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Impact of Public Spending on Health and Education of Children in India: A Panel Data Simultaneous Equation Model

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Abstract

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Keywords: Public Expenditure, Education, Health, SEM, 3SLS, IMR, GER, NER, Dropout Rates

JEL Code: H51, H52, I18, I28, C33

Acknowledgements:

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Impact of Public Spending on Health and Education of Children in India: A Panel Data Simultaneous Equation Model

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1. Introduction

"*Investing fully in children today will ensure the well-being and productivity of future generations for decades to come*."

-- Carol Bellamy

India is far behind several developing countries in terms of both educational attainment and health status of children. In terms of educational attainment, the net enrolment rate (NER) reached 94% in 2010 (table 1) which was satisfactory according to the international standard (The World Bank, 2010)[1]. But the dropout rate of primary schooling is only 34% in the cohort 2002-11 (table 1) which is considerably higher than the Millennium Development Goals (MDG) in 2015. Notably, the primary dropout rate in India is higher in India as compared to Bangladesh. Despite the gradual progress in enrolment rates, high dropout rate in the elementary level remains an important concern in the way to achieve 100% completion rate in primary education.

Table 1: Education and health status of children

Countries	Primary GER (%) 2011	Primary NER (%) 2010	Primary Dropout Rate (%) 2002-11	IMR 2010	U5MR 2010	MMR 2012
Norway	99	99	-	3	3	7
Sri Lanka	99	94	1.4	14	17	35
China	111	-	-	16	18	37
India	118	94	34.2	48	63	200
Bangladesh	-	92	33.8	38	48	240

Source: World Health Statistics 2012, WHO, Human Development Report 2013, UNDP and The World Bank

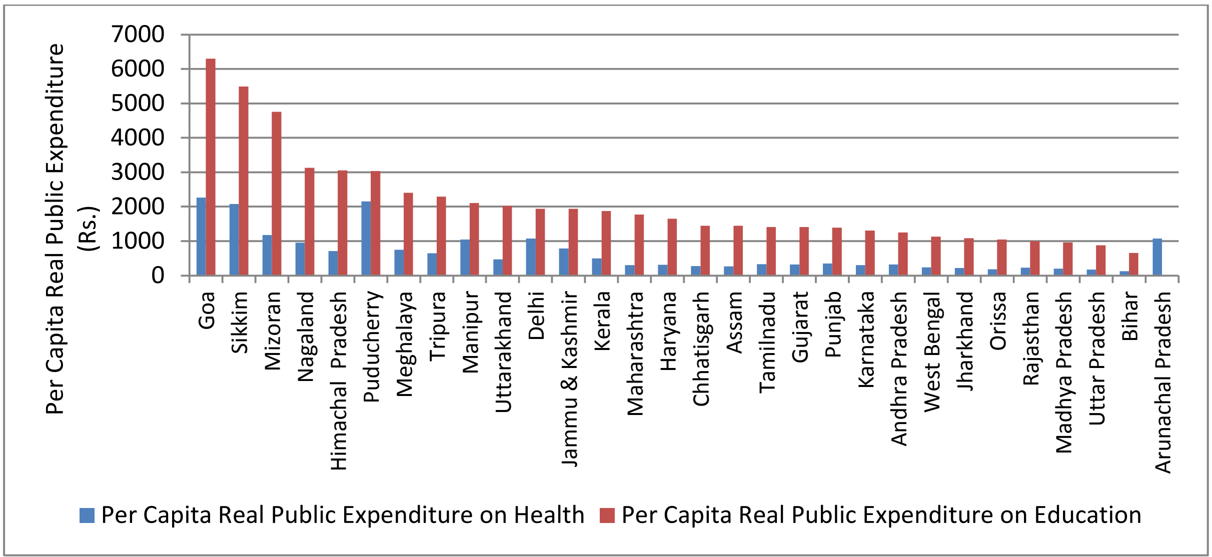
While concerning the health status of children, child mortality rates are considerably high in India as compared to other developing countries like Sri Lanka, China and Bangladesh (table 1). In 2010, both infant mortality rate (IMR) and under-5 mortality rate (U5MR) was three times higher in India than its' neighbouring countries Sri Lanka and China. In addition, Bangladesh is doing much better than India in terms of both IMR and U5MR. In 2010, IMR was 48 per thousand live births in India which is likely to be 44 against the MDG target of 27 in 2015. The U5MR has declined to 63 in 2010 and expected to decline further to 52 in 2015 which is 10 points greater than the MDG target (Planning Commission of India, 2010)[2].

Both education and health are considered as priority sectors in almost all five year plans in India. Although total public expenditure in these sectors has increased significantly over time, per capita expenditure in real terms has stagnated for several states, which may have been responsible for such slow progress in these sectors. In 2010, the share of public expenditure on education and health are

[1] http://data.worldbank.org/indicator/SE.PRM.NENR
[2] http://planningcommission.gov.in/data/datatable/index.php?data=datatab

3.1 and 1.2 per cent of GDP respectively (The World Bank, 2013)[3] which are significantly lower than in developed countries. In addition, there prevail wide disparities in per capita real public expenditures in both health and educational sectors across states (as shown in figure 1) which may have led to the existing regional disparities in India.

Figure 1: Per capita real public expenditure on health and education across states in 2011



In this regard, several studies have estimated the impact of public expenditure on health and education for India and other countries. They present contradictory results in terms of the effectiveness of such public expenditures on these social sectors. For the health sector, Filmer and Pritchett (1999) and Deolalikar (2005) find no significant impact of current health expenditure on child mortality rates. In contrary, Mayer and Sarin (2005), Bhalotra (2007) and Farahani et al. (2009) argue in favour of increasing public spending on health care to achieve lower child mortality rates. For the education sector, Gupta et al. (2002) find that both the total public expenditure and composition of public expenditure in different level of education play important role in determining the enrolment rate, persistence rate and dropout rates whereas De and Endow (2008) conclude that changes in education expenditure improve access, but retention and learning achievements remain very low in less developed states.

These studies are typically undertaken in isolation for health and education separately using macro level data. They ignore the inter-relationship that exists between health and education of children. Micro-level studies show that child health status affects child education outcomes (Moock and Lestie, 1986; Chutikul, 1986; Jamison, 1986; Bouis, 1992; Behrman and Lavy, 1994; Glewwe and Jacoby, 1995; Behrman, 1996), which may have a significant role in determining the relationship while estimating the impact of public spending of education. Thus existing studies give biased estimates by ignoring this impact of health status on the educational attainment of children. Moreover, empirical data suggests that enrolment rates (GER and NER) are negatively associated with IMR in India (figure 2 and 3) whereas dropout rates and IMR are positively correlated (figure 4). These plots indicate that total enrolment rates could improve and dropout rate is likely to decline with an improvement in child health status.

[3] http://data.worldbank.org/indicator/GC.TAX.TOTL.GD.ZS

Figure 2: Scatter plots between GER and IMR across states (2003-11)

