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Assessing public expenditure efficiency at the subnational level in India: Does governance matter?

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The issue of public expenditure efficiency has drawn the attention of both policymakers and researchers globally. The paper attempts to measure the efficiency of government expenditures on the social sector, especially health and education, among the major Indian states using various data envelopment analysis. The paper also attempts to understand what drives public expenditure efficiency. The results suggest that there is a wide variation in the efficiency of public spending as well as scope for resource-saving at the subnational level in India. It finds that states are spending their resources more efficiently on education than on health and the overall social sector spending. It also finds that quality of governance, economic growth, and mothers' schooling affects the efficiency of education, health, and social sector with governance to have a larger effect compared to other factors. Overall, the study suggests that improving governance could yield better outcomes from public expenditure.

Highlights

- The paper looks at understanding the issue of public expenditure of efficiency of education, health, and overall social sector over the 15 year period since the year 2000, broadly covering the millennium development goal period at the subnational level in India.
- By using data envelopment analysis, the study derives the efficiency scores for major states for three-time periods for input-oriented, output-oriented, and non-oriented conditions.
- The results broadly suggest that there is wide divergence in terms of efficiency levels across the states and also finds some spatial patterns. States in Western region appear to be more efficient than compared to other regions.
- Overall, the states appear to be spending efficiently on the education compared to health.
- In terms of what explains such divergences in efficiency levels, the study looks at broader determinants-overall governance-with conditional variables such as level of incomes and mothers' schooling.
- The econometric results suggest that it is the level of governance that affects the efficiency levels at the subnational level in India.

1 | INTRODUCTION

One of the major objectives of the governments is to provide a host of public goods and services such as health, education, public infrastructure, and public safety to their citizens. But the limits to governments' budgets do restrict the scope for increasing public expenditure above a certain level. That pressures policymakers to get the most out of existing resources through improving public spending efficiency. In the recent period, some studies have focussed on this issue,[1] which suggests that the spending activities of the government should generate maximum potential benefits for the population and prevent the use of resources inefficiently.

Public expenditure is efficient when the government produces a maximum possible outcomes for its citizens. Everything being equal, governments that produce more outputs while spending less on inputs can be viewed as more efficient than governments that produce fewer outputs and use more inputs. Public expenditure not being efficient would mean either the outcomes could be increased without spending more, or expenditure could be reduced without affecting the output, which is the focus of this paper. It tries to assess the efficiency of government expenditure on education, health, and social sectors among major Indian states by using a mix of outputs and inputs.[2]

The analysis of public expenditure efficiency becomes very important given the wide regional divergences in terms of both economic growth as well as the extent of human development among the Indian states. While the public policy in India aims to reduce such divergences, however, at present, the focus is more on resource allocation (through both horizontal and vertical equalization principle). Despite many years of this course of action, the impact on overall development outcomes appears to be negligible (Chatterjee, Hammill, Kumar, & Panda, 2015). Further, the existing difficulties associated with budget constraints due to the enactment of the fiscal responsibility and budget management (FRBM) Act reinforced the urgent need for improving the efficiency of public spending.[3]

By using data envelopment analysis (DEA) methods, this study focuses on measuring efficiency in education, health, and social sector in the Indian states. Economic theory suggests that the social sector expenditure, especially education and health sectors, are a vital source of human capital formation, which enhances economic growth.[4] Therefore, an efficient allocation of resources in such growth-promoting expenditures is quite pertinent. In India, which has a federal setup, at the central (national) government level, the total public expenditures are nearly 19% of gross domestic product (GDP), whereas the state (subnational) governments spend between 12 and 55% of their gross state domestic product (GSDP) in 2015–2016.[5] Hence, any improvement in the efficiency of public spending could have a significant impact on the overall budget as well as on growth. While India has adopted millennium development goals (MDGs) in September 2000, it has remained an unfinished agenda in most of the states even after 15 years. At this juncture, one needs to understand the relationship between social sector expenditures and their outcomes. Further, it is also important to ask whether public expenditure alone is sufficient enough to improve the social sector outcomes. Or if not what determines such social sector outcomes? Here, the issue of expenditure efficiency becomes crucial from the policy perspective. Against this background, exploiting efficiency gains from social sector expenditures becomes crucial to meet the new Sustainable Development Goals (SDGs), without making public finances unsustainable.[6]

The study contributes to the existing literature in the following ways. First, to our knowledge, this is the first attempt to measure the efficiency of public spending among the Indian states. Second, it uses DEA to compute input-oriented, output-oriented, and non-oriented efficiency scores in a given period and also changes in efficiency over time. Finally, the study extends to understand what determines divergences in public expenditure inefficiencies. This paper is organized as follows. Section 2 provides a brief review of the literature on public expenditure efficiency. Section 3 discusses the datasets and the methodology used in the paper. Section 4 presents and discusses the results of the DEA analysis. An econometric analysis of efficiency, governance, growth, and mother's schooling is presented in Section 5. Section 6 summarizes the results and policy implications.

2 | REVIEW OF LITERATURE

The studies on this subject are few. These studies are both at the country level and also at cross-country level, and use either nonparametric (such as DEA) or parametric (such as Stochastic Frontier Analysis) approaches. One study by Gupta and Verhoeven (2001) looked at the efficiency of government expenditure on education and health in 37 African countries during 1984–1995. The study found that, on average, African countries were less efficient in providing health and education services when compared with the Asian and the Western Hemisphere countries. Herrera and Pang (2005) showed the efficiency of expenditure depended on expenditure levels, wage bills, income inequality, and public provision of services. Dutu and Sicari (2016) found a wide dispersion in the efficiency of health care, secondary education, and general public services in a sample of Organisation for Economic Co-operation and Development (OECD) countries. In the case of education expenditure, Sutherland et al. (2010) measured the efficiency of 30 OECD countries at the school level. The results demonstrated that better school outcomes were found to be highly dependent on high-quality teaching resources.

Two studies by Afonso and Aubyn (2005, 2006) showed similar results with wide divergence in efficiency levels across OECD countries, especially in education. These studies also found that efficiency gains could be amplified through improvement in the human capital stock and wealth. Efficiency levels could also depend on the size of the public sector, as shown by Afonso, Schuknecht, and Tanzi (2005), suggesting that a smaller public sector had better efficiency gains compared to the larger public sector. Further, Afonso et al. (2010) showed that public sector efficiency could also depend on other factors such as the security of property rights, per capita GDP, the competence of civil servants, obesity, smoking habits, and the level of education. Joumard, Andre, and Nicq (2010) found that institutional

frameworks in health care expenditure, for example, the allocation of resources between inpatient and outpatient cares, the payment schemes, and the existence of incentives for providers could have a significant impact on the efficiency (outcomes). Grigoli and Kapsoli (2018) found that African economies had the lowest efficiency in public health spending, which did matter for health outcomes.

Few studies have highlighted the role of governance and economic growth in improving efficiency. In the Russian Federation, Hauner (2007) found that efficiency gains in health care and social protection were larger than in education. The difference in these outcomes among regions was positively related to per capita income and the quality of governance and was negatively related to the share of federal transfers and the level of spending. A study by Rajkumar and Swaroop (2008) found that public spending had more effectively increased primary education attainment and reduced child mortality in countries with good governance, whereas it had virtually no impact on health and education outcomes in poorly governed countries.[7]

It may be noted from the above review that most of the studies have focussed on advanced countries especially in the European region. The studies use a mix of parametric as well as nonparametric methods. Moreover, the conclusions are mixed, with some studies suggesting that the public expenditure efficiency depends on the type of expenditures (education, health, social protection, and so forth), while studies on the determinants of public expenditure efficiency show that outcomes depend largely on governance parameters. But there is no such study in India which is grappling with budget constraints and gaps in human development. Within India, the issue becomes much more crucial at the state level, as the demands, budget constraints, and absorptive capacities are quite diverse. To this end, the present study tries to understand the relationship between inputs and outcomes that determine the level of public expenditure efficiency. The next section presents the data and methodology used in the study.

3 | DATA AND METHODOLOGY

3.1 | Data

The efficiency of public expenditure among 27 Indian states[8] is calculated for three different periods, that is, 2002–2003, 2008–2009, and 2015–2016. This confines the analysis to the MDGs period, (2000–2015). But the choice of three points is largely driven by the availability of outputs/outcomes indicator data, which is sparse especially at the state level, and it also reflects the beginning, the middle, and the end of the MDG period. While measuring the efficiency of public spending in 2002–2003, the analysis excludes three newly formed states, namely, Chhattisgarh, Jharkhand, and Uttarakhand. However, for the later analysis, these states are included in the analysis. The analysis focuses on two major social sector expenditures, that is, education and health, and covers the overall social sector separately.[9] As the analysis needs to link outlays to the outputs, the considered variables are total education expenditure, health expenditure, social sector expenditure, total expenditure, gross state domestic product, population, gross enrollment ratio for school education (6–17 years), gross enrollment ratio for higher education, mother's schooling, infant mortality rate (IMR), life expectancy at birth (LE), MDG composite performance index, and governance index.

All public expenditure related variables are collected from "State Finances: A study of Budget," Reserve Bank of India. Data on GSDP is obtained from National Accounts Statistics, Central Statistics Office. Mid-year population figures are obtained from a report entitled "Population Projections for India and States 2001–2026," Office of The Registrar General & Census Commissioner, Government of India. Data on education-related indicators such as "gross enrolment ratios" are from Educational Statistics of EPWRF India Time Series from EPW Research Foundation, and on "mothers' schooling" above standard 10th is collected from the Annual Status of Education Report 2016. The health-related indicators such as infant mortality rate and life expectancy are collected from the Sample Registration System Bulletins, Office of the Registrar General & Census Commissioner, Government of India. Finally, MDG composite performance index and governance index are sourced from Chatterjee et al. (2015) and the Public Affairs Centre, respectively. For the analysis, as the relationship between outlays and outputs are not contemporaneous, we have taken 3-year averages for public spending while the outputs for the same are for 1 year.

3.2 | Data envelopment analysis

For measuring the efficiency of public spending, the DEA is applied. It is a nonparametric technique and was developed by Charnes, Cooper, and Rhodes (1978). It assumes the existence of a convex production frontier. In the DEA approach, a linear programming method is used to construct the frontier. The terminology "envelopment" stems out from the fact that the production frontier envelops the set of observations. It is very popular in empirical studies on efficiency since it can easily handle multiple inputs and outputs while constructing efficiency. It is less vulnerable to the misspecification problems that can affect econometric models. The advantage of this method is that no prior specification (potentially erroneous) of the functional relationship between production inputs and outputs is required. The efficiency using DEA is measured relative to the highest observed performance rather than an average. The alternative method, as suggested by the literature, could have been the parametric approach such as the stochastic frontier approach (SFA) as suggested in Aleskerov, Belousova, and Petrushchenko (2017).[10]

Efficiency is a comparison between inputs used in a specific activity that produced outputs. A DMU[11] is said to be efficient and operates on the frontier when it attains the maximum level of output or outputs with a given amount of input or inputs, and the existing technology. When it produces less than what can be attained, the DMU is considered to be inefficient.

Figure 1 plots the inputs on the *x*-axis and the outputs on the *y*-axis. It illustrates that M, Q, N, and P (DMUs) are located on the

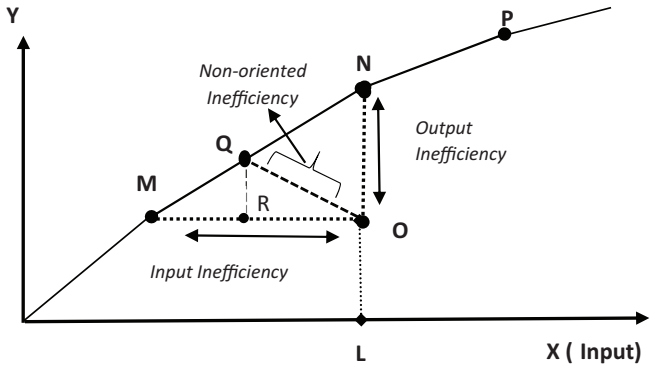

FIGURE 1 Example of an efficiency frontier. M, N, P, and Q represent DMUs on the efficiency frontier. O and R are inefficient DMUs. L represents the quantity of input. DMUs, decision-making units. *Source:* Authors' interpretation

efficiency frontier, and are therefore efficient. On the other hand, DMU "O" is inefficient. With the given level of input, it produces "OL" units of output and it could increase by "ON" units to be on the possibility frontier.[12] The deviations between observed values and an estimated frontier are attributed to inefficiency. The vertical distance (ON) from the efficiency frontier is called "output inefficiency," which shows to what extent output could be expanded while keeping inputs constant. The horizontal distance (OM) from the frontier is measured as "input inefficiency," means the extent to which inputs could be reduced without affecting output. Similarly, the distance of "OQ" is measured as "nonoriented inefficiency" means the extent to which output could be expanded (RQ) and input could be reduced (OR). DEA allows the calculation of technical efficiency scores of the selected DMU.[13] These efficiency scores will be set between 0 and 1, and all the DMUs placed on the efficient frontier will be assigned the maximum score of 1. In the next section, the empirical results based on the above methods are presented and discussed.

4 | EMPIRICAL ANALYSIS

As discussed in the previous section, various DEA methods are used to measure the efficiency of public spending on education, health, and the overall social sector. Variable returns to scale are assumed (proposed by Banker, Charnes, & Cooper, 1984) in all of these models. The results are discussed below.

4.1 | Education

The estimation of efficiency scores for education is undertaken using two outputs, that is, gross enrolment ratio for school education, gross enrolment ratio for higher education, and two inputs such as education expenditure to GDP ratio and non-education expenditure[14] to GDP ratio. As mentioned in the previous section, the data for education and noneducation spending are averaged over three periods (2000–2002 for 2002, 2006–2008 for 2008, and 2013–2015 for 2015). The results of the efficiency scores for education through an input-oriented, output-oriented, and non-oriented approach are given in Table 1.[15]

The results of the input-oriented efficiency score show that in 2015, seven states are labeled as efficient: Goa, Gujarat, Haryana, Himachal Pradesh, Maharashtra, Tamil Nadu, and Tripura. Among these states, only Haryana, Maharashtra, and Tamil Nadu are consistently efficient from 2002. These efficient states have achieved a higher enrolment ratio using a smaller proportion of resources than the national average. Most of the northeastern states (except Tripura) are the poor performers in 2015 as these states are using a high share of public spending to achieve the given outcome. In 2015, the input efficiency score of all states is 0.75 (0.81 in 2008 and 0.89 in 2002) meaning that, on average, they should be able to attain the same level of output using about 75% of the inputs they are currently using. The least efficient state from an input-oriented perspective is Arunachal Pradesh (0.31). It means it can achieve the current outcome by using only 31% of the current spending. Rest resources are used inefficiently. Our results of the input-oriented approach (Figure 2) suggests that most of the Indian states could achieve the same level of output by reducing the current level of public spending and following the best practice followed in the efficient states.

The results of output-oriented efficiency scores also find similar efficient states as in input-oriented (as expected). However, it finds that in 2015, the bottom five states are Nagaland, Jammu and Kashmir, Uttar Pradesh, Jharkhand, and Bihar. The output-oriented efficient score of all states is 0.78. It implies that with the same inputs, all states on average are producing about 22% lesser output than they should if they are efficient. For example, the output efficiency score of Bihar is 0.70, which implies that only 70% of output is produced with the existing resources. Similarly, many other states are also producing less output than they could (Figure 3) with the current level of public spending.

The non-oriented analysis also shows that seven states namely Goa, Maharashtra, Tripura, Himachal Pradesh, Tamil Nadu, Haryana, and Gujarat are efficient in 2015–2016, using their resources more efficiently. There is a large potential among all the states (efficiency score 0.61) for a simultaneous increase in current outputs and reduction in inputs. Thus, by following their peer groups, many states could enhance their outcomes and can use their resources more efficiently.

Over the time from 2002 to 2015, the relative efficiency of education spending has improved significantly in several states (Goa, Gujarat, Punjab, Kerala, Andhra Pradesh, Tripura, and so forth), deteriorated in some states (Chhatisgarh, Jharkhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Odisha, Uttarakhand, Meghalaya, and so forth), and remain unchanged in few of the states (Himachal Pradesh, Tamil Nadu, Haryana, and Maharashtra).

4.2 | Health

In the case of health, two outputs and two inputs are considered in the DEA set up. It takes two conventional measures of health

TABLE 1 Education efficiency scores in the Indian states

	Input-oriented			Output-oriented			Non-oriented		
States	2002	2008	2015	2002	2008	2015	2002	2008	2015
Andhra Pradesh	0.56	0.57	0.67	0.75	0.84	0.77	0.49	0.45	0.53
Arunachal Pradesh	0.34	0.27	0.31	0.78	0.85	0.85	0.22	0.21	0.25
Assam	0.84	0.62	0.58	0.71	0.68	0.72	0.53	0.33	0.3
Bihar	0.69	0.48	0.5	0.57	0.63	0.7	0.39	0.25	0.28
Chhattisgarh	–	0.89	0.57	–	0.97	0.84	–	0.71	0.34
Goa	1	0.78	1	1	0.89	1	1	0.7	1
Gujarat	0.91	1	1	0.88	1	1	0.79	1	1
Haryana	1	1	1	1	1	1	1	1	1
Himachal Pradesh	1	0.99	1	1	1	1	1	0.9	1
Jammu and Kashmir	0.5	0.49	0.4	0.65	0.84	0.66	0.26	0.37	0.29
Jharkhand	–	0.74	0.72	–	0.87	0.69	–	0.5	0.42
Karnataka	0.87	1	0.8	0.86	1	0.81	0.79	1	0.64
Kerala	0.93	0.9	0.88	0.94	0.95	0.99	0.73	0.67	0.84
Madhya Pradesh	0.8	1	0.63	0.75	1	0.75	0.64	1	0.45
Maharashtra	1	1	1	1	1	1	1	1	1
Manipur	1	1	0.34	1	1	0.92	1	1	0.29
Meghalaya	0.53	0.73	0.41	0.83	0.98	0.78	0.5	0.7	0.3
Mizoram	0.27	1	0.43	0.89	1	0.97	0.24	1	0.4
Nagaland	0.46	0.35	0.34	0.42	0.62	0.63	0.2	0.24	0.19
Odisha	0.69	0.74	0.61	0.74	0.83	0.74	0.57	0.48	0.43
Punjab	0.88	0.94	0.96	0.76	0.91	0.92	0.67	0.69	0.9
Rajasthan	0.77	0.68	0.65	0.75	0.84	0.72	0.61	0.45	0.47
Tamil Nadu	1	1	1	1	1	1	1	1	1
Tripura	0.42	0.54	1	0.83	0.92	1	0.28	0.42	1
Uttar Pradesh	0.81	0.58	0.52	0.7	0.8	0.66	0.58	0.41	0.4
Uttarakhand	–	0.73	0.7	–	0.93	0.87	–	0.56	0.65
West Bengal	0.93	0.84	0.86	0.76	0.76	0.83	0.71	0.58	0.59
All states	0.89	0.81	0.75	0.78	0.85	0.78	0.73	0.68	0.61

Source: Authors' calculation based on DEA analysis.

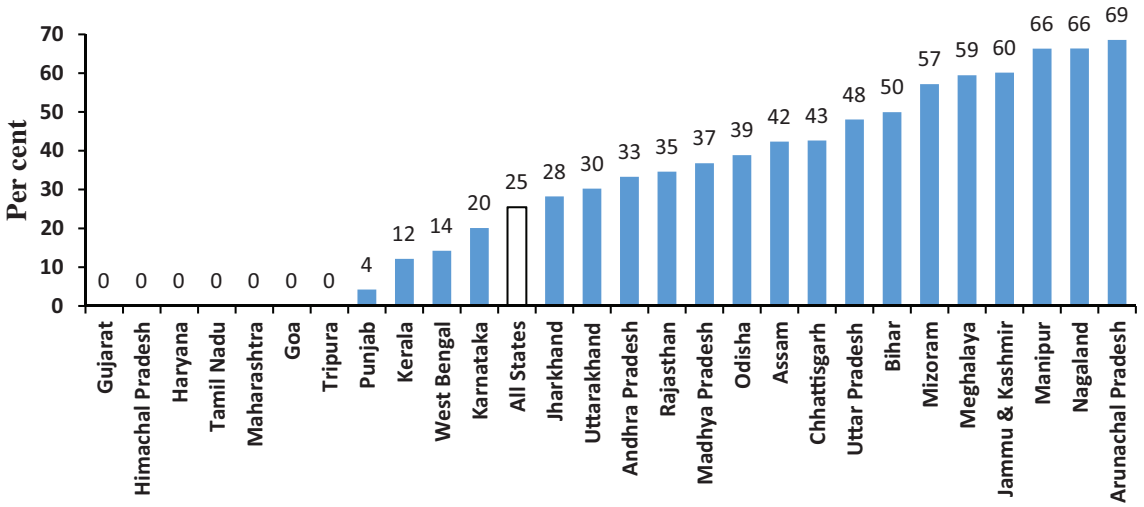

FIGURE 2 Input inefficiency (Education, 2015). *Source:* Authors' calculation based on DEA analysis

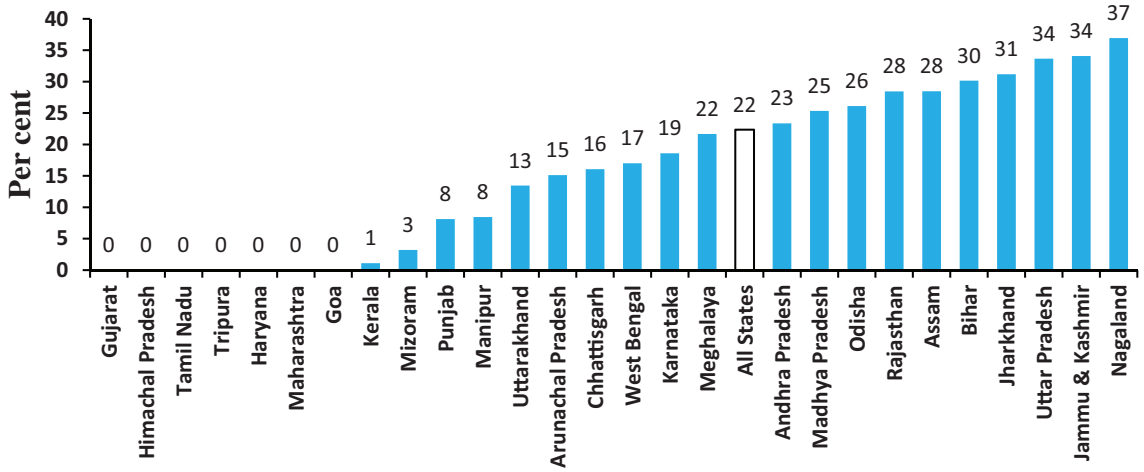

FIGURE 3 Output inefficiency (Education, 2015). *Source:* Authors' calculation based on DEA analysis

TABLE 2 Health efficiency scores in the Indian states

	Input-oriented			Output-oriented			Non-oriented		
States	2002	2008	2015	2002	2008	2015	2002	2008	2015
Andhra Pradesh	0.52	0.39	0.51	0.88	0.88	0.92	0.16	0.2	0.36
Assam	0.79	0.6	0.54	0.81	0.82	0.86	0.22	0.22	0.28
Bihar	0.69	0.47	0.53	0.88	0.87	0.91	0.22	0.21	0.34
Chhattisgarh	–	–	0.55	–	–	0.87	–	–	0.34
Gujarat	0.78	0.98	0.95	0.96	0.96	0.95	0.45	0.74	0.64
Haryana	1	1	1	1	1	1	1	1	1
Himachal Pradesh	0.5	0.43	0.49	0.95	0.94	0.96	0.16	0.22	0.37
Jammu and Kashmir	0.37	0.3	0.39	0.92	0.94	0.97	0.14	0.13	0.28
Jharkhand	–	–	0.64	–	–	0.91	–	–	0.49
Karnataka	0.87	0.69	0.67	0.91	0.92	0.93	0.3	0.42	0.56
Kerala	1	1	1	1	1	1	1	1	1
Madhya Pradesh	0.79	0.63	0.59	0.81	0.83	0.86	0.18	0.24	0.33
Maharashtra	1	1	1	1	1	1	1	1	1
Odisha	0.69	0.72	0.55	0.82	0.86	0.89	0.16	0.33	0.33
Punjab	0.82	0.82	0.84	0.95	0.98	0.99	0.35	0.61	0.78
Rajasthan	0.78	0.68	0.63	0.88	0.89	0.9	0.18	0.26	0.35
Tamil Nadu	0.97	0.82	0.82	0.95	0.95	0.96	0.5	0.7	0.79
Uttar Pradesh	0.82	0.57	0.48	0.86	0.83	0.86	0.26	0.19	0.27
Uttarakhand	–	–	0.65	–	–	0.95	–	–	0.45
West Bengal	0.95	0.83	0.84	0.93	0.94	0.96	0.35	0.57	0.69
All states	0.9	0.78	0.71	0.9	0.9	0.92	0.31	0.4	0.47

Source: Authors' calculation based on DEA analysis.

attainment, namely, IMR and LE as outputs and health expenditure to GDP ratio and nonhealth expenditure[16] to GDP ratio as two inputs for measuring health efficiency. The DEA techniques imply that outputs are measured in such a way that "more is better." Here, the IMR refers to the (number of children who died before 12 months)/ (number of born children) × 1,000. Therefore, we have calculated an "Infant Survival Rate"[17] as (1,000 − IMR)/IMR.

Finally, the infant survival rate and LE are used as final outputs in the DEA approach. The data for health and non-health spending are averaged over three periods (2000–2002 for 2002, 2006–2008 for 2008, and 2013–2015 for 2015). The efficiency analysis for health is carried out for 20 states based on data availability.[18] The results of the efficiency scores for the health sector through an input-oriented, output-oriented, and nonoriented approach are given in Table 2.

It is observed from Table 2 that three states are the most efficient ones in the input-oriented approach: Kerala, Maharashtra, and Haryana. The lowest IMR (12) and highest LE (more than 75) is found in Kerala, while Maharashtra and Haryana are among the lowest share of health spending to GDP with a better health outcome. Another set of five states are at the bottom, Jammu and Kashmir, Uttar Pradesh, Himachal Pradesh, Bihar, and Andhra Pradesh. In 2015, the input efficiency score of all states implies that, on average, the same level of output could be achieved by using about 71% of the current inputs. Over time the efficiency of health has declined from 0.90 to 0.71 from 2002 to 2015.

Figure 4 shows that based on 2015–2016, most of the Indian states could achieve the same level of output by reducing the current level of public spending, compared to the states on the frontier. The results of the output-oriented approach find that Kerala, Maharashtra, and Haryana are the most efficient states, while Uttar Pradesh, Assam, Madhya Pradesh, Odisha, Chhattisgarh, and Bihar are the least efficient states. The output efficient score of all states is 0.92. It implies that with the same inputs, all states on average are producing about 8% fewer outputs than they should if they are efficient. Figure 5 displays the output inefficiency of the remaining states.

The non-oriented analysis shows almost similar results. There is a vast potential among all the states (efficiency score 0.47) for a simultaneous increase in current outputs and reduction in inputs. Thus, many states by following their peer groups can enhance their health outcomes and can use their resources more efficiently. Over time from 2002 to 2015, the relative efficiency of health spending among all states has improved regarding output and nonoriented approach and deteriorated in an input-oriented approach.

4.3 | Social sector

Social sector spending is necessary and an essential source for human development. For this purpose, the efficiency of social sector expenditure is calculated for 27 states in 2015.[19] In terms of outcomes, social sector spending in India is meant for achieving most of the MDG targets, hence we have relied on MDG composite performance index calculated by Chatterjee et al. (2015)[20] as an output for social sector and two inputs, such as social sector expenditure to GDP ratio and non-social sector expenditure[21] to GDP ratio. We averaged these expenditures over three periods from 2013–2014 to 2015–2016 for 2015–2016. The estimated efficiency scores for the social sector in the year 2015 are shown in Table 3.

The estimated DEA results suggest that Goa, Maharashtra, and Punjab are the most efficient states. As per the input-oriented approach, the five least efficient states are Arunachal Pradesh, Mizoram, Manipur, Nagaland, and Meghalaya, while using the output-oriented approach, the five least efficient states are Bihar, Jharkhand, Uttar Pradesh, Arunachal Pradesh, and Madhya Pradesh. The input efficiency score of all states is 0.71 meaning that on average, all states can attain the same level of output by reducing current inputs by 29%. Similarly, the output efficient score of all states is 0.69. It implies that with the same inputs, all states on average could produce 31% more outputs to achieve efficiency. The non-oriented analysis also shows that the efficiency score of all states is 0.58, which implies that on average, they can utilize more than 40% of their resources more efficiently in the form of a simultaneous increase in current outputs and reduction in inputs. Thus, in many states, there is a huge potential for improving efficiency by following their peer groups. The input and output inefficiency among states are plotted in Figures 6 and 7, respectively.

Overall, a region-wise analysis of the performance of individual states finds that the western states such as Maharashtra, Goa, and Gujarat are more efficient in public spending than the other regions. Most of the northeastern regions, excluding Tripura, and the eastern Indian states of Bihar, Jharkhand, and Odisha (excluding West Bengal) are less efficient in the given public spending. These states are "off-track" in a significant proportion of indicators of the MDGs. Among the North Indian states such as Haryana, Punjab, and, some extent Himachal Pradesh are more efficient than Uttar Pradesh, Rajasthan, and Jammu and Kashmir. Kerala and Tamil Nadu stand out to be more

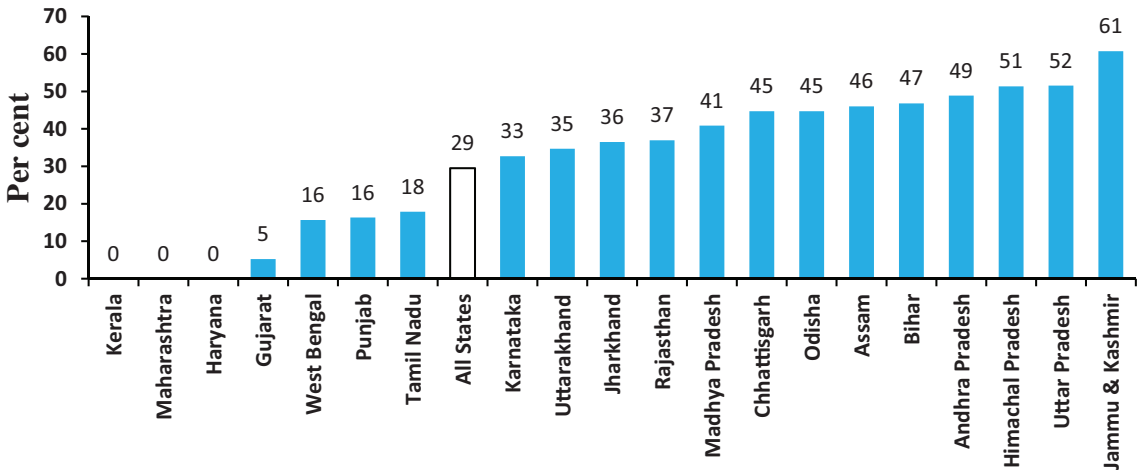

FIGURE 4 Input inefficiency (Health, 2015). *Source:* Authors' calculation based on DEA analysis

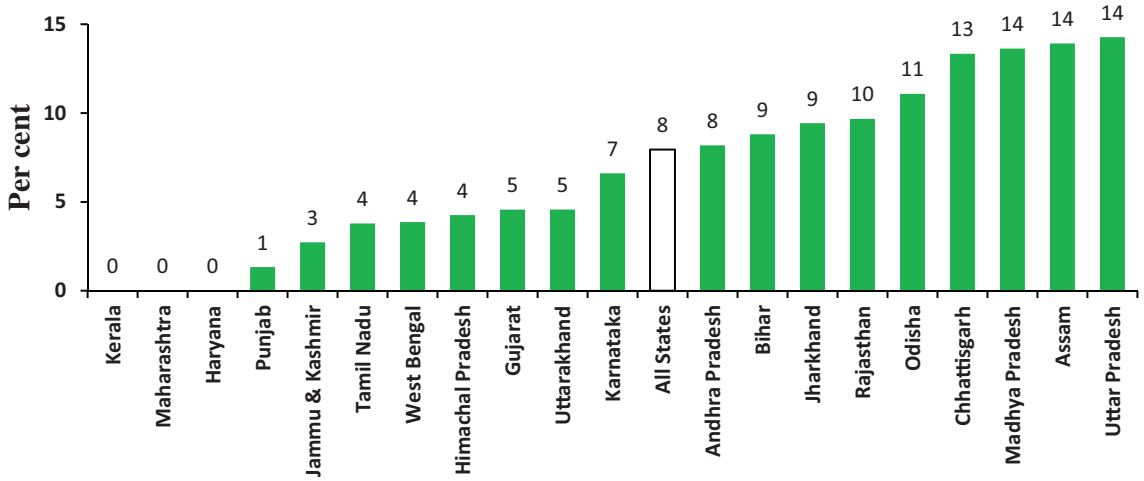

FIGURE 5 Output inefficiency (Health, 2015). *Source:* Authors' calculation based on DEA analysis

TABLE 3 Social sector efficiency scores in the Indian states

States	Input-oriented	Output-oriented	Non-oriented
Andhra Pradesh	0.52	0.78	0.48
Arunachal Pradesh	0.25	0.49	0.13
Assam	0.59	0.56	0.36
Bihar	0.52	0.38	0.22
Chhattisgarh	0.57	0.58	0.38
Goa	1	1	1
Gujarat	0.94	0.85	0.83
Haryana	0.96	0.81	0.81
Himachal Pradesh	0.52	0.8	0.47
Jammu and Kashmir	0.39	0.74	0.31
Jharkhand	0.68	0.42	0.32
Karnataka	0.71	0.75	0.6
Kerala	0.84	0.98	0.82
Madhya Pradesh	0.6	0.53	0.38
Maharashtra	1	1	1
Manipur	0.26	0.77	0.22
Meghalaya	0.38	0.65	0.3
Mizoram	0.26	0.73	0.22
Nagaland	0.35	0.63	0.23
Odisha	0.57	0.56	0.37
Punjab	1	1	1
Rajasthan	0.68	0.57	0.43
Tamil Nadu	0.9	0.93	0.84
Tripura	0.4	0.81	0.38
Uttar Pradesh	0.51	0.49	0.29
Uttarakhand	0.69	0.7	0.55
West Bengal	0.9	0.83	0.73
All states	0.71	0.69	0.58

Source: Authors' calculations based on DEA analysis.

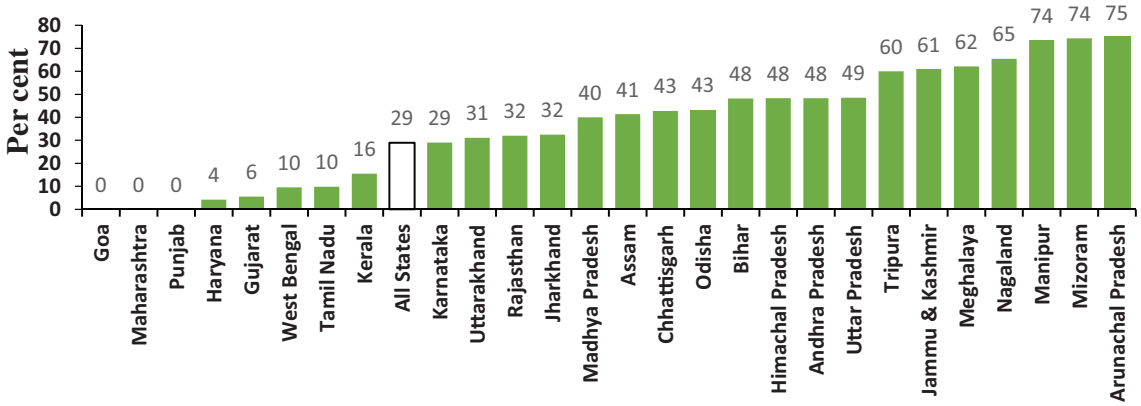

FIGURE 6 Input inefficiency (Social sector, 2015). *Source:* Authors' calculations based on DEA analysis

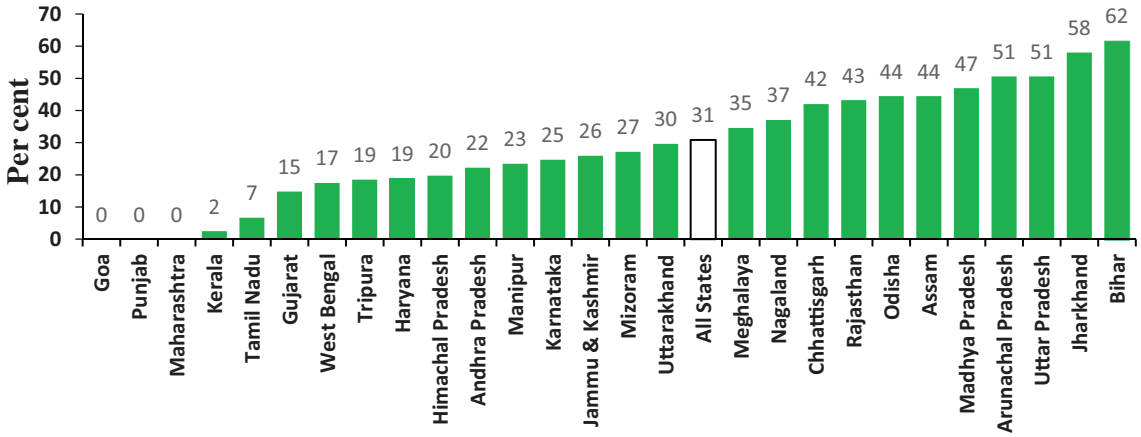

FIGURE 7 Input inefficiency (Social sector, 2015). *Source:* Authors' calculations based on DEA analysis

efficient in the South Indian regions than the other states such as Andhra Pradesh and Karnataka. In the Central Indian states of Chhattisgarh and Madhya Pradesh, efficiency levels are just about average compared to other states for given public spending. In the case of health and education, our results show a wide variation among states in terms of public expenditure efficiency. At this juncture, a crucial question is: what determines such divergences in public expenditure efficiencies across states? This is the focus of the next section.

5 | WHAT DETERMINES PUBLIC EXPENDITURE EFFICIENCY?

The level of efficiency across states is found to be diverse in the previous section. One of the reasons for such diverse outcomes could be that public expenditure alone might not be sufficient to enhance efficiency. It may just be a necessary condition. There could be various other factors that might affect the efficiency of the social sector in addition to public expenditure. The effectiveness of public spending could be determined by institutional capacity, the extent of leakage in public spending, poor budget management, and so forth. Existing literature suggests that, in addition to public expenditures, human development outcomes also depend on the quality of governance (Bhanumurthy, Prasad, & Jain, 2018; Rajkumar & Swaroop, 2008). It means that public spending becomes more effective in increasing development outcomes with the presence of good governance.

It is believed that higher economic development is significantly correlated with better outcomes of major service delivery like education, health care, and so forth. Rapid economic development helps in bolstering revenues collection, which increases the fiscal space of the economy. Improved resources with governments motivate them to invest in education, health, livelihood promotion, water, sanitation, and other basic services, which would improve the productivity and efficiency of human resources. Thus, economic development should be taken into account when assessing/enhancing the efficiency of government spending (Afonso et al., 2010; Anand & Ravallion, 1993). From the literature, three major factors that could influence the efficiency levels: that is, resources, institutions, and endowment. We have taken per capita GDP as a proxy for resources, governance index as a proxy for institutions and mother's education as a proxy for the endowment factors, which might affect the public expenditure efficiency. The econometric analysis is carried out using the Tobit models instead of Ordinary Least Squares (OLS) as the inefficiency scores are truncated and lie between 0 and 1.

The estimated DEA analysis provides an efficiency score equal to one for the fully efficient states and below one for less inefficient states. Here, we undertake a Tobit analysis on the inefficiency (I) where I = 1 – efficiency score.[22] We use the left censor for states with less than or equal to 0.1 (fully efficient states) as zeros. It implies that we form a group of efficient states whose efficiency score is at least 0.9 and limit the observable states to only inefficient states. The standard Type-I Tobit model is used and is defined as follows:

$$I_i^* = X_i\beta + \epsilon_i$$

$$I_i = I_i^*, if\ I_i^* > 0.1$$

$$I_i = 0, otherwise.$$

where, I_i^* is a latent variable, which is unobservable; X_i is a vector of explanatory variables, that is, per capita GSDP (PGSDP), governance index (GOV)[23] and mother's schooling (MS); β is a vector of parameters; "i" is the number of states and ϵ_i is error terms that follow a normal distribution. Various interaction term has been taken to analyze the direct and indirect linkages of these variables on the efficiency of public spending. The results of estimated Tobit models are presented in Tables 4, 5, and 6.[24]

The coefficients of governance in the models are negative and statistically significant at 1% level (Table 4). Thus, better governance helps in reducing inefficiency in the social sector. It also finds that the per capita GSDP and mother's schooling have a negative impact on social sector inefficiency. However, the magnitude of the governance coefficient is more than the coefficient of other selected variables implying governance has a larger impact compared to per capita GSDP and mother's schooling for improving the efficiency of the social sector. The same analysis is done by using the interaction term between governance and mother's schooling, the interaction term between per capita GSDP and mother's schooling, and the interaction term between governance and per capita GSDP.[25] The negative and statistically significant of these coefficients of interaction terms suggest that the efficiency of the social sector improves with better governance, mother's schooling, and higher economic growth. Thus, the impact of governance and economic development on the efficiency of the social sector improves in the presence of the mother's schooling.

While analyzing the efficiency of the education sector, it also finds that per capita GSDP and mother's schooling reduces inefficiency. Governance has an adverse and significant effect on the inefficiency of education only in the presence of the mother's schooling (Models 2 and 3). The interaction term of governance and mothers' schooling, per capita GSDP and mothers' schooling, and governance and per capita GSDP has a negative and statistically significant effect on the inefficiency of the education sector. Thus, it also confirms that the impact of governance and per capita GSDP on the efficiency of the education sector is higher in the presence of the mother's schooling as well as governance with better per capita GSDP helps in improving the efficiency of the education sector. Here, it also finds that the magnitude of the governance coefficient is more than the coefficients of per capita GSDP and mother's schooling.

Similarly, in the health sector inefficiency, results suggest that the coefficient of governