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Determinants of state level financing of health: Panel data evidence from Southern Indian states

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ABSTRACT

The paper empirically examines the important factors determining states' expenditure on medical and public health and total health expenditure, verifies the importance of federal transfers and observes whether health is a luxury in India. To this end, a panel data set for four southern Indian states for the period 1993-94 to 2009-10 is used. Double log multiple panel regression equations have been specified for analysis. Feasible generalized least square estimator has been employed to estimate the coefficients with the option of first order panel specific auto-regressions. The findings suggest that the change in health spending of the southern Indian states are mainly determined by the states' resource capacity, availability of resources in terms of central transfers and due to the pressure from demand side factor like higher infant mortality rate. The health is not luxury in Indian context, as the income elasticity of aggregate health expenditure is found to be 0.697. The paper calls for strengthening states' resource capacity, and sanction of more specific purpose central grants for increasing state spending on health.

Keywords: States' health spending, Determinants of health expenditure, Federal transfers, FGLS, Panel Data Econometrics

JEL Classification: I18, H51, H77, C23

1. Introduction

Adequate financing of health has serious implications for quality health care provisions. The mid-term appraisal of the Tenth Plan of government of India highlights that increasing the level of expenditures on health in many states has assumed significant importance in achieving millennium development goals (MDGs) and Tenth Plan objectives (Choudhury,2006). The resource availability and financing pattern for health are critical in determining indicators of health and relative development of health services in the country.

In Indian context, the presence of externalities and asymmetry of information is more common in provision of health care and it can lead to market failure. Thus, there is a need of state intervention for optimal provision of health services. Further, In India as nearly 27 percent of total population still lives below poverty line (BPL), and a major section of people lacks capability to finance their health out of pocket spending, government spending on health is essential. Hence, role of public sector and public spending on health have vital roles and receive more attention of researchers and policy makers for analysis.

In India health is in state subject, that is the item; "Pubic health and sanitation, hospitals and dispensaries" is placed under the State List in the 7th Schedule to the Constitution of India. Hence, the analysis of public health expenditure of the state governments' assumes greater significance. Government intervention in health sector is not adequate, given the nature and demand for health care. Considering the deterioration of state finances, increased non-developmental spending, states are forced to spend a less proportion of their revenue income on health care services and other health related aspects. In this perspective, it is worth to examine how socio-economic situations in states influence the public expenditure on health.

Though the health related indicators in southern states[1] are relatively better among Indian states, considering the people below the poverty line and low capacity of people to finance for health, role of government and analysis of the public spending on health are extremely important. Besides, Southern Indian states being middle-income states can form ideal case studies to reflect the factors that determine health spending in India.

In this context, the paper looks at examining major economic and need based factors determining states' total expenditure on health and specifically expenditure on medical and public health in southern states of India. The main objectives of this paper are:

(i) to examine the main factors determining total public health expenditure and expenditure on medical and public health in southern Indian States;

(ii) to observe how the resource transfers from centre influences the health expenditure of these States; and

(iii) to observe whether health is a luxury.

The rest of the paper is structured as follows. Section-2 reviews relevant literature pertaining to the study. Section-3 explains the data and variables used in the study. Model specification

[1] Among the southern states, Kerala has already achieved the millennium development goals (MDGs) pertaining to health indicators like MMR and IMR. Tamil Nadu is also joining with Kerala by crossing the bench-mark in 2007. Though, Andhra Pradesh is close in achieving the MDGs targets, Karnataka is still lagging behind. However, in terms health outcomes, southern states perform better than the all states' average. For details, see sample registration system reports, Registrar General, GOI, 2011.

and estimation techniques are outlined in section-4. Section-5 provides empirical results and necessary discussion. Robustness checking of results is done in section-6 and section-7 concludes the study.