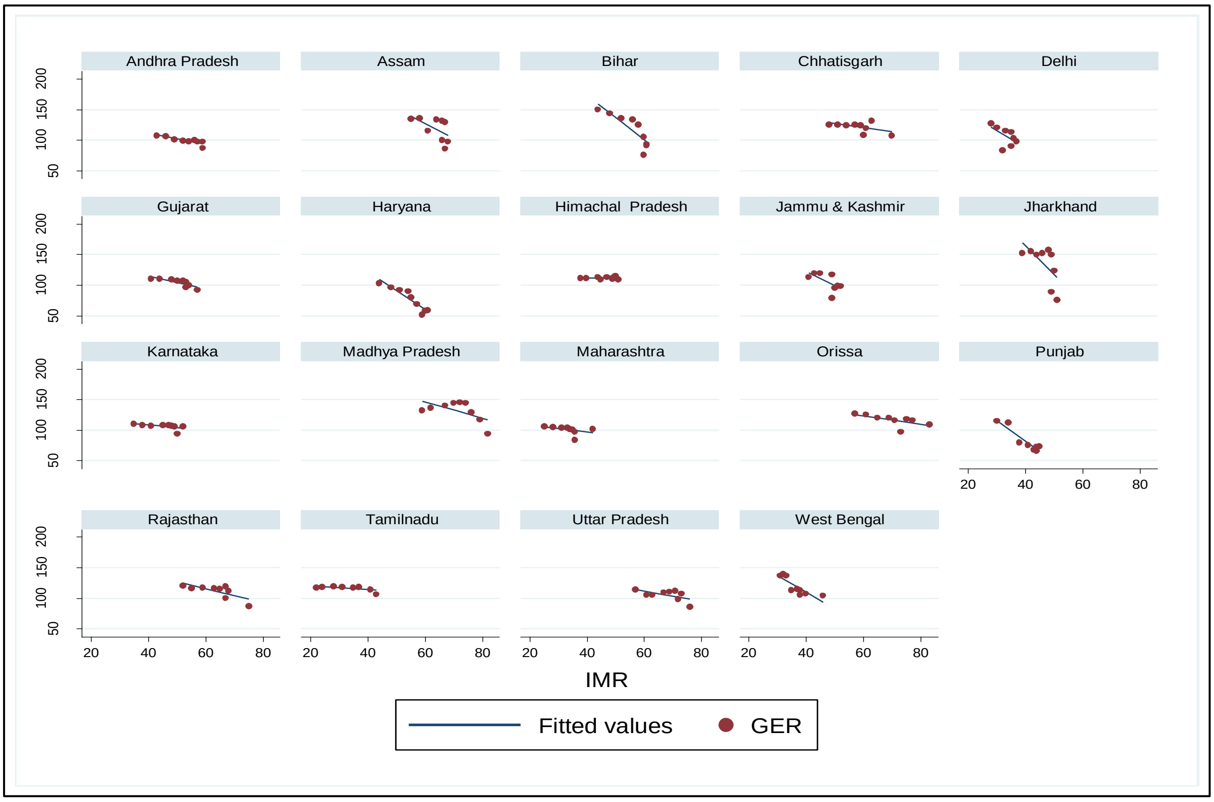


Figure 3: Scatter plots between NER and IMR across states (2003-10)

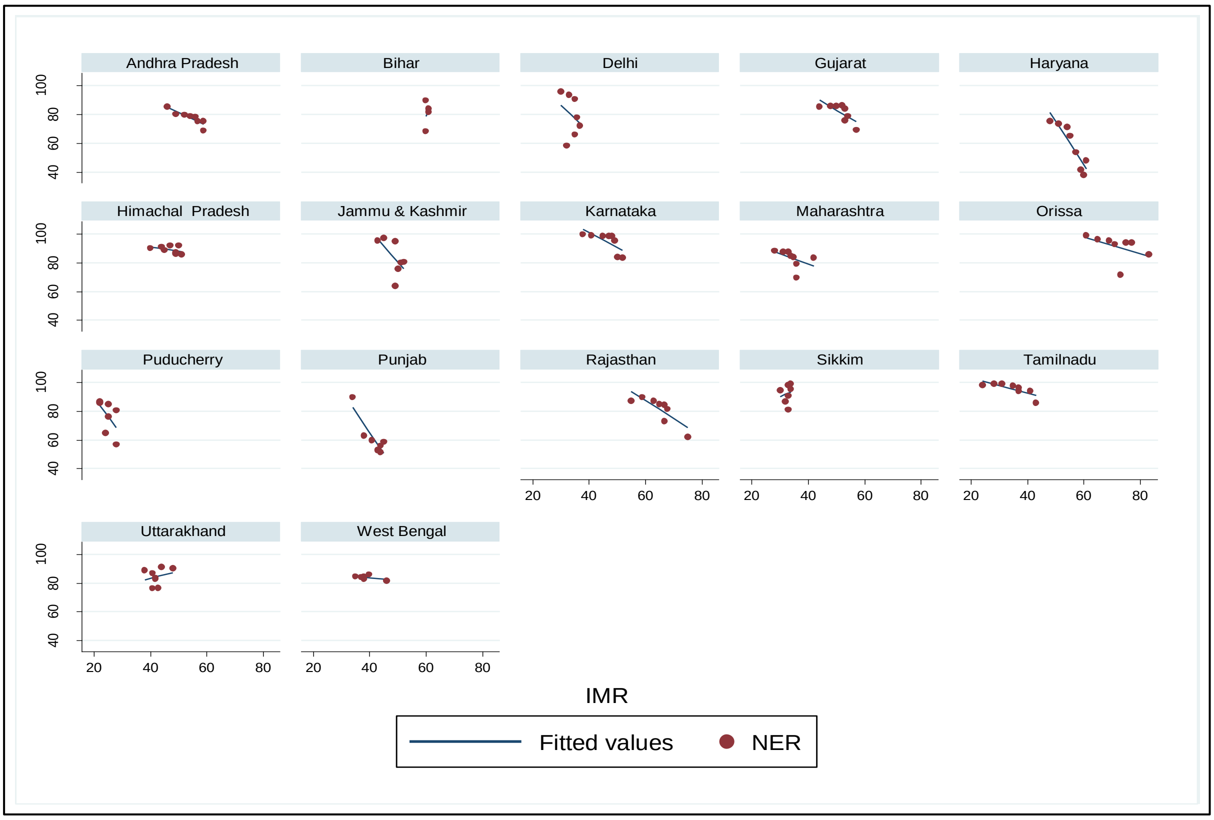
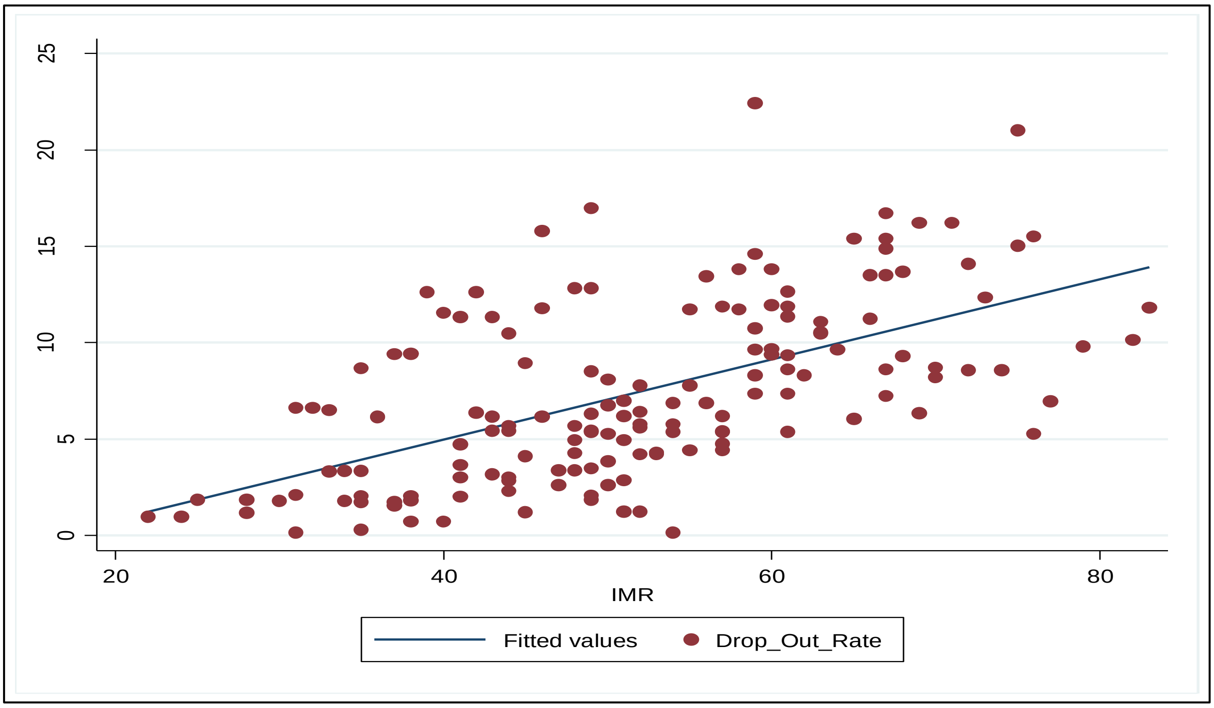


Figure 4: Scatter plot between dropout rates and IMR (2003-11)



Thus, the estimates of the impact of public expenditure on health and education need to factor the inter-relation between these outcome variables. The objective of the paper is to overcome the shortcoming of existing studies and to examine the impact of public spending in health and education sectors after incorporating the linkages between children health status and their educational achievements. This enables us to measure both direct and indirect impact of public expenditure on these social sectors and thereby facilitates the estimation of level of public expenditure required to achieve the desired level of these social indicators. Here, we hypothesise that gross enrolment increases at diminishing rate with an increase in public expenditure at the initial level of development. Initially GER may increase far beyond 100 to enrol those children who did not complete their primary education at the age of 6-11 years. Then gradually GER is likely to reach towards 100 with further increase in public expenditure after significant improvement in education level. Thus we are expecting to have an inverted U-shaped relation with per capita expenditure on education. At the same time NER should increase monotonically at a decreasing rate with an increase in public expenditure. In addition, the paper examines the relational pattern of dropout rates over time with an expansion of public spending in education sector. Thus the essential conditions of attaining 100% completion rate in elementary level of education are; (i) NER should reach 100, (ii) initially GER should increase far greater than 100 to educate those children who could not complete primary schooling in 6-11 years of their age and then gradually decreases towards 100 where GER should converge to NER and (iii) the dropout rate should decline to zero.

Towards this, a simultaneous equation model (SEM) of educational attainment and health status of children and the public expenditure on health and education sector is developed here. The health status of children is captured by IMR which is found to be a good proxy for several other indicators of child health status (see appendix). Educational outcome of children is captured by GER, NER and drop-out rates.

Existing studies have mostly considered cross section data which may suffer from the effect of unobservable state level variables. Thus panel data for the period 2003-11 is utilised in this analysis to incorporate the state level unobservable effects in the specified model. To the best of our knowledge, hardly any study exists that attempts a state level analysis in a SEM framework incorporating the linkage effect between health and education to measure the impact of public spending on these social sectors.

On the basis of these estimated models, we have estimated percentage changes in per capita public expenditure on both health and education sectors required to accelerate the prevailing rate of growth in each of these indicators. The results show that the required changes in public spending vary considerably across indicators. Achieving IMR at the standard of developed nations would be much more difficult as compared to educational indictors. More interestingly, required increase in public expenditure is substantially high for declining dropout rate in comparison to improving enrolment rates.

The rest of the paper is organised as follows. Section 2 discusses about the model specification of the SEM and its' estimation procedure, then section 3 explains the data sources of relevant variables with their descriptive statistics. This section also discusses about the trends and interrelationships among the underlying variables. The results are presented in section 4 and followed by the conclusions and policy implications.

2. Model Specification and Estimation Procedure

To estimate the impact of public spending on child education and health; we have designed a structural model where the impact of health of children on their educational attainment is incorporated. A few studies exist which employed system equations to account for health status and educational achievements (Poças and Soukiazis, 2012; Cai, 2010; Andrei, et al., 2009) but none of them has studied the impact of public spending on these sectors. This paper aims to fill the gap and provide consistent estimates for the impact of public expenditure in these concerning sectors in India.

The health status of children of a particular state in India is captured by the IMR (see appendix) which is defined as the number of deaths of children less than one year of age per 1000 live births. The equation for IMR in state 'i' at time 't', is specified as follows;

$$IMR_{it} = \beta_1 + \beta_2 PubExpHlt_{it} + \beta_{3j} SLC_{itj} + \delta_{it} + \epsilon_{it} \text{ ………………} (1)$$

This equation will estimate the impact of public spending in health sector ($PubExpHlt$) on IMR after controlling other state level control factors (SLC), indexed by subscript 'j'. The per capita expenditure on health is deflated by GSDP (Gross State Domestic Product) deflator to examine its' impact on IMR. Additionally, per capita real expenditure on Supplementary Nutrition Programme (SNP) is included in an alternative model to analyse the effectiveness of this programme in particular, as this programme is a part of the Integrated Child Development Scheme (ICDS). Here, the expenditure on SNP plays a crucial role to improve their nutritional status as nutritional supplementary food is provided to pregnant women and children below 5 years of ages. The SLCs appearing in Equation (1) are described below.

Educational attainment of children is captured by gross enrolment ratio (GER), net enrolment ratio (NER) and dropout rate (DOR) for the primary level because mere increase in enrolment rate is not sufficient enough to improve educational status of children. DOR has to decline significantly to have a 100 per cent completion of basic primary education. Thus GER, NER and DOR are analysed in this study to have a better picture about the educational attainment in India.

The equations for GER, NER and DOR are defined as follows;

$$GER_{it} = \alpha_1 + \alpha_2 IMR_{it} + \alpha_3 PubExpEdu_{it} + \alpha_{4j} SLC_{itj} + \gamma_{it} + \varepsilon_{1it} \quad \text{..................(2)}$$

$$NER_{it} = \delta_1 + \delta_2 IMR_{it} + \delta_3 PubExpEdu_{it} + \delta_{4j} SLC_{itj} + \mu_{it} + \varepsilon_{2it} \quad \text{..................(3)}$$

$$DOR_{it} = \varphi_1 + \varphi_2 IMR_{it} + \varphi_3 PubExpEdu_{it} + \varphi_{4j} SLC_{itj} + \tau_{it} + \varepsilon_{3it} \quad \text{..................(4)}$$

Here, GER, NER and DOR will be estimated on health status of children (IMR) and public expenditure on education ($PubExpEdu$) and other state level variables (SLC) as shown in equation (2), (3) and (4), respectively. $PubExpEdu$ is taken as per capita real public expenditure on elementary education in the model.

In each equation, the SLC is a vector of relevant state level characteristics that includes per capita state domestic product, percentage of households has access to toilet in own residence and safe drinking water, adult literacy rate, fertility rate, urbanization rate, percentage of households in scheduled castes (SC) and scheduled tribes (ST), sex ratio, population from Hindu and Muslim religion. As the analysis uses a panel data where the outcome variable may get affected by both individual effects and time effects, these equations include δ_{it}, γ_{it}, μ_{it} and τ_{it} respectively to incorporate both state level effects and time effects. During estimation, the inclusion of variables in each model depends on their significance level.

These above mentioned equations form a simultaneous equation model (SEM) which can be expressed in the following generalised form;

$$B \times y + C \times x = \in$$

Here $\in$ is a vector of error terms which is assumed to be normally distributed as N(0,Ω) with the variance covariance matrix Ω given as $\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} & \sigma_{14} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} & \sigma_{24} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} & \sigma_{34} \\ \sigma_{41} & \sigma_{42} & \sigma_{43} & \sigma_{44} \end{bmatrix}$.

y is a vector of endogenous variables; IMR, GER, NER and DOR. X is a vector of exogenous variables; SLC, PubExpEdu, $PubExpHlt$, δ_{it}, γ_{it}, μ_{it} and τ_{it} all of which are assumed to be uncorrelated with error terms. As the matrix of coefficients of the model, B is triangular, these equations are exactly identified.

We have followed the following steps to choose optimal models. As health equation does not contain any endogenous variable, equation (1) is estimated using fixed effect model with alternative model specifications to choose most suitable model for health. Then we have utilised the estimated health equations in the three stage least squares (3SLS) technique to allow for cross-equation correlation between the error terms to obtain consistent and efficient estimates of the other equations. But actual specification of each model depends on the data availability and nature of cross-equation correlation between the error terms.

3. Data Sources and Descriptive Statistics

This study utilises state level data on health, education, public spending and other state level characteristics from 2003 to 2011. We have considered 20 states of India; which are Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal; due to the fact that the required information for all the relevant variables for a given time period are available only for these states. The dataset contains information for selected indicators of health, education, public spending and other socio-economic variables capturing different state level characteristics. The definitions of all underlying indicators are given in table 2 along with their data sources.

Table 2: Definitions and data sources of relevant variables

Variable	Definition	Data Source
Gross Enrolment Rate of Primary Education (GER)	The number of pupils enrolled in the primary level, regardless of age, expressed as a percentage of the population in the 6-11 years of age group.	District Information System for Education (DISE)
Net Enrolment Rate of Primary Education (NER)	The number of pupils of 6-11 years of age who got enrolled in the primary level, expressed as a percentage of the population in the 6-11 years of age group.	DISE
Dropout Rate (DOR)	Children withdraw prematurely before completion of primary/elementary level as a percentage of those students who got enrolled in first grade.	DISE
Infant Mortality Rate (IMR)	The number of deaths of children less than one year of age per 1000 live births	Sample Registration System
Public Spending on Education	Expenditure incurred by Govt. of India (GOI) on education in both revenue and capital account	EPW database
Public Spending on Health	Expenditure incurred by GOI on health in both revenue and capital account	EPW database
Public Spending on Family Welfare	Expenditure incurred by GOI on family welfare in both revenue and capital account	EPW database
Public Spending on Elementary Education	Public expenditure on elementary education	Ministry of Human Resource Development
Public Spending on ICDS Program	Government Expenditure on the Integrated Child Development Scheme	IndiaStat Website
Public Spending on SNP	Government Expenditure on the Supplementary Nutrition Program under the ICDS	IndiaStat Website
Per Capita NSDP (current and Constant)	Per capita net state domestic product both in current prices and constant prices	EPW database
GSDP Deflator	Calculated as (GSDP Current/GSDP Constant)*100	EPW database
Safe Drinking Water	Percentage of households have access to safe drinking water	Census of India
Sanitation Facility in own residence	Percentage of households have toilet facility in own residence	Census of India
Total Fertility Rate	The average number of children that would be born per woman	Sample Registration System
Scheduled Caste (SC) and Scheduled Tribe (ST)	Percentage of households belongs to SC or ST	Census of India
Urbanisation	Percentage of population belongs to urban areas	Census of India
Villages have electricity	Percentage of villages have electricity	EPW database
Literacy Rate	Percentage of population aged seven years and above who can both read and write	Census of India, NSS
Sex Ratio	Total number of female population per 100 male population	Census of India

Among the explanatory variables, public spending on health, education and family welfare are collected from the EPW website. Here per capita expenditure for each sector is calculated as total expenditure divided by total population for each state. The GSDP deflator, calculated as the GSDP current divided by the GSDP constant, is used to measure real per capita public spending for each sector. In addition, variables, collected from the Census of India, are only available once in each decade. Thus we have interpolated those variables for the required years applying compound rate of growth for each year.

The descriptive statistics of these undertaken variables are given in table 3. The dataset exhibits considerable variations in undertaken variables. The sample consists of 180 data points where 20 states have data for at least 5 consecutive years for all relevant variables. Indian states are experiencing slow but monotonous progress in health and education in recent years except Mizoram, Meghalaya and Nagaland. Although the pattern of change in each sector is different across states, overall there is progress over last decade. For health status, IMR varies widely from 11 in Goa to the maximum of 83 in Orissa.

In some states GER becomes greater than 100 as it is calculated as the number of pupils enrolled in the primary level, regardless of age, expressed as a percentage of the population in the 6-11 years of age group. Thus pupils not in the age group can get enrolled in the primary level. But NER is strictly less than 100 as it considers only those children who get enrolled in 6-11 years of their age. Notably, NER data is available for 2003-10 where most states experience gradual improvement over time with significant variation across states.

Table 3: Descriptive statistics of relevant variables, 2003-11

Variables	Obs	Mean	Std. Dev.	Min	Max
Endogenous Variables					
GER	177	108.31	20.23	51.81	157.37
NER	139	80.16	14.28	38.08	99.85
Dropout rate	162	7.22	4.68	0.08	22.43
IMR	180	49.04	15.51	11.00	83.00
Exogenous Variables					
Public Expenditure on Health and Education (Rs.)					
Per capita real expenditure on education	180	999.63	466.83	355.70	3056.38
Per child real expenditure on elementary education	162	388.31	229.66	67.81	1630.75
Per capita real expenditure on health	180	266.00	190.00	59.30	1072.00
Per capita real expenditure on health and welfare	180	297.00	192.00	70.90	1085.00
Per child real expenditure on SNP	138	265.00	150.00	32.00	771.00
State Level Characteristics					
Literacy rate (Male)	180	79.97	6.83	62.35	96.11
Literacy rate (Female)	180	59.73	12.22	35.81	100.76
Literacy rate	180	71.11	8.95	49.65	94.00
Safe drinking water	180	79.95	16.36	25.14	97.60
Sanitation facility	180	48.42	20.96	15.85	97.80
TFR	180	2.57	0.73	1.60	4.40
Sex Ratio	180	941.03	49.85	830.19	1084.00
Households have electricity	180	67.95	25.28	11.30	99.10
Village with electricity	178	87.99	18.33	30.40	100.00
SC	180	16.05	6.10	6.70	31.90
ST	153	11.16	9.08	0.14	31.56
Urbanization	180	31.31	18.13	9.84	97.50

Source: Author’s estimates

While concerning the exogenous variables, public spending on both health and education sectors are expressed in real terms. Per person real public spending in primary education is calculated by dividing total number of children in 6-11 years of age group of the state and deflated by GSDP deflator. In average, states are spending about 38% of total public expenditure per person on education. As seen earlier, the per capita real public expenditure on education varies widely across states (figure 1). For instance, Goa spends more than Rs.6000 whereas Bihar placed at last with less than Rs.1000 per capita public expenditure on education in 2011. Figure 5 shows the nature of relationship between GER and per capita real public expenditure on elementary education which does not show any clear pattern of trend. We hypothesise that gross enrolment should increase with an increase in public expenditure at the initial level of development. Initially GER may increase far beyond 100 to enrol those children who did not complete their primary education at the age of 6-11 years. But gradually GER will decrease towards 100 with further increase in public expenditure where GER will merge to

NER after a significant improvement in education level. Thus we are expecting to have an inverted U-shaped relation of GER with per capita public expenditure on education.

As NER is the number of children of 6-11 years of age-group who get enrolled in the primary level as a percentage of total population in that age group, it cannot increase beyond 100. This paper analyses whether there is any significant improvement in NER with an increment in public spending in primary level. But at the same time, we hypothesise that the rate of improvement in NER decreases gradually as it becomes difficult to enhance total coverage all over India after significant expansion in government facilities. Moreover, the scatter plot between NER and public expenditure (figure 6) on elementary education show a positive relation but actual impact of public spending is estimated with the help of 3SLS technique in the following section.

Similarly, the scatter plot between drop-out rates and per child expenditure on elementary education (figure 7) shows a strong negative relationship. Here, we test whether the rate of decrease in drop-out rates changes with an increase in per capita level of expenditure on education in elementary level after controlling other determining factors.

Figure 5: Scatter plot between GER and per capita public expenditure on elementary education (2003-11)

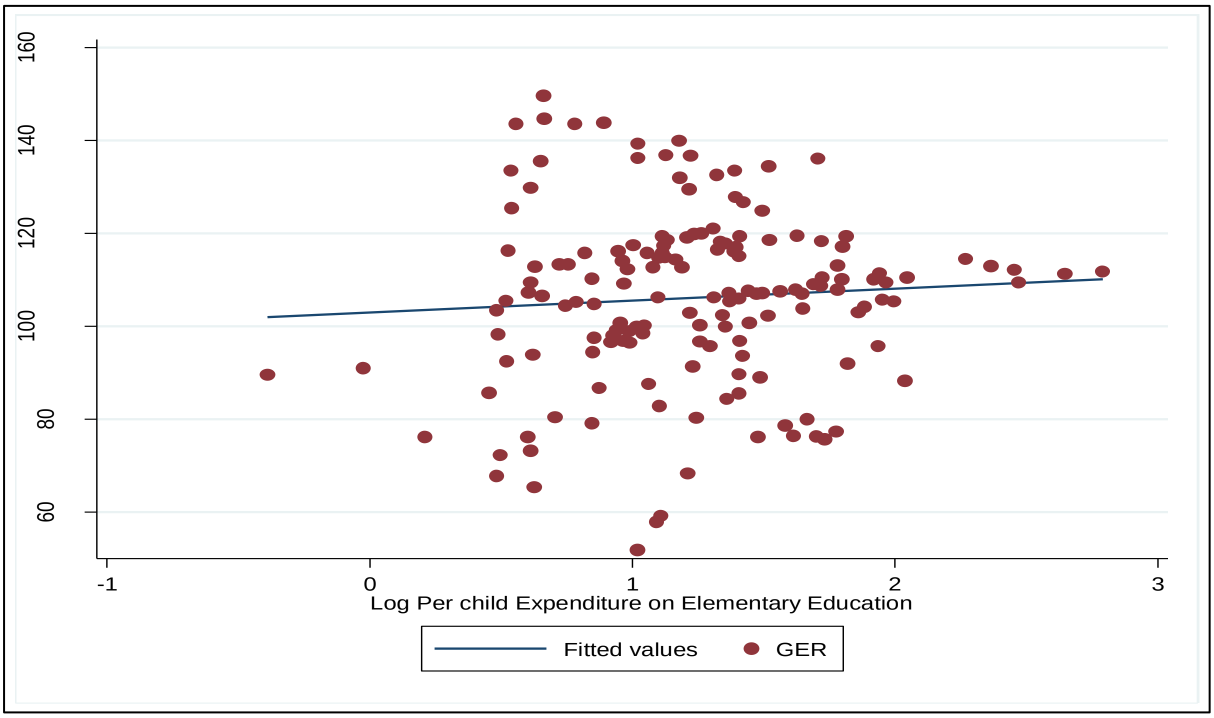


Figure 6: Scatter plot between NER and per capita public expenditure on elementary education (2003-10)

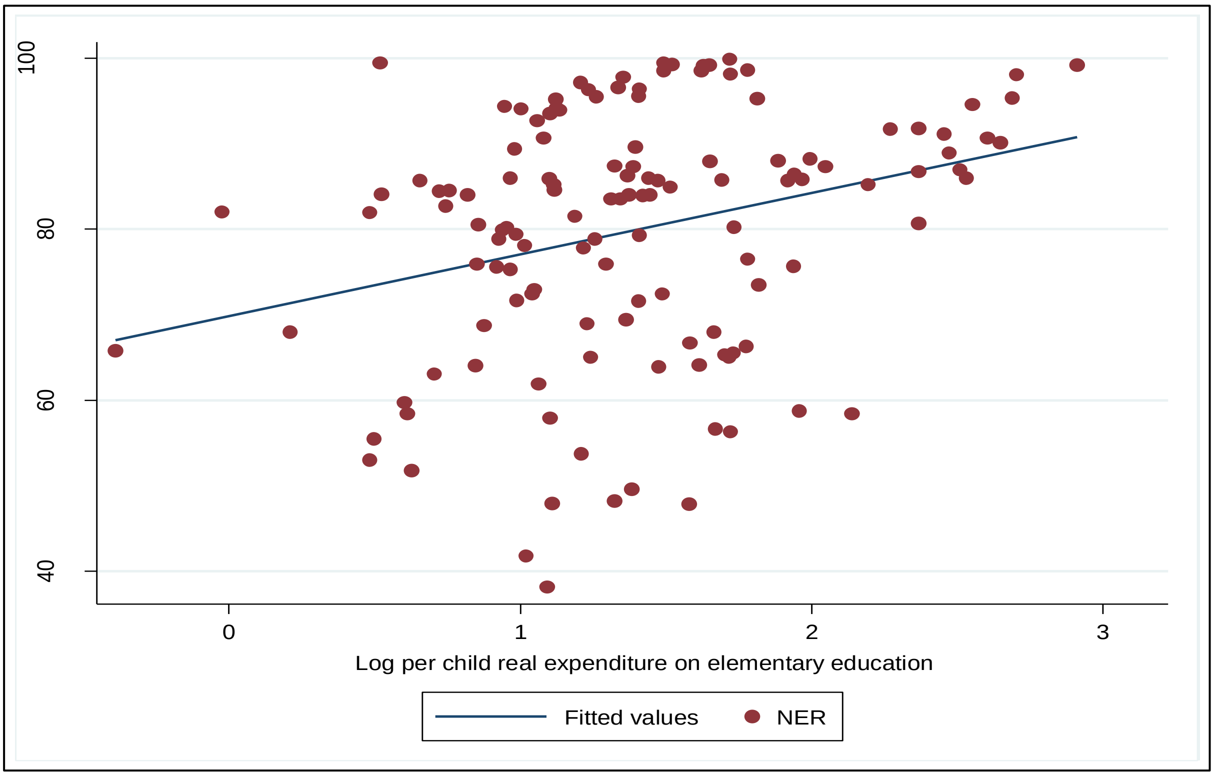
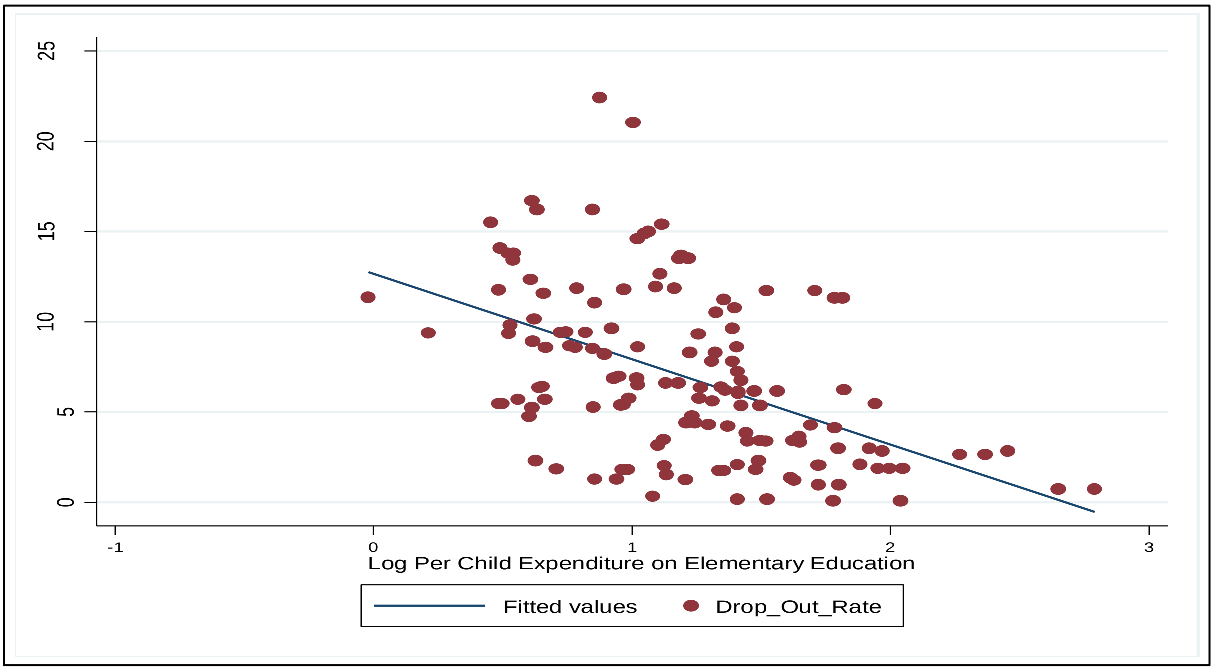


