_j + \sum_{j=1}^{*} c_{ij} \ln y_j + d_i \ln k \qquad (5\ 7)$$

$$(i = 1,2, \ldots 6)$$

The cost function in (5 6) must be homogeneous of degree one in input prices Further, we impose the symmetry restrictions on a_{ij} and b_{ij} parameters to ensure the existence of an underlying dual production function for the translog cost function These restrictions include,

$$\sum_{i=1}^{6} b_i = 1, \sum_{i=1}^{6} b_{ij} = 0, \sum_{j=1}^{6} b_{ji} = 0, \sum_{i=1}^{6} c_{ij} = 0, \sum_{i=1}^{6} d_{ii} = 0,$$

$$b_{ij} = b_{ji}, \forall j \neq i \qquad (5\,8)$$

We also delete one share equation to avoid the singularity of the associated additive error disturbance term The parameters of the deleted equation can be obtained by using the restrictions given in (5 8) The translog cost function along with the share equations is estimated using the non-linear estimation method given in SHAZAM software package It uses Zellner's iterative seemingly unrelated regression estimation for non-linear equations The resultant estimates are identical with the maximum likelihood method

We estimate the model under three different variants, viz Cobb-Douglas Logarithmic Quadratic and the Translog forms This enables us to see the effect of

3 In recent literature, we find frontier cost functions being estimated in plance of average cost function. For discussion on efficiency. it would have been better to use a frontier cost function Due to non-availabity of

functional form (within the translog family) on the parameters of interest, including 'efficiency' We can perform a formal nested hypothesis testing for the appropriateness of functional form for the cost function

The simple Cobb-Douglas form is obtained by restricting all the parameters, a_{ij}, b_{ij} and c_{ij}, V i, j to zero This model is specified as below

Cobb-Douglas form:

$$\ln C^{v} = a_0 + \sum_{i} a_i \ln y_i + \sum_{i=1}^{6} b_i \ln w_i + d_0 \ln k + e_0 dum \qquad (59)$$

$$S_i^{v} = b_1 \quad (i = 1,2, \ ,6) \qquad (5\ 10)$$

On the other hand, if we restrict only the off-diagonal elements of 'a' and 'b' matrices to zero, we get the logarithmic quadratic form as below

Logarithmic Quadratic form:

$$\ln C^{v} = a_0 + \sum_{i=1}^{4} a_i \ln y_i + (1/2)\sum_{i=1}^{4} (\ln y_i)^2 + \sum_{i=1}^{6} b_i \ln w_i + (1/2)\sum_{i=1}^{6} b_{ii} (\ln w_i)^2 + \sum_{i=1}^{6}\sum_{j=1}^{4} c_{ij} \ln w_i \ln y_j + d_0 \ln k + d_{00}(\ln k)^2 + \sum_{i=1}^{6} d_i \ln k \ln w_i + \sum_{i=1}^{4} e_i \ln k \ln y_i + e_0 dum \qquad (5\ 11)$$

$$S_i^{v} = b_i + b_{ii} \ln w_i + \sum_{j=1}^{4} c_{ij} \ln y_j + d_i \ln k \qquad (5\ 12)$$

(i=l,2- ,6)

required software. we confined to average cost functions only

The model in (511) and (512) is theoretically consistent provided the following restrictions are imposed on the parameters

$$\sum_{i=1}^{6} b_i = 1, \sum_{i=1}^{6} b_{ii} \ln w_i = 0, \sum_{i=1}^{6} c_{ij} = 0, \sum_{i=1}^{6} d_i = 0$$

(5.13)

It can be seen that the restriction on b_{ii} parameters in (5 13) involves the (logarithmic) prices and therefore the restriction can be imposed only at the sample mean values of prices

After estimating each of the above model, we can compute other parameters of interest *viz* , index of allocative inefficiency marginal cost of each output. Allen-Uzawa partial elasticities of substitution, factor demand elasticities, product-specific & overall economies of scale and economies of scope Specifically, the index of allocative inefficiency (AI), an overall measure of whether a hospital is efficient or not in allocating resources, can be defined as below

$$AI = \frac{C^v(obs) - C^v(est)}{C^v(est)} \qquad (5\ 14)$$

where C^v(obs) and C^v(est) are the observed and estimated (optimal) total variable costs respectively This crude index measures the rate of departure of observed cost from the optimum

The marginal cost of i^{th} output can be computed as,

$$MC_i = \frac{\partial C^v}{\partial y_i} = (C^v / y_i)(a_i + \sum_{j=1}^{4} a_{ij} \ln y_j + \sum_{j=1}^{6} c_{ji} \ln w_j + e_i \ln k)$$

(1= 1,2, ,4)

(5 15)

Allen-Uzawa partial elasticities of substitution are given by,

$$\varepsilon_{ij} = (b_{ij} + S_i^v S_j^v)/(S_i^v S_j^v) \quad \forall j \neq i$$

$$\varepsilon_{ii} = (b_{ii} + S_i^v S_i^v - S_i^v)/S_i^v S_i^v \qquad (5\ 16)$$

Factor demand elasticities are given by,

$$\eta_{ij} = \varepsilon_{ij} S_j^v \qquad (5\ 17)$$

The product-specific cost elasticities are computed as,

$$E_i = \partial \ln C^v / \partial \ln y_i = a_i + \sum_{j=1}^{4} a_{ij} \ln y_j + \sum_{j=1}^{v} c_{ji} \ln w_j + e_i \ln k$$

i=1,2, ,4)

(5 18)

The overall economies of scale[4], also known as ray economies of scale, are computed by,

$$SCE = 1 - \sum_{i=1}^{4} E_i \qquad (5\ 19)$$

A positive (negative) value for SCE implies economies (diseconomies) of scale Finally, economies of scope are defined for each pair of outputs Let us denote the (variable) cost of producing the i^{th} output alone, i e keeping all other outputs at zero level, as $C^v(i,0)$, the cost of producing the j^{th} output alone as $C^v(0,j)$ and the cost of producing both the outputs jointly as $C^v(i,j)$ We say economies of scope exists between the two outputs if

$$C^v(i,0) + C^v(0,j) - C^v(i,j) > 0$$

[4] There are at least mo other definitions for the same measure These include (3) sum of product-specific cost elasticities and (b) reciprocal of the sum of product-specific cost elasticities

This implies economies of scope exist when the sum of the total cost of producing the two outputs individually exceeds the cost of their joint production A unit free measure of economies of scope is defined as

$$e_{ij}, = [c^{v}(i,0) + c^{v}(0j) - c^{v}(i,j)]/c^{v}(i,j) \qquad (5\ 20)$$

where i and j are the subscripts of the two outputs under consideration If $\theta_{ij} > 0$, economies of scope exists for the pair of outputs (i,j) It implies that there is some cost saving in the joint production of the two outputs It can be shown that cost complementarity, i e $\partial^2 C^{v}/\partial y_i \partial y_j < 0$ is a sufficient, but not **necessary** condition for the existence of scope and hence joint production This view is however contested in recent literature Since our functional form is in logarithmic outputs, computation of individual costs with zero output levels is not possible To avoid this problem, some investigators compute scope by assigning a very small value, call it epsilon (ε), for the output variable Unfortunately, the degree of scope computed in this way seems sensitive to the assigned (low) value Therefore, they compute scope by using few alternative values for ε

Alternatively, all output variables except the variable of interest and their interactions, if present, are dropped from the right hand side of the cost function in logarithmic form to compute the cost of producing a specific output Likewise, the two variables and their interactions are retained for computing the joint cost of producing them together Thus, in both these methods, the degree of scope measured is only a crude indicator, probably useful to know the direction of change only

The formulae given in (5 15), (5 16) and (5 18) can easily be modified to suit the Cobb-Douglas and Log-Quadratic forms Other formulae are already in general form

Empirical results:

In what follows, we discuss the goodness of fit of all the three variants, compare them and choose the 'best' model For this 'best' model, we discuss other aspects such as factor- shares, levels, and ratios, cost elasticities, overall scale and economies of scope

Goodness of fit:

The parameter estimates of the Cobb-Douglas cost function for the secondary level district hospitals in A P are given in Table 5 7 There are only 12 coefficients in this model The goodness of fit, viz R^2 for equation (5 9) is quite good at 0 91 (Table 5 10). but the share equations in (5 10) have poor fit because of their special nature The share equations in fact are simply the average factor shares for the sample as a whole, which are fixed No regression is involved For this reason, the R^2 for these share equations are all in fact zeroes Even then, joint estimation of (59) and (5 10) is necessary for theoretical consistency

Since the data used is 'mean scaled', the parameter estimates correspond to the 'average' hospital In particular, theb_1,parameter coincides with the i^{th} factor share for this 'average' hospital The estimated factor shares corresponding to each specific hospital are obtained by multiplying the b_1, parameter with the respective mean factor share The estimated b_1 coefficients have good precision as indicated by the high t-ratios

It is interesting to note that the coefficient of (In) k, the hospital beds variable, which represents the fixed capital, is positive and highly significant This shows that the A P secondary level district hospitals suffer from 'excessive' fixed capital investment and the hospitals do not seem to attain long-run cost minimization objective Similar findings are reported for developed countries as well (see e g Cowing et al 1983) The negative

Table 5.7: Parameter estimates and related measures of Cobb-Douglas cost function for district hospitals in AP.

Input related parameters:

Coefficient of	Price(salary) of					Non-salary
	Doctor	Nurse	Parame-dical staff	Support staff	Other staff	
Linear term	0.169 (490)	0162 (300)	0167 (550)	0166 (370)	017 (290)	0166 (NA)

Output related parameters:

Coefficient of	Outpatients	Inpatients	Major surgeries	Minor surgeries
Linearterm	-0035 (-14)	0050 (18)	0011 (057)	0005 (052)

Three other parameters:

Overall Intercept	Coefficient of	
	Beds	Dummy
180 (15500)	0417 (818)	-000 (-on)

R^2 =091,D-W = 179

Figures in parenthesis are t-ratios

and significant sign for year dummy shows that the total variable costs, on average, are lower in 1996 as compared to 1995 Due to the mean scaled nature of the data used for estimation, the parameters may not have much interpretation value on their own. The estimated parameters are used to compute factor shares, factor ratios, elasticities etc (See Appendix Tables 5C.1- 5C 8).

The parameter estimates along with t-ratios for the Log-Quadratic form are given in Table 5 8 Unlike in the Cobb-Douglas form, the factor shares in this model are not constant They depend explicitly on the explanatory variables The log-likelihood function has increased substantially compared to Cobb-Douglas model (Table 5 1 1) A total of 51 coefficients are estimated in this model, after taking the restrictions into consideration The estimated factor share equations have moderate R^2 values given the cross-section nature of the data (Table 5 10) The factor share equation corresponding to 'other staff' category has the largest R^2 (0 74), while the share equations for both doctors and paramedical personnel have the least R^2 (0 30) The cost function itself has a goodness of fit, R^2 value, 0 92 A large proportion of the estimated parameters is statistically significant at 1% or less As in the case of Cobb-Douglas form, the coefficient of the fixed input variable, number of available beds in the hospital, has a positive and significant value suggesting excess capacity and long-run disequilibrium The quadratic term of the same variable is also positive but insignificant The year dummy is negative and statistically significant

The parameter estimates along with t-ratios for the Translog model are given in Table 5 9 The goodness of fit measured by R^2 has increased further for all equations compared to log quadratic model The maximum R^2 value (0 91) is obtained for the input

Table 5.8: Parameter estimates and related measures or logarithmic quadratic cost function for district hospitals in AP.

Price related parameters:

Coefficient of	Price (salary) of					Non-salary
	Doctor	Nurse	Para-Medical staff	Support staff	Other staff	
Linear term	0.169 (43.0)	0.172 (420)	0 169 (610)	0 171 (570)	0 172 (480)	0 147 (NA)
Quadratic term	0 182 (73)	0220 (81)	0064 (43)	0 121 (120)	0 154 (110)	0008 (NA)

Input related parameters:

Factor share	Outpatients	Inpatients	Major surgeries	Minor surgeries	Beds
Doctor	-0011 (-0 72)	-0 005 (-035)	0014 (1 30)	0009 (1 50)	-0 101 (-4 10)
Nurse	-0004 (-0 28)	0018 (140)	-0001 (-0 05)	0015 (220)	0032 (140)
Paramedicalstaff	0005 (046)	0017 (180)	0005 (063)	0007 (180)	-0046 (-2 80)
Support staff	-0022 (-190)	0005 (049)	0002 (032)	0014 (360)	0014 (076)
Other staff	-0012 (-091)	-0008 (-0 65)	0003 (038)	0011 (220)	-0022 (-1 10)
Non-salary	00449 (NA)	-0027 (NA)	-0024 (NA)	-0056 (NA)	0 123 (NA)

Output related parameters:

Coefficient of	Outpatients	Inpatients	Major surgeries	Minor surgeries
Linear output term	-0034 (-091)	0066 (1 70)	-0005 (-017)	0036 (260)
Quadratic output term	-0076 (-081)	0041 (0 42)	-0 166 (-440)	-0054 (-3 10)
Beds	-0095 (-1 20)	-0034 (-026)	0 115 (1 90)	0 123 (370)

Contd

Four other parameters:

Overall Intercept	Coefficient of		
	Beds	Beds-square	Dummy
1.830 (13800)	0.484 (676)	0.167 (132)	-0.0155 (-2 78)

R^2 = 092, D-W= 141
Figures in parenthesis are t-ratios

Table 5.9: Parameter estimates and related measures of translog cost function for district hospitals in AP.

Price related parameters:

Factor share	Price (salary) of						
	Doctor	Nurse	Paramedical staff	Support staff	Other staff	Non salary	Intercept
Doctor	0147	-0084	0017	-0023	-0031	-0 0267	0163
	(71)	(-71)	(11)	(-32)	(-47)	(NA)	(770)
Nurse	-0084	0157	-0018	-0007	-0028	-00204	0168
	(-71)	(140)	(-16)	(-14)	(-37)	(NA)	(740)
Paramedical staff	0017	-0018	0061	-0017	-0015	-0 0275	0168
	(11)	(-160)	(31)	(-25)	(-16)	(NA)	(880)
Support staff	-0023	-0007	-0017	0110	-00318	-00309	0168
	(-32)	(-14)	(-25)	(210)	(-66)	(NA)	(1300)
Other staff	-0031	-0028	-0015	-0032	0132	-0027	0169
	(-47)	(-37)	(-16)	(-66)	(140)	(NA)	(780)
Non-salary	-0027	-0020	-0028	-0031	-0027	0132	0165
	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)

Contd

Input related parameters:

Factor share	Outpatients	Inpatients	Major surgeries	Minor surgeries	Beds
Doctor	0.002	-0027	0019	-0010	-0041
	(037)	(-4.70)	(310)	(-3.80)	(-260)
Nurse	0011	0024	-0009	-0002	0072
	(1.30)	(3-00)	(-1.40)	(-0.60)	(5.40)
Paramedical staff	0010	0.023	-0004	0004	-0035
	(1.50)	(320)	(-062)	(140)	(-2 50)
Support staff	-0015	0.010	-0009	0009	0041
	(-3-30)	(240)	(-2 50)	(490)	(500)
Other staff	-0.013	-0007	-0005	0005	0022
	(-1 60)	(-0 89)	(-0 72)	(160)	(150)
Non-salary	0004	-0023	0007	-0005	-0058
	(NA)	(NA)	(NA)	(NA)	(NA)

Output related parameters:

Output variable	Outpatients	Inpatients	Major surgeries	Minor surgeries	Intercept	Beds
Outpatients	-0.222	0021	0060	0009	-0022	0024
	(-430)	(074)	(190)	(078)	(-076)	(052)
Inpatients	0021	-0043	0010	0011	0 150	0051
	(074)	(-047)	(030)	(036)	(610)	(030)
Major surgeries	0060	0010	-0055	0004	-0051	-0207
	(190)	(030)	(-200)	(043)	(-2 10)	(-2 40)
Minor surgeries	0009	0011	0004	-0008	0037	0006
	(078)	(036)	(043)	(-0 74)	(380)	(014)

Four other parameters with their t-ratios:

Overall intercept	Coefficient of		
	Beds	Beds- square	Dummy
1 810	0341	0026	0006
(19700)	(602)	(038)	(207)

$R^2 = 090$, D-W = 1 41

Figures in parenthesis are t-ratios

factor, support staff, and the minimum value (046) for doctors The cost function however seems to have suffered a marginal decline in R^2 (0 90) The log-likelihood function (664.6) has increased substantially Total 67 coefficients are estimated A good proportion of these is statistically significant at 1% or lower level

From the signs of the estimated coefficients, it follows that the cost function is strictly concave in input prices ($b_{ii} > 0$, V i) and strictly convex in outputs ($a_{ii} < 0$, V i) The function however violated the monotonicity property as will be noted later The variable cost seems to increase at an increasing rate write the fixed input, number of available beds in the hospital This is contrary to the expected behavior and interpreted as over investment of fixed capital It also violates the long-run equilibrium condition for this variable

Choice of the 'best' model:

Before we undertake a formal statistical test for the choice of 'best' model, we may compare the summary measures of MAPE and RMPE computed for each factor share equation, in each model As the names indicate, the above measures summarize the percentage deviations between observed and estimated factor shares in each case A model with lower values of MAPE and RMPE is considered better than the one with higher values In our case, based on the above measures (Table 5 10), Log-quadratic model seems to fit the observed data better than the Cobb-Douglas, and Translog model better than the Log-quadratic There are however some exceptions where MAPE and RMPE values are higher for some variables in a 'better' mode! than the alternative This seems particularly true for 1996 Thus, overall, the Translog model seems to have an edge over the other two models in tracing the observed data on factor shares

Table 5.10: Estimated R^2, MAPE and RMPE values for different models

Factor Share or Total cost	C-D R2	C-D MAPE	C-D RMPE	L-Q R2	L-Q MAPE	L-Q RMPE	TL R2	TL MAPE	TL RMPE
				1995					
Doctor	0	11.16	13.17	03	1561	1868	0 46	6 46 (4 19)	74 (5 03)
Nurse	0	13.12	1671	068	1552	2293	0 83	4 56 (6 96)	6 59 (9 70)
Paramedical Staff	0	902	10.85	03	957	128	0 53	7 33 (995)	8 82 (1196)
Support Staff	0	1247	1543	061	1179	1433	091	48 (748)	551 (854)
Other staff	0	20 93	25 06	074	1542	185	0 86	8 74 (972)	9 85 (1130)
Non-salary	0	957	1295	NA	33 72	44 6	NA	378 (091)	453 (1 24)
Total cost	091	NA	NA	0 92	NA	NA	0 9	NA	NA
				19%					
Doctor	0	1222	1383	03	1902	2172	046	1739 (3 89)	2128 (4 94)
Nurse	0	1238	1546	068	2152	2922	083	2006 (1065)	241 (1343)
Paramedical Staff	0	10	1322	03	1198	1781	053	1285 (1023)	1832 (1225)
Support Staff	0	1191	1571	061	2012	2988	091	2338 (846)	3174 (1127)
Other staff	0	1866	2237	0 74	29 96	38 09	0 86	30 36 (964)	36 46 (1282)
Non-salary	0	934	105	NA	531	7638	NA	1604 (085)	1944 (107)
Total cost	091	NA	NA	0 92	NA	NA	0 9	NA	NA

MAPE Mean absolute percentage error, RMPE Root mean percentage error
Figures in parenthesis correspond to (actor levels
C-D Cobb-Douglas. L-Q Log-quadratic TL Translog NA. Not available

Flexible models such as Translog are most commonly used for testing the empirical validity of theoretical (homogeneity and symmetry) and other a priori hypotheses (additivity and separability) It is also possible to test the superiority of any model, which is nested with translog, such as Cobb-Douglas and log quadratic models The maximum likelihood method used for estimating the models readily facilitates the statistical testing of restrictions or hypotheses using likelihood ratio test The test criteria is the ratio of the likelihood value of a more restrictive model or hypothesis (L_{0},) to that of a less restrictive one (L_i) Defining the ratio $\lambda = L_0/L_i$, it can be shown that (- 2) In λ follows a chi-square distribution with k degrees of freedom Here, k is the number of restrictions or the difference in the number of parameters estimated in the two models

Thus,

$$-2 \ln \lambda = -2 (\ln L_0 - \ln L_1) = \chi^2 \text{ (say)} \sim \chi^2_k$$

If the calculated value of the x^2 is larger than the critical value from the x^2 distribution at a specified level of significance, a, we reject the null hypothesis of the restrictive model in favor of the less restrictive alternative In the present case, we have three model alternatives, Cobb-Douglas, Log quadratic and the Translog Three hypotheses can be tested, Cobb-Douglas vs Log quadratic, Cobb-Douglas vs Translog and Log quadratic vs Translog Table 5 11 gives the log likelihood values and the x^2 associated with each of the hypotheses

It can be seen from the above table that the calculated x^2 value far exceeds the corresponding critical value for all the null hypotheses Hence, all the three null hypotheses are rejected at 1% level of significance This implies that both Log Quadratic and Translog models are superior to Cobb-Douglas, and Translog model is superior to

Table 5.11: Estimated log likelihood and x^2 statistic values

Model Type	Log likelihood Value (L)	Null Hypothesis Vs. Alternative	Calculated x^2	Critical x^2 at 1% level
Cobb-Douglas	486.52 (12)	Cobb-Douglas Vs Log Quadratic	2147 (39)	6369*
Log Quadratic	593.85 (51)	Cobb-Douglas Vs Translog	4986 (55)	88.38[a]
Translog	73584 (67)	Log Quadratic Vs Translog	2840 (16)	320

The value corresponds to 40 degrees of freedom
The value corresponds to 60 degrees of freedom
Figures in parentheses are degrees of freedom

Log Quadratic with 99% confidence Thus, Translog model stands out as the 'best' model statistically We now move on to discuss certain features of this 'best' model

Factor shares:

Table 5 12 gives the observed and estimated factor shares using the Translog model for each hospital in the sample It also gives the percentage deviation between the observed and estimated (optimal) factor shares Since Translog form has variable shares, which are also the elasticities, we notice different values for the estimated factor share across hospitals A quick glance at these numbers shows that there is a close agreement between the observed and optimal factor shares, particularly for 1995, using this model For comparison, similar combined tables are given in Appendix Table 5C 1- 5C 8 for all the three models The fit is much better for non-salary component Between the two years, relatively, the performance is not so good for 1996 Large RMPE values (Table

5.10) show wide variability in the percentage errors across hospitals. Despite this, we may say that a fully flexible cost function seem to underlie the resource allocation behavior of secondary level district hospitals in AP. Simpler forms like Cobb-Douglas and log quadratic models could not adequately describe the observed data.

For 1995, the estimated average shares of factor inputs are, doctors: 17.1%, nurses: 26%, paramedical staff. 7.6%, support staff: 19.6%, other staff: 6.5%, and non-salary: 23.2%. The average factor shares for 1996 are also quite close to the above values. Nurses' salary is the largest component in the variable hospital costs. The average share of all manpower in the total variable cost is estimated to be 76.8%, leaving a meager 23 2% for non-salary and material inputs in secondary level district hospitals in AP. This

Table 5.12: Observed And estimated factor input shares (percent) using translog cost function for district hospitals in AP, 1995

District Hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs..	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.
Srikakuiam	18.3	180	1 6	26 0	26 0	01	64	73	-132	187	188	-06	68	65	49	23 8	234	20
Vizianagaram	19.4	18.4	5.7	24.1	245	-15	68	72	-50	13 5	14 7	-84	62	64	-36	300	28 8	40
Rajamundry	16.8	17 1	-1.8	292	248	177	74	78	-47	170	180	.100	67	72	-78	22 0	24 1	-52
Eluru	15.6	16 8	-7 1	28.0	287	-24	79	72	93	180	168	69	39	3 4	139	266	270	-1 6
Machilipatnam	16.3	15.8	3 1	23.5	255	-7.9	70	71	-23	202	205	-18	8 3	78	57	248	23 2	70
Ongole	21.9	19.5	127	21 7	254	-145	76	80	-47	158	166	-49	94	91	35	23 5	21 5	07
Nellore	15.3	164	-70	26 1	25 3	35	7 3	7 3	1 1	21 4	21 1	14	44	46	-40	25 5	254	03
Chittore	17.6	174	1.5	294	280	49	80	74	82	147	154	-48	50	67	-12 0	245	252	-27
Cuddapah	16.1	139	15.1	35.5	360	-14	65	76	-15 1	204	21 3	-40	53	63	-15 1	163	150	00
Anantapur	17.3	15.9	8.7	28.0	29 2	-38	6.3	7.0	-9 3	196	205	-46	40	42	167	23 8	23 2	27
Mahboobnagar	20.5	187	9.5	24 1	243	-10	71	74	-32	175	185	-53	55	65	-15 1	25 3	24 7	27
Sangareddy	23.2	22.5	3.3	19.1	187	2.1	8.1	86	-62	208	21 5	-34	84	88	-43	203	108	25
Nizamabad	14.8	15.8	-6.4	230	24.9	-76	83	80	35	203	19 1	61	71	65	96	26 5	25 6	3 3
Adilabad	20.3	19.1	6.3	19.2	188	1.9	7.9	8.6	-8 1	243	243	00	88	02	-43	195	200	-23
Karimnagar	16.7	18.1	-7.8	24.7	25 2	-22	7.0	58	20 7	21 8	202	80	53	50	58	24 6	25 7	-45
Khammam	18.4	196	-6.3	23.2	23.4	-08	91	87	56	190	182	45	85	78	80	21 8	223	-25
Nalgonda	20.8	22.2	-6 1	18.8	196	-4.2	90	86	45	24 2	22 6	68	65	57	133	20 8	213	-24
Average	19.8	17.1	157	27.1	26.0	4.2	63	76	-172	197	196	05	67	65	41	203	232	-122

Obs: Observed factor share, Est: Estimated factor share, P E Percentage error

Contd

Table 5.12: Observed and estimated factor **input** shares **(percent) using translog cost function for district hospitals in AP, 19%**

District Hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs..	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	ON.	EH.	P.E.
Srikakulam	20.6	20.0	3 2	23.9	263	-89	69	75	-88	139	1 9 6	-29 0	6 1	6 4	-4 5	28 5	20 2	4 13
Vizianagaram	16.7	207	-195	274	228	199	62	69	-97	176	14 7	199	59	6 3	-68	26 1	28 6	-91
Rajamundry	15.6	190	-182	31.4	225	396	76	64	189	196	174	129	47	62	-232	21 1	286	-26 1
Eluru	16,3	160	1.7	22.7	31 6	-283	63	72	-126	188	18 3	27	82	45	81 7	277	223	218
Machilipatnam	22.5	165	364	21 8	235	-75	66	63	39	146	190	-234	83	79	51	263	267	-17
Ongole	15.0	21.2	-294	275	235	169	73	70	48	228	147	553	40	82	-51 0	2.3 5	255	-79
Nellore	16.9	16.4	2.5	31.1	252	234	8.1	69	177	119	22 4	-46 8	62	43	42 8	259	248	44
Chittore	15.3	19.6	-220	31.1	28.0	110	7 6	7 1	7 1	192	105	824	50	67	-247	21 7	280	-225
Cuddapah	18.6	14.6	27.8	26.9	31.6	-14.9	77	75	24	167	193	-134	46	59	-220	255	211	206
Armntapur	21 4	195	95	243	263	-78	66	74	-106	174	17 1	16	53	3 8	41 6	250	258	-33
Mahboobnagar	20.3	189	7.4	21.3	25.3	-15.9	77	74	40	209	183	139	82	61	33 2	21 7	240	-94
Sangareddy	14.1	16.3	-13.8	23.7	229	3.8	80	82	-28	196	236	-17 1	71	8 9	-20 3	275	200	374
Nizamabad	20.9	143	45.7	17.7	259	-31.8	89	76	168	206	190	83	88	67	324	23 1	264	-125
Adilabad	16.8	21 0	-200	23.6	15.4	53.1	7.1	8.9	-205	209	21 3	-18	46	93	-502	270	24 1	120
Karimnagar	17.9	16.5	90	24.9	25.3	-1.4	99	62	59 7	183	209	-128	66	45	46 9	224	266	-160
Khammam	21.2	20.1	5.4	19.1	25.8	-25.9	92	88	44	235	16 1	460	68	57	184	202	235	-139
Nalgonda	17.8	23.5	-243	255	194	31 1	75	86	-13 7	193	21 5	-103	64	58	94	236	21 1	118
Average	17.9	17.8	0.1	25.5	25.4	04	75	75	06	186	187	-05	62	62	-1 2	24 4	24 4	01

Obs: Observed factor share, Est Estimated factor share, P E Percentage error supports the general argument that public hospitals suffer from excessive manpower and shortage of other crucial variable inputs like drugs, consumables etc. Specific hospitals may have even more inadequate shares between manpower and other variable inputs

From the table, we notice that despite reasonable overall fit, the observed factor shares differ from the optimal in a substantial way for specific inputs in some hospitals The largest percentage deviation varies across factor inputs and occurs in different hospitals for different inputs In 1995, the largest deviations are (+)1 5 1% for doctors in Cuddapah, (+) 17 7% for nurses in Rajamundry, (+)20 7% for paramedical staff in Karimnagar, (-)10.0% for support staff in Rajamundry, (+)16.% for general staff in Anantapur and (+)9.7% for non-salary component in Ongolc hospital These include some excessive (+) share than optimal and some deficit (-) as well

In order to have an overall picture of departure between observed and optimal factor shares, mean absolute percentage error (MAPE) and root mean percentage error (RMPE) are computed (Table 5 10) The MAPE and RMPE values reported there for this model reflect these (large) deviations This large degree of inaccuracy/departure between the observed and optimal factor shares may also be termed as inefficiency The average degree of inaccuracy (MAPE) varies across factor inputs and found to be largest for general category (other staff) of hospital manpower and least for the non-salary component The RMPE values are larger than the MAPE for all factor inputs, indicating large variability in inefficiency across hospitals

Factor input **levels:**

Table 5 13 gives the observed and estimated (optima!) factor levels for each hospital in both the years using the Translog model In addition, the annual averages for

Table 5.13: Observed and estimated factor input levels (No.) using transient cost function for district hospitals in AP, 1995

District hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs,	Est.	P.E.
Srikakulam	28.0	28.0	00	490	497	-15	160	187	-145	500	51 1	-22	710	688	12	10 5	304	04
Vizianagaram	27.0	27.2	-0.8	340	368	-76	170	19 1	-108	360	41 9	-14 1	53 0	58 6	-95	356	365	-24
Rajamundry	29.0	28.2	28	68 0	55 1	23 3	21 0	21 0	-01	600	616	-57	770	79 8	-35	178	180	-0.7
Eluru	31.0	325	-46	81 0	808	03	270	240	123	84 0	76 5	98	94 0	80 3	171	5 3 0	5 2 4	I I
Machilipatnam	31.0	32.3	-4.1	690	805	-143	220	242	-90	640	700	-86	850	86 4	-16	44 1	44 1	-0 4
Ongole	28.0	27.3	2.4	31 0	399	-223	140	162	-134	420	486	.136	59 0	62 7	-60	230	230	-03
Nellore	27.0	29.2	-7.6	64.0	622	2.9	220	219	05	670	665	08	79 0	82 7	-45	444	446	-03
Chittore	28.0	27.2	2.9	64.0	602	6.3	250	228	96	650	674	-36	730	81 9	-109	367	372	-14
Cuddapah	31.0	28.4	9.0	83 0	88.9	-6.6	24.0	298	-196	82 0	90 2	-91	81 0	1007	-196	296	287	32
Anantapur	32.0	30.2	5.8	81 0	865	-64	260	294	-117	78 0	84 0	-71	1050	924	136	479	479	00
Mahboobnagar	30.0	28.7	46	470	497	-54	20.0	216	-75	530	586	-95	61 0	75 I	-188	31 7	323	-1 9
Sangareddy	34,0	33.9	0,3	490	49.4	-0.9	200	220	-89	47.0	50 1	-62	62 0	66 8	-71	250	25 1	-05
Nizamabad	280	307	-88	650	722	-10.0	24 0	23 8	09	76 0	73 5	3 5	95 0	88 9	68	413	411	07
Adilabad	36.0	33.2	8.3	550	53.0	3.8	190	20.3	-64	590	579	19	750	769	-25	248	249	-04
Karimnagar	29.0	29.7	-2.3	530	51.1	3.6	23.0	18.0	27.8	570	498	144	780	696	120	329	32.5	1.2
Khammam	28.0	29 1	-3.7	50.0	49.1	1.9	210	194	85	590	550	73	79 0	70 6	119	285	285	01
Nalgonda	29.0	30.0	-3.3	40.0	40.6	-1 4	200	18.6	76	560	509	100	820	703	167	234	233	05
Average	29.8	29.7	0.3	578	61.2	-5.5	21 2	225	-58	609	643	-53	770	810	-49	347	353	-1 8

Obs. Observed number, Est.. Estimated number, P.E Percentage error

Contd

Table 5.13; Observed and estimated factor input levels (No.) using translog cost function for district hospitals in AP, 1996

District hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-slary (Rs lacs)		
	Obs.	Est	PE	Obs	Est	P E	Obs	Est	P E	Obs	Est	P E	Obs	Est	P E	Obs	Est	P E
Srikakulam	28.0	28.2	-0.7	490	474	33	160	190	-158	500	496	08	71 0	6,7 1	58	288	286	00
Vizianagaram	27.0	272	-06	340	325	45	170	17 1	-08	360	380	-53	510	532	-10	15 1	353	-04
Rajamundry	290	299	-2.9	68 0	50 3	351	21 0	194	82	600	534	123	77 0	72 5	62	40 2	48 2	10
Eluru	31.0	30.2	2.7	81 0	77 1	51	27 0	24 2	114	84 0	74 2	133	940	84 2	116	41 7	41 7	01
Machilipatnam	31.0	32.5	-4,5	69.0	742	-70	220	229	-39	64 0	67 1	-46	850	S4 1	00	552	552	00
Ongole	28.0	27.3	2.5	31 0	346	-104	140	154	-89	42 0	43 7	-18	50 0	60 3	-2 2	124	125	-04
Nellore	27.0	28.1	-39	64.0	55,5	153	220	197	118	670	623	76	70 ()	80 5	- 19	44 6	44 5	00
Chittore	28.0	29.7	-5.7	640	527	21 6	250	199	255	65 0	52 5	23 7	73 0	72 0	15	40 3	39 8	14
Cuddapah	31.0	30.8	0.6	830	88.1	-58	240	247	-29	820	859	-46	810	990	-182	445	45.3	-1 7
Anantapur	32.0	32.7	-2,2	81.0	77.3	4.8	260	245	63	780	779	02	105 0	83 8	25 3	56 1	55 5	11
Mahboobnagar	30.0	28.2	6.3	470	52.1	-9.9	200	236	-153	530	593	-106	610	746	-183	367	374	-20
Sangareddy	34.0	30.0	13.4	49.0	57.7	-15.1	200	236	-152	470	584	-195	620	745	-168	286	289	-10
Nizamabad	28.0	29.7	-5.7	65.0	74.1	-122	240	238	08	760	77 1	-15	95 0	92 7	25	48 1	48 3	-04
Adilabad	36.0	35.1	2.4	55.0	46.6	18.0	19.0	18.5	28	590	593	-04	75 0	76 8	-23	322	326	-10
Karimnagar	29.0	28,7	1.2	53.0	57.1	-7.2	230	204	127	57 0	57 4	-0 7	78 0	76 0	27	41 5	41 3	05
Khammam	28.0	29,5	-5,0	500	48.6	28	21.0	175	200	590	490	205	70 0	64 6	22 2	33 0	32 6	14
Nalgonda	29.0	308	-57	400	388	30	200	179	114	560	488	146	82 0	67 5	21 5	24 1	24 1	02
Average	29,8	30.0	-0.8	57.8	58.1	-0.5	21.2	21 3	-03	609	61 8	-14	77 0	78 7	-21	395	390	-08

Obs. Observed number, Est.. Estimated number, P E Percentage error all the hospitals are also given It can be seen that the observed and estimated factor levels are fairly close to each other for several of the hospitals in both the years There are however exceptions Due to the non-availability of quantity/price data for the non-salary component, only the expenditure figures (in Rs lacs) are reported The wide gaps between observed and estimated (optimal) factor levels, e g Rajamundry and Ongole for nurses, Cuddapah for paramedical and other staff, show the presence of inefficient factor allocation in secondary level district hospitals in AP It must be quickly added that this inference is conditional on the assumption of Translog model as the 'true' functional form The nature and degree of perceived (in)efficiency may vary with the functional form The largest deviation between the observed and optimal factor levels vary across hospitals and factor inputs They are also different from what we noticed for factor shares For example, the percentage deviation was largest for doctors (+13 4%) in Sangareddy hospital in 1996, for nurses (35 1%) in Rajamundry for 19% etc These hospitals have excessive manpower The MAPE and RMPE values for factor levels are larger in 1996 than in 1995, except in the case of doctors and non-salary

For all the hospitals put together, the Translog model predicts for 1995 and 19%, a negligible deficit of 1%, in available financial resources, compared to the required optimum In a physical sense, in 1995 and 19%, the estimated deficits were, doctors (03%, -0 8%), nurses (-5.5%, -05%), paramedical (-5 8%, -03%), support staff (-5 3%, -1 4%), other staff (-4 9%, -2 1%) and non-salary (-1 8%, -0 8%) A positive percentage indicates a surplus This shows a deficit in the available manpower compared to the required levels The extent of deficit is lower in 1996.

Factor ratios:

In order to analyze the allocative efficiency of secondary level district hospitals in A.P in a more formal way, we computed the observed and estimated factor ratios of each variable factor w r t the fixed factor namely the number of available beds in each hospital The annual averages are also computed According to the neoclassical approach, allocative inefficiency is said to exist if the observed factor ratios differ from the optimal factor ratios implied by the chosen cost function In the absence of any specific measure of allocative inefficiency, we computed the percentage error between the observed and optimal (estimated) factor ratios, with the estimated factor ratio as the denominator Specifically, a positive (negative) error implies excessive (under) allocation of that factor than required with cost minimization as the objective Further, as an overall measure of allocative inefficiency, we computed the mean absolute percentage error (MAPE) and the root mean percentage error (RMPE) Table 5 14 gives the observed and optimal factor ratios along with the percentage error for each hospital as well as annual averages for all hospitals using the Translog model

Broadly, the factor ratios depict similar trends as that of factor levels In fact, the percentage errors are identical for both the variables, as they should be A perusal at these figures shows that the observed factor ratios differ significantly from the optimal factor ratios for some hospitals in both the years The percentage error varies across hospitals and input factors It is to be noted that the percentage error takes both positive and negative values This shows both over and under allocation of certain factor inputs in relation to the fixed input namely the number of available hospital beds We notice from the table that the number of positive and negative errors is approximately the same,

Table 5.14: Observed and estimated factor ratios with respect to fixed factor (beds) using translog cost function for district hospitals in AP, 1995.

District hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs.lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs,	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.
Srikakulam	0.122	0122	00	0213	0216	-1 5	0070	0081	-145	0217	0222	-22	0 309	0299	32	0 111	0 112	04
Vizianagaram	0 180	0 181	-08	0 227	0 245	-7 6	0 115	0 127	.108	0240	0279	-14 1	0 353	0 391	-95	0237	0243	-24
Rajamundry	0,116	0113	28	0272	0221	233	0 084	0 084	-0 1	0 240	0 254	-5 7	0 108	0 319	-35	0 151	0 152	-07
Eluru	0091	0096	-46	0238	0238	03	0079	0071	123	0247	0225	98	0276	0236	17 1	0 156	0 154	11
Machilipatnam	0 092	0.096	-4 1	0204	0238	-143	0065	0072	-90	0 I89	0207	-86	0251	0255	-16	0131	0131	-04
Ongole	0 147	0.144	24	0.163	0210	-223	0074	0085	-134	0221	0256	-136	0 311	0330	-60	0 121	0121	-0 3
Nellore	0.108	0.117	-76	0 256	0 249	29	0 088	0 088	0 5	0268	0266	08	0,116	0331	-45	0 178	0 178	-03
Chittore	0104	0.101	2.9	0.237	0.223	63	0 093	0 084	9 6	0241	0250	-36	0270	0303	-109	0 136	0 138	-14
Cuddapah	0.088	0.081	9.0	0,236	0252	-66	0.068	0085	-196	0233	0256	-91	0230	0286	-196	0084	0081	32
Anantapur	0.091	0.086	5.8	0,231	0.247	-6.4	0074	0084	-11 7	0 223	0 240	-7 1	0300	0264	136	0 137	0 137	00
Mahboobnagar	0.128	0.122	4.6	0.200	0.211	-5.4	0 085	0 092	-7 5	0226	0249	-95	0260	0320	-188	0135	0138	-19
Sangareddy	0.155	0.154	0.3	0 223	0.225	-0 9	0091	0.100	-8.9	0214	0228	-62	0 282	0 303	-7 1	0 114	0 114	-05
Nizamabad	0.093	0.102	-8.8	0.215	0.239	-100	0079	0.079	09	0.252	0243	35	0315	0295	68	0 137	0136	07
Adilabad	0.157	0.144	8.3	0.239	0.230	3 8	0.083	0 088	-6.4	0257	0252	19	0 326	0 334	-2 5	0 108	0.108	-0.4
Karimnagar	0.113	0.115	-2.3	0.206	0.199	36	0.089	0 070	27 8	0222	0194	144	0304	0271	12,0	0 128	0,127	1.2
Khammam	0.133	0139	-3.7	0.238	0.234	1.9	0 100	0.092	8 5	0.281	0262	73	0 376	0 336	1 1 9	0 136	0136	0.1
Nalgonda	0.161	0.167	-3.3	0.222	0.225	-1.4	0111	0 103	76	0311	0283	100	0456	0390	167	0 130	0 130	05
Average	0.116	0.116	0.3	0,226	0 239	-5 5	0 083	0 088	-5 8	0238	0251	-53	0301	0316	-49	0 136	0 138	-1 8

Obs. Observed factor ratio, Est. Estimated factor ratio P E . Percentage error

Contd

Table 5.14: Observed and estimated factor ratios with respect to fixed factor (beds) using translog cost function for district hospitals in AP, 1996.

District Hospital	Doctor			Nurse			Paramedical staff			Support staff			Other staff			Non-salary (Rs lacs)		
	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obs.	Est.	P.E.	Obi.	Est.	P.E.
Srikakulam	0122	0123	-07	0213	0206	33	0070	0083	-158	0217	0216	08	0 109	0 292	5 8	0125	0124	09
Vizianagaram	0.180	0181	-0.6	0227	0217	45	0113	0 114	-08	0 240	0 253	-5 3	0 151	0368	-39	02314	0235	-04
Rajamundry	0116	0.119	-2.9	0272	0201	35 1	0 084	0 078	82	0240	0214	123	0 108	0 290	62	0 197	0 193	1 9
Eluru	0091	0089	2.7	0 238	0 227	51	0079	0071	114	0247	0218	133	0 276	0248	11 6	0123	0123	01
Machilipatnam	0,092	0.096	-4.5	0204	0220	-70	0 065	0 068	-3 9	0 189	0 198	-46	0251	0249	09	0163	0163	00
Ongole	0.147	0.144	2.5	0.163	0 182	-104	0074	0081	-89	0221	0230	-.38	0 3 1 1	0 317	-22	0 171	0171	-04
Nellore	0.108	0,112	-3.9	0256	0222	153	0 088	0 079	118	0 268	0 249	76	0 316	0322	-1 9	0 178	0178	00
Chittore	0.104	0.110	-5.7	0237	0.195	21 6	0 093	0 074	25 5	0241	0195	237	0 270	0 266	15	0 149	0 147	14
Cuddapah	0.088	0088	0.6	0236	0.250	-58	0 068	0 070	-2 9	0 233	0 244	-4 6	0230	0281	-182	0 126	0 129	-1 7
Anantapur	0,091	0.093	-2.2	0.231	0221	48	0074	0070	63	0 223	0 222	02	0 300	0 239	25 3	0 160	0 158	1 1
Mahboobnagar	0.128	0.120	6.3	0200	0222	-99	0.085	0.100	-153	0226	0252	-106	0260	0318	-183	0 156	0 159	-20
Sangareddy	0.155	0.136	13.4	0.223	0262	-15 1	0091	0107	-152	0214	0265	-195	0282	0339	-168	0130	0132	-10
Nizamabad	0.093	0,098	-5.7	0.215	0.245	-122	0079	0.079	08	0252	0255	-1 5	0315	0307	25	0 159	0 160	-04
Adilabad	0.157	0.153	24	0.239	0.203	180	0 083	0 080	28	0 257	0 258	-0 4	0 326	0 334	-2 3	0 140	0 142	-1 0
Karimnagar	0.113	0.112	1.2	0.206	0.222	-72	0089	0079	12,7	0 222	0.223	-0 7	0 304	0 296	27	0 161	0 161	05
Khammam	0.133	0.140	-5.0	0.238	0.232	2.8	0.100	0083	200	0281	0233	205	0 176	0 308	22 2	0 157	0 155	14
Nalgonda	0.161	0.171	-5.7	0.222	0216	30	0 111	0100	114	0311	0271	146	0456	0375	21 5	0134	0134	02
Average	0.116	0.117	-0,8	0226	0.227	-05	0 083	0 083	-0 3	0238	0241	-14	0 301	0307	-2 1	0 154	0 156	-08

Obs. Observed factor ratio, Est. Estimated factor ratio P E Percentage error implying an overall nullifying effect in the allocation of most of the hospital inputs across hospitals Similar comparisons are possible for every pair of factor inputs

Product-specific cost elasticities:

Based on the estimated model, we computed the marginal cost using equation (5 15) for each output category in each of the district hospital in the sample As in the case of ad hoc cost functions, the translog function also seems to violate the monotonicity property This resulted in negative marginal costs for two output categories, outpatients and major surgeries in some of the hospitals As a consequence, product-specific cost elasticities (equation 5 18) are also negative in such cases The product-specific cost elasticities are both positive and negative, but low. They show significant variation across hospitals and output categories Using the product-specific cost elasticities, the overall economies of scale (equation 5 19) is estimated Annual averages are also computed for the above measures and presented in Table 5 15

Non-negative marginal cost for all output categories is also a regularity condition for the existence of an underlying dual production function This condition is being violated Thus, the model is theoretically not (fully) consistent as a neoclassical tool Although such results are not uncommon in empirical work, they however cast doubts on the methodology and or quality of data at hand Other studies have also reported such negative marginal costs The problem probably lies in under valuation of hospital costs and or hidden subsidies for certain hospital services. This result is independent of the cost function specification It is however not uniform across hospitals and output categories Therefore, we tend to suspect the quality of data and the assumption of cost minimization in the provision of hospital services in AP secondary level district hospitals. Since such

Table 5.15: Estimated product-specific cost elasticities and overall economies of scale using translog cost function for district hospitals in AP.

District hospital	Out-patients	In-patients	Major surgeries	Minor surgeries	Overall EOS.	Out-patients	In-patients	Major surgeries	Minor surgeries	Overall EOS
			1995					1996		
Srikakulam	-0 11	0 17	0 00	004	091	-0 11	0 17	--0.02	004	091
Vizianagaram	0,04	0.12	0 02	004	078	007	0 12	000	004	077
Rajamimdry	-0.08	0.18	-0 02	003	090	-002	0 15	-0 05	004	089
Eluru	-0.05	0.14	-0 10	005	096	-005	0 15	-0 10	005	096
Machilipatnam	-0.06	0 14	-0 10	005	097	-004	0 14	.0 10	005	096
Ongole	0.00	015	001	003	081	007	0 15	-001	001	079
Nellore	0.02	0,13	-0 03	003	085	000	0 17	-003	002	084
Chittore	-0.10	0 14	-0 01	003	093	003	0 14	-0 11	004	089
Cuddapah	-0.01	0.13	-0 10	005	093	001	013	-0 11	005	092
Anantapur	0.03	0.12	-0 12	004	092	-002	0 14	-011	004	095
Mahboobnagar	-0,01	0.17	-0 05	003	086	-002	0 15	-0 04	003	088
Sangareddy	-0 07	0.14	-0 03	005	091	-003	0 15	-002	004	086
Nizamabad	-009	0.17	-0.06	003	095	-005	0 17	-006	003	092
Adilabad	-0.03	0.16	-0 02	003	086	003	0 14	-004	003	083
Karimnagar	001	015	-0.08	004	087	-004	0 15	-004	003	089
Khammam	-0.08	0.15	0 02	004	088	-015	0 16	002	004	093
Nalgonda	0.09	0.13	-0 02	003	076	0 11	0 14	-004	004	075
Average	-0.03	0.15	-0 05	004	089	-001	0 15	-0 06	0 04	088

EOS. Economies of scale

violations are common in empirical work, particularly with flexible models, we are constrained to accept it as a viable alternative provided rt satisfies other basic properties These include downward sloping factor demand equations and negative own elasticities of factor substitution The problem probably lies with the quality of data

Economies of scale:

Due to the flexible nature of Translog form, the estimated overall economies of scale, also referred to as 'ray economies', van. across hospitals We notice a high degree of overall economies of scale, close to unity, in the provision of hospital services in AP This shows almost negligible rate of increase in costs corresponding to any given rate of increase in all output services This implies significant cost saving in expanding the activities of the existing hospitals The hospitals probably have large unutilized capacity of fixed inputs This result is independent of cost function specification (see Appendix Tables 5C 5- 5C 6)

Economies of scope:

In order to assess the usefulness of joint production in hospital services and suggest policy measures for continuation, diversification or otherwise of more than one patient service, economies of scope are computed for pairs of outputs' These are presented in Table 5 16 From the results, we notice a high degree of scope for joint production of all pairs of services There appears to be significant cost saving

[5] This result is in the tradition of Baumol Panzar and Willig (1982) and many subsequent followers It is recognized however that economies of scope are neither necessay nor sufficient for the existence of a multi-product firm A host of other reasons are cited for firms to undertake joint production. reader may refer to Teece (1982)

Table 5.16: **Estimated economies of scope between pain of outputs using translog cost function for district hospitals in AP.**

District Hospital	OP,IP	OP MAJS	OP, MINS	IP, MAJS	IP, MINS	MAJS, MINS	OP,IP	OP, MAJS	OP, MINS	IP, MAJS	IP, MINS	MAJS, MINS
	1995						1996					
Srikakulam	1 09	1 01	1 03	1 06	1 09	1 01	1 10	102	1 04	1 08	109	1 01
Vizianagaram	103	1 00	1 03	1 02	1 06	1 03	1 06	1 01	1 06	1 05	1 11	1 05
Rajamundry	1 06	1 00	097	1 04	1 03	096	1 06	099	1 03	1 06	1 09	1 03
Eluru	094	103	1 04	095	096	1 05	094	1 03	1 04	096	096	1 05
Machilipatnam	0.97	100	103	096	099	1 02	1 00	098	1 04	098	105	102
Ongole	1 11	099	1 04	1 12	1 14	1 05	1 14	1 02	1 06	1 14	1 16	1 04
Nellorc	1.01	096	1 01	098	1 01	099	1 08	096	0 99	1 06	1 07	097
Chittore	1.03	0.99	1.02	099	1 03	098	099	1 06	1 04	1 05	1 03	1 11
Cuddapah	0.90	098	1.02	0.88	092	1 00	093	096	1 03	089	097	1 00
Anantapur	0.90	1.01	1,01	0.91	092	1 03	093	1 03	1 03	096	096	1 06
Mahboobnagar	1.05	1.02	097	1 06	102	099	1 01	1 01	099	1 02	099	1 00
Sangareddy	1.00	1.02	1 04	1.00	1 02	1 04	099	1 00	098	099	097	098
Nizamabad	1.01	104	0.98	1.00	093	098	099	1 01	097	098	094	096
Adilabad	1.03	0.98	0.98	1.03	102	098	1 03	098	1 00	1 02	1 02	099
Karimnagar	1.08	1.00	1.05	1,09	1 13	1 06	1 06	097	1 02	1 04	1 08	1 00
Khammam	1.03	1.01	1.01	1.03	104	1 01	i 07	1 05	1 07	1 02	1 04	1 02
Nalgonda	1.03	1.02	1 02	1.02	1 02	1 00	1 03	1 04	1 03	1 01	1 02	1 01
Average	0.99	1 00	1.00	0.99	099	099	1 01	1 00	1 00	101		1 01

OP, Outpatients, IP: Inpatients, MAJS Major surgeries, MINS Minor surgeries (complementarity) in producing these outputs together The degree of scope is overestimated because of negative marginal cost for two output services, outpatients and major surgeries In fact, we encounter a very peculiar situation where total cost falls when output is increased These results are somewhat misleading and point to the unreliable nature of cost and output data.

The estimated economies of scope (Appendix Tables 5C 5- 5C 6) seem to be quite similar across functional forms and suffer from the same drawback Thus, cost function specification has very little impact on the degree of scope measurement As mentioned in the beginning, cost functions using logarithmic outputs are not quite suitable to measure economies of scope

Elasticities of factor substitution:

Since Translog model specification underlies variable factor shares, the estimated values for Allen-Uzawa elasticities of substitution are different across hospitals These are given in Table 5 17 The own-elasticities of factor substitution are somewhat on the higher side, particularly for the paramedical and other staff categories Overall, the order of magnitude of these estimates compares quite favorably with those available in the literature Large magnitude for own-elasticities of substitution implies perhaps specialized nature of the input It may have adverse consequences for hospital finances in the event of rise in its price This problem seems to be compounded by the inelastic factor

Table 5.17: Estimated Allen-Uzawa partial own elasticities of factor substitution using translog cost function for the district hospitals in AP.

District Hospital	Doctor	Nurse	Paramed-ical staff	Support staff	Other staff	Non-salary	Doctor	Nurse	Parame-dical staff	Supper staff	Other staff	Non-salary
	1995						1996					
Srikakulam	-355	-239	-1062	-380	-11 27	-270	-3 18	-2 36	-10 36	-362	-11 46	-3 17
Vizianagaram	-347	-257	-1080	-494	-11 43	-209	-307	-270	-11 21	-496	-11 54	-2 11
Rajamundry	-3,72	-253	-1006	-377	-1032	-260	-3 35	-284	-1 1 21	-4 15	-11 79	-2 11
Eluru	-3.79	-2 11	-1075	-429	-1708	-226	-3 96	- 1 86	-10 77	-3 91	-1 4 79	-284
Machilipatnam	-402	-244	-1089	-343	-065	-272	-386	-269	-12 08	-3 74	-9 57	-2 .30
Ongole	-3.27	-247	-984	-434	-840	-297	-299	-270	-11 09	-496	-925	-244
Nellore	-3.87	-248	-1072	-333	-1466	-244	-3 87	-249	-11 19	-3 10	-15 13	-252
Chittore	-367	-2 18	-1057	-471	-11 07	-247	-324	-2 17	-1091	-682	-11 03	-2 17
Cuddapah	-4.48	-1 54	-1026	-329	-11 64	-427	-431	-1 85	-10 39	-369	-1221	-302
Anantapur	-3.99	-207	-11 10	-344	-1533	-272	-326	-235	-1050	-421	-16.35	-240
Mahboobnagar	-3.41	-259	-10.59	-388	-11 29	-253	-3 37	-247	-1057	-391	-11 84	-262
Sangareddy	-2.80	-346	-9 11	-325	-8 65	-324	-389	-278	-9 54	-290	-855	-320
Nizamabad	-4.02	-2.52	-980	-3.72	-11 30	-242	-438	-240	-1026	-375	-1106	-233
Adilabad	-3.34	-3.44	-9.17	-2.80	-8.34	-320	-302	-4 19	-886	-329	-824	-261
Karimnagar	-3.52	-248	-1296	-3.50	-1383	-241	-387	-247	-1225	-3 36	-1481	-231
Khammam	-3.25	-271	-9 10	-3.93	-968	-284	-3 16	-241	-894	-449	-1248	-269
Nalgonda	-2.84	-3.30	-9 16	-3.06	-1249	-300	-266	-3 33	-9 12	-325	-1230	-303
Average	-3.72	-2.39	-10.24	-362	-11 33	-273	-3 58	-246	-1046	-3 81	-11 66	-257

demand[6] However, the impact of price rise can be reduced to some extent when there is high factor substitutability

Due to space limitation, the estimated own and cross elasticities of substitution are presented only for average of all hospitals (Table 5 18) The cross elasticities look significantly different from unity and reject the use of Cobb-Douglas form for the purpose Since the elasticity depends on the level of variables in a non-linear way, significance levels could not be established Positive sign for all cross elasticities of substitution imply gross substitutability between all factor inputs and help contain unforeseen input shortages and effect of price rise The elasticities do not change much between the two years

Elasticities of factor demand:

It is interesting to see that all factor demand elasticities (both own and cross price) inelastic and all cross-price elasticities positive (Tables 5 19-5 20) Due to the linear homogeneity of the cost function in input prices, the sum of all factor demand elasticities in each row add to zero This implies that an equi-proportional change in all factor prices leads to an identical rate of increase in total variable cost and leaves the factor shares unchanged

In 1995, from the numerical values of factor demand elasticities (Table 5 20), a ten percent increase in doctor's salary would lead to a 6 4% decrease in the demand for services of doctors This will be accompanied by increase in demand for services of all other factor inputs- nurses 0.9%, paramedical staff 1.9%. support staff 1.5%, other

[6] The estimated price responses are somewhat confounded with quality response because of cross section nature of the data used. The available data do not permit their separation.

Table 5.18: Average Allen-Uzawa partial elasticities of factor substitution using translog cost function for the district hospitals in AP.

Factor input	Doctor	Nurse	Parame-dical staff	Support staff	Other staff	Non-salary
1995						
Doctor	-3721	0519	1097	0871	0826	0838
Nurse	0519	-2.391	0933	0973	08%	0919
Paramedical staff	1097	0933	-10237	0780	0810	0626
Support staff	0871	0973	0780	-3616	0843	0837
Other staff	0826	0896	0810	0843	-11329	0568
Non-salary	0838	0919	0626	0817	0568	-2726
1996						
Doctor	-3577	0527	1096	0870	0827	0852
Nurse	0527	-2461	0930	0971	0890	0921
Paramedical staff	1096	0930	-10460	0764	0798	0636
Support staff	0870	0971	0764	-3814	0829	0838
Other staff	0827	0890	0798	0829	-11660	0575
Non-salary	0852	0921	0636	0838	0575	-2570

Table 5.19: Estimated own-price elasticities of factor demand using translog cost function for the district hospitals in AP,

District Hospital	Doctor	Nurse	Parame-dical staff	Support staff	Other staff	Non-salary	Doctor	Nurse	Parame-dical staff	Suppor staff	Other staff	Non-salary
	1995						19%					
Srikakulam	-064	-062	-078	-071	-073	-063	-064	-062	-078	-071	-073	-064
Vtzianagaram	-064	-063	-078	-073	-073	-060	4) 63	-064	-077	-071	4) 71	-0 60
Rajamundry	-0.64	-063	-078	-071	-075	-063	-064	-064	-077	-072	-073	-060
Eluru	-0.64	-0.61	-078	-072	-058	-061	-063	-059	-078	-072	-066	-063
Machilipatnam	-0.63	-062	-078	-070	-075	-063	-064	-063	-076	-071	-076	-061
Ongole	-0.64	-063	-078	-072	-077	-064	-063	-061	-077	4) 71	-076	-0 62
Nellore	-0.64	-063	-078	-070	-067	-062	-064	-061	-077	-069	-065	-062
Chittorc	-0.64	-0.61	-0.78	-073	-074	-062	-064	-061	-078	-072	-074	-061
Cuddapah	-0.63	-055	-078	-070	-071	-064	-061	-0 59	-078	-071	-072	-0 64
Anantapur	-0.63	-0.60	-077	-071	-065	-063	-064	-062	-078	-072	-061	-062
Mahboobnagar	-0.64	-0.63	-078	-072	-073	-062	-064	-063	-078	-072	-073	-063
Sangareddy	-0.63	-0.65	-0.79	-070	-076	-064	-064	-064	-079	-069	-076	-064
Nizamabad	-0.63	-0.63	-0.78	-071	-073	-062	-063	-062	-078	-071	-074	-062
Adilabad	-0.64	-0.65	-079	-068	-077	-064	-063	-065	4) 79	-070	-077	-063
Karimnagar	-0.64	-0.63	-075	-0.71	-069	-062	-064	-063	-076	-070	-066	-061
Khammam	-0.64	-0.63	-0.79	-072	-075	-063	-064	-062	-079	-072	-071	-063
Nalgonda	-0.63	-0.65	-079	-069	-071	-064	-063	-065	-079	-070	-072	-064
Average	-064	-062	-078	-071	-073	-061	-064	-0 62	-078	-071	-0 73	-063

Table 5,20: Average elasticities of factor demand using translog cost function for the district hospitals in AP,

	Doctor	Nurse	Parame-dical stiff	Support staff	Other staff	Non-salary
	1995					
	-0.637	0135	0.084	0171	0054	0194
Nurse	0.089	•0622	0071	0191	0058	0213
Paramedical staff	0188	0243	-0781	0153	0052	0145
Support staff	0149	0253	0060	-0710	0055	0194
Other staff	0142	0233	0062	0166	-0 733	0132
	0144	0239	0048	0164	0037	-0631
	1996					
	-0638	0134	0082	0163	0052	0208
Nurse	0094	-0625	0069	0182	0056	0224
Paramedical staff	0195	0236	-0779	0143	0050	0155
Support staff	0155	0247	0057	-0714	0052	0204
Other staff	0147	0226	0060	0155	-0728	0140
Non-salary	0152	0234	0047	0157	0036	-0626

staff 1 4% and non-salary 1 4% The highest cross elasticity of factor demand is found for nurses' category (0.25).

Further, the price elasticities are fairly constant across hospitals As mentioned in the beginning, since the data used here is mainly cross section in nature , there is the possibility of confounding price and quality responses If we can separate out these two responses, the price response is like to be much higher, because we expect positive quality response The low price response may also reflect less importance given to input prices (salaries of medical and other personnel) while deciding on factor levels in these public hospitals It may also imply low factor mobility in these institutions The positive sign for cross price elasticities also imply that all inputs are pair wise substitutes The magnitude of cross price response is found to be more w r t the price of nurses and non-salary Probably, the duties of nurse are very general in nature and therefore can be performed by other medical staff as well Nurses, it appears, are not indispensable relatively

5.5 Summary and conclusion:

This chapter has looked at two ad hoc cost functions and three variants of translog family The tatter set of functions is also called structural cost functions It is found thai the structural cost functions are superior to ad hoc cost functions in terms of statistical goodness of fit and predicting factor shares or levels Within the translog family, the Cobb-Douglas and Log-quadratic forms are found to be less appropriate than the full translog function In fact, the formal statistical test has rejected both Cobb-Douglas and Log-quadratic forms in favor of translog model However, all the five estimated cost

[7] The data is cross section time series for two consecutive years and do not show much variation between the years

functions seem to violate the monotonichy property and gave inadmissible (negative) marginal costs for one or more output categories in some of the district hospitals We also find significant deviations of observed input factor shares, levels and factor ratios from the model predicted (optimal) values, which indicates allocative/price inefficiency of varying degrees across AP district level hospitals There could be several reasons for this broad result The non-availability of detailed and reliable data is naturally the foremost reason Some of the other possible reasons are the following

It is argued that negative marginal costs may be due to non-inclusion of some input costs, and or errors in measurement of costs, output levels in a multi-product hospital set-up There may also be some hidden subsidies Due to cross-section nature of data, confounding of quality and price of medical service is also cited as a possible reason Problems of case-mix, disease prevalence pattern, geographical specificity, lack of demand and a host of such reasons may have affected the performance of district level hospitals in AP Not withstanding all the above, it is likely that cost minimization may not be the objective in these public owned institutions Despite the above limitations, a more pragmatic view of the results is perhaps needed

Since such violations of theoretical properties are not uncommon in empirical work, we accepted the translog model as the "best" model and computed other parameters of interest, like product-specific cost elasticities, overall economies of scale and scope The results show negligible and even negative product-specific cost elasticities The latter is a direct consequence of negative marginal costs Further, the results have shown significant economies of scale as well as scope for joint production of hospital services in

PATIENT SATISFACTION (Outpatients):

(I) Outpatient waiting time at different points of service delivery:

Ql. How much time did you wait for following services? (in minutes)

(1) At registration counter:__________________

(2) Consulting the doctor:___________________

(3) For diagnostic report.____________________

(4) At pharmacy: ___________________________

(II) Patient's perception regarding various aspects of services provided:

Q2, Was there adequate privacy during consultation? Y/ N

Q3. Did the doctor suggest any diagnostic test for you? Y/ N

Q4. Did the doctor prescribed any medicine for you? Y / N

Q5. Did you get all the medicines at pharmacy? Y / N

(III) Patients' satisfaction regarding behavior of hospital staff:

Staff	Extre-mely cordial	Very cordial	Not very cordial	Just cordial	Not at all cordial	Don't know	Not mention ed
Doctor							
Nurse							
Paramedical							
Others							

(IV) Patients satisfaction on other services of the hospital:

Services	Excellent	Good	Fair	Average	Below average	Don't know	Not mentioned
Drugs							
Medical equipment							
Surgical equipment							
Bedding							
Food							

Appendix 5A.1: Basic data on annual salary (Rs) for district hospitals in AP.

District hospital	Doctor	Norse	Paramedical staff	Support staff	Other staff	Non-salary (Rs lacs)
1995						
Srikakulam	2337374	3331248	813857	2388924	874270	3050619
Vizianagann	2303255	2861201	811317	1600357	731963	3558948
Rajamundry	2776142	4813720	1223342	2*13555	1100799	3775609
Eluru	3106842	5576647	1572870	3582481	773030	5295782
Machilipatnam	2895879	4183369	1239024	3585840	1471667	4414911
Ongole	2141214	2115527	741090	1543943	920400	22%976
Nellore	2662389	4556422	1278058	3725403	761433	4440879
Chittore	2638558	4392861	1192824	2195399	876000	3671420
Cuddapah	2915545	6440589	1173486	3710222	965112	2959539
Anantapur	3472605	5632072	1271278	3929261	991491	4785641
Mahboobnagar	2563155	3014856	891578	2188488	691440	3173125
Sangareddy	2862385	2359441	999174	2562734	1040652	2497817
Nizamabad	2307695	3595099	1291500	3171813	1110428	4133830
Adilabad	2574086	2434484	1000611	3087827	1115013	2480495
Karimnagar	2237797	3307152	941989	2920186	704232	3292777
Khammam	2406891	3043768	1199143	2496471	1112629	2852850
Nalgonda	2348453	2118053	1013294	2726259	731183	2344360
19%						
Srikakulam	2806796	3839623	895590	2796454	955301	2*81299
Vizianagann	2537800	2945860	844550	1714883	750204	3512934
Rajamundry	3117628	5122038	1166295	3291688	1103474	4916070
Eluru	3072617	6193385	1499522	3872419	934447	4172509
Machilipatnam	3255287	4523999	1258378	3756389	1645723	5520666
Ongole	2776569	2689315	812606	1801601	1024514	3240907
Nellore	2843378	5219046	1390229	4324721	763156	4455648
Chittore	2629393	4843225	1268164	1853876	963600	4033017
Cuddapah	3143614	63871%	1563322	3950467	1033606	44493*0
Anantapur	4102797	5925010	1693600	36S3446	1011386	5606810
Mahboobnagar	3138825	3563824	973644	2554217	781331	3666752
Sangareddy	2679335	2811070	1009986	2750357	1075454	2864734
Nizamabad	2464884	4159072	1401420	3426324	1248018	4812776
Adilabad	2904352	2463400	1237331	2869726	1228113	3222672
Karimnagar	2580569	3637935	1088113	3222629	712547	4148167
Khammam	2650967	3686454	1469925	2698571	971*36	3304280
Nalgonda	2527351	2282639	1098151	2809648	*0*S40	2411474

Contd...

Appendix 5A.2: Basic data on inputs and outputs of district hospitals in AP.

District Hospital	Input (No.)						Output (No.)			
	Doctor	Nurse	Parame-dical staff	Support staff	Other staff	Bed-I	Total OPs.	Cum-IP days	Major surgeries	Minor surgeries
1995										
Srikakulam	28	49	16	50	71	230	334538	42283	1023	691
Vizianagarm	27	34	17	36	53	150	192525	53990	1927	410
Rajamundry	29	68	21	60	77	250	318557	47626	1109	3010
Eluru	31	81	27	84	94	340	357999	108837	1854	570
Machilipatnam	31	69	22	64	85	338	314908	84453	1390	619
Ongole	28	31	14	42	59	190	174170	33767	716	459
Nellore	27	64	22	67	79	250	191058	67038	786	936
Chittore	28	64	25	65	73	270	298688	57972	644	728
Cuddapah	31	83	24	82	81	352	260399	133176	1221	685
Anantapur	32	81	26	78	105	350	244388	141598	1656	764
Mahboobnagar	30	47	20	53	61	235	289166	51071	2274	2632
Sangareddy	34	49	20	47	62	220	335069	71790	2122	604
Nizamabad	28	65	24	76	95	302	430427	79342	1918	4369
Adilabad	36	55	19	59	75	230	226410	53152	989	1491
Kanmnagar	29	53	23	57	78	257	204026	40530	1496	280
Khammam	28	50	21	59	79	210	282594	55174	854	864
Nalgonda	29	40	20	56	82	180	148256	59120	1448	1085
1996										
Srikakulam	28	49	16	50	71	230	356426	41822	1368	721
Vizianagarm	27	34	17	36	53	150	161251	43742	1913	225
Rajamundry	29	68	21	60	77	250	241102	43695	1332	485
Eluru	31	81	27	84	94	340	348373	103290	1895	592
Machilipatnam	31	69	22	64	85	338	258162	66948	1179	383
Ongole	28	31	14	42	59	190	146396	29491	1309	363
Nellore	27	64	22	67	79	250	204863	41038	772	2015
Chittore	28	64	25	65	73	270	256248	70841	3122	363
Cuddapah	31	83	24	82	81	352	224831	113576	1042	461
Anantapur	32	81	26	78	105	350	309385	106916	1956	609
Mahboobnagar	30	47	20	53	61	235	294675	64628	2086	1595
Sangareddy	34	49	20	47	62	220	263659	70766	1415	1995
Nizamabad	28	65	24	76	95	302	329052	75882	1491	3600
Adilabad	36	55	19	59	75	230	185771	56218	1117	1173
Kanmnagar	29	53	23	57	78	257	237113	44365	86S	682
Khammam	28	50	21	59	79	210	457776	59641	1444	664
Nalgonda	29	40	20	56	82	180	151195	60755	2165	810

Appendix 5B: Estimation of conversion factor between IP and OP.

Step 1: Consider the simple cost function such as the one in equation (5 1)

$$C^v = a_0 + \sum_{i=1}^{6} b_i w_i + \sum_{i=1}^{4} a_i y_i + \sum_{i=1}^{4} \sum_{j=i}^{4} a_{ij} y_i y_j + \sum_{i=1}^{4} c_i y_i^3$$
$$+ d_0 k + d_{00} k^2$$

(A1)

Step II Assume that the coefficients a_0, a_1, b_{ij}, c_i. d_0 and d_{00} are estimated using mean scaled data on total cost, outputs, factor prices and bed strength Rewrite (A1) such that only y_1 and y_2 variables are retained on the R H S of (A1) This amounts to purifying the total cost variable from the influence of all variables other than y_1 and y_2 This gives us a modified form of A1 as

$$C_1^v = \sum_{i=1} a_i y_i + \sum_{i=1} \sum_{j=1} a_{ij} y_i y_j + \sum_{i=1} c_i y_i \qquad \text{(A2)}$$

where,

$$C_1^v = C^v - (a_0 + \sum_{i=1}^{6} b_i w_i + \sum_{i=3}^{4} a_i y_i + \sum_{i=3}^{4} \sum_{j=i}^{4} a_{ij} y_i y_j + \sum_{i=3}^{4} c_i y_i^3$$
$$+ d_0 k + d_{00} k^2$$

(A3)

Let us assume that $y_1 = my_2$, where 'm' is the conversion factor Substituting the value of y_1 in (A2) we get,

$$C_1^v = a_1(my_2) + a^2 y^2) + a_{12}(my_2)y_2 + a_{13}(my_2)y_3$$
$$+ a_{14}(my_2)y_4 + a_{22}y_2 + a_{23}y_2y_3 + a_{24}y_2y_4 + c_1y_1 + c_2y_2$$

Since the data is mean scaled, the mean value of y_3 and y_4 is equal to 1. After putting the mean values of y_3 and y_4 and solving for y_2 we obtain

or, $C_1^V - b_1y_2 - b_2y^2 + b_3y_2^3$ (A4)

where,

$b_1 = (a_1 + a_{13} + a_{14})m + (a_2 + a_{23} + a_{24})$, $b_2 = (a_{22} + a_{12}m + a_{11}m^2)$,

and $b_3 = (C2 + c_1 m\ )$

(A5)

Now solving for **'m'** from above three equalities we **have**:

$$m_1 \frac{b_1 - a_2 - a_{23} - a_{24}}{a_1 + a_{13} + a_{14}},\ m_2 = \frac{-a_{12} + [a_{12}\ \ - 4a_{11}(a_{22} - b_2)]}{2a_{11}},$$

$$m_3 = \frac{-a_{12} - [a_{12}^2 - 4a_{11}(a_{22} - b_2)]^{1/2}}{2a_{11}} \qquad - \frac{b_3 - c_2}{[\quad c_1}$$

It is to be noted that (A4) be estimated without a constant term After obtaining the values of b_1, b_2 and b_3, we can solve for m_1 to m_4 using (A5) in terms of known coefficients It will be noticed that between m_2 and m_3, one of the values will coincide with m_1 and m_4. This common value will be called ' m' the conversion factor between *y* and y_2.

Appendix5C.1: Observed and estimated factor input shares (percent) for district level hospitals in AP, 1995.

District Hospital	Doctor				Nurse				Paramedical staff			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	18.3	18.2	16.0	18.0	26.0	24.9	22.9	260	64	7.5	7.0	7.3
Vizianagaram	19.4	18.2	23.3	18.4	241	24.9	295	24.5	68	75	82	7.2
Rajamundry	168	182	20.6	17.1	292	249	304	248	74	7.5	83	78
Eluru	156	182	14.3	168	280	249	252	287	79	75	68	7.2
Machilipatnam	16.3	18.2	14.7	15.8	23.5	249	236	255	70	7.5	73	71
Ongole	21.9	182	170	195	21.7	249	219	254	76	75	73	80
Nellore	15.3	182	185	164	261	249	269	253	73	75	74	73
Chittore	17.6	18.2	15.5	17.4	29.4	249	243	280	80	75	64	74
Cuddapah	161	18.2	132	13.9	355	249	315	360	65	75	66	76
Anantapur	17.3	18.2	16.3	159	280	249	280	292	63	75	67	70
Mahboobnagar	20.5	18.2	19.1	187	241	249	251	243	71	75	74	74
Sangareddy	23.2	18.2	18.7	22.5	191	249	134	187	81	75	81	86
Nizamabad	148	182	151	158	230	249	234	249	83	75	79	80
Adilabad	203	182	149	191	192	249	120	188	79	75	79	86
Karimnagar	16.7	182	125	181	247	249	173	252	70	75	54	58
Khammam	184	182	183	196	232	249	21 1	234	91	75	81	87
Nalgonda	20.8	182	199	222	188	249	160	196	90	75	78	86
Average	198	18.2	170	17.1	271	249	249	260	63	75	75	76

Contd

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C.1: Observed and estimated factor input shares (percent) for district level hospitals in AP, 1995.

District Hospital	Support staff				Other staff				Non-salary			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	18.7	18.9	17.1	18.8	68	64	6.1	65	238	240	309	234
Vizianagaram	13.5	18.9	17.4	14.7	62	64	76	64	300	240	140	288
Rajamundry	17.0	18.9	21.1	189	6.7	64	80	72	229	240	116	24 1
Eluru	180	189	152	168	39	64	29	34	266	240	356	270
Machilipatnam	20.2	18.9	21.3	205	83	64	79	78	248	240	25 1	23 2
Ongole	15.8	18.9	146	166	94	64	81	91	235	240	31 1	21 5
Nellore	21.4	189	21.2	21 1	44	64	48	46	255	240	21 2	254
Chhtore	14.7	189	12.7	154	59	64	56	67	245	240	355	252
Cuddapah	20.4	18.9	177	21 3	53	64	52	63	163	240	258	150
Anantapur	19.6	189	193	205	49	64	39	42	238	240	258	232
Mahboobnagar	17.5	189	184	185	55	64	64	65	253	240	236	247
Sangareddy	20.8	189	207	21 5	84	64	84	88	203	240	307	198
Nizamabad	20.3	189	189	191	71	64	62	65	265	240	284	256
Adilabad	24.3	189	220	243	88	6 4	8 1	9 2	195	240	351	200
Karimnagar	21 8	189	167	202	53	64	38	50	246	240	442	257
Khammam	190	189	170	182	85	64	73	78	21 8	240	282	223
Nalgonda	242	189	202	226	65	64	50	57	208	240	311	21 3
Average	197	189	190	196	67	64	63	65	203	240	253	232

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C.2: Observed and estimated factor input shares (percent) for district level hospitals in AP, 1996.

District Hospital	Doctor				Nurse				Paramedical			
	Observed	Estimated			Observed	Estimated			Observed	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	20.6	18.2	20.7	20.0	239	249	28.7	26.3	69	75	76	7.5
Vizianagaram	16.7	18.2	250	207	274	249	286	228	62	75	80	69
Rajamundry	15.6	182	212	190	314	24.9	27.3	225	76	75	73	64
Eluru	16.3	182	146	160	227	249	291	316	63	7.5	68	72
Machilipatnam	22.5	182	17.0	165	218	249	251	235	66	75	7.1	63
Ongole	15.0	18.2	24.3	21.2	275	249	308	235	73	75	78	70
Nellore	169	182	21.1	164	31 1	249	326	252	81	75	77	69
Chittore	15.3	182	17.4	196	31 1	249	270	280	76	75	69	71
Cuddapah	186	182	14.7	146	269	249	308	316	77	75	73	75
Arrantapur	21.4	182	196	195	243	249	288	263	66	75	74	74
Mahboobnagar	20.3	182	22.9	189	213	249	312	253	77	75	79	74
Sangareddy	14.1	182	18.7	163	237	249	234	229	80	75	87	82
Nizamabad	20.9	182	16.6	143	177	249	287	259	89	75	82	76
Adilabad	16.8	18.2	182	210	236	249	126	154	71	75	88	89
Karimnagar	17.9	18.2	15.4	165	249	249	229	253	99	75	62	62
Khamnum	21.2	182	199	201	191	249	267	25 8	92	75	87	88
Nalgonda	17.8	182	221	235	255	249	183	194	75	75	83	86
Average	17.9	182	195	178	255	249	282	254	75	75	78	75

Contd

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C2: Observed and estimated factor input shirrs (percent) for district level hospitals in AP, 1996.

District Hospital	Support stiff				Other staff				Non-salary			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	III		III		III		I	II	III
Srikakulam	13.9	18.9	20.0	19.6	6.1	64	69	64	285	24.0	160	202
Vizianagaram	17,6	18.9	178	147	59	64	7.7	63	263	240	129	286
Rajamundry	196	18.9	20.3	17.4	47	64	7.2	62	21 1	240	166	286
Eluru	188	18.9	167	183	82	64	41	45	27.7	240	287	223
Machilipatnam	14.6	18.9	21.8	190	83	64	86	79	263	240	203	267
Ongole	22.8	18.9	17.8	147	40	64	93	82	235	240	100	255
Nellore	11.9	189	24.7	22.4	62	64	54	43	259	240	86	248
Chittore	19.2	189	105	105	50	64	62	67	217	240	321	280
Cuddapah	167	189	186	193	46	64	56	59	255	240	229	21 1
Anantapur	17.4	189	178	171	53	64	40	38	250	240	224	258
Mahboobnagar	209	189	20.4	183	82	64	70	61	217	240	106	240
Sangareddy	196	189	251	236	71	64	95	89	275	240	146	200
Nizamabad	206	189	208	190	88	64	71	67	231	240	187	264
Adilabad	209	189	219	213	46	64	90	93	270	240	295	241
Karimnagar	183	189	194	209	66	64	42	45	224	240	319	266
Khammam	235	189	164	161	68	64	62	57	202	240	221	235
Nalgonda	193	189	207	215	64	64	56	58	236	240	250	21 1
Average	186	189	201	187	62	64	68	62	244	240	176	244

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C.3: Observed and estimated factor input levels (No.) for district level hospitals in AP, 1995.

District Hospital	Doctor				Nurse				Paramedical			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	II		I	II	III		I	II	III
Srikakulam	28.0	29.3	25.8	280	49.0	49.2	45.4	497	160	198	18.5	187
Vizianagaram	27.0	26.4	31.6	27.2	34.0	367	405	368	170	195	199	191
Rajamundry	29.0	30.0	32.6	28.2	68 0	55 5	64 8	55 1	210	203	21.5	210
Eluru	31.0	32.1	28.4	32.5	810	639	729	808	270	227	233	240
Machilipatnam	31.0	37.6	29.9	32.3	690	794	739	805	220	25.7	247	242
Ongole	28.0	28.0	24.7	27.3	31.0	430	356	399	140	167	153	162
Nellore	27.0	29.7	30.4	29.2	64 0	56.3	615	62 2	220	208	207	219
Chittore	28.0	27.6	23.6	27.2	640	51.9	509	602	250	225	193	228
Cuddapah	31.0	33.7	26.3	284	830	560	760	889	240	268	254	298
Anantapur	32.0	31.4	31.6	30.2	810	671	848	865	260	287	287	294
Viahboobnagar	30.0	28.0	28 8	28 7	470	51 1	506	497	200	221	214	216
Sangareddy	340	29.0	27.7	33.9	490	695	347	494	200	202	204	220
Nizamabad	280	34.3	29.1	307	650	700	672	722	240	217	234	238
Adilabad	360	32.5	26.7	33.2	550	720	348	530	190	182	191	203
Karimnagar	29.0	30.7	21.8	297	530	520	372	51 1	230	239	176	180
Khammam	280	27.8	27.4	291	500	538	445	491	210	173	1S1	194
Nalgonda	29.0	24.9	28.0	300	400	521	344	406	200	164	176	186
Average	298	308	29.4	297	578	572	584	612	212	216	220	225

Contd

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix **5C.3: Observed a**nd estimated **factor** input **levels (No.) for district level** hospitals **in AP, 1995.**

District Hospital	Support staff				Other staff				Non-salary			
	Obs-erved	Estimated			Obs-erred	Estimated			Obs-erved	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	50.0	53.1	48.4	51.1	71.0	69.9	66.8	68.8	30.5	32.3	41.7	304
Vizianagaram	36.052.645.3			41.9	53.0	57.4	64 0	58 6	356	29.7	163	365
Rajamundry	60.0	63 5	67.8	63.6	77.0	706	848	798	378	379	175	380
Eluru	84.0	78.2	70 9	76.5	9401376		710	803	53 0	42 4	710	52 4
Machilipatnam	64.0651		718	70.0	850	715	864	864	44 1	46 4	47 6	44 3
Ongole	42.0	60.5	44.2	48.6	59 0	48 3	57 6	62 7	23 0	28 3	34 5	23 0
Nellore	67.054662.1			66.5	790106.8		81.2	827	44 4	38 6	34 5	44 6
Chittore	65.079.9541			67.4	730	763	668	819	367	343	510	372
Cuddapah	82.0	72.8	73.3	90.2	810	938	815	1007	296	419	483	287
Anantapur	78.0	70.3	80.7	84.0	105 0	127 1	88 0	92 4	47 9	45 0	54 3	47 9
Mahboobnagar	53.0	60.2	57.6	58 6	61 0	74 4	72 8	75 1	317	316	306	323
Sangareddy	47.0465		47.5	50.1	620	512	628	668	25 0	32 2	38 5	25 1
Nizamabad	76.070.3		71.9	735	95 0	85 1	84 2	88 9	413	373	451	41 1
Adilabad	59.0461		53.9	57.9	750	551	696	769	248	307	449	249
Karimnagar	57.0480438			498	78 0	92 4	57 2	69 6	329	313	594	325
Khammam	59058.7		516	550	790	598	669	706	285	316	361	285
Nalgonda	56043.0473			509	820	795	640	703	234	266	355	233
Average	60 9	60 3	62 0	64 3	770	781	780	810	34 7	35 8	38 4	353

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C.4: Observed and estimated factor input levels (No.) for district level hospitals in AP, 1996.

District Hospital	Doctor				Nurse				Paramedical			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	28.0	27.0	302	28.2	49.0	47.4	536	47.4	160	200	19.9	190
Vizianagaram	27.0	24.8	31.2	27.2	34.0	36.9	38.7	32.5	170	194	187	17.1
Rajamundry	29.0	29.3	33.1	29.9	680	572	608	503	210	234	219	194
Eluru	31.0	32.8	28.7	30.2	810	583	745	77.1	27.0	242	241	242
Machilipatnam	31.0	36.7	32.5	32.5	690	805	768	742	220	278	249	229
Ongole	28.0	26.5	32.2	27.3	310	41.5	465	346	140	187	177	154
Nellore	27.0	29.2	34.4	23.1	640	51.7	686	555	220	201	209	197
Chittore	28.0	294	26.9	297	640	500	517	527	250	224	199	199
Cuddapah	31.0	36.1	295	30.8	83.0	652	819	881	240	232	229	247
Anantapur	32.0	289	33.9	32.7	810	694	87.3	773	260	234	252	245
Mahboobnagar	30.0	26.7	33 1	282	470	505	620	521	200	237	244	236
Sangareddy	34.0	33.2	330	300	490	625	565	577	200	214	238	236
Nizamabad	280	35.9	335	297	650	676	795	741	240	223	248	238
Adilabad	360	324	313	351	550	799	390	466	190	166	187	185
Karimnagar	29.0	300	27.2	287	530	533	526	571	230	233	205	204
Khammam	28.0	276	301	295	500	485	517	486	210	154	179	175
Nalgonda	29.0	248	295	308	400	518	373	388	200	162	175	179
Average	298	305	328	300	578	569	645	581	212	214	224	213

Contd

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix 5C.4: Observed and estimated factor input levels (No.) for district level hospitals in AP, 1996.

District Hospital	Support staff				Other staff				Non-salary			
	Obs-erved	Estimated			Obs-erved	Estimated			Obs-erved	Estimated		
		I	II	III		I	II	III		I	II	III
Srikakulam	50.0	50.3	52.5	49.6	71.0	70.9	75.1	67.1	28.8	35.8	23.5	28 6
Vizianagaram	36.0	50.8	43.6	38.0	53.0	580	63.6	55.2	35.1	30.8	15.1	353
Rajamundry	60.0	59.5	62.1	53.4	77.0	77.3	84.6	72.5	492	41.5	27.8	482
Eluru	84.0	73.3	70.7	74.2	94.0	115.3	80.3	84.2	41.7	43.0	560	41 7
Machilipatnam	64.0	68.1	74.4	67.1	85.0	700	89.5	84.3	55.2	50 8	40 8	55 2
Ongole	42.0	63.6	54.5	43.7	59.0	53.3	70.1	60.3	324	347	13.1	325
Nellore	67.0	49.5	65.6	62.3	79.0	112.1	95.5	80.5	446	406	147	445
Chittore	65.0	100.5	53.4	52.5	73.0	736	67.7	72.0	403	365	465	398
Cuddapah	82.0	79.0	79.1	85.9	81.0	101.1	90.5	990	445	484	469	453
Anantapur	78.0	81.4	83.6	77.9	105.0	1354	93.0	838	561	489	497	555
Vlahboobnagar	53.0	60.3	63.8	59.3	610	769	826	746	367	369	160	374
Sangareddy	47.0	46.4	59.4	58.4	62.0	531	760	745	286	345	203	2S9
Nizamabad	76.0	72.7	81.7	77.1	95.0	846	956	927	48 1	41 7	33 2	48 3
Adilabad	59.0	55.8	62.6	59.3	750	562	76.1	768	312	345	410	326
Karimnagar	57.0	49.0	54.1	57.4	78.0	1029	726	760	415	352	502	413
Khammam	590	59.3	51.3	49.0	79.0	741	717	646	330	345	316	326
Nalgonda	56.0	44.7	48 0	48 8	820	771	665	675	241	215	290	241
Average	60.9	62.1	66.2	61 8	77.0	804	851	787	395	392	289	399

I - Using Cobb-Douglas cost function
II - Using logarithmic quadratic cost function
III - Using translog cost function

Appendix5C.5:Estimatedproductspecifictostelasticitiestadoveralleconomiesofscaleforalldistricthospitalsla AP, 1995.

District Hospital	Outpatients			Inpatients			Major surgeries			Minor surgeries			Overall		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Srlkakulam	-0.03	-0.05	-0.11	0.05	0.06	0.17	0.01	0.05	0.00	0.00	0.06	0.04	0.97	0.89	0.91
Vizianagartm	-0.03	0.04	0.04	0 05	0.08	0 12	001	-0 11	002	000	003	004	097	097	078
Rajtmundry	-0.03	-0.05	-0.08	0.05	005	018	001	004	-002	000	-002	003	097	097	090
Eluru	-0.03	-0.06	-0.05	0.05	0.07	0.14	001	-002	-010	000	008	005	097	093	096
Machillpatnam	-0.03	-0.07	-0.06	0.05	0.06	0.14	0.01	003	-010	000	010	005	097	088	097
Ongole	-0.03	0.01	0.00	0.05	0.06	0.15	001	0.09	001	000	007	003	097	077	081
Nellore	-0.03	0.00	0.02	0.05	0.07	0.13	0.01	0.09	-003	000	003	003	097	08)	085
Chittore	-0.03	-0.04	-0.10	0.05	0.06	014	001	0.14	-001	000	006	003	097	079	093
Cuddapah	-0.03	-0.07	-0.01	0.05	0.09	0.13	001	007	-010	0 00	0 11	0 05	097	080	093
Anantapur	-0.03	-0.05	0.03	0.05	0.08	0.12	001	0.01	-0.12	000	008	004	0 97	0 88	0 92
Mahboobnagar	-0.03	-0.03	-0.01	0.05	0.06	0.17	0.01	-0.09	-0.05	000	-002	003	0.97	108	086
Sangareddy	-0.03	-0.06	-0.07	0.05	0.08	0.14	0.01	-0.07	-0.03	0.00	007	005	097	099	0.91
Nizamabad	-0.03	-0.07	-0.09	0.05	0.06	0.17	0.01	-0.04	-0.06	0.00	-003	003	0.97	1.08	0.95
Adilabad	-0.03	-0.03	-0.03	0.05	0.06	0.16	0.01	0.06	-0.02	0 00	0 02	0 03	0.97	089	086
Karimnagar	-0.03	-0.02	0.01	0.05	0.05	0.15	0.01	-0.01	-008	000	0.11	004	097	087	087
Khammam	-0.03	-0.03	-0.08	0.05	0.07	0.15	0.01	0.07	0.02	000	004	004	0 97	0 85	0 88
Nalgonda	-0.03	0.03	0.09	0.05	0.08	0.13	0.01	-004	-0.02	000	001	003	097	0.91	0.76
Average	-0.03	-0.04	-0.03	0.05	0.07	0.15	001	0.01	-0.05	000	003	004	097	093	089

I: Using Cobb-Douglas cost function, II: Using logarithmic quadratic cost function, III: Using translog cost function

Appendix 5C.6: Estimated product specific cost elasticities and overall economies of scale for all district hospitals in A.P, 1996,

District Hospital	Outpatients			Inpitients			Major surgeries			Minor surgeries			Overall		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Srikakulam	-0.03	-0.06	-0.11	0.05	0.06	017	001	000	-002	000	007	004	095	093	091
Vizianagaram	-0.03	0.05	0.07	0.05	007	0.12	001	-0 11	000	000	006	004	095	093	077
Rajamundry	-0.03	-0.02	-0.02	0.05	0.04	0.15	001	000	-005	000	007	004	095	090	089
Eluru	-0.03	-007	-0.05	005	007	015	001	-002	-010	000	010	005	095	092	096
Machilipatnam	-0.03	-005	-0.04	0.05	004	0 14	001	006	-010	0.00	0.11	005	095	084	096
Ongole	-0.03	0.03	0.07	0.05	0.05	0.15	001	-0.02	-003	0 00	0.07	0 03	095	087	079
Nellore	-0,03	-0.01	0.00	0.05	0.05	0.17	0.01	0.10	-003	000	000	002	095	087	084
Chittore	-0.03	-0.02	0.03	0.05	0.06	0.14	0.01	-0.13	-0.11	000	0.09	004	095	100	089
Cuddapah	-0.03	-0.04	0.01	0.05	0.08	0.13	0.01	0.09	-0.11	000	0.12	005	0.95	0.77	092
Anantapur	-0.03	-0.06	-0.02	0.05	0.07	0.14	0.01	-0.02	-0.11	0.00	0.09	0 04	0.95	092	0.95
Mahboobnagar	-0.03	-0.04	-0.02	0.05	0.07	0.15	0.01	-007	-004	0.00	001	003	0.95	1.03	088
Sangareddy	-0.03	-0.04	-0.03	0.05	0.08	0.15	0.01	-0.01	-0.02	0.00	0.00	0 04	0.95	0.97	086
Nizamabad	-0,03	-0.05	-0.05	0.05	0.06	0.17	0.01	0.00	-0.06	0.00	-0.02	003	0.95	1.01	0.92
Adilabad	-0.03	0.00	0.03	0.05	0.06	0.14	0.01	0.03	-0.04	000	0.02	003	0.95	0 89	0 83
Karimnagar	-0.03	-0.02	-0.04	0.05	0.05	0.15	0.01	0.08	-0.04	0.00	0 05	0 03	0.95	084	0.89
Kharamam	-0.03	-0.06	-0.15	0.05	0.08	0.15	0.01	-0.02	0.02	0.00	005	004	0.95	096	0.93
Nalgonda	-0.03	0.02	0.11	0.05	0.09	0.14	0.01	-0.10	-0.04	0.00	0.03	0.04	0.95	0.96	0.75
Average	-0.03	-0.03	-0.01	0.05	0.06	0.15	0.01	-0.02	-0.06	0.00	0.04	004	095	0.94	088

1: Using Cobb-Douglas cost function, II: Using logarithm! quadratic cost function. III: Using translog cost function

Appendix 5C.7: Estimated economies of scope by pairs of output for all district hospitals in AP, 1995.

District Hospital	OP, IP			OP,MAJS			OP, MINS			IP, MAJS			IP. MINS			MAJS, MINS		
	I	II	III	I	II	III	I	II	HI	I	II	III	I	II	III	I	II	III
Sriktkulam	103	104	109	101	101	101	101	1 03	1 03	1 03	1 04	1 06	1 03	1 05	I 09	101	1 03	1 01
Vizianagiram	100	103	103	0 99	1 03	1 00	099	101	1 03	1 01	1 04	1 02	1 02	1 02	1 06	1 00	1 03	1 03
Rajamundry	1.02	103	106	1.01	101	100	1 00	1 00	0 97	1 02	1 03	1 04	101	101	103	100	100	0 96
Eluru	099	0.99	094	101	101	103	10	106	104	097	097	095	098	101	0 96	1 00	1 04	1 05
Machilipatnam	0.99	1.00	097	101	101	100	10 1	1 06	1 03	099	099	096	099	1 01	099	100	105	102
Ongole	1.02	1.05	1.11	0 99	1 02	0 99	0 99	1 04	1 04	1 04	1 07	112	1 04	1 09	11 4	101	1 06	1 05
Nellore	099	1.00	1.01	1 00	1 02	096	099	100	101	101	103	098	1 00	! 00	1 01	1 01	1 03	099
Chittore	1.01	1.01	1.03	101	106	099	101	102	102	1 02	1 07	0 99	1 01	1 03	1 03	1 01	1 08	098
Cuddapah	0.97	0.95	0.90	1.00	101	098	1 00	1 05	1 02	097	096	088	0 97	1 00	0 92	100	106	100
Anantapur	0.96	0.95	0.90	1 00	0 99	1 01	1 00	1 02	1 01	096	095	091	096	098	092	1 00	1 02	1 03
Mahboobnagar	1.02	1.02	1.05	1.00	1.02	1.02	1.00	1.00	097	1 01	1 04	1 06	1 01	1 01	1 02	0 99	1 02	0 99
Sangareddy	1.00	1.01	1.00	1.00	1.03	102	101	1.04	104	099	1 01	I 00	1 00	1 03	1 02	1 00	1 05	1 04
Nizamabad	1.01	1.02	1.01	1.01	103	1.04	101	1.02	098	0 99	0 99	1 00	098	098	093	099	099	098
Adilabad	1.01	1.01	1.03	1.00	1.00	0.98	0.99	0.98	098	102	102	1.03	1 01	1 01	1 02	1 00	1 00	0 98
Karimnagar	1.02	1.02	1.08	0.99	0.99	1.00	1.00	1.10	105	1 03	1 03	1 09	1 03	113	1 13	101	11 0	1 06
Chammam	1.01	1.02	1.03	1.01	1.01	1.01	l.00	1.01	101	1.02	103	103	101	1 02	1 04	1 01	1 02	1 01
Nalgonda	0.99	1.01	1.03	0.98	1.00	1.02	0.98	1.00	1 02	1 01	1 01	1 02	1 01	101	1 02	100	100	100
Average	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1 00	1 00	1 00	0 99	I 00	0 99	0 99	1 00	1 00	0 99

IP. Inpatients, OP. Outpatients, MAJS: Major surgeries, MINS: Minor surgeries

V. Using Cobb-Douglas cost function, II: Using logarithmic quadratic cost function. III Using translog cost function

Appendix 5C.8: Estimated economies of scope by pairs of output for all district hospitals in AP, 1995.

District Hospital	OP, IP			OP.MAJS			OP, MINS			IP, MAJS			IP, MINS			MAJS, MINS		
	I	II	III	I	II	III	I	II	HI	1	II	III	II	II	III	I	II	III
Srikakulam	1.03	1,05	1.10	1.01	1.02	1.02	101	104	104	102	103	108	103	106	109	100	102	101
Vizlanagaram	1.00	1.05	1.06	0.98	104	101	099	105	106	102	106	105	103	107	111	100	106	105
Rajtmundry	1.02	1,02	1.06	1.00	1.00	099	100	104	1.03	102	102	106	103	106	109	100	104	103
Eluru	0.99	0.99	0.94	1.01	1.02	1.03	101	1.07	104	098	097	096	098	102	096	100	105	105
Machilipatnam	1.00	1.00	1.00	1.00	1.01	0.98	100	109	104	100	101	098	100	109	105	101	1.10	102
Ongole	1.02	1.06	1.14	0.98	1.00	1.02	0.9	1.05	106	1 04	1 05	114	1 05	110	1 16	101	105	104
Nellore	1.02	1.03	1.08	1.00	1.02	0.96	0.99	099	0.99	103	106	106	1.02	102	107	100	102	097
Chittore	1,00	1.00	0.99	0.99	105	1.06	100	107	104	099	105	105	100	107	103	100	112	111
Cuddapah	0,97	0.96	0.93	1,00	101	096	100	107	103	098	099	089	098	105	097	101	1 10	100
Anantapur	0.98	0.98	0.93	1.00	1.01	1.03	1.0	1.05	1.03	097	0.97	096	0.98	101	0.96	1.00	1.04	106
Mahboobnagar	1.01	1.01	1.01	1.00	1.02	1.01	1.00	1.00	0.99	100	1.02	1.02	100	1.00	0.99	099	1.01	1.00
Sangareddy	1.00	1.00	0.99	1.00	1.00	1.00	1.00	0.99	0.98	1.00	1.00	0.99	0.99	0.99	0.97	1.00	0.99	0,98
Nizamabad	1.00	1.00	0.99	1.01	1.01	1.01	1.00	1.00	0.97	0.99	0.99	0.98	0.99	0.98	0.94	0.99	0.99	096
Adilabad	1.00	1.01	1.03	0.99	1.00	0.98	0.99	0.99	1.00	1.01	1.01	.02	.01	1.01	.02	1.00	1.00	0.99
Karimnagar	1.02	1.02	1.06	1.00	1.02	0.97	1.00	1.02	1.02	1.03	1.04	.04	.02	1.04	.08	101	1.04	1,00
Khammam	1.02	1,03	1.07	1.02	1.02	1.05	1.02	1.04	1.07	1.01	1.01	.02	.01	1.03	.04	1.00	1.02	1.02
Nalgonda	0.99	1.01	1.03	0.98	1.03	1.04	0.9$;	1.01	1.03	1.00	1.04	.01	.01	1.01	.02	00	1.03	1.01
Average	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.01	.00	101	.01	00	1.00	1,01

IP: Inpatients, OP: Outpatients, MAJS: Major surgeries, MINS: Minor surgeries

V, Using Cobb-Douglas cost function, II: Using logarithmic quadratic cost function, III: Using translog cost function

CHAPTER VI
FINANCING HEALTH SERVICES: AN ASSESMENT[1]

6.0. Introduction:

Though remarkable success in reducing mortality and morbidity has happened during the post-independence period, the resulting population growth is a major threat to India's economic development The demand for health services has been increasing continuously with rising income, urbanization and aging population These competing needs have put tremendous pressure on health system at a time when the public spending in general can not be increased due to worldwide recession and other problems related to resource allocation Thus, there is a need to examine the financing policies on health services in order to find out feasible solutions towards this end This is the objective of the present chapter The kinds of questions that are relevant in this context are, to start with, what is the scope of inquiry when we talk of hearth financing i e . what should we include under 'health' here? Once this is settled, then how much should the state spend? Related, or perhaps even prior to this, what are the health facilities that should be provided by the state? Then there is the question of how the stale is to finance this expenditure? We take up these questions in an inter-related manner in this chapter, which is organized along the following lines

We begin by looking at the different types of services provided in the health sector, and examine their characteristics Based on these characteristics we look at the

[1] I would like to place on record the invaluable help rendered by Dr.N.Naramimhan, Senior Lecturer Department of Economics, University of Hyderabad in the preparation of this chapter I am immensely benefited from the long and untiring discussions that I had with her during this period. She was kind

mode of providing these goods, namely public or private provisioning, and summarize the received theory in this context Through this we also look at the method of financing the public provisioning of these goods wherever it is deemed necessary In this context, the suggestion for charging user fees for some types of services is discussed We end by looking at the feasibility of doing this at the district-level secondary hospitals for the state of Andhra Pradesh, through a case study

6.1. Health care activities:

In talking of the health sector, one would have to include all activities having a direct bearing on the improvement on the health of the society This is of course very broad It would include all expenditure on medical infrastructure, such as institutions for medical education and research on hospitals at various levels (starting from primary health centers), on drugs, etc It would also include expenditure on various programs for prevention of diseases and expenditure on water supply and sanitation

Without attempting any rigorous delineation of boundaries, we point out that total expenditure on health and health related services may be sub-divided into three components, viz, public health, hospitals, and health education and training The expenditure on public health would include (i) primary health care institutions which in turn include the entire PHC network of community hearth centers primary health centers subsidiary health centers and sub-centers, dispensaries maintained by government etc (ii) primary health care services, which consists of various health interventions such as child survival and development, special nutrition programs and farmily planning and (iii)

enough to read the draft more than once and gave her suggestions for improvement. However, I am only responsible for the remaining errors, if any.

disease control The expenditure on hospitals can be further sub-divided into expenditure on secondary and tertiary hospitals

The services provided through these may then be re-classified into two broad groups of 'preventive' and 'curative' services Curative services would essentially be those provided by dispensaries/hospitals at all levels in the form of outpatient and inpatient care Preventive services encompass a wider canvas including disease control programmes and immunizations, basic family planning, and health related services like water supply and sanitation

6.2. Characteristics of health care:

This obviously covers a variety of services with different characteristics seen from an economist's point of view These characteristics. broadly are whether the services exhibit externalities and any other public-good characteristics, whether the information regarding these services is freely available, whether their markets are perfectly competitive or face distortions All these are of importance in trying to answer what health facilities should be provided by the state

We can see that most preventive services have substantial positive externalities associated with them, in the sense that one person's consumption of the service directly affects the well being of others For example, let us take the inoculation against a disease Those who are vaccinated benefit themselves, of course, by reducing the probability that they would contract a contagious disease But they also provide benefits to those who do not receive inoculations by reducing the number of persons who will become hosts for the disease This, in turn, reduces the probability of outbreaks of the disease for the entire population, including those who are not vaccinated Eventually if the disease is eradicated in this way, the entire world population will benefit Similarly, the basic family planning services not only help in improving the health of child and mother but also bring overall economic development by controlling the population growth- Many of these services, in fact, not only have externalities, but in addition exhibit the strong characteristic of being public-goods in that they have the characteristic of non-depletability, i e , one person's consumption does not decrease the availability for others They also have the characteristic of non-excludability from use once the good is at all produced Examples of services with public-good characteristic are health information and knowledge (which flows out of medical education and research) and the control of contagious diseases If, for instance, malaria is controlled in an area, it is not possible to let one person benefit while another is excluded from the benefits

We also note that there are some health services which are in the nature of investment goods we are referring here to the field of health education and research

6.3. Intervention in preventive care:

It is well known from economic theory that the presence of goods with externalities in general, and public-goods in particular, poses serious problems for the functioning of the market economy The market is advocated **as** an instrument for achieving the distribution of goods and services on the ground thai it leads to socially optimal solutions at least cost However, externalities lead to the failure of the market in achieving a socially optimal end The working of the market is predicated primarily on individual self-interest Now for a good with beneficial externalities the social benefits are much higher than individual benefits" Thus, the market working through individuals'

[2] Marginal Social Benefit (MSB) *is* the extra benefit obtained by making one unit of that good available The MSB of a good is assumed to decline **as** more of that good is made available. Marginal Social Cost

private benefits will produce too small an amount of the good In order to maximise social benefits, therefore, the state will have to intervene in the production of the goods if it does not directly provide the good itself, then it will have to pay subsidy to the providers.

With public goods, the problem is compounded further If the consumption of the good is non-competitive, it may even be difficult to establish a market for the good, since typically it is not possible to divide the good into salable units Further, the characteristics of non-excludability from use would mean that if the good were made available provided to even one person, then all would benefit This gives rise to 'free rider' problem, i e . each individual consumer would be unwilling to pay for the good'service knowing fully well that he would benefit equally when someone else provides the funds for its production Clearly, under these circumstances, no private market can come up for the provision of these goods Either we must rely on philanthropists or the government must step in to provide these goods

There is thus a clear case for government intervention in the market for preventive services In so far as there are externalities, but a private market can exist (i c . not a public good) then it might suffice for the government to subsidise the consumption of these goods Example of this is provided by vaccinations However, for those hearth services, which are in the nature of public goods, clearly there is the need foe the public provisioning of these goods

(MSC) of a good is the minimum amount of money that is required to compensate the owners of inputs used in producing the good for making an extra unit of the good available. A person who consumes a pure public good, generates benefit not only for himself but also for others residing in the community in which he says. The MSB of this good therefore will be more than the extra benefit to the purchaser. However, the producer in a competitive market will only produce up to the level at which the price is equal to his marginal cost, which is same as the MSC (Hyman 1990).

There are also some goods with externalities, which are in the nature of investment goods Even if it is possible to charge for them (i e. there exists a demand, and it is possible to divide it into salable units), the market would in general invest a lower amount than is socially optimal. A typical example is educational and training facilities Here too, government intervention is called for both in direct provisioning and in subsidising medical education There is one more aspect of government intervention in this area that must be taken note of viz licensing of medical practitioners While this is usually done in the interest of maintaining quality and standard, which a private un-restricted market may not do, it also leads to concentrating medical knowledge in the hands of few i e , it leads to an asymmetry of information between doctor and patients It thus has implications for the competitive nature of the market for certain health services, which we shall shortly look at

6.4. Intervention in curative services:

In what went above, a case was made out for government intervention in the market for preventive health care A question that arises then is whether the government should restrict itself to the provision of only these services, leaving curative services to the private market There are however, some characteristics of the market for curative services, which are of importance here Most important of these is the characteristic of uncertainty In case of other goods and services the consumer can make a decision of his own regarding the goods he wants to consume, us availability in the market and the point of time in which he wants to consume the good But in case of health care the consumer cannot exactly tell when he wants it, what are the available options and their place of availability This gives rise to the demand for risk sharing through insurance markets for health.

In the absence of these markets, a wedge is driven between social benefits and private benefits and the market will fail to optimize social welfare[3] However, by its very nature, this insurance market faces the problem of (a) dis-economies of small scale (in order to reap actuarial profits, the insurance firm would have to have a large clientele). (b) moral hazard and (c) adverse selection The first of these would lead to the formation of a large monopoly insurer who might then turnout to be exploitative An alternative would be to have a public monopoly in this. The problem of 'moral hazard" rises because the availability of insurance reduces the incentive for individuals to avoid health medical risks, thereby providing both a potential demand, and the opportunity for doctors to provide more medical care than is required, leading to a socially sub-optimal situation, with resources being withdrawn from other more useful sectors

The problem of adverse selection is also well known variations in health risk across the population lead to situations where insurance companies refuse to insure, or charge high premiums to the very people who need insurance most (i.e. typically the low paid, the elderly and those more likely to fall ill) The argument goes as follows Normally, insurance premiums would be set at actuarial fair levels taking average risk of the entire population into account However, people who know themselves to be at below average risk would not take the policy at these rates So the average risk of those who demand insurance would be raised Keeping this in mind insurance companies

[3]In a classic article. Kenneth Arrow (1963) explores die issue regarding the failure of private arrangements in the health care market and gives substantial reasons for government intervention in the production and allocation of health care services

would carry out extensive screening and either refuse to insure those at high risk, or do so only at very high premiums

All these make a case for government intervention We should be clear of course that the forgoing arguments are for intervention in the insurance markets- i e. in the financing of health care, not necessarily for the direct provision of curative hearth care services themselves The latter would be one extreme form of providing of this insurance There is another characteristic of the health-care market that emphasizes the direct provision of curative health-care services by the government This is the asymmetry of information regarding medical care that we have mentioned earlier[4] Given this asymmetry of information, the patient is directly dependent on the doctor regarding the nature of medical care or intervention Indeed, patients could even be ignorant about what the outcome of the intervention should be So clearly, this is a market where the demand is induced by the supplier[5] This is likely to lead to both an over-supply as well as escalating costs and therefore, a socially sub-optimal situation Therefore, even if the government takes steps to encourage social (or even private) insurance, this is a problem that will still need to be taken care of

So far, we have considered various economic reasons for government intervention in the financing or the provisioning of curative health care services Apart from this there could be strong reasons on humanitarian grounds of on arguments based in equity

[4] As we saw then, one of the (perhaps unavoidable) causes of this is the intervention of the state in the market for medical education, i e. the licensing of the medical practitioners.

[5] Culyer (1971)argues for intervention on the following grounds. He points out that the consumer(i.e. patient) is ignorant about the price. which propels the supplier (physician) to play a dominant role. The non-existence of perfect competition in health care market leads to the concept of supply induced demand in this sector This type of arguments is also found in the writings of Newhouse(1970), that give an extensive support for government intervention for providing health care.

considerations If one takes the view that access to health is a basic human right[6] then it becomes incumbent upon government to provide free health care services to specific target groups the poor will be priced out of private health care markets, and private insurance will also not be available to them If health is in fact seen as one of the goals of the development process itself, then government must ensure universal access to health care

Our discussion above has outlined several arguments for government intervention in health care The arguments pointed out that, if left to the free market, several essential health services (mainly preventive) may not be provided at all and even for those that are provided (mainly curative), large sections have no access to medical care

These arguments appear to be accepted in principle by most countries Government intervention in health care in developed countries is extensive This follows from Table 6 1, which gives the data for OECD countries

Table 6.1: Share of government health expenditure (percent) in different countries

Country	1970	1980	1984
USA	370	42 5	414
UK	870	904	889
Sweden	860	92 0	91 4
Norway	91 6	984	888
Canada	702	744	744
Belgium	870	874	91 6
Austria	59 1	623	00 9
Australia	55 8	62 5	84 5

Source Donaldson and Gerard (1993) "Economics of health care financing. The hand", The Macmillan Press Ltd , p 48

[6] This is a perspecctive that is embodied in the goal of Health for Ally by the year 2000' spelt out in the Alma-Ata declaration of WHO in 1978.

The situation as far as developing counties are concerned is not so encouraging The WHO's Alma-Ata declaration of 1978 outlines a 'global strategy' for health for all by the year 2000 through primary- health care systems (WHO, 1981) WHO estimates thai annual per capita cost of implementing these systems would be an additional USS15 for most developing countries Since per capita public spending is currently USS2.3. there is an annual resource gap of US$50 billion for all the developing countries Even if developing countries could fund as much as 50% of this amount. They would have to seek external funding about seven times the present level of international transfers The growth of per capita domestic public spending, therefore, is not anywhere near the levels required to meet the goals of the global strategy [WHO (198 la). World Bank (1980b)]

These raise questions, which are relevant from the perspective of financing of health care Firstly, what should be the priority areas for government expenditure, and secondly, how is the government to actually finance this expenditure? These are inter-related in the sense that the mode of financing also depends on the nature of expenditure

That the debate on government intervention in health care is not conclusive is clear from the fact that even in developed countries, the intervention takes different forms in different countries We shall discuss these questions in the next section

6.5. Financing health interventions:

We saw that among the preventive services there are some which are of the nature of public goods (these are mostly health-related services but also include some health services, like disease control) Since a private market is unlikely to come into being for these goods, the government mast necessarily stop into provide them. Further given the non-exclusion property and the difficulty of defining salable units for these goods, it is not possible to charge user fees There are also, some among the preventive services, which can be made available in salable units, but non-the-less, have strong externalities and low demand (e.g. immunization) It is well known that private markets would fail to provide optimal amounts and to government must either provide them or subsidize their production, which prevents cost recovery through user fees The financing of these preventive services therefore has to be through the general budget of the government It falls outside the scope of the thesis to look into details of fiscal and budgetary financing Therefore, we shall not say anything more about financing preventive services[7]

Curative services, unlike preventive services, have low externalities associated with them Since their benefits accrue directly to the user, there is a high demand tor them There is a market for these services, which could be provided publicly (through the government) or privately It is debated by some whether these should be provided it all by the government, or whether the government should restrict itself to preventive services / primary care In our earlier discussion, we had pointed out the need for government intervention in the financing of these services The idea essentially was to provide access to those who would otherwise be priced out of the market One (extreme) way of doing this would be for government to provide the service directly, at no cost, or at a highly subsidized price However, the actual provision of health services could also be left to private providers, with government intervention taking the form of providing social insurance, or other schemes to finance consumers' purchase of health services

[7]We may note that the second group of preventive services considered here are largely provided through primary health clinics and outreach services Though they can be provided through hospital, they do not form a priority are for hospital/market.