2. Literature review

A large body of literature at international level examines the health expenditure determination in a multi-country perspective. Studies like those of Leu (1986), Hitiris and Posnett (1992), Gerdtham et al. (1995), Zeynep (2000) and Sen (2005) examined various issues and factors influencing health expenditure in OECD countries and verified whether health was a luxury. In the above studies, the important variables that significantly affect public spending on health were identified as per capita income and ageing. While, Some studies like Newhouse, 1977; Gbesemete and Gerdtham 1992; Hitiris and Posnett, 1992; and Wilson, 1995 found income elasticity of health expenditure was equal to or more than unity. Others like, Gerdtham et al. 1995; Casanovas and Saenz, 1998; Font and Novell, 1999; and Sen, 2005 found the income elasticity of health expenditure was less than unity and they declined to state health as a luxury good.

In Indian context, sparse literature addresses the issues of health care expenditure and its determinants. Bansal (1999) examined health expenditure of central and state governments and found that health expenditure exhibited an increasing trend in all states and there was a wide interstate variation in allocation of per capita resources to health care. Guruswamy et al. (2008) examined the levels, trends and patterns of public expenditure on health for the period 1995 to 2006.and found that public expenditure on health as a proportion of GDP had remained stagnant over the years, and revenue expenditure accounting for the larger share. Some studies like Bhat and Jain (2004); and Rahman (2008) empirically verified the determinants of public health expenditure in Indian states. Their findings suggested that per capita income was the important factor determining health expenditure and health was not luxury in Indian states.

From the analysis of the afore-mentioned literature it is observed that there exist numerous health expenditure determinants studies at international level, while little attention has been paid to the dynamics of state level health expenditure determination in india. Further, existing studies suffer from lack of using an appropriate measure of public health expenditure which can include all possible important components of government spending to promote health services. The determinant studies are mainly analysed with older data set and they do not consider an appropriate econometric technique for analysis.

3. Data and Variables

An annual dataset for analysis is obtained from various secondary data sources for four southern Indian States for the period of 1993-94 to 2009-10. The States selected for the study are Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. Per capita aggregate public health expenditure and per capita expenditure on medical and public health are alternatively used as dependent variables in the model to analyze the determinants of public health expenditure. The explanatory variables used in different regression models are mainly certain resource based, demand and supply based factors like Per capita GSDP, per capita revenue transfers from centre, infant mortality rate, population and number of primary health centre. While infant mortality rate, population and primary health centre are used in number, all other dependent and explanatory variables are expressed in terms of per capita Indian rupees and adjusted with the base year price of 1999-2000.

Gross State domestic product (GSDP) data at current prices and constant prices in the 1993-94 series and 1999-2000 series are obtained from the Central Statistical Organization (CSO). The 1993-94 series data are converted into 1999-2000 series by splicing the indices to make them comparable with the CSO in the 1999-2000 series data. Comparable GSDP (in per-capita terms) at constant price (1999-2000 prices) has been used in the study. The data for infant mortality rate have been drawn from Sample Registration System, Registrar General of India. Mid-year population data are obtained by interpolating population data from Census of India (Registrar General of India).

In the study, Per capita revenue transfers from centre is obtained by normalizing total revenue transfers by mid –year population. The revenue transfers from centre include the transfer of resources in terms of sharing taxes and grants. However, loans mediated to States from the Centre are not taken into account, as they are not strictly transfers. Aggregate public expenditure on health includes both revenue expenditure and capital disbusements on the following components: (i) medical and public health; (ii) family welfare; (iii) nutrition; and (iv) water supply and sanitation.

The data for transfers, various components of health expenditure are obtained from different issues of the *RBI Bulletin*, and *State Finances - A Study of Budgets*. Price deflator is recovered from the ratio of current to constant price GSDP figures. The price deflator and mid-year population figure are used to convert the fiscal data to constant price terms (with 1999-2000 prices as base) and to per capita terms respectively, wherever necessary. Data pertaining to number of primary health centres are obtained from Centre for Monitoring Indian Economy (CMIE).

The variables used in the study with their abbreviation and the summary statistics are reported in table-1. The data set includes 68 observations for each variable spanning across four states over 1993-94 to 2009-10. The standard procedure of reporting over all mean values, standard deviation along with minimum and maximum values for each variable is adopted.

