Household Expenditure on Health Care in India : An Econometric Analysis

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ABSTRACT: In this study, household expenditure on medical care in India has been identified and categorized according to the sources (Govt. and Private) as well as the sectors (Urban and Rural), on the basis of published survey data on 15 Indian states. The expenditures in all categories were assumed to be determined jointly by different sets of socio-economic, demographic and health-infrastructure variables within the health service system. An econometric model has been specified to estimate the relevant parameters. The results show varying impacts of each variable on average household expenditure on health, by different sectors and sources.

INTRODUCTION

The relationship between household expenditure on health care and several economic and non-economic variables is one of the current research issues being addressed by health economists. However, the econometric studies related to this problem mostly focus on international comparison of health expenditure on the basis of cross-section or pooled data received from developed and developing countries (See Mcguire *et al* (1993) and Murillo *et al* (1993) for a brief review of literature). The potentiality of using econometric tools to analyze the determinants of national health or medical expenditure, especially in India, still remains unexplored, possibly due to insufficiency of household data for conducting such macro analysis.

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Two recent surveys, the first by National Sample Survey (NSSO, 1992) and the second by National Council of Applied Economic Research (NCAER 1992), have come up with much information regarding the household health expenditure pattern in India. Recently, Purohit and Siddiqui (1994) have analyzed this new data base to explore the utilization aspects of health services in India. This has been done on the basis of classification of the states into three categories, *viz.*, low, medium, and high expenditure groups. The focus of the study is on the comparative analysis across these categories, not on identifying or estimating the general pattern of the relation between the household health expenditure and its determinants in the nation as a whole.

The present study focuses on the major determinants of the health expenditure in India, using the most recent data base (i.e., the NCAER study). An econometric model is specified, where average household expenditure on health is linearly associated with various socio-economic, demographic, and infrastructural factors. The model has been estimated, and different elasticity estimates of expenditure (or, utilization) have been derived.

Given the ongoing structural changes and growing influence of the private sources of medical care facilities on the utilization pattern of health care in India, the analysis of household expenditure at the sectoral level (e.g., urban and rural) and at the source level (e.g., government and private hospitals) is urgently required for providing more precise information towards the macro policy-making process. As revealed by the surveys, the expenditure varies significantly not only across the states, but also across the sectors and sources.[1] This raises some important questions which need to be addressed before formulating a national health policy. For example, what should be the optimum allocation rule for public health expenditure in the urban

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1. Throughout this study, the expenditure on health care has been classified on the basis of the 'sectors', *viz.*, the rural sector and the urban sector, and the 'sources' from where the medical care has been bought, *viz.*, private sources (or, private hospitals) and government sources (or, government hospitals). Thus, there are four combinations, e.g., expenditure on health care on the private sources in the urban sector, and so on.

and the rural sectors? Or, is health care provided by the private sources, in both the sectors, a luxury good? The present paper is an attempt to provide precise quantitative information to help address these and other issues.

The following section deals with the method of estimation and the data used in the next section. Finally, in the concluding section, the limitations of the study and some of its implications for policy and future research are discussed.

METHODS AND DATA

The Model

The specification of the model is based on the assumption that the variations in real health care expenditure across the states may be attributed to the variations in the factors that describe the socio-economic, demographic and health infrastructure conditions of the country. It is also assumed that the average price index of medical care is the same across the states.

The econometric model of the health care expenditure on each source (government and private) in each sector (urban and rural) for t-th state can be presented in the form of a system of the following four equations:

(1) $GUEXP_t = f_1(UPQLI_t, UILL_t, UBED_t, UDEP_t, NDP_t, STEXP_t).\ exp(\Sigma_{1t})$

(2) $GREXP_t = f_2(RPQLI_t, RILL_t, RBED_t, RDEP_t, PHC_t, NDP_t, STEXP_t).\ exp(\Sigma_{2t})$

(3) $PUEXP_t = f_3(UPQLI_t, UILL_t, UBED_t, UDEP_t, NDP_t, STEXP_t).\ exp(\Sigma_{3t})$

(4) $PREXP_t = f_4(RPQLI_t, RILL_t, RBED_t, RDEP_t, PHC_t, NDP_t, STEXP_t).\ exp(\Sigma_{4t})$

where f_i (.) is a multiplicative function with parameters as exponents of respective variables (i = 1, 2, 3, 4), and

$GUEXP_t$, $GREXP_t$ = Average real household expenditure on government hospitals (in 1982 prices) in the urban and the rural sectors respectively in the t-th state.

$PUEXP_t$, $PREXP_t$ = Average real household expenditure on private hospitals and clinics (in 1982 prices) in the urban and the rural sectors respectively in the t-th state.

$UPQLI_t$, $RPQLI_t$ = Physical quality of life index[2], formed by a simple average of the data on three attributes, *viz.*, literacy rate, infant mortality rate and percentage of population above the poverty line, in the urban and the rural sectors respectively in the *t*-th state.

$UILL_t$, $RILL_t$ = Prevalence rate of illness (Per '000 population) in the urban and the rural sectors respectively in the *t*-th state.

$UBED_t$, $RBED_t$ = Population per bed in hospitals in the urban and the rural sectors respectively in the *t*-th state.

$UDEP_t$, $RDEP_t$ = Percentage of population of age 60 years and above in the urban and the rural sectors respectively in the *t*-th state.

PHC_t = Rural population per rural PHC in the *t*-th state.

NDP_t = Per capita real state net domestic product (in 1982 prices) in the *t*-th state.

$STEXP_t$ = Per capita real state health expenditure (in 1982 prices) in the *t*-th state.

E_i = Stochastic disturbance corresponding to the *i*-th equation (i=1, 2, 3, 4).

Note that several important factors have not been explicitly included in the list of the independent variables of the model, to avoid severe multicollinearity problem. For example, the variables representing the population-doctor ratio and the average distance from the nearest hospital could not be included, since they are believed to be strongly correlated with the population-bed ratios (UBED and RBED). Similarly, to maintain the parsimony of the model, the variables representing infant mortality, literacy and income distribution have not been considered explicitly; instead, the variables UPQLI and RPQLI (which represent all of them) have been used.

Hypotheses

In the above model, household expenditure on health, by different sources/sectors, has been hypothesized to be the product of different but interrelated decision-making processes.

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2. The index is designed and applied by the social scientists primarily to measure the performance of the world's developing countries in meeting the basic needs of the people (Unisa, 1990).

These processes are defined on the basis of interaction among the variables within a set of socio-economic, demographic, and infrastructural indicators. In the present study, NDP, STEXP, UPQLI and RPQLI have been used to define the socio-economic condition; UDEP, RDEP, UILL, and RILL are used to represent the health/ demographic condition; and, PHC, UBED, and RBED are used to indicate the health infrastructure of the country, by states.

It is natural to suppose that, in a developing country like India, the income elasticity at the macro level may exceed unity, i.e., the percentage of total disposable income of a household consumed for health care, would rise with the increased availability of income[3] (Over, 1991). But, when consumption is disaggregated according to the sources from where the health care is bought, the income elasticities may be different, and may even have opposite signs. As per the people's perception about the quality of health care in the private hospitals and clinics, it has been hypothesized that the income elasticity would be greater than unity for the private sources and less than unity for the government sources. The same hypothesis holds for physical quality of life index, the other socio-economic indicator.

In the context of international health care cost analysis, Leu (1986) suggested that health care expenditure should increase with the share of public finance, assuming implicitly that increased government financing reduces the price of medical care to the consumer. Within a national framework, however, it is difficult to adopt such a hypothesis unless we know how efficiently the increased financial resources are being utilized. Also, the question remains whether it affects the utilization pattern in the urban and the rural sectors in a similar way. Although the complexities of the public health financing system in India can hardly be expressed by a single variable, we can expect that increased per capita real state health expenditure tends to reduce the demand for private health care and, hence, the expenditure on it.

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The morbidity factor and the percentage of population above 60 years of age are instrumental in causing variations in health care expenditure across the states. It is expected that, all other things remaining the same, variations in these factors tend to have a positive effect on the variation of the expenditure for all sources/ sectors.

The model includes five other variables on two attributes of health infrastructure, *viz.*, the population-bed ratio and the population-PHC ratio (in the rural sector). The variation in these attributes in India is caused mainly by the investment strategy of earlier plans of the government and the private sectors (Berman, 1991). Since almost 70 per cent of total beds are in government hospitals[4] and utilization of free-of-payment services to the hospitalized cases in public hospitals is very high (Purohit and Siddiqui (1994)), it is expected that a decline in population-bed ratio would lead to higher utilization of services from government hospitals, especially in rural areas.

Procedure

The model contains four endogenous variables, *viz.*, GUEXP, GREXP, PUEXP, PREXP. Since several unmeasurable factors, which are not explicitly included in the model, may affect the disturbances of all the expenditure functions,[5] it may be more efficient to estimate all equations jointly by Zellner's seemingly unrelated regression (SUR) method,[6] rather than estimate each one separately, using least squares. In the present context, on the basis of the assumption that the random disturbances follow a multivariate normal distribution, the iterative SUR procedure was applied to derive the efficient set of estimates. To test whether correlation among the equations really exists, standard Lagrange multiplier test[7] was carried out after the estimation.

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4. See Health Monitor (1993), vol. 1, no. 1, p-108.
5. For example, people's attitude towards medical care facilities, social awareness, environmental hazards, etc.
6. See Judge *et al* (1988, pp 444-462) for the description of the method.
7. The test statistic is computed in the following way:
   LM = TR2
   where, T = Number of observations in an equation,
   R2 = Sum of estimated correlation coefficients between the residuals of each pair of equations. Under H0 (i.e., no correlation), LM is asymptotically *Chi*-squared, distributed with M(M-1)/2 degree of freedom, where M = number of equations.

The functional form in Equations 1-4 implies that the estimation requires double-log transformation of the model. Apart from flexibility in the specification, this has the additional advantage of deriving the estimates directly in elasticity forms.

Data

The study utilized NCAER sample survey data on household expenditure for medical care (GUEXP, GREXP, PUEXP and PREXP) and prevalence rate of illness (UILL and RILL). The survey was conducted in 1990, and it consisted of 18,102 households, spread over 21 states and union territories in India. The estimated state level (average) expenditure data on health for each source/sector was computed by putting the percentage of respondents as weightage.

Data on physical quality of life index (UPQLI and RPQLI) was taken from *"Special Statistics-8"* provided by EPW Research Foundation and published in *Economic and Political Weekly* (May 21, 1994). The index was computed by the foundation, using data on infant mortality, literacy rate and percentage of population above the poverty line. Data on health infrastructures (UBED, RBED, PHC), and socio-economic and demographic indicators (UDEP, RDEP, NDP, STEXP) has been taken from *Health Monitor* (March, 1994) and *Health Information India* (1993). CPI (1982=100) has been used for necessary deflation of the variables GUEXP, GREXP, PUEXP, PREXP, NDP, and STEXP.

The final model has been able to utilize the data for 15 major states because, for the remaining states and union territories, the data for all the variables were not available. Summary statistics for variables used in the final analysis are reported in Table 1.

TABLE 1

Means and Standard Deviations of the Variables Used in the Model

Variables	Mean	S.D.
GUEXP	32.543	24.023
GREXP	56.177	42.190
PUEXP	54.755	22.968
PREXP	50.975	29.999
UPQLI	43.883	19.786

Variables	Mean	S.D.
RPQLI	41.909	21.331
NDP	1965.600	629.020
STEXP	33.746	8.129
UDEP	4.855	.674
RDEP	6.186	1.058
PHC	29256.000	8519.000
UILL	71.339	32.968
RILL	75.771	35.174
UBED	449.320	147.350
RBED	14765.000	12443.000

RESULTS

Table 2 shows the parameter estimates obtained from the iterative SUR method. Since the variables were converted into their natural logarithms, the coefficients can be interpreted as estimated elasticities. With few exceptions, the estimated coefficients are significant at the 5 per cent level or less and have the expected signs. The estimated LM statistic is 15.59.

TABLE 2

SUR Estimates for Parameters in the Health Care Expenditure Model*

Independent Variable	Equation/Dependent Variable			
	Eq. 1 log (GUEXP)	Eq. 2 log (GREXP)	Eq. 3 log (PUEXP)	Eq. 4 Log (PREXP)
CONSTANT	23.080	36.717	-6.450	-6.971
	(2.897)	(4.375)	(1.390)	(.626)
log (UPQLI)	0.119	-	0.744	-
	(0.241)		(2.593)	
log (RPQLI)	-	- 0.697		-1.123
		(3.333)		(3.821)

Independent Variable	Equation/Dependent Variable			
	Eq. 1 log (GUEXP)	Eq. 2 log (GREXP)	Eq. 3 log (PUEXP)	Eq. 4 Log (PREXP)
log (UBED)	-0.759	-	0.432	-
	(1.216)		(1.385)	
log (RBED)	-	-1.002	-	0.334
		(5.618)		(1.387)
log (UILL)	-0.362	-	0.536	-
	(0.767)		(1.898)	
log (RILL)	-	-1.507	-	0.931
		(4.424)		(2.150)
log (UDEP)	-3.609	-	3.635	-
	(2.434)		(4.844)	
log (RDEP)	-	-0.454	-	0.381
		(0.671)		(0.423)
log (NDP)	-2.009	-2.614	1.186	0.441
	(2.581)	(4.512)	(2.383)	(0.642)
log (STEXP)	1.895	0.269	-3.402	-0.878
	(1.490)	(0.279)	(4.619)	(0.727)
log (PHC)	-	0.460	-	-0.123
		(1.393)		(0.285)
R^2	0.65	0.71	0.59	0.62
LOG(L)	-21.0388			
LM	15.592			

** Figures in parentheses are asymptotic t-ratios.*

The 5% critical value from the *chi*-squared distribution with 6 degrees of freedom is 12.59. Hence, we reject the null hypothesis and conclude that correlation among the equations does exist (thereby justifying the application of the SUR method). Physical Quality of Life index (in log terms) is observed to have a significant positive effect on expenditure for private health care sources in both urban and rural sectors. This indicates that higher literacy rate or lower infant

mortality rate defines a socio-economic situation which encourages more expenditure on private hospitals and clinics.

The estimated coefficients of log (NDP) can be interpreted as income elasticities. The result shows negative elasticity for government sources in both the sectors and positive elasticity for private sources in the urban sector. This helps us infer that health care from government sources is treated as an inferior good, while the same from private sources is a luxury good. Specifically, all other things remaining the same, a 1 per cent increase in per capita real income would lead the urban health care expenditure on private sources increase by 1.19 per cent, and the same on public sources decrease by 2 per cent.

The effect of state expenditure on public health was found to be non-significant on GUEXP, GREXP and PREXP. However, it was statistically significant for PUEXP with a high and negative elasticity estimate. More specifically, a 1 per cent increase in per capita state health expenditure is expected to reduce household expenditure on health care on private sources in the urban areas by 3 per cent.

The rate of illness significantly affects the variation in the expenditure in the rural sector. While the elasticity has the expected positive sign with values 0.54 and 0.93 in Equations 3 and 4 (i.e., for PUEXP and PREXP respectively), the negative sign in the case of government sources is hard to explain with the present level of information. However, this result should be taken with caution, since the survey data (NCAER, 92) covered the prevalence rate of illness during the pre-monsoon period only (excluding the monsoon and the winter months).

The age factor seems to be highly significant in the urban sector. Here again, the negative elasticity (-3.61) for the government sources points to the need for further exploration.

Finally, the population-bed ratio is observed to be statistically significant with the expected negative sign (-1.00) only for the expenditure in the rural sector government hospitals.

CONCLUSION

The above analysis presents a simplified framework of the process of determining household expenditure on health care in

India. Several indicators of socio-economic, demographic, and infrastructural conditions of different sectors of the states were hypothesized to be the determinants of household health expenditure. A system of four equations was specified, where each equation represented the real household expenditure on health care in a sector on the private or the government sources. The correlation among the equations was found to be statistically significant. A simultaneous estimation process produced different elasticity estimates for any specific variable across the equations. Income elasticity estimates showed that health care from private sources was a luxury good in the urban sector, while the same from the government sources was inferior. State expenditure on health care appeared to have a negative effect on the utilization of health care provided by private hospitals. An improvement in physical quality of life in both the sectors was found to lead to higher consumption of private health care.

There remain a few limitations of this study for which the results are to be interpreted with caution: (a) The purely statistical basis of the analysis leaves a number of issues addressed incompletely. For example, the qualitative differences of health care output between the sources and the sectors could not be assessed and taken into account, due to the restrictive nature of the model; (b) the existing literature on aggregate economic behaviour of the consumers in the health care market is grossly insufficient to come up with definite irrefutable hypotheses; this has limited the scope of the present study; and (c) the study utilizes information on only 15 states. The small sample, coupled with a set of data which may have significant aggregation bias, weakens the reliability of the statistical estimates. Therefore, the results of this study should be considered as conditional on the assumptions of the econometric model used in the study.

The study has a few implications for macro health policy research and management. It is obvious from the study that disaggregation of health expenditure, with respect to the sectors and the sources of treatment, adds new dimensions to the measurement of demand for health care in countries like India, where medical care facilities and people's perception significantly vary with respect to the sources and sectors. Also, the great deal of variations in elasticity

stimates, as found in this study, may help formulate a national health olicy with sectoral and source-wise diverse action plan.

The limitation of cross-sectional study, *viz.*, the small sample ize as encountered in this study, can hardly be overcome by using nore sophisticated econometric tools. Since the sample size is mited by the number of states, future research should be guided owards utilizing information on intertemporal (as well as cross- ectional) variations in state-wise health care expenditure. Time- eries econometric tools would be useful in explaining seasonal ariations, as well as the long-run trend of expenditure. In the absence f time-series survey data on household expenditure, future research hould be directed also towards exploring the potential of secondary ime-series data bases on average state expenditure on health.

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