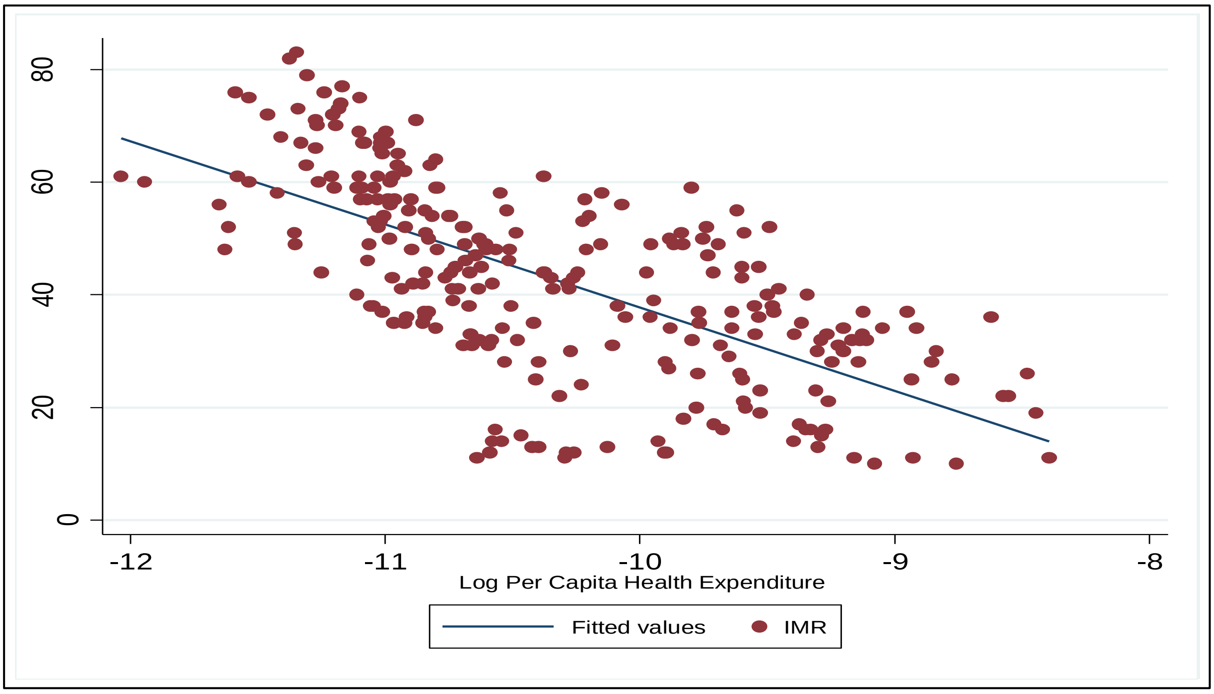
Figure 7: Scatter plot between dropout rate and per capita public expenditure on elementary education (2003-11)



In case of per capita real expenditure on health, total public spending is divided by total population of the particular state and GSDP deflator. States are investing by lesser amount in health as compared to education. Health sector is primarily the responsibility of state governments. Public expenditure on health in each state is often compromised in several states due to financial shortages. The World

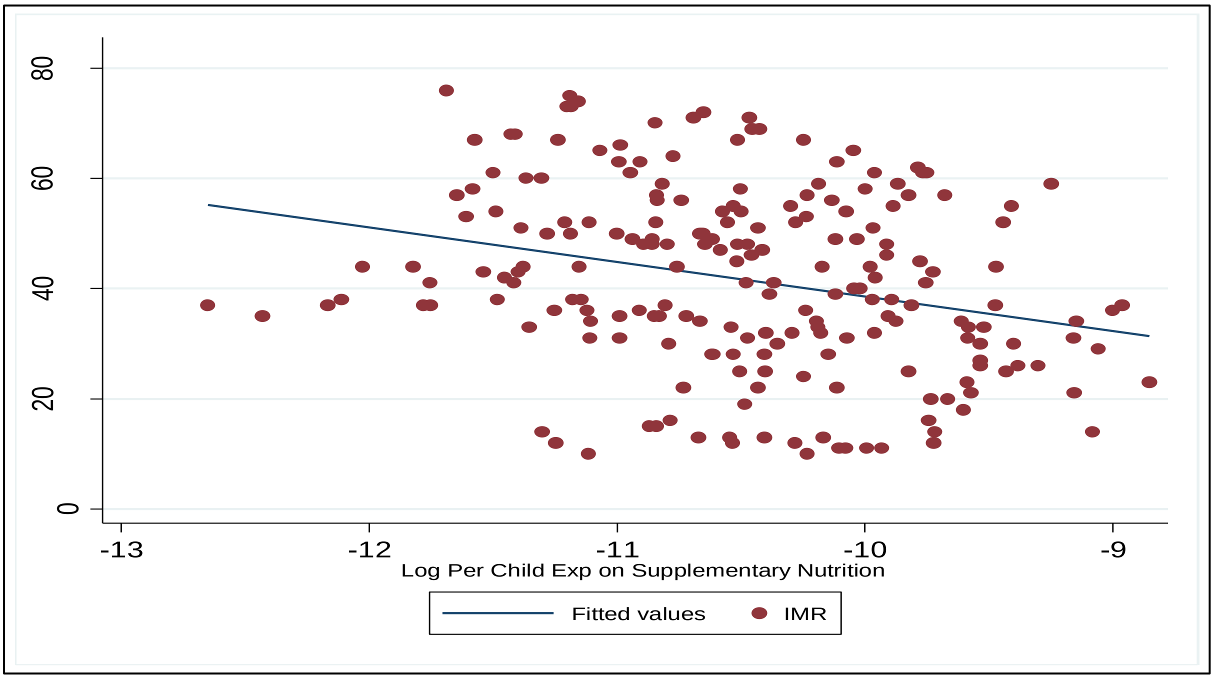
Health Statistics (2009) suggests only about 3.4% of total public expenditure is spent on health in 2006, out of which more than 75% is contributed by the State governments and the remaining amount is spent by central government. But, as seen earlier, there prevails a wide disparity among states in terms of real per capita expenditure (Figure 1). Goa and Sikkim spent about Rs.2000 per capita in real terms on health whereas highly populated states like Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal and Orissa spend less than Rs.250 per capita in real terms. Interestingly, Goa reported the lowest infant mortality which is 11 in 2011 whereas IMR in the later mentioned states vary from 44 in Bihar to 59 in Madhya Pradesh. Figure 8 suggests a strong negative relation between IMR and per capita public expenditure on health. In contrary, Kerala spends merely Rs.500 per capita on health nevertheless experiences a high health status where IMR is just 12 in 2011. Thus other socio economic factors may have significant impact on actual health outcomes. For instance, literacy rate is identified by several economists as an important determining factor for health status of children (Dreze and Sen, 1995).

Figure 8: Scatter plot between IMR and per capita public expenditure on health (2003-11)



Moreover, states receive additional support from Central government for various centrally sponsored national health programs. These national programs are mostly sponsored by the joint contribution of both states and central governments. The SNP program is implemented under the ICDS with the objective to improve the health, nutrition and development of children by providing supplementary nutrition, health check-ups, immunisation, and referral services to children and expecting and nursing mothers at Anganwadi or child care centre. This study has included the per child spending on SNP in an alternative model which is defined with respect to total number of children in 0-5 years of age as the SNP focused especially to reduce malnutrition and infant mortality rates caused due to lack of nutritional intake. The scatter plot (figure 9) between IMR and per capita public expenditure on the SNP suggests a negative relationship as expected.

Figure 9: Scatter plot between IMR and per capita public expenditure on SNP (2003-11)



Among other exogenous variables literacy rates are expected to have a significant effect on both education and health (Dreze and Sen, 1995). We find considerable variation in literacy rates across states and female literacy rates are consistently lower than male literacy rates over time. About 31% population live in urban areas, 80% households have access to safe drinking water and only 48% have sanitation facility in their own residence. In recent years, total fertility rate has come down to 2.57 in average but low sex ratio remains a concerning factor in India. Population from scheduled caste and scheduled tribes are about 16% and 11% respectively.

4. Results

We have estimated alternative health equations including per capita real public expenditure on health, family welfare and the SNP. Table 4 presents estimated models for IMR which are most suitable for different kinds of public expenditure related to health. Here per capita real public spending on health and welfare do not have significant impact on IMR after controlling other state level effects and time effects (model 1 and model 2). Log per capita real expenditure on SNP turn out to be highly significant in model 3 and 4 where IMR decreases significantly with one percentage increase in per child real public expenditure in the SNP.