TABLE 1. Statistical summary

Variable	**Abbreviation**	**Obs.**	**Mean**	**S.D.**	**Min.**	**Max.**
Per-capita Aggregate Public Expenditure on Health	PCPEH	68	330.01	123.68	107.56	641.76
Per-capita expenditure on Medical and public Health	PCMPH	68	157.17	61.91	60.03	337.24
Per-capita Gross State Domestic Product	PGSDP	68	21,559.26	5,563.25	13,441.93	37,507.47
Per-capita Revenue Transfer from Centre	PCRTC	68	885.34	474.08	352.36	2,228.52
Infant Mortality Rate	INFMR	68	44.63	19.73	10	67
Population	POPLN	68	55,600,000	16,500,000	29,900,000	82,100,000
Primary Health Centre in Number	PHCNO	68	1,419.28	381.03	918	2,423

Source: Calculated by the author using Stata 10.1 (Basic data from various issues of *RBI Bulletins; State Finance- A Study of Budgets*, RBI; Census; and CSO reports).
Notes: Obs-observations; S.D. - standard deviation; Min. - Minimum and Max. - Maximum values.

4. Model Specification and Estimation Techniques

Selection of an appropriate econometric model is important for an empirical study. Considering the data set in the present study, panel data econometric models have been used to analyze the determinants of public health expenditure. The Panel models or the covariance models are found to perform better than conventional models based on a single dimension (either time-series or cross-section) data. In these models the quality of parameter estimates might be better, as pooled sample permits the incorporation of specificities of individual States or time in the model.

Before proceeding to specification of model and selection of estimation procedure to analyse the objectives, correlation matrix is computed to analyze the correlation among the explanatory variables. The variables which are highly correlated are omitted from the model. Correlation matrix of the variables used in study is presented in table - 2. All the coefficients except PCRTC are within limits, indicating that no serious multi-collinearity problem would emerge in the estimation of the panel models. The correlation coefficient of PCRTC and PGSDP found to be slightly higher at 0.6563. Considering the importance of these variables in modelling health expenditure, both the variable are included. However, excluding one of these from the model does not affect the regression results.

TABLE 2. Correlation matrix of explanatory variables

Variable	**PGSDP**	**PCRTC**	**INFMR**	**POPLN**	**PHCNO**
PGSDP	1.0000				
PCRTC	0.6563	1.0000			
INFMR	-0.4971	-0.1612	1.0000		
POPLN	-0.1477	0.1874	0.4826	1.0000	
PHCNO	0.0767	0.3397	0.4213	0.3976	1.0000

Given these considerations, the panel model specified to empirically examine the determinants of public health expenditure is:

$$\ln(PCHEX_{hit}) = \beta_0 + \beta_1 \ln(PGSDP_{it}) + \beta_2 \ln(PCRTC_{it}) + \beta_3 \ln(INFMR_{it}) + \beta_4 \ln(POPLN_{it}) + \beta_5 \ln(PHCNO_{it}) + \lambda_i + \mu_t + \varepsilon_{it}$$

where,

$PCHEX_h$ = per capita health expenditure of type h; and h = 1, 2;
$PCHEX_1$ = per capita aggregate public expenditure on health (PCPEH);
$PCHEX_2$ = per capita expenditure on medical and public health (PCMPH);
PGSDP = per capita GSDP;
PCRTC = per-capita revenue tansfer from Centre;
INFMR = infant mortality rate per thousand live births;
POPLN = population;
PHCNO = primary health centre in number;
i = 1…….4; t = time (1, 2, 3,…, 17); t = current year; i = State;
ε= random error terms; λ and μ = panel specific effect; β_0 = intercept coefficient; and $\beta_{1\ldots\ldots} \beta_5$ = coefficients of explanatory variables.

The explanatory variables taken in the model can have both temporal and spatial variations. But, there are certain determinants which vary in one dimension. State specific dummies are included (vector λ_i in the equation) to control for time invariant and state specific unobservable explanatory variables like institutions, geographical and factors. Similarly, over time the Central government brings certain policy changes or schemes for health and implements them across states. The impact of such policies, which are state invariant and time specific are incorporated in the above equation by the vector μ_t by including time dummies. The unexplained variations in the regression are controlled by the error term ε_{it} which is assumed to be normally distributed, homoskedastic and independent across observations.