One can therefore have various mixes of public or private Provision of curative services with public or private financing of them. We shall discuss these in general before going on to considering what obtains in the Indian case In view of our earlier discussion, the two combinations we are interested in are private provision with public finance, and public provision with public finance

We begin with the private provision of health services Public health care finance would here mean that the government pays for services, which are privately provided The need for public finances arises in order to take care of the problems of moral hazard and adverse selection The later would lead to large sections not being covered at all while the first would lead to 'avoidable' demand Public finance would require a mobilization of funds by the government It can do this either through taxation (general, or taxes earmarked for health), or through some form of public or social insurance To the extent that insurance at a fixed premium is compulsory, the two forms of fund mobilization would be equivalent Let us see to what extent, if at all. public finance overcomes the problems associated with private insurance First of all, consider the problem associated with adverse selection, which means that high-risk groups would not get coverage under private insurance This problem is obviously taken care of if coverage of public insurance is universal, with premiums based on ability to pay which also satisfies the requirements of equity

The problem of moral hazard however still remains under public finance, since, for the consumer, health care would be obtained 'free'. We also sec that the supplier-induced demand we mentioned earlier is likely to increase when a third party,(i.e., neither the consumer nor the provider) finances it One way of taking care of the consumer's moral hazard would be to make the consumer bear a part of the cost, i.e, insurance need not be complete Another solution (which would also take care of the supplier-induced demand) would be to cover only certain types of services / prescriptions However, we must note that in this case, a private market for insurance would also co-exist for those services not covered by social insurance

We move on to the second case, viz. public provisioning of health care. This would have to be done through government run hospitals Funds would have to be mobilized for the running of these hospitals As in the earlier case, this could be done through taxation, or public/social insurance As noted earlier, to the extent that insurance, like taxation, is compulsory, the two would be equivalent. A third source of finance would be 'user-charges' (which would really be private financing in the absence of insurance)

We first consider public provision with public finance, in the absence of user charges For the same reason as earlier, we see that the problem of moral hazard remains This leads to an unnecessary increase in demand, and therefore, an increase in need for more funds to be mobilized One solution for this would be for government to provide only basic or restricted care (which necessarily implies the existence of private provisioning as well), or the government could institute user charges for certain services, providing only some services free Once again, if the public provision' caters to all the sections, particularly the poor, the problem associated with adverse selection will not arise Equity considerations could be taken care of here, (in the absence of user fees) by progressive tax-rates, or insurance premium being linked to the ability to pay. Finally, we note that the problem of a high supply-induced demand will be mitigated under government provisioning if doctors are paid salaries rather than fees for service. The incentive to induce higher demand will not be there

There is, however, also an adverse side to the whole package of free provisioning. which comes from the lack of prices to act as guiding signals for the proper allocation of resources The criticism is that this can lead to various inefficiencies both in the mix of various health services that are provided, and in the use of inappropriate input mixes This can be compounded if the funds at the disposal of the government are meager to start with[8] It is on these grounds that the charging of user fees is advocated The argument is that this will provide both the funds for the running of the services, as well as the right market signals for allocation

Let us look at the possible heads under which user-fees could be charged tor curative services

(i) Drug charges: Most of the drugs can be purchased from the private market and can be supplied to the patients by the hospital authorities on payment The resources generated so could be used for purchasing the drugs. This will help reducing the possibility of non-availability 'inadequate availability or the essential drugs, which is a common problem

(ii) Impatient charges: Modest fees for impatient care at the entrance regardless the length of stay, a charge for linen, meals and other replenishables specific charges for different type of tests could be introduced for all the inpatients who are using the hospital facilities Additional "hotel services' provided could be charged tor at higher rates

[8] This is the often-repeated complaint refining the poor quality of government run services.

(iii) Outpatient fees: A small charge for the registration card or other record of visits could give patients more incentive to keep their card and bring it on all visits

(iv) Bypass fees: One problem that could (and often does) arise is that, under free services at all levels, patients bypass lower levels of service where a basic care is available and go directly to a higher level If there is a good referral system, then higher fees may be charged for simple type of care obtained at higher level facilities.

If the consideration of equity is to be kept in mind, then the fees should be made discriminatory We note, of course that hospital charges could be paid directly by insurance providers for those who participate in the insurance schemes. As, we noted earlier, it is precisely the poor that will be left out of such schemes Free curative services could therefore be restricted to lower income groups

As we can see from the above, there are various possible policies of financing health That no method is agreed upon as the best is clear from the observation that every country has evolved its own system and combination

In Western European countries, the basic funding for health care comes from two sources i e, tax revenue and social insurance Major chunk of the health services for Norway, Sweden, UK and Denmark are financed through social insurance Similar kind of arrangement is found in France and Germany Some countries viz Italy and Spain get their health funding from both the sources Arrangements for health care provision also differ One such arrangement is the introduction of companion in the provision of health services rather than financing as could be seen in case of UK and Netherlands. In U K the district health authorities (DHAs) purchase the health services on behalf of the communities they serve The health providers then compete with each other for getting the funds from DHAs giving better quality with lower cost

Before 1989, major source of health funding in East European countries like Poland, USSR, Hungary, etc was monies from general tax revenue After realizing that the funding from general tax revenue has led to problems like perverse incentives, shortages of necessary supplies and equipment, and duplication of services between primary health care clinics and hospitals, the governments of those countries have made certain changes recently The changes include the introduction of voluntary health insurance and social insurance schemes

In North American, countries like Canada and the USA, the system of financing is more diversified In Canada, the health care is financed through public health insurance schemes USA has completely different system In USA the public health-care system is divided into two parts Medic aid for low-income citizens, and Medicare for those aged above 65 years The former is financed through general tax revenue, where **as** the Utter partly from general revenue and partly from direct charges and pay roll taxes The private health sector is then left to be financed through private health care insurance

There is a two-tier system of health financing in Latin American countries like Argentina and Brazil A major chunk of this system meant for poorer section - is financed through social insurance, whereas, the rich class receiving access to belief hearth facilities has to finance their services through private insurance

However, it is worthwhile looking at the feasibility of some of the methods of financing suggested here for developing countries, like India. The first point to note here is that we have large proportions of the population that are unemployed or employed in the unorganized sector For the same reasons that they fall out of the tax net, they would also fall out of the social insurance net, given the difficulty, sometimes bordering on impossibility, of collecting a regular payment of premium One could of course argue for a discriminatory system where the better off contribute to the insurance scheme, or pay tax, while those just mentioned are provided subsidized or free service We must note however, that no scheme by which they pay first, and are reimbursed later would be feasible, given difficulties of making a workable arrangement to monitor the re-imbursement This obviously rules out private provision of health services, at least to this group Thus, government provision does seem necessary This takes us to the question of how the government is to mobilize funds for the actual provision of these services[9] Charging user fees is one suggestion, but for the same reasons discussed above, it would not be possible to charge the lower-income groups What could be argued is that government provision be restricted to these sections or if it is provided to all then a system of discriminatory fees should be charged with free services to the poor Social insurance could however be provided to others

6.6. The Indian case:

As we saw in Chapter I, the Indian government has had an extensive and widespread presence in the provision of health and health related services even though it falls short of what is perhaps required The government has a monopoly as far as provision of preventive and pro motive care is concerned but It also provides curative services The central government funds national level preventive and promotive programs In addition, the state government is also responsible for various preventive and

[9]This is different from the question of financing of consumer expenditure through social insurance schemes.

public health services The state government also provides curative care at primary, secondary and tertiary levels through primary health centers, community health centers and other secondary and tertiary hospitals The government employs a large number of salaried doctors, nurses and other staff.There is also a private sector in curative care, with private sector hospitals gaining its importance over the last decade Government curative services are however open to all sections of the population, regardless of income These services have all along been provided virtually free, though some fees have been charged particularly in tertiary hospitals, for what can be named 'hotel services' It is only relatively recently that some spates have tried to introduce user fees for some services

Government hospitals often come in for the criticism of inefficiency. A major cause of this 'inefficiency' could very well be the shortage of funds In earlier chapters we have considered the 'efficiency' aspect In this section we would like to look at the financing aspect, specifically for the state of Andhra Pradesh We begin by looking first at the pattern of expenditure and the division between preventive and curative health services We follow this by a case study of a district hospital in Karimnagar district

6.6.1. Pattern of health expenditure in AP:

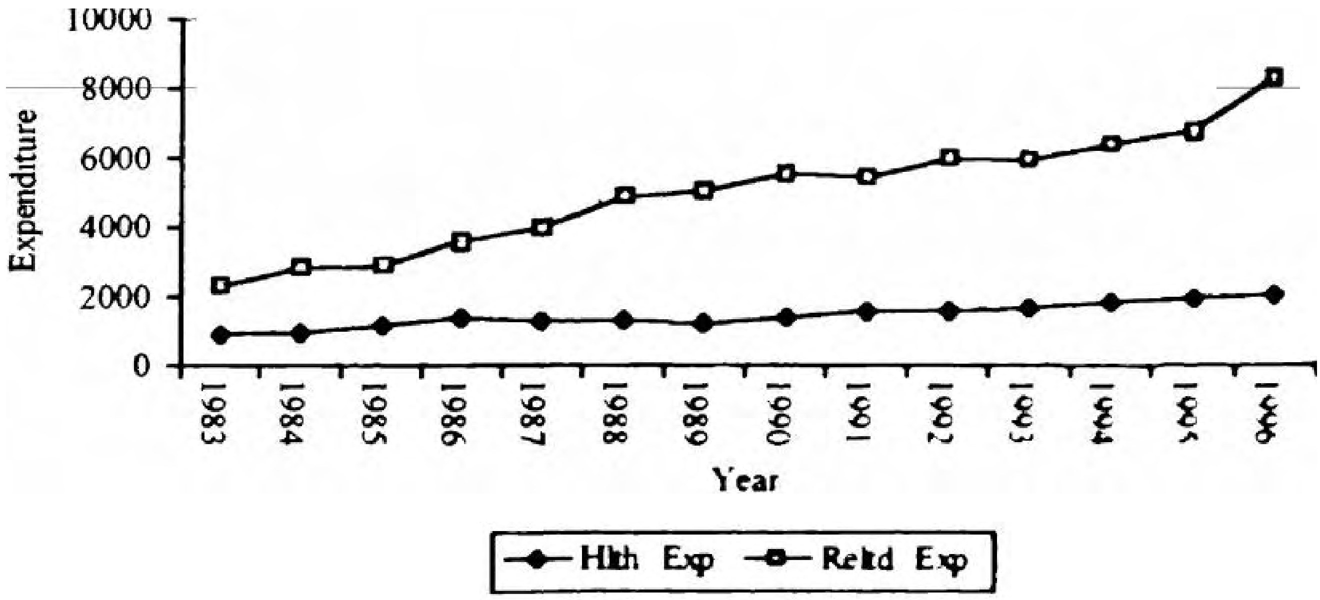
Expenditure data on health and health related services of the government of AP was obtained from the appropriation accounts in the AG's office and supplemented by the data from budget books This data was collected sub-head wise[10] and then aggregated

[10]Government expenditure on different services are classified under various major heads, e.g. the expenditure on education, medical and public health, water supply and sanitation etc. some major heads may have sub-classification within them. They are called sub-major heads. Expenditure on each program is classified under a separate minor head Examples of minor heads under public health are; direction and administration, prevention and control of disseases, etc. The next tier classification, namely the sub-head of account under each minor head reflects the identity of schemes undertaken in pursuance of programs

according to our requirement[11] The data (in current prices) collected for the period 1983-84 to 1995-96 and converted in to 1983-84 prices[12] These data are in Appendix Table 6A1

From Appendix Table 6A 1, we notice that the government expenditure on both health and health related services has grown considerably in real terms during the study period However, the increase in health related expenditure is much higher than that on health (Chart 6 1)

Chart 6.1: Real government expenditure (Rs mil) on health and related services, 1983-96



The real expenditure on health, as a percentage of total government expenditure (Table 6 2), has been fluctuating in a narrow range of **4** 5-6 **5** over the y**ears.** In contrast, the share of real expenditure on health-related services his doubted during the same period.

represented by the minor head The major, sub-major and minor heads are fixed at the national level and are common for all the states The sub-heads are created by each state government according to their needs

[11]These heads were assigned as per the requirement of our analysis and hence called analytical heads.

[12] The nominal expenditures are deflated with consumer price indices for urban non-manual employees with 1983-84 values as 100. The price deflators for 1983-84 to 1966-97 are; 100, 111.92, 120.86, 133.33, 144 17. 153 93. 166 12. 177.78, 188 34. 202 98 214 90 227.64, 243.09 respectively.

although with some fluctuations Thus, we see that there has been a significant rise in the quantum of government expenditure on health but more on health related services As a result, the per capita expenditure on health has not increased at an adequate pace (Table 62)

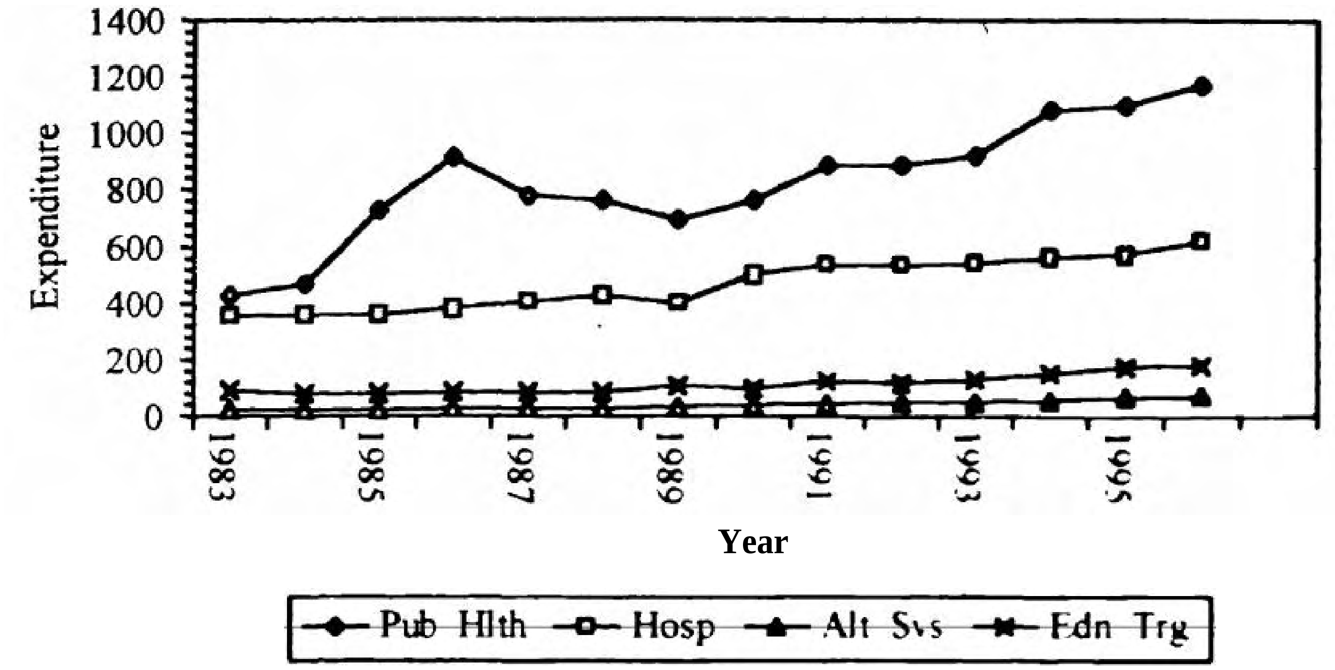
Table 6.2: Real government expenditure on health and health related services in Andhra Pradesh *

Year	Health related sen ices			Heahh services		
	Per-capita (Rs)	%of SDP	%ofGovt. Exp.	Per-capita (Rs)	%of SDP	%of Govt. Exp.
1983	5209	315	1334	1684	1 22	5 18
1984	6403	355	1532	17 15	1 16	5
1985	7013	358	1447	21 47	1 48	5 .97
1986	8291	417	17	24 99	1.63	6.52
1987	8509	485	1447	22 59	1 56	44.66
1988	91 33	556	1805	22 24	1 49	4 84
1989	8833	59	1903	20 67	1 43	4 62
1990	9536	566	2072	23 13	1 43	6 25
1991	8921	464	1961	2585	1 36	5 74
1992	9447	486	21 04	254	1 2 9	561
1993	99 13	423	1934	24 77	1 17	5 37
1994	11975	403	1836	2746	1 17	5 34
1995	12386	382	1841	2789	1 07	5 18
1996	13122	404	24	29 31	0.99	5 76

* At 1983-84 prices

Real government expenditure on each component of health services has increased in absolute terms (Chart 62) The increase was more in case of public health services followed by hospitals, medical education and alternative systems of medicine in that order (Appendix Table 6A 1)

Chart 6.2: Real government health expenditure (Rs mil) on different components, 1983-96



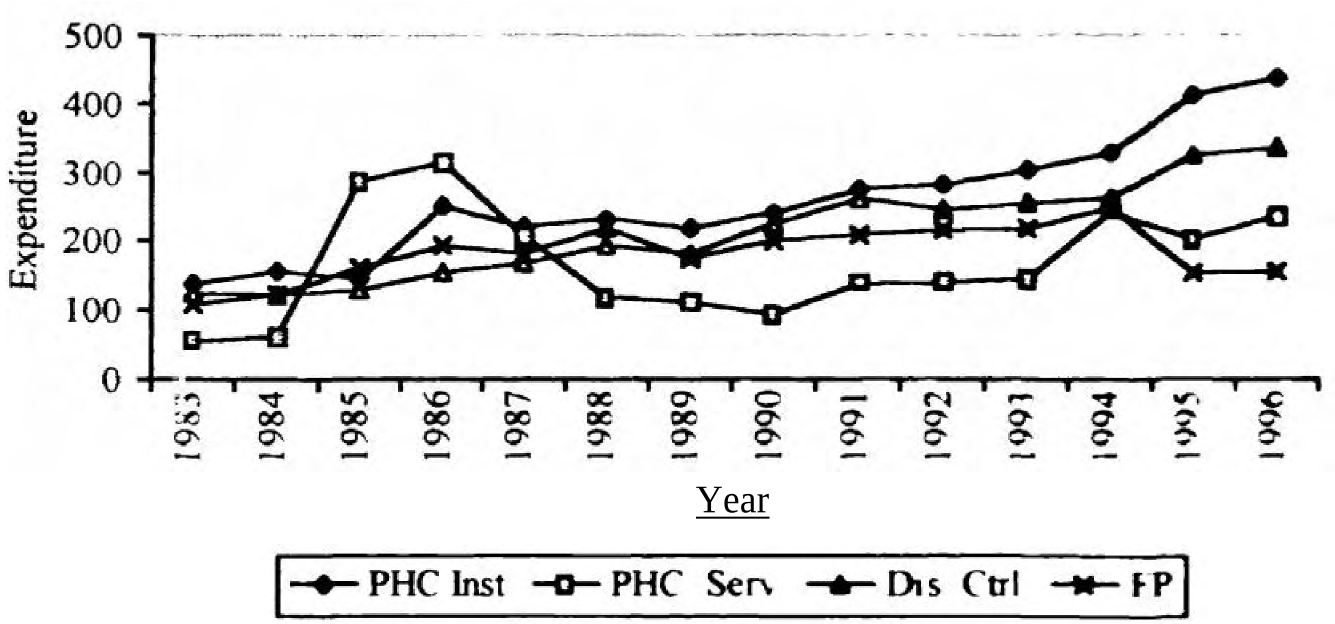
The expenditure on public health is subdivided further into four components. namely primary health care institutions[13], primary health care service[14], disease control and family planning These are shown in Appendix Table 6A *2* and Chan 6.3. It may be observed that PHC institutions, family planning and disease control programs had almost the same level of funding These three groups of services have shown a fairly good deal of stability in the level of allocations to them Expenditure on PHC services has been somewhat low The expenditure on hospitals is further subdivided into secondary and tertiary hospitals Secondary level hospitals are mainly non-teaching district and sub-distnct hospitals. All teaching hospitals are classified as tertiary hospitals Chart 6 4

[13] Primary health care institutions include the PHC network consisting of community health centre primary health centers, subsidiary health centers and sub-centers dispensaries maintained by government and employees states insurance (ESI) corporation Expenditure on severaldepartment such as vital statistics, registration of births and deaths, prevention of food adulteration, drug control administration Hater testing laboratories are also included in this.

[14] primary health care services consists of health interventions except disease control and family planning programs. These include child survival and safe motherhood (CSSM), integrated child development

shows the expenditure on secondary and tertiary hospitals Both the groups of hospitals had almost similar levels of expenditure at the beginning of the eighties To judge the

Chart 6.3: Real government expenditure (Rs mil) on public health services, 1983-96

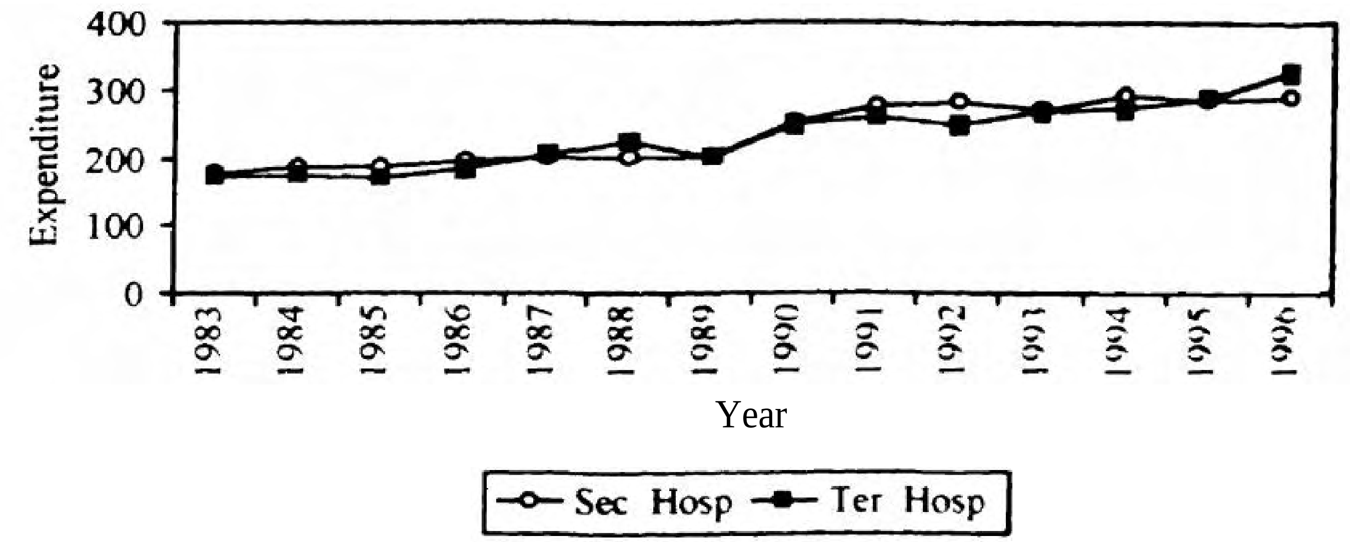


appropriateness of allocation within the hospital sub-sector of health services, some normative notion of composition is required Mahapatra and Berman (1991) suggest that the allocation between secondary and tertiary level hospitals should be 21. As against this norm, it is observed that there has been an allocative bias in favor of tertiary level hospitals during the post Alma-Ata period

This is a somewhat mixed bag of observations. One thing is clear that there is tendency towards preventive as opposed to curative servers as seen from above analysis But, within public health services, the trend towards services with more externalities or public good characteristics is not so clear as shown in the decline in disease control Finally, within hospitals, the emphasis on tertiary hospitals can be seen as

scheme (ICDS). and special nutrition program (SNP) administered by women and child welfare department

Chart 6.4: Real government expenditure (Rs mil) in secondary and tertiary level hospitals. 1983-96



expenditure on services benefiting a smaller segment of population We must remember that total funds allocated to the health sector is insufficient in terms of per capita expenditure on health services, according to the WHO criteria

As mentioned earlier, financing of government expenditure on preventive services will have to depend upon government budgetary provisions, and on taxation (men an overall budget that is small, it is natural to ask whether it would be possible to self-finance curative services provision, leaving taxes for the provision of primary services public health care As mentioned earlier, the AP secondary level hospitals have been collecting 'user fees' for certain services in principle let us examine its scope coverage and drawbacks

6.6.2. User fees and its present status:

Before the formation of APVVP, all health care services were provided free of cost One of the first things that APVVP did immediately on its creation was introduction of user charge for services provided Among the various type of fees that were introduced in APVVP district hospitals were, room rent, radiography and lab investigation charges, drug charges, etc

As could be seen from Appendix Tables 6A.3-6A 4, the amount collected through user fees has been quite negligible compared to the total expenditure on hospitals For almost all hospitals, it is less than 1 percent of the total expenditure except for Anantpur and Nizamabad where it is more than 1 percent Even this amount is not comparable with the figures of other developing countries like Malaysia, where 5% of total government health cost is collected by user charges (Jimenez 1987) This implies that health subsidies account for a major share of the AP health budget

The immediate question is why the user fees have been consistently low even if there is a system of collection[9] Is there any possibility of improvement' Can some pan of the cost of hospital care be recovered through a further expansion of user fees? The next section examines these questions by drawing conclusions through a field study

6.7. Case study:

6.7.1. Field survey:

Before imposing user fees, we must have a clear idea of various demand side factors The present study was meant to look at this Specifically we attempt to examine (a) the socio-economic profile of the hospital users and (b) the quality of services as perceived by the users

The field study was conducted in the Karimnagar district hospital of AP during the 15-30th June. 1997 It may be pointed-out that the choice of the hospital was somewhat arbitrary Cost considerations of data collection familiarity with the area, and the coincidence of another on going health related study there were the reasons for choice of Karimnagar hospital for this study as well

The responses of hospital users were recorded through a structured questionnaire (Appendix 6B), supplemented by the method of non-participant observation in order to confirm the answers of respondents We took 125 inpatients and 125 outpatients of the above hospital as the sample respondents for our study Inpatient sample was divided further equally among the seven wards From each ward, a minimum of 18 patients were interviewed

Initially, it was proposed to survey the inpatients after they were discharged from the hospital There were problems in getting adequate number of discharged patients for interview As the survey period was very short, we could get only 60 discharged cases from the hospital Given the time constraint, we interviewed another 65 inpatients that had been in the hospital for a minimum of four days This was on the assumption that they would be familiar about the hospital services

Outpatient (OP) respondents were drawn from OP cases coming to the hospital The patients were interviewed after they finished their work in the hospital There was no difficulty in getting adequate number of outpatients for the survey

Socio-economic aspects of hospital users:

We first asked questions on age, sex, educational status, occupation and income of the sample respondents, common to both inpantients and outpatients. These responses are analyzed first The specific questions to inpatients and outpatients are analysed subsequently As seen from Table 6 3, inpatient sample for our study consisted of 54 males (43 2%) and 71 females (56.8%) This reflected the relatively larger number of female admissions It was also found thai more than half of the patients was in the age group of 21-40 years (55.2%) followed by age group 5-20 years (24.0%) The lowest numbers of respondents were infants, in the age group 0-4 years (2.4%).

The sex composition of the outpatients is roughly the opposite, 72 males (57.6%) and 53 females (42.4%) in the sample. Among the outpatients, the age distribution seems to have shifted away a little bit. A larger proportion of older male population seems to visit the hospital for outpatient treatment This implies relatively larger proportion of women under-went inpatient-care in that district during the survey period This may also reflect the differential nature of disease prevalence between the two sexes. More women might be suffering with chronic (long-duration) illnesses than men in the district might

Table 6.3: Age and sex distribution of sample hospital users, Karimnagar

Age group (Years)	Inpatients		Outpatients	
	Number	Percentage	Number	Percentage
0-4	3	2.4	0	000
5-20	30	24.0	18	144
21-40	69	55.2	59	47.2
41-60	15	12.0	34	27.2
61 and above	8	6.4	14	112
Total Male	54	43.2	72	576
Total Female	71	568	53	424
Total	125	1000	125	1000

From the distribution of educational level among the patients, more than half the hospital users were illiterates (Table 6 4). The proportion is as high as 61.8% among the outpatients. This shows Karimnagar government hospital is mostly catering to the health needs of uneducated population in the district. The educated population may be using the private health care facilities.

Table *6.4:* Educational status of sample hospital users. Karimnagar

Education level	Inpatients		Outpatients	
	Number	Percentage	Number	Percentage
Illiterate	64	512	76	608
Std. I-IV	16	128	9	72
Std. V-VII	23	184	18	144
Std VII-X	12	96	13	104
College and above	8	64	9	72
Not applicable*	2	16	0	000
Total	125	1000	125	1000

* Children below 4 years of age

The largest proportion of the inpatients (26.4%) at the Karimnagar hospital was either agricultural laborers or housewives (Table 6 5) Almost an equal proportion of the respondents (25.6%) did not mention their occupation This category includes elderly people and pre-school children Some of them, probably, are unemployed or indifferent to reveal their occupation Among the outpatients, the proportion of non-respondents was much less (16 8%) Likewise, the proportion of housewives using outpatient services was lesser (14.4%) compared to inpatients

An attempt was made to get an idea of the economic status of the respondents in two ways First, based on the occupation of the main earner of the family second, based on the actual monthly income of the family Based on the occupation of the main earner, we have divided the patients into four economic classes Lowest class All households in which the main earner is either a mazdoor or unorganized sector workers or marginal fanner owning up to 2 5 acres of land or village artisan or unskilled industrial worker

Lower middle class All households in which the main earner is either an organized sector worker or attendant or skilled worker or small peasant owning between *25 to 5* acres of land or household poultry or petty shop owner Middle class All households in which the main earner is either a white-collar worker or middle peasant owning between 5 to 15 acres of land or priestly class or owner of retail shop ' other medium scale trade industry. Rich All households in which the main earner is either a peasant owning above 15 acres of land / dairy- / poultry or large-scale industrialist or large-scale trader or professional From Table 6 *6,* we infer that the hospital users at Karimnagar were mostly from lower or lower middle class

Table 6 7 shows the economic classification based on actual monthly family income of the users From the results, more than one-fourth of the inpatients (26.4%) was earning a monthly household income of less than Rs 500 For the outpatient category, this percentage was much lesser (14.4%) An overwhelming proportion of the sample households (55.2% among inpatients and 73.6% among outpatients) reported then monthly income between Rs 501-1500 Thus, from the survey it appears that the health services at Karimnagar government hospital were exclusively (80-90 percent) used by poorer households We reiterate that the above result may not be extendable in toto to all district hospitals in AP

Quality aspects of health services:

Quality of care can be perceived from two angles demand and supply side Demand side factors affecting the quality and ultimately the use of hospital services are generally judged from the patients' perception on the various services provided. The supply side factors that interact with demand are non-monetary price of access, the quality of services with respect to the adequacy of drugs and other medical supplies, staffing and the availability of critical specialties. In this study, we have examined the quality of hospital services by looking at the patients' perception on the different services provided by the hospital.

In order to elicit the information on quality of hospital services, patients' satisfaction and difficulties encountered, a whole range of questions was addressed to respondents. We give a summary of the answers below.

A large proportion (65.6%) of users at Karimnagar district hospital seems to have bypassed the lower level facilities. Among the reasons cited are non-availability of proper diagnostic facility at the lower level, non-availability of specialists and doctors to handle serious cases. Regarding the quality of care, as assessed by respondents, there appears to be no consensus. While a significant proportion (40%) of users expressed dissatisfaction about the overall behavior of staff working for patient care, an equal proportion was of the opposite opinion.

Table 6.5: Occupational distribution of sample hospital users, Karimnagar.

Occupation	In-patients		Outpatients	
	Number	Percentage	Number	Percentage
Agricultural Laborer	33	264	34	277
Unorganized sector Laborer	5	40	9	72
Peasant	8	64	12	96
Self employed	6	48	11	8 8
Industrial worker	4	32	1	0.8
Housewife	33	264	18	144
Others	4	32	19	152
Unknown*	32	256	21	16 8
Total	125	1000	125	1000

Did not respond

Table 6.6: Distribution of sample users of Karimnagar hospital based earner's occupation

Income class	Inpatients		Outpatients	
	Number	Percentage	Number	Percentage
Lowest class	71	568	56	448
Lower middle class	41	328	61	488
Middle class	11	88	8	64
Rich	0	0	0	0
Notmentioned	*2*	16	0	0
Total	125	100	125	100

Table 6.7: Distribution of sample users of Karimnagar hospital based on income

Monthly household income	In-patients		Outpatients	
	Number	Percentage	Number	Percentage
Less than 500	33	264	18	144
501-1500	69	552	92	736
1501-3000	20	160	14	112
3001-5000	2	16	1	08
5001 and above	1	08	0	00
Total	125	1000	125	1000

Answers regarding the availability and quality of drugs, medical and surgical equipment and food seem to suggest overall satisfaction by the inpatients, although some rated these as only 'fair' The cleanliness of the hospital is being judged based on whether the hospital changes the bed sheets, clean the floors and toilets on a regular basis and the hospital has adequate dustbins and spittoons In addition, we also asked the opinion of patients regarding the cleanliness of laboratory and dressing room as well. When it came to general cleanliness, again the average response appears to be one of satisfaction regarding cleanliness of wards, laboratories, and dressing rooms. However the inadequacy of spittoons was noticed Regarding water supply in the hospital all but 9% seemed to find it adequate[15].

The questions asked to outpatients about their assessment of quality of services had to be different from those asked to inpatients The amount of time spent at different points of service delivery is closely linked with the quality of outpatient services provided by the hospital Since the opportunity cost of waiting time is high, patients' perception on the time spent is used to judge the efficiency and qualm of hospital services In addition to the usual questions on availability, quality, cleanliness etc . the outpatients were asked about the waiting time[16] at different stages. namely registration counter, for consulting doctor, pharmacy and for diagnostic report From the responses of the hospital users, we found that they had to wait for considerable time (ranging up to 30 minutes) at different counters Though the users seemed concerned about this they did not express serious dissatisfaction As far as the behavior of staff was concerned the responses were similar to that of in-patients They were, on average, satisfied with the doctors and nurses, and a little less so with supportive staff They were broadly satisfied with the cleanliness of the hospital and dressing rooms and with privacy during consultation at the outpatient clinic[17] .About the availability of drinking water the

[15]Our own observation regarding the availability of water supply indicates that the hospital did not have basic drinking water facility. consequently the attendants of all the patients collect the water from the bore wells that are situated within the hospital campus for the purpose of drinking similar type of answers were obtained when we asked about the adequacy of electricity supply to the hospital

[16] It is to be noted that the long waiting time (30 minutes or most of the patients was mostly due to the late arrival of concerned doctor/staff for long queue. We have examined this point during the survey. The investigators were asked to follow some patients randomly and note down the time taken at different points of service delivery. It was found that at some specialities, patients had to wait for long time because of lengths queues

[17]There are different counters, where the outpatients services are delivered. These include doctor's counter pharmacy counter, lab test counter etc. The outpatients' satisfaction on these points of service delivery is being judged on the basis of the type of services that are provided at these counters. Though the responses to these questions are completely subjective, still it provides some information about the quality of care. Questions pertaining to doctors' counter were whether there was adequate privacy during consultation,

responses were more equivocal as many as 44% found it 'not adequate enough' or 'not at all adequate' About sanitary conditions, again, over 50% found it merely 'average' or 'less than average'[18]

Finally, we asked some open-ended questions to all the respondents The first was their opinion on areas where the hospital should pay more attention, and the second was their view on overall satisfaction on different cares delivered by the hospital The responses were similar to both the questions Therefore, we present only the responses for the first question

Variety of responses were obtained The largest number of responses from both inpatients (IPs) and outpatients (OPs) was regarding the need for supply of adequate and good quality medicine and provision of safe drinking water Inpatients also felt that there could be a better supply of good food items including bread and milk Some respondent gave importance to the provision of toilets and improvement in sanitary conditions

We may note here that this tallies with over all observations We have already referred to our observation regarding sanitation and water supply We also had discussions with the hospital superintendent, which were quite revealing We found that the necessary drugs for the hospital are supplied from the APVVP headquarters. In addition to these drugs, the respective hospital authorities are provided with Rs. 100 per month per bed for purchasing the emergency drugs. This is highly inadequate. As far as the food supply of the hospital is concerned, there is a fixed allocation of Rs. 5 per bed per

whether the doctors presented any jmedicine/test. In addition, a question regarding the availability of drugs was also asked

[18]We must mention our own (non-participant) observation regarding the availability of toilets. As per our observation, there were no toilets in the hospital for outpatients. The outpatients attending the hospital use the toilets available in inpatient wards.

day, which is obviously very low Clearly, then, there is very low funding for these recurrent costs

6.7.2. Summary:

Let us summarize the findings based on the responses from the field survey

(i) The clientele of the hospital comes very largely from the lower income groups

(ii) Broadly, the patients were satisfied with the services, even if they did not rate them very high They were satisfied with the infra structural facilities, and the behavior of the staff[19]

(iii) However, the responses elicited by the open-ended questions suggest that the supply of food, water and drugs was inadequate, and while the patients were generally tolerant, the need for improvement in these basic facilities was felt

(iv) One important observation that can be made is that lot of these patients came to the higher level facilities (district hospital) without going to the lower level facilities

6.8. Conclusion:

Our starting point had been to see whether the hospital needed to generate its own funds and to examine the possibility of doing so through charting; user fees for services The survey yielded two findings that pull in opposite directions. First there does seem to be a need for additional recurrent funds in the hospital particularly for supply of drugs, food, and perhaps other consumables in the laboratories etc. It is here that user charges suggest themselves Secondly, the hospital is used basically by the lower income groups,

[19]It should be clear that this is not saying anything about the purely medical services/medical competence, and that it is a subjective response

and our earlier discussion in the chapter suggests free treatment for them In this context, there are few points to note The mere existence of private hospitals has already led to a near-polarization the lower income groups come to government hospitals, while the upper income groups use private facilities One is led to infer that the upper income groups find the services unsatisfactory in the government hospitals, while they find private services better. The reasons could be the sanitary conditions, or the level of 'hotel services' offered, or perhaps the waiting time and queues at the government hospitals, which turns them to go to the private hospitals (To repeat, this is not making a judgement about the purely 'medical' services of the doctor - about which the layman is not in a position to judge, given the acute asymmetry of knowledge mentioned earlier) On the other hand, the lower income groups, who do use government hospitals appear to be broadly satisfied with services obtained there It is as though the market is segmented

Clearly, therefore it will not only be undesirable on equity grounds, but also difficult to enforce user charges Inpatient and outpatient fees, particularly, will be ethically difficult to endorse 'Hotel service' charges, on the other hand, will be largely irrelevant, since the lower-income group patients (who dominate in numbers) would be satisfied with the lowest level facility of general wards This would be largely true of food charges as well (It is not so surprising then why the recovery through user fees has been so low despite the APVVP having instituted them) This leaves only the possibility of drug charges, which, too, are difficult to advocate on ethical grounds

What are the possible suggestions thai can come out of this, then? There are two possibilities the government could take conscious decisions to restrict the use of government hospitals to lower income groups alone, in which case, they could also provide only the most basic hotel facilities - general wards, simple food, etc This could perhaps cut down the capital cost, as well as operation costs, and perhaps reduce the manpower requirement of non-medical staff[20]. Funds saved here could be used for better running of basic facilities As far as user charges are concerned, we may make the following points:

(a) Given that adequate quantity of medicines are not supplied in the hospital, and patients do have to purchase them from outside, perhaps the hospital could institute charges for medicines, which could then be supplied in full

(b) The other type of fee that could be charged is what we have referred to as 'by-pass fees' In view of our survey, this might help keep down numbers using higher facilities some of them would go to lower level facilities, where COST of providing basic services would be lower

The other possibility is to improve facilities available in the government hospitals in order to attract the better-off patients The latter could then be charged steep, discriminatory prices However, given the competition from private sector, this alternative may not work

In the final analysis then, it appears the government has no option but to make budgetary allocations financed through taxes, or through monetary means However, the need for this could be kept within limits by (i) restricting use of government hospitals to lower income groups alone and (ii) taking steps to improve the efficiency of working of these hospitals

[20]As could be seen from the results of Chapter V the non-salary cost is under funded compared to the salaried personnel in most of the hospitals thereby forcing the hospitals to operate under sub-optimal efficiency One possibility is to look at these results and make decisions on cost savings.

We may mention that Karimnagar town/hospital is located in a less prosperous Telengana region of the state of Andhra Pradesh. A host of concomitant factors might influence the socio-economic milieu of the district/region. This makes it somewhat difficult to extend the findings from this hospital in 'toto' to the rest of the state Therefore, the findings of this field study are at best indicative of the situation prevailing in some of the AP district hospitals Similar studies are necessary in some more hospitals before any thing concrete said about the imposition of user fees We should keep the above limitations in mind while understanding the results

Appendix Table 6A.1: Real government expenditure (Rs. mil) on health and health" related services in Andhra Pradesh*

Year	Components of health expenditure[2]				Health (1+2+5+4)	Health related services*
	Public health (1)	Hospitals (2)	Alternate sys.ofmed. (3)	Health edn. and trg. (4)		
1983	428.6	350.5	24.6	89.9	894.0	2303.5
	(47.9)	(39.2)	(28)	(101)	(5.2)	(133)
1984	464.8	360.8	24.8	786	9290	2S448
	(50.1)	(38.8)	(2.7)	(8.5)	(50)	(153)
1985	726.2	357.5	24.2	782	11862	28775
	(61.2)	(30.1)	(2.0)	(66)	(60)	(145)
1986	914.0	382	26.2	844	14066	36049
	(65.0)	(27.2)	(1.9)	(60)	(6.5)	(170)
1987	7806	4058	26.26	82.9	12955	40222
	(60.3)	(31.3)	(2.0)	(64)	(47)	(145)
1988	763.0	425.5	272	83.7	12993	48432
	(58.7)	(328)	(2.1)	(64)	(48)	(181)
1989	6917	4004	318	1056	12296	50613
	(56.3)	(326)	(3.0)	(86)	(46)	(190)
1990	7643	501 1	37.7	977	14008	55309
	(545)	(358)	(27)	(70)	(53)	(207)
1991	887.7	536.4	444	1247	15932	54443
	(55.7)	(33.7)	(2.8)	(78)	(57)	(196)
1992	887.5	5352	48.5	1216	15929	59800
	(55.7)	(33.6)	(3.1)	(76)	(56)	(210)
1993	923.2	539.7	53.5	1307	16462	59334
	(56.1)	(32.8)	(33)	(79)	(54)	(19.3)
1994	1080.6	565.9	560	1536	18560	63847
	(582)	(30.5)	(30)	(83)	(53)	08.4)
1995	1097.8	5731	668	1770	19147	68052
	(57.3)	(299)	(35)	(92)	(52)	(18.4)
1996	11708	6186	727	1803	20426	83447
	(57.3)	(303)	(36)	(88)	(58)	(240)

*At 1983-84 prices

[1] Health related services include genera) education (primary and secondary), water supply and sanitation.

[2] Figures in parenthesis are percentage to total health expenditure.

Appendix Table 6A.2: Distribution of real expenditure (Rs. mil) on public health and hospitals*

Year	Public health services[1]				Hospitals[2]	
	PHC institutions	PHC services	Disease Control	Family Planning	Secondary Hospitals	Tertiary
1983	140.3	54.0	125.4	108.9	178.0	1723
	(32.7)	(12.6)	(29.3)	(25.4)	(50.8)	(49.2)
1984	156.9	61.1	122.4	124.4	186.0	174.7
	(33.8)	(13.2)	(26.3)	(26.8)	(51.6)	(484)
1985	145.3	287.6	130.9	162.4	1862	177.3
	(20.0)	(39.6)	(18.0)	(22.4)	(521)	(479)
1986	251.8	314.1	154.1	1939	196.1	185.9
	(27.6)	(34.4)	(16.9)	(21.2)	(513)	(487)
1987	221.4	207.9	169.7	181.6	200.6	205.2
	(28.4)	(26.6)	(21.7)	(23.3)	(494)	(506)
1988	232.1	118.7	193.8	2185	200.5	2250
	(30.4)	(15.6)	(25.4)	(28.6)	(47.1)	(529)
1989	2202	112.4	182.6	176.5	2003	2000
	(31.8)	(16.3)	(26.4)	(25.5)	(500)	(500)
1990	242.7	93.6	226.4	201.6	2516	2494
	(31.8)	(12.2)	(29.6)	(26.4)	(502)	(498)
1991	275.9	139.7	261.6	210.5	2757	2607
	(31.1)	(15.7)	(29.5)	(23.7)	(514)	(486)
1992	282.2	142.1	246.4	216.9	2839	251.3
	(31.8)	(16.0)	(27.8)	(24.4)	(531)	(470)
1993	303.2	1456	255.8	218.6	2709	2689
	(32.9)	(15.8)	(27.7)	(23.7)	(502)	(498)
1994	327.7	242.0	262.2	248.6	2913	2746
	(30.3)	(22.4)	(24.3)	(23.0)	(515)	(485)
1995	412.5	203.7	325.4	1562	2855	2876
	(37.6)	(18.6)	(29.6)	(142)	(498)	(507)
1996	4383	237.7	337.1	157.7	2908	3214
	(37.4)	(20.3)	(28.8)	(135)	(470)	(531)

* At 1983-84 prices

[1] Figures in parenthesis are percentage to total expenditure on public health.

[2] Figures in parenthesis are percentage to total expenditure on hospitals.

Appendix Table 6A.3: Composition of user fees (Rs.) collected from APVVP district hospitals during 1995

Hospital	Room rent	Radio-graphy	Lab test	Sale of drugs	Certifi-cation charge	Ambu-lance chance	Others	Total user fee (a)	Hospital Expenditure (b)	(a)/(b) (%) 1.14
Srikakulam	200	1670	72198	0	9265	0	97086	180419	15786614	0.36
Vizianagaram	9120	1571	0	0	0	7790	34599	53080	14714251	0,97
Rajamundry	43735	4529	4990	7430	764	20	106941	168409	17275904	0.95
Eluru	0	43199	0	10314	10099	0	153827	217439	22905503	0.55
Machilipatnam	14046	5880	6739	7900	114	16450	76974	128103	23223077	0.44
Ongole	7116	480	295	530	13175	1750	24708	48054	10957896	0.55
Nellore	49401	10575	0	0	34476	0	17498	111950	20232015	0.74
Chittore	13342	13318	28073	0	8105	3785	83938	150561	20408312	0.86
Cuddapah	24494	52300	31140	0	7794	0	59346	175074	20320029	1.47
Anantpur	138982	58036	135	1573	5505	0	128127	332358	22677672	0.60
Mahboobnagar	100	5450	300	0	320	128.	84241	90539	15054973	0.44
Sangareddy	17400	3481	1454	0	10028	0	27314	59677	13492276	1.09
Nizamabad	970	1420	1204	0	1050	0	120996	125640	11476535	0.57
Adilabad	16294	16115	5041	0	10229	20	58806	106505	18767648	1.03
Karimnagar	8450	18159	27788	11208	31153	2130	49333	148221	14376935	0.39
Khammam	2096	10950	8264	873	13300	0	21744	57227	14659609	0.94
Nalgonda	6595	16586	0	2100	64679	0	30301	120261	12811749	0.79
Total	352341	263719	187621	41928	220056	32073	1175781	2273519	289141003	

Appendix Table 6A.4: Composition of user fees (Rs.) collected from APVVP district hospitals during 1996

Hospital	Room rent	Radio-graphy	Lab test	Sale of drugs	Certifi-cation charge	Ambu-lance charge	Others	Total user fee (a)	Hospital Expenditure (b)	(a)/(b) (%)
Srikakulam	5475	16380	9453	5033	9036	18868	67300	131545	16738087	0.79
Vizianagaram	3100	2516	633	0	3873	16618	39635	66375	14376075	0.46
Rajamundry	45231	810	20375	10810	225	8603	96560	182614	20382751	0.90
Eluru	25670	0	0	15800	294	0	3881	45645	21760650	0,21
Machilipatnam	12395	15385	6689	9607	6581	29618	93844	174119	24286170	0.72
Ongole	0	4453	2867	2978	21555	7485	15009	54347	14890843	0.36
Nellore	26035	4875	627	1381	15919	14408	97323	160568	23460577	0.68
Chittore	17203	33826	32564	0	9745	5733	56753	155824	19552660	0.80
Cuddapah	13649	33151	21736	4560	4150	36881	37775	151902	23158267	0.66
Anantapur	56048	72208	7671	7326	15092	55243	111992	325580	24481977	1.33
Mahboobnagar	19130	35661	1620	0	1722	7161	70578	135872	16069953	0.85
Sangareddy	20425	1095	0	0	6983	4416	35522	68441	13851279	0.49
Nizamabad	17972	7340	4275	1300	3250	50153	267815	352105	19401476	1.81
Adilabad	19684	8800	3181	0	6425	3425	39283	80798	16848983	0.48
Karimnagar	5670	7592	25942	10524	18924	15402	37333	121387	16370392	0.74
Khammam	1854	12540	6158	6380	5100	3734	48858	84624	15645273	0.54
Nalgonda	4050	11500	0	0	11545	15230	21703	64028	13291106	0.48
Total	293591	268132	143791	75699	140419	292978	1141165	2355775	314566525	0.75

APPENDIX 6B: QUESTIONNAIRE USED FOR SURVEY OF HOSPITAL USERS IN KARIMNAGAR DISTRICT HOSPITAL, ANDHRA PRADESH

SI. No: **Date:**

(A) SOCIO ECONOMIC PROFILE (Same for inpatients and outpatients):

Ql Name and address of the patient ______________________________________

Q2. Age Q3 Sex Q4 Religion Q5 Caste

Q6. Rural / Urban

Q7. House ownership 1 Own / 2 Rented

Q8 Education of the respondent (a) Illiterate (b) Std I-IV, (c) Std V-VII (d) Std VII-X (e) Inter pass, (f) Graduation (g) PG or professional (h) Others (Please specify)

Q9 Occupation of the respondent________ _

Q10 Occupation of the main earner of the family _______

Qll Number of days worked in last 30 days______

Q12 Other earning sources (Please specify) ______

Q13 Total monthly income of the family (Rs) (a) Less than 500 (b) 501 -1500 (b) 1501-3000 (d) 3001-5000, (e) 5001-10.000 (0 10,000 and above

(B) REASONS FOR COMING TO DISTRICT HOSPITAL:

Q14 Why did you come to this hospital? (a)Hospital is nearby, (b) Convenient hospital timings (c) Doctors are available always (d) Good hospital facilities, (e) Has facilities for emergency treatment, (0 Difficult to afford for private hospitals, (g) Others (specify) (h) Not mentioned

Q15 Did you attend nearby community/area hospital PHC before coming to this hospital? Y N

Q16 If no, why you did not attend nearby (a) Doctors are not regularly available, (b) No specialist doctors, (c) No convenient hospital timings, (d) No diagnostic facilities, (e) I felt my case was severe,

(f) Other reasons (please specify)_______

(g) Not applicable (h) Not mentioned

(Note: If the answer to Q.16 is yes then Q. 17 becomes not applicable)

(I)

(C) PATIENT SATISFACTION (Inpatients):

(I) Inpatient waiting time at different points of service delivery:

Q17 How much time did you wait for following services? (in minutes)

(a) Before admission

(1) At registration counter _______________

(2) To meet the doctor__________________

(3) For completion of admission __________

(b) After the admission

(1) Time taken for initial treatment

(2) Time taken for specific treatment after diagnosis

(Note: Questions 19 to 21 are applicable for surgical March only)

Q18 How much time did you wait for surgery?

Q19 Did you see any patient dying after 48 hours of the operation? Y/ N

Q20 Did you hear any person dying inside the operation theatre? Y N

(II) Patient's perception regarding the qualitv of services inside the ward:

Q21 Is the space between the beds adequate? Y N

Q22 Is there communication facility (telephone) available in the hospital? Y N

Q23 Is there any ambulance facility in the hospital? Y N

Q24 Are there lockers at the bed site? Y N

(HI) Patient's satisfaction regarding behavior of hospital staff:

Staff	Extremely cordial	Very cordial	Not very cordial	Just cordial	Not at all cordial	Don't know	Not mention ed
Doctor							
Nurse							
Parame-dical							
Others							

(IV) Patients satisfaction on other services of the hospital:

Services	Excellent	Good	Fair	Average	Below average	Don't know	Not mentioned
Drugs							
Medical equipment							
Surgical equipment							
Bedding							
Food							

(V) Hospital cleanliness rating:

Q25 How frequently the following services are rendered"

(1) Changing of bed-sheets — (a)Daily, (b) Once in two days, (c) Twice a week, (d) Weekly, (e) Not even weekly, (f) Don't Know, (g) Not mentioned

(2) Cleaning of floor — (a) Daily, (b) Once in two days, (c) Twice A week, (d) Weekly, (e) Not even weekly, (0 Don't Know, (g) Not mentioned

(3) Cleaning of toilets — (a) Daily, (b) Once in two days, (c) Twice a week, (d) Weekly, (e) Not even weekly. (f) Don't Know, (g) Not mentioned

Q26 Are there adequate dustbins and spittoons in the hospital? — (a) Sufficient, (b) Not sufficient, (c) Don't know,(d) Not mentioned

Q27. Are the dressing rooms sufficiently clean? (a) Extremely clean, (b) Very clean, (c) Not so clean, (d) Not at all clean, (e) Don't know, (f) Not mentioned

(VI) Patient's perception on the availability of following basic facilities in the hospital:

Q28. How is the water supply in the hospital? (a) Immensely available, (b) Quite adequate, (c) Not adequate enough, (d) Not at all adequate, (e) Don't know, (f) Not mentioned

Q29. Are the sterilized needles used for giving injection in the hospital? Y / N

Q30. Are the disposable needles are used for giving the blood? Y / N

(D) GENERAL QUESTIONS

Q31, Will you suggest this hospital to your relatives and friends? Y / N

Q32. If yes, what are the reasons? (a) Good facilities, (b) Good doctor services, (c) Good nursing care, (d) Other reasons (if any)

Q33. Are you satisfied with the overall service of the hospital? Y / N

Q34. If not, what improvements do you expect for the IP care from the hospital?

(II)

PATIENT SATISFACTION (Outpatients):

(I) Outpatient waiting time at different points of service delivery:

Ql, How much time did you wait for following services? (in minutes)

(1) At registration counter:__________________

(2) Consulting the doctor:___________________

(3) For diagnostic report:____________________

(4) At pharmacy: __________________________

(II) Patient's perception regarding various aspects of services provided:

Q2. Was there adequate privacy during consultation? Y/ N

Q3. Did the doctor suggest any diagnostic test for you? Y / N

Q4. Did the doctor prescribed any medicine for you? Y / N

Q5. Did you get all the medicines at pharmacy? Y / N

(III) Patients' **satisfaction regarding behavior of hospital staff:**

Staff	Extre-mely cordial	Very cordial	Not very cordial	Just cordial	Not at all cordial	Don't know	Not mention ed
Doctor							
Nurse							
Paramedical							
Others							

(IV) Patients satisfaction on other services of the hospital:

Services	Excellent	Good	Fair	Average	Below average	Don't know	Not mentioned
Drugs							
Medical equipment							
Surgical equipment							
Bedding							
Food							

(V) Hospital cleanliness rating:

Q6. How frequently the following services are rendered?

(1) Cleaning of floors (a) Daily, (b) Once in two days, (c) Twice a week, (d) Weekly, (e) Not even weekly, (f) Don't Know, (g) Not mentioned

(2) Cleaning of toilets (a) Daily, (b) Once in two days, (c) Twice a week, (d) Weekly, (e) Not even weekly, (f) Don't Know, (g) Not mentioned

Q7. Are the dressing rooms sufficiently clean? (a) Extremely clean, (b) Very clean, (c) Not so clean, (d) Not at all clean, (e) Don't know, (f) Not mentioned

(VI) Patient perception on the availability of following basic facilities in the hospital

Q8. How is the water supply in the hospital? (a) Immensely available, (b) Quite adequate, (c) Not adequate enough, (d) Not at all adequate, (e) Don't know, (0 Not mentioned

Q9. Are the sterilized needles used for giving injection in the hospital? Y / N

(VI) General questions:

Q10. Will you suggest this hospital to your relatives and friends? Y / N

Q11. If yes, what are the reasons? (a) Good facilities, (b) Good doctor services, (c) Good nursing care, (d) Other reasons (if any)

Q12 Are you satisfied with the overall service of the hospital? Y N

Q13. If not, what improvements do you expect for the OP care from the hospital?

Name of the investigator:

Time taken for the interview:

Comments:

CHAPTER VII
SUMMARY AND CONCLUSION

In this thesis, we tried to examine three aspects relating to health sector in general and secondary level district hospitals in particular in Andhra Pradesh (AP) Two of these are relating to hospital performance and efficiency, and the third one to financing health services The performance of secondary level hospitals in AP was evaluated through combined utilisation and productivity analysis, a managerial technique, and hospital efficiency through estimation of hospital cost functions, a technique that is commonly used by heal h economists and policy makers in recent times The financing aspect was examined through a theoretical discussion accompanied by a field study to assess the feasibility of introducing user fees as an alternative to government financing of health services

The results of evaluating hospital performance and efficiency are broadly in agreement with similar studies for developing countries, namely public hospitals do suffer from the problem of low performance and allocative inefficiency The theoretical arguments of health services financing and the empirical results from a case study, though preliminary in nature, do not seem to support the introduction or expansion of user fees in secondary level district hospitals of Andhra Pradesh The details are as under

As a background to the present study, in Chapter I we gave a brief outline of health sector in India and Andhra Pradesh The efforts on improving health sector by the Government of India as well as AP during each five-year plan were also assessed. The need for the present study was justified The chapter ended with the two broad objectives of the present study, namely evaluating the performance/efficiency of secondary level hospitals in AP and examining the viability of introducing user fees in these hospitals.

In Chapter II, we gave a brief review of the past studies on health sector performance/efficiency in general and hospitals in particular In addition, the issues related to financing of health sector were mentioned briefly The studies on health sector performance and efficiency were grouped on the basis of countries as well as methods/issues As far as country-specific studies are concerned, it was observed that there are many studies for developed countries focussing on the issue of hospital performance and efficiency. In this process, there has been a substantial improvement in the methods of evaluating efficiency Unfortunately, there were not many studies for the developing countries

In Chapter III, we presented a detailed outline of the methods that are used for evaluating hospital performance and efficiency Among the methods used for evaluating hospital performance and efficiency, we came across the method of cost accounting, ratio analysis, combined utilisation and productivity analysis, econometric estimation of production and cost functions and data envelopment analysis Though each methodology has its merits and demerits, it was found that econometric method was more commonly used for efficiency evaluation both in developed and developing countries The reasons are understandable The econometric methods address issues of interest to economists, such as economies of scale and scope, product specific cost elasticities, in addition to assessing allocative and technical efficiency Moreover, other methods require detailed data on several variables that are not easily obtainable from the hospitals of developing and developed countries In spite of the usefulness of this method, we have not come across any published study in India Therefore, the specific objectives of the present study were (1) to evaluate the performance of secondary level district hospitals in AP through the application of CUP analysis. (2) to analyse the hospital efficiency using econometric estimation of cost functions, and (3) to assess the issue of hospital financing from theoretical as well as empirical perspectives

In Chapter IV, we gave a brief history of Andhra Pradesh Vaidya Vidhana Parishad (APVVP), which is the nodal agency for funding and monitoring secondary level district hospitals in AP A brief discussion on the hospital statistics data used for the empirical analysis of this chapter is also given We then tried to evaluate the performance of secondary level hospitals using combined utilisation and productivity (CUP) analysis CUP analysis was carried out for each category of secondary level hospitals, namely community, area and district level hospitals, separately for each year during 1991-96 as well as combined The methodology followed is similar to Lasso (1986)

The results of this analysis supported the general perception, namely low performance and wide differentials in performance indicators across hospitals in each category Variability of bed occupancy rate (BOR) and bed turnover rate (BTR) was much higher than average length of stay (ALS) A large number of the hospitals are either in low turnover and low-occupancy group (about 30-3.5%) or high-turnover and high-occupancy group (about 42%) Although the trends are not systematic, there is a tendency of the hospitals moving towards low utilisation and low productivity region over the years This indicates that the secondary level hospitals in the state of AP are associated with low performance and facilities This result is similar to that of Mahapatra and Berman (1994), who have studied the secondary level health care system in AP during

1989-90 It may be added that the methodology of CUP analysis could be used as a managerial tool for quick identification of low performing hospitals The low performing hospitals could further be investigated for finding out the appropriate reasons for their low performance However, major economic decisions could not be made on the basis of the results from CUP analysis.

In the same chapter, as an extension to CUP analysis, we also tried to identify the possible determinants of hospital performance indicators (BOR and BTR) using multiple regression technique In the absence of appropriate data on the demand and supply sides of hospital services (output), we treated BOR and BTR to represent these forces Further, we used the same set of determinants for both BOR and BTR It was found that, in the case of community level hospitals, where the data is rich enough, these determinants have played a significant and expected role in explaining the variation in both BOR and BTR Due to limited data available for area and district hospitals, some perverse responses were noticed Among other things, factors such as disease incidence pattern, geographical location, socio-economic conditions of the people surrounding the hospital, proximity of the hospital to the locality etc play an important role in determining the utilisation and productivity of the secondary level hospitals These factors seem to play a greater role in the case of district and area hospitals compared to community hospitals

The objective of Chapter V was to evaluate the efficiency of secondary level district hospitals through econometric estimation of cost functions using pooled time series of cross-section data for 1995 and 1996 We used five types of cost functions, namely simple cubic cost function, flexible hybrid cost function, and three variants of translog family (Cobb-Douglas, Logarithmic-quadratic and translog cost function) for this purpose For each of the cost functions, we estimated factor shares, factor levels, factor ratios, marginal cost, economies of scale and scope, Allen-Uzawa elasticity of substitution etc

In addition, the simple cost function was used to determine the shape of total, average and marginal cost curves for one particular output, namely inpatient days of the district hospitals in AP The marginal and average cost curves exhibited their usual 'U' shape as expected Unfortunately, the total cost function seems to violate the monotonicity property This violation may be due to cross-section nature of the data and the heterogeneity of hospital services in our study From the average cost curve, we traced the minimum point in order to find out the optimum values of output and cost A comparison of the optimum values across the hospitals shows that there are only four hospitals (Eluru, Cuddapah, Anantapur, Nizamabad in 1995 and Eluru in 1996) which are near to the optimum values of output and cost The hybrid cost function also gave similar results

The estimated factor- shares, levels, and ratios differ significantly from their respective observed values It is well known from microeconomic theory, that a wide difference between the observed and estimated factor levels indicates allocative inefficiency Thus, from the empirical results, we find that many of the secondary level district hospitals in AP seem to operate under allocative inefficiency of varying degree This result is also invariant to cost function specification. Overall results show that the district hospitals in AP over invest on manpower and under invest on other necessary inputs like drugs, materials, equipment and food We may point out that the observed inefficiency could also be due to market imperfections, particularly) in factor markets, rather than wrong decision-making by the hospital administrators It is also possible that cost minimisation may not be the sole objective of these public hospitals

Based on summary measures such as mean absolute percentage error (MAPE) and root mean percentage error (RMPE), it was found that the full translog cost function predicted the factor shares, levels and ratios more closely than the other two variants of translog family. The performance seems better for 1995 than for 1996 The nested likelihood ratio test has also shown that the translog model stands out at the best model statistically However, for all the estimated models, we computed the marginal cost of each output category in each of the sample hospitals For some of the outputs, the marginal cost was negative, implying violation of monotonicity property As a result, the product specific cost elasticities were also negative for such outputs Using product specific cost elasticities, we estimated the overall economies of scale We noticed a high degree of overall economies of scale in the provision of hospital services in AP Further, this result was independent of the specification of cost function The estimated economies of scope between different pairs of outputs also show a high degree of scope in producing the outputs jointly rather than individually

Chapter VI of the thesis discusses alternative ways of financing health services in the state of Andhra Pradesh Towards this end, first few sections of this chapter were devoted to recapitulate the current theoretical discussions on health sector financing Here, we discussed the nature of health-care good, its provisioning and financing sources It was concluded that the preventive health services must be financed through government sources, whereas for the curative services, in addition to government financing, other alternative sources may have to be identified In this context, a brief discussion was made on the alternative methods of financing the curative services in some of the developing and developed countries It was traced that 'user fees' seems to be the more frequently used way of financing the curative health services in many countries Therefore, an attempt is made to look at the viability of imposing user charges for the curative health services in AP.

Our examination of feasibility of imposing/expanding user charges has two steps First, through a brief assessment of the pattern of government health expenditure for the state of AP Second, an investigation of the demand side factors associated with hospital care by a field study The health expenditure analysis shows that the level of real expenditure on health and health-related services in AP has increased appreciably over the period, 1983-84 to 1995-96 However, its share out of government expenditure has not increased much The expenditure on primary health care seems to be higher compared to expenditure on hospitals, medical education and training, and alternative systems of medicine Greater emphasis on primary health care, which is mostly preventive care, is consistent with the objective of achieving 'health for all by 2000' However, the per-capita annual expenditure on health was found to be much below the WHO norm of US$15 Therefore, given the budgetary constraint of the government for allocating additional resources, there exists the need for supplementing, if not fully self-financing, the curative health services in AP

The idea of user fees started with the birth of APVVP itself in 1986 But, it never took off The share of user fees out of health expenditure has still hovered around l% in 1995 and 1996 across all district hospitals In the field study, we looked at two major aspects that are closely connected to the imposition and collection of user fees, namely the socio-economic profile of the hospital users and the quality of care provided by the hospital The study had a sample of 125 inpatients and 125 outpatients from Karimnagar district hospital in AP.

It was found that most of the hospital users were either from lower or lower-middle class, with monthly household income between Rs. 1500-3000 in 1995 Almost all the hospital users were either illiterate or had education below secondary- level Further, the quality of care, as perceived by users, is merely satisfactory and does not merit any worthwhile fees Most of the recurrent inputs such as medicines & drugs, dressing materials, and other consumables including food, were found to be severely under funded, thereby implying low quality of care Likewise, though the patients seem to be somewhat satisfied with the services of the doctors, nurses and other medical staff, the same is not true with basic facilities such as water supply, sanitation and cleanliness In almost all the cases, patients seem to be tolerant of these facilities due to their low economic condition Therefore, it is concluded that user fees is justified only if there will be significant improvement in all the above mentioned aspects

Another way of justifying the user fees may be on the basis of whether the patients bypassed the lower level facility before coming to the district hospital If the patients bypass the lower level community and area hospitals, a penal charge may be levied Like the existing user fees, this may not result in any significant COST recovery Moreover, patients claimed that they had no option but to bypass lo\ver level facilities because of either non-availability of the required service at community/area hospital or the severity of the illness requiring speciality treatment If this were true, then there is no justification for penal levy either Thus, from all counts, imposition of user fees may not be justified as matters stand Then, what are the possible ways of meeting the health sector expenditure[9] Two suggestions come to our mind

(a) Restricting the government run facilities for the poor This may help in reducing the number of nursing and other staff, the savings from which can be spent in strengthening the lower level facilities that are cost effective

(b) The government may improve the quality of care to attract the better off patients In this case, the government may follow discriminatory pricing, where the better off people could be charged cost recovery rates, thereby subsidising the low-income people

The present study was a preliminary attempt to investigate the issues of efficiency and financing of health services in Andhra Pradesh The field survey undertaken here covered only one hospital located in a backward district In order to extend the findings to the whole of Andhra Pradesh, probably some more hospitals may also have to be covered in similar surveys Though we made an attempt to cover most of the aspects related to health sector efficiency, due to data and other limitations some of the major issues like quality of hospital care, case mix issues etc could not be covered in this study The future research needs to take these issues into consideration Furthermore, more recent techniques such as frontier cost and production function or data envelopment analysis could be used for evaluating technical and economic efficiency in a more meaningful way A more detailed analysis of the factors affecting the performance indicators such as bed occupancy rate (BOR) and bed turnover rate (BTR) will enable the hospital administrators and policy makers to draw useful conclusions from the CUP analysis

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