Access to safe drinking water and sanitation facilities in own residence are significant in both equations and their coefficients remain similar irrespective of the model specification. One percentage increase in the access to safe water reduced the level of IMR by 0.3 whereas sanitation facilities improve the health condition by 0.1. In addition, different sets of control variables were included in each model on the basis of their significance level. The fertility rate (TFR) has positive impact on IMR whereas increase in per capita gross state domestic product (GSDP) and literacy rate improves the health status of children by decreasing IMR. Notably, the level of coefficient of log per capita real expenditure on SNP changes from 2.17 in model 3 to 1.20 in model 4 especially after the inclusion of adult literacy rate and per capita GSDP in the model which explains the importance of these variables in explaining the child health status of a state.

Table 4: The estimated results for the health equations using fixed effect model

Variable	model1	model2	model3	model4
Log per child real expenditure on SNP			-2.168***	-1.200**
Log per capita real expenditure on health	-1.19			
Log per capita real expenditure on health & welfare		-0.461		
Safe drinking water	-.375**	-0.265	-.388**	-.302*
Sanitation facility	-.145***	-.117**	-.097**	-.063*
TFR	10.876***	9.083***	7.750***	
Literacy rate		-0.134		-.622**
Ln per capita GSDP		-4.069		-10.699**
Urbanization				.576***
Year 2010	-2.944***	-2.662***	-2.804***	-2.420***
Year 2011	-4.148***	-3.917***	-4.553***	-4.003***
State dummies	Yes	Yes	Yes	Yes
Interceprt	46.147*	100.215*	42.319**	201.645***
Observations	180	180	138	138
"R-sq Adj"	0.8	0.8	0.88	0.9

Source: Author's estimates

Note: * p<0.05; ** p<0.01; *** p<0.001

Moreover, increase in percentage of population live in urban areas has positive effect on IMR. This may be due to the fact that total population in slum areas increases by 25 percentage from 2001 to 2011 which may cause a negative impact on the health status of child due to lower vaccination rates, lack of education among parents, improved health facilities, safe drinking water and access to toilet facilities in slum areas (Ghosh and Shah, 2004; Agarwal and Taneja, 2005; Jorgenson and Rice, 2012; Unger, 2013). After comparing adjusted R-squares of estimated models, we have selected 4th model for the rest of the analysis because this model has significantly higher R-square than other models.

To get consistent and efficient estimates for GER and DOR equations we have applied 3SLS techniques utilising most appropriate health equation of IMR. The SEM comprises four separate equations of IMR, GER, NER and DOR. But empirical analysis suggests that the error terms of GER, NER and DOR equations are not significantly correlated. Thus we have estimated three sets of SEMs separately. First GER & IMR equations are estimated applying 3SLS technique then same technique is used to estimate the SEM for NER & IMR and DOR & IMR to get efficient and consistent estimates for each equation. In this way we are able to maintain maximum possible degrees of freedom for each model due to the fact that the pattern of data availability is different for each variable.

The estimated results for the SEM of GER and IMR are given in table 5. In the selected health equation (model 4 in table 4), per child real expenditure on SNP program and percentage of population have sanitation and water are taken as the base variables and other state level factors are included as control variables. We can observe that IMR has negative impact on gross enrolment rate (table 5) whereas per child real expenditure on elementary education improves the enrolment rate significantly as expected. But an increase in per capita real expenditure in primary level improves gross enrolment at a decreasing rate. Thus there exist diminishing returns of public expenditure on education. The significant negative coefficient of the quadratic term for public expenditure suggests an inverted U-shaped relation of GER on per capita public spending. This explicitly explains that initially GER will increase far beyond 100 with an increase in public expenditure to enrol those children who are not in the age of primary education then it declines gradually towards 100 and converges to NER.

Table 5: The estimated results for the SEM of GER and IMR using 3SLS technique

Variable	Model
GER	
IMR	-.502***
Per child real expenditure on elementary education	3.430*
Per child real expenditure on elementary education^2	-.189*
Time	1.424**
State dummies	Yes
Intercept	100.757***
IMR	
Log per child real expenditure on SNP	-0.486*
Safe drinking water	-.744***
Sanitation facility	-.110***
Literacy rate	-13.957***
Log per capita GSDP	-.396***
Urbanization	.845***
Year 2010	-2.189***
Year 2011	-3.483***
State dummies	Yes
Intercept	263.509***
GER	
Observations	124
RMSE	7.86
"R-sq"	0.81
Chi2	544.65***
IMR	
Observations	124
RMSE	1.16
"R-sq"	0.99
Chi2	22182.77***

Source: Author's estimates

Note: The IMR equation in model 4 is the model in table 3

* p<0.05; ** p<0.01; *** p<0.001

In addition, decrease in IMR will have positive impact on GER by 0.5 per cent. We have incorporated trend variable and state dummies to control for both time and state level effects. Other state level factors do not have any additional effect on GER because IMR has already taken care of the impact of adult literacy and other state level characteristics.

The estimated result for NER is given in the following table which shows a significant decrease in net enrolment with an increase in mortality rates. Thus health status of a child is important to achieve 100 per cent enrolment in primary level. In addition, per child real public expenditure on elementary education improves net enrolment significantly but at a decreasing rate.

Table 6: The estimated results for the SEM of NER and IMR using 3SLS technique

Variable	Model
NER	
IMR	-.643***
Log per child real expenditure on elementary education	12.502***
State dummies	Yes
Intercept	99.086***
IMR	
Log per child real expenditure on SNP	-2.091***
Safe drinking water	-.667***
Sanitation facility	-.143***
Literacy rate	-.724***
Urbanization	.771***
Year 2010	-3.016***
State dummies	Yes
Intercept	117.584***
NER	
Observations	93
RMSE	5.05
"R-sq"	0.88
Chi2	702.36***
IMR	
Observations	93
RMSE	1.39
"R-sq"	0.99
Chi2	11912.45***

Source: Author's estimates

Note: * p<0.05; ** p<0.01; *** p<0.001

Table 7 shows the estimated results for the structural model of DOR and IMR using 3SLS technique to incorporate the correlation between error terms of these equations. This model provides efficient and consistent estimates of the coefficients. An increase in IMR represents deterioration of health status of children which magnifies dropout rates significantly across states at the rate of 0.2 per cent. Further an additional real expenditure per child on elementary education decreases dropout rates by around 0.18 per cent. State dummies capture significant variation across states. This model does not include other state level factors as they are suffering with multicollinearity problem as IMR already captures the impact of other state level characteristics in the model.

Table 7: The estimated results for the SEM of DOR and IMR using 3SLS technique

Variable	Model
Dropout rate	
IMR	.201***
Per child real expenditure on elementary education	-.186*
year 2011	1.059*
State Dummies	Yes
Intercept	-4.588**
IMR	
Log per child real expenditure on SNP	-.547*
Safe drinking water	-.746***
Sanitation facility	-.110***
Literacy rate	-.383***
Log per capita GSDP	-14.332***
Urbanization	.858***
Year 2010	-2.068***
Year 2011	-3.288***
State dummies	Yes
Intercept	265.548***
Dropout rate	
Observations	109
RMSE	2.20
"R-sq"	0.76
Chi2	344.02***
IMR	
Observations	109
RMSE	1.14
"R-sq"	0.99
Chi2	17154.57***

Source: Author's estimates

Note: The IMR equation in model 4 is the model in table 3

* p<0.05; ** p<0.01; *** p<0.001

Moreover, these estimated models are satisfactory in terms of goodness of fit and level of significance of the coefficients. The chi-square values and the corresponding significance level represents that these models are overall significant at .01% level. If we compare the impact of public expenditure on primary education, it is more effective to increase gross enrolment rates i.e. 3.4% which is significantly higher than the effect on dropout rates (0.18%).

Public expenditure requirement

To achieve 100 per cent completion in primary education, NER and GER should be 100 and DOR should decline to 0. Given the influence of IMR on the education attainment of children, it is important to ensure IMR also declines to acceptable levels. A target value of 10 for IMR may be considered reasonable on the basis of the current levels in developed countries. Assuming that public expenditure in health and education grows at the prevailing rates, in a business as usual (BAU) scenario, at the existing rate of growth in health and education sectors it would take 20 years to achieve the targeted rate of IMR whereas 6 and 10 years for NER and DOR respectively. By how much should public expenditure increase to accelerate these trends?

On the basis of these estimated models, we have estimated percentage changes in per capita public expenditure on both health and education sectors required to accelerate the prevailing rate of growth in each of these indicators. Table 8 shows required changes in per capita public expenditure for each sector in different scenario. For instance, if we want to increase the growth rate of IMR by 1.25 times then public spending has to be increased by 95% in health sector. The required changes are gradually increasing if we want to achieve the target at a lesser time period. Similarly, it holds for educational indicators. Moreover, the required rate of change in public expenditure is notably high for declining dropout rates as compared to enrolment rates at the same rate.

Table 8: Required changes in per capita public expenditure to accelerate current trend

Indicator	IMR	NER	DOR
Current value of indicator*	40	86.93	5.71
Target value of indicator**	10	100	0
Observed growth rate (BAU)***	-0.037	0.027	-0.105
Years to reach the target value (BAU)	20	6	10
Accelerated growth scenario FAST-1 = 1.25 times BAU growth rate			
Targeted growth rate	-0.05	0.03	-0.13
Years require to reach the target	16	5	8
Required change in per capita public expenditure	95%	23%	75%
Accelerated growth scenario FAST-2 = 1.50 times BAU growth rate			
Targeted growth rate	-0.06	0.04	-0.16
Years require to reach the target	14	4	6
Required change in per capita public expenditure	115%	28%	89%
Accelerated growth scenario FAST-3 = 1.75 times BAU growth rate			
Targeted growth rate	-0.06	0.05	-0.18
Years require to reach the target	12	3	5
Required change in per capita public expenditure	134%	32%	104%
Accelerated growth scenario FAST-4 = 2 times BAU growth rate			
Targeted growth rate	-0.07	0.05	-0.21
Years require to reach the target	10	3	5
Required change in per capita public expenditure	153%	37%	119%

Notes: * Current value of each indicator is estimated using simple average across states. Current year is 2011 for IMR and DOR, and 2010 for NER.

** We have assumed target value of each indicator at the standard of developed countries

*** Exponential growth rate

5. Conclusions and Policy Implications

The basic objective of the study is to estimate the impact of public spending on health and education of children after incorporating the linkages between health status and educational attainment. Thus the analysis examines both direct and indirect impact of public spending on these social sectors. Here the health status of children is captured with IMR which represents a good proxy for several indicators of child health status as shown in appendix. The educational attainment is captured with both enrolment rates and dropout rates in elementary level of education. To capture primary enrolment of each state we have considered GER which is calculated as total enrolment in the primary level divided by total children in the age group of 6-11 years. In India, many children cannot complete their primary education in that age group due to late enrolment which results in GER to exceed the limit 100. Thus we hypothesise that in the early stage of development GER increases with an increase in public expenditure on education where GER can exceed the limit 100 and then it comes down gradually to

100 with further development in education. In addition the paper has examined the nature of impact of public spending on NER and dropout rate.

Here we have formulated a suitable structural model for health and educational outcomes with basic assumptions. The SEM comprises four separate equations of IMR, GER, NER and DOR. But empirical analysis suggests that the error terms of GER, NER and DOR equations are not inter-correlated. Thus we have estimated three sets of SEMs separately. First GER & IMR equations are estimated applying 3SLS technique then same technique is used to estimate the SEM for NER & IMR and DOR & IMR to get efficient and consistent estimates for each equation.

The results suggest that per capita real expenditure on health by state governments does not have a significant impact on IMR but additional expenditure on SNP improves the health status significantly but at diminishing rate. These results reinforce the idea that government should expand total expenditure on the SNP program through anganwadis[4] (courtyard shelter). An expansion of nutritional intake of children under 5 years of age improves their health status and it significantly declines infant mortality rate across states. Further increase in percentage of households with access to safe water and sanitation facility in their own residence, literacy rate and per capita GSDP improve health status at significant rate. At the same time fertility rate and urbanisation increase IMR.

In addition, the results show that bad health status among children, captured by high IMR, is responsible to have lower enrolment and high dropout rates in primary level of education. In the GER equation, the IMR is turn out to be significant and it has negative impact on enrolment rates. Thus public expenditure on SNP has indirect impact on education through the improvements in health status of children whereas per capita expenditure on elementary education has direct impact on the enrolment rate. But the impact of public expenditure on education has diminishing returns on GER.

We have similar results for NER as well. The estimated result for NER shows a significant decrease in net enrolment with an increase in mortality rates. Thus health status of a child is important to achieve 100 per cent enrolment in primary level and per capita real public expenditure on elementary education improves net enrolment monotonically but at a decreasing rate.

On the other hand, dropout rate declines with a decrease in IMR and additional spending on education in primary level. Thus public spending has to be increased in the nutritional program and education sector at primary level to have a better future in terms of health status and educational attainments of children. Notably, the impact of public expenditure on elementary education is considerably lower on dropout rates as compared to gross enrolment of children. Thus relatively more public spending is required in the education sector to reduce dropout rates as compared to enrolment rates.

To achieve 100 per cent completion in primary education, NER and GER should be 100 and DOR should decline to 0. Given the influence of IMR on the education attainment of children, it is important to ensure IMR also declines to acceptable levels. A target value of 10 for IMR may be considered reasonable on the basis of the current levels in developed countries. In the business as usual (BAU) scenario with current public expenditure on each sector, we require 20 years to achieve the targeted rate of IMR whereas 6 and 10 years for NER and DOR respectively.

[4] Anganwadi is a government sponsored child-care and mother-care centre in India. They were started in 1975 as a part of the ICDS programme to provide basic health care facilities and supplementary food to the children in 0-6 years of age group.

In this situation, we have to increase total public spending at a significant rate to accelerate the trend. Our results show how the required changes in public spending vary considerably across indicators. Achieving IMR at the standard of developed nations would be much more difficult as compared to educational indictors. More interestingly, required increase in public expenditure is substantially high for declining dropout rate in comparison to improving enrolment rates. For instance, if we want to increase the growth rate of IMR by 1.25 times then public spending has to be increased by 95% in health sector whereas merely 23% increase in per capita real public expenditure in education sector would accelerate the growth in NER by equal rate. But the public spending in education has to be increased further to 75% in each year to achieve zero dropout rate.

It must be noted that we have only estimated the additional expenditure requirement to accelerate the trends in child health and education attainment. Most importantly, we have not examined the fiscal feasibility / sustainability of increasing public expenditure. Further, several other conditions need to be ensured in order to accelerate the trends in child health and education attainment. For instance, the human capital requirement in the health and education sectors may be a severe constraint, at least in the short to medium-run. Further, our estimation shows the importance of clean water supply and sanitation, which affects IMR and through that education attainment. A more holistic approach may hence essential to improve child health and education status. This, however, is beyond the scope of the present paper.

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Appendix

In this analysis, our primary objective is to analyse the effect of child health status on their educational attainment. For this, we need to measure the health status of those children who are in the age of primary level of education. Thus percentages of children who are malnourished, stunted and severely underweight are more suitable variables to capture the health status of children in the particular age group. But these measures are available only for 1992-93, 1998-99 and 2005-06 in the National Family Health Survey (NFHS) for India. Instead we have considered IMR as a proxy of child health status for which data is available for the required time period. To test the suitability of IMR as a proxy of child health status, simple linear regression models are estimated relating different indicators of child health status to IMR by applying OLS techniques. The results demonstrate the fact that IMR is a good proxy explaining a significant percentage of variation in several indicators of child health status, viz. severely stunted, stunted, wasted, severely underweight and underweight (table 9). This gives us a basis for using IMR as a proxy for overall child health status in the main analysis in this paper.

Table 9: The estimated results for different child health status on IMR using OLS technique

Variable	Severely Stunted	Stunted	Severely Wasted	Wasted	Severely Underweight	Underweight
IMR	.250***	.297***	0.002	.078*	.221***	.388***
Constant	6.655***	26.156***	3.894***	11.394***	1.476	18.455***
Observations	74	74	74	74	79	79
R-sqr	0.48	0.47	0.01	0.07	0.49	0.51
F-Value	67.42***	62.93***	0.01	5.39*	74.27***	81.01***

Note: * p<0.05; ** p<0.01; *** p<0.001