The table-3 shows the hypothesized relations and signs of the variables of interest with the various components of health expenditure as dependent variables. This is derived in tune with analyzing the relationship between health expenditure and explanatory variables selected in the study.

TABLE 3. Expected signs

Dependent Variable →	**PCPEH**	**PCMPH**
PGSDP	+	+
PCRTC	+	+
INFMR	+	+
POPLN	+	+
PHCNO	+	+

Note: '+' indicates positive relationship.

Considering the cross-sectional and time series nature of data used in the present study, the standard Ordinary Least Squares (OLS) assumptions of independent and identically distributed errors is unlikely to be satisfied. Further, the problems of heteroskedasticity and autocorrelation are most likely to occur since the panel data have both temporal and spatial dimensions. In the presence of heteroskedasticity and serial correlation, feasible generalized least square (FGLS) will help to yield efficient estimators (Wooldridge, 2002). In the present study, FGLS estimator has been employed to estimate the coefficients with the option of first order panel specific auto-regressions in order to correct for first order autocorrelation within specific panels. The condition pertaining to dataset required for FGLS estimation is that the number of years should exceed the number of groups. In the present study this condition is met well as the number of years (17) exceeds the number of states (four). As robustness checking of results, alternate estimation technique like Panel Correcting Standard Errors (PCSE) and estimation of the data at levels are adopted.

5. Empirical Results and Discussion

Per capita public health expenditure and per capita expenditure on medical and public health are alternatively regressed on a set of explanatory variables. The results of the estimated regression equations are presented in table 4.

TABLE 4. Determinants of public expenditure on health: FGLS Panel estimation results (Log-linear specification)

Dependent Variable →	**(1)** ***ln*(PCPEH)**	**(2)** ***ln*(PCMPH)**
ln(PGSDP)	0.697***	1.473*
	(1.79)	(5.02)
ln(PCRTC)	0.436**	-0.005
	(2.25)	(-0.06)
ln(INFMR)	0.385**	0.158***
	(2.09)	(1.76)
ln(POPLN)	1.716	-0.285
	(0.71)	(-0.22)
*ln(*PHCNO)	-0.053	0.080
	(-0.24)	(0.75)
Constant	-35.99	-5.80
	(-0.83)	(-0.25)
Wald Test	597.33	2275.43
P-value	0.000	0.000
State Effects	Yes	Yes
Time Effects	Yes	Yes
Number of Observations	68	68

Notes: t-values are given in parentheses; *, ** and ***denote significance at 1%, 5% and 10% level respectively; and state and time dummies are included in regression

Source: Calculated by author, using Stata 10.1 (Basic data from various issues of *RBI Bulletins; State Finance- A Study of Budgets*, RBI ; Census; and CSO reports).

Table-4 shows the factors influencing the size of health expenditure in Southern Indian states. Among all the variables of interest, while PGSDP, PCRTC and INFMR emerged significant for per capita aggregate public health expenditure (PCPEH), PGSDP and INFMR are found to be significant for per capita expenditure on medical and public health (PCMPH). The sign of the coefficients of these variables are obtained in desired line and found to be positive. The variables like POPLN and PHCNO found to be insignificant for both the dependent variables. The results indicate that the public expenditure on health in southern Indian states is determined by the change in resource capacity of the states and resource availability in terms of Central transfers. Increase in infant mortality rate pressurised the states to increase their health spending.

The change in per capita GSDP of a state in real terms tends to change its taxable capacity and hence tax revenue. So the state can spend more on different aspects of expenditure including the health along with the change in its fiscal capacity. Further with the rise in per capita income people may demand for quality health care services. When GSDP of the state expands, the service sector including health also expands. In the model per capita GSDP (PGSDP) is found to be significant and positively influences state's spending on medical and public health and total spending on health as well. One percent increase in GSDP in percapita rupees increases per capita total health expenditure by 0.697 percent and per capita spending on medical and public health by 1.473 percent. Income elasticity of government expenditure on medical and public health exceeds unity. This may be due to the facts: (i) the baseline spending on medical and public health is low and (ii) when resource capacity of states expand due rise in income, government increases expenditure on medical and public health more proportionately considering its need to the public into account. If government increases the spending on medical and public health more proportionately than

the increase in income, the spending of other sectors may increase at lower rate. But, considering a broad measure of health expenditure by including spending on different aspects of health, the income elasticity of aggregate health expenditure is found to be 0.697, lower than unity. Hence, it is concluded that health is not luxury in Indian context.

Per capita revenue transfer is used as explanatory variable in order to analyse the resource availability to states from centre and to observe the linkage between central transfers and health spending of states. In Indian union, states receive revenue transfers from the Centre in terms of tax devolution and grant-in aids. States largely depend on these revenue transfers to finance their expenditure including health. .Further it is the objective of fiscal transfers to supplement to resource poor states in the provision of a normatively designed level of services across states. From the results it is observed that PCRTC emerged significant and positive for per capita aggregate public expenditure on health in southern Indian states. A one percent increase in PCRTC increases aggregate health expenditure of southern states by 0.436 percent. However, PCRTC failed to influence per capita expenditure on medical and public health (PCMPH) significantly at the acceptable levels of significance. One possible reason for this is the unconditional or general purpose nature of central transfers. Unless central grants would be conditional and meant for specific use, increase in its size may not help to improve the spending of a particular health component like medical and public health. As a result the coefficient becomes negative and insignificant for PCMPH.

Infant mortality rate is used to represent the health situation of the state and urgency of states to increase its spending on health. This is related to demand for health care. As expected, INFMR emerged significant and found to be positively associated with PCPEH and PCMPH respectively at five percent and ten percent level of significance respectively. The states with higher INFMR would be pressurised to increase its spending on health. A one percent increase in infant mortality rate increases per capita aggregate health spending of southern Indian states by 0.38 percent and per capita expenditure on medical and public health by 0.158 percent.

Population is also a demand side factor in influencing health spending. When the size of population increases in a state, the state needs to spend more on medical and public health, and provision of water supply, sanitation and for their nutrition. In the present study POPLN found to be insignificant in influencing both PCPEH and PCMPH. The reasons that partially address this insignificance are: (i) considering the weak resource capacity, the states do not respond to increase health spending in lines with increase in size of population and (ii) the size of the sub-group of population like proportion of children or proportion of aged population who seek more health care, may be more appropriate in influencing health spending than the size of the whole population.

Primary health centre in number is taken as a proxy to indicate supply-side factor of health care and spending. PHCNO failed to be significant at accepted level of significance to influence both aggregate spending (PCPEH) and its component (PCMPH) in per capita terms in southern Indian states. The possible reason for this is that the number of primary health centre and the facilities in them are not increased adequately and qualitatively. Further, the proportion of health spending made on primary health centre would be considered small.

The overall findings suggest that the predictions made regarding the behaviour of resource capacity, demand and supply related factors in influencing health spending are justified. Per capita states' income found to be important and emerged significant in influencing health spending and its component of states. Other variables that emerged significant are PCRTC and INFMR. The change in health spending of the southern Indian states seems to have been determined by the states' resource capacity, availability of

resources in terms of central transfers and due to the pressure from demand side factor like rise in infant mortality rate. Overall size of population and supply side factor like PHCNO failed to influence health spending in southern states.

6. Robustness of the Results

In this section an attempt is made to test the robustness of the findings that are discussed in the previous section.

The first strategy adopted to check the robustness of the results is using an alternate estimation technique. The specification of the model remains same as of the original regression analysis. But, the results are re -calculated with an alternate estimation technique which corrects for heteroskedasticity and first order panel specific autocorrelation. Panel correcting standard errors (PCSE) estimation techniques with option of first-order panel specific auto-regression could be used which can also help to correct the problem of heteroskedasticity and autocorrelation. The results calculated with PCSE with option of first-order panel specific auto-regression are displayed in the table-5. The results estimated with PCSE do not vary much from the baseline results. The expected signs remain same. The numerical magnitude of the coefficients is almost same. But, the significance level of the variables of interest changed marginally. Hence, the baseline regression results are robust and quite insensitive to change in estimation technique.

TABLE 5. Determinants of public expenditure on health: Panels corrected standard error (PCSE) estimation results (Log-linear specification)

Dependent Variable →	**(1)** ***ln*(PCPEH)**	**(2)** ***ln*(PCMPH)**
ln(PGSDP)	0.697*** (1.78)	1.476* (4,49)
ln(PCRTC)	0.436*** (1.86)	-0.0059 (-0.06)
ln(INFMR)	0.385** (2.01)	0.158*** (1.69)
ln(POPLN)	1.71 (0.65)	-0.2853 (-0.18)
*ln(*PHCNO)	-0.052 (-0.29)	0.080 (0.71)
Constant	-35.946 (-0.75)	-
Wald Test P-value	23384.54 0.000	33600 0.000
State Effects	Yes	Yes
Time Effects	Yes	Yes
R-Square	0.9854	0.997
Number of Observations	68	68

Notes: t-values are given in parentheses; *, ** and ***denote significance at 1%, 5% and 10% level respectively; and state and time dummies are included in regression

Source: Calculated by author, using Stata 10.1 (Basic data from various issues of *RBI Bulletins; State Finance- A Study of Budgets*, RBI ; Census; and CSO reports).

The second strategy adopted to verify the robustness of results is changing the specification from log-linear to linear. The regression results by using the data at their levels are shown in table-6. The results obtained here are similar to the baseline results. The important variables of interest like PGSDP and INFMR are significant and positively associated with both PCPEH and PCMPH. Numerically magnitude of the coefficients changed marginally. But, instead of PCRTC, here POPLN emerged significant in influencing PCPEH. However, impression of the results is not different from original results.

The third strategy to verify the original results is done by introducing new variables like literacy rate and supply side variables like number of registered doctors. With the advancement of literacy, the level of awareness increased and government may be pressurised to increase health care service and spending. Similarly, increase in number of doctors is key for development clinical service and can affect spending. With the introduction of these new variables, no notable changes are observed in the results of the original variables of interest. Further the new variables never emerged to be significant. Hence, baseline results are found to be robust.

TABLE 6. Determinants of public expenditure on health: FGLS Panel estimation results (Linear specification)

Dependent Variable →	**(1)** **PCPEH**	**(2)** **PCMPH**
PGSDP	0.014*** (1.76)	0.008* (3.37)
PCRTC	0.017 (0.31)	0.002 (0.13)
INFMR	3.923** 2.25	1.604* (3.45)
POPLN	0.00001** (2.04)	-1540.45 (-0.85)
PHCNO	0.011 (0.36)	-0.014 (1.47)
Constant	-885.12 (-1.32)	0.463 (0.002)
Wald Test P-value	675.47 0.000	2550.5 0.000
State Effects	Yes	Yes
Time Effects	Yes	Yes
Number of Observations	68	68

Notes: t-values are given in parentheses; *, ** and ***denote significance at 1%, 5% and 10% level respectively; and state and time dummies are included in regression

Source: Calculated by author, using Stata 10.1 (Basic data from various issues of *RBI Bulletins; State Finance- A Study of Budgets*, RBI ; Census; and CSO reports).

After considering all three strategies to verify the robustness of baseline results, it could be concluded that original findings of this study are robust and consistent. Few exceptions are observed, but they are not serious enough to turn down the original results. Hence, the claims that are made in the study hold well.

7. Conclusion

In this paper, an attempt is made to determine the important factors influencing public expenditure on health in southern Indian States. From the findings of results it is observed that the change in health spending of the southern Indian states is determined by the states' resource capacity, availability of resources in terms of central transfers and due to the pressure from demand side factor like higher infant mortality rate. Overall size of population and supply side factor like PHCNO failed to influence health spending in southern states. The income elasticity of aggregate health expenditure is found to be 0.697, lower than unity, which provides us to conclude that health is not luxury in Indian context. The paper calls for strengthening resource capacity of the state, increasing expenditure for health and more specific purpose central grant-in-aid in increasing state spending on health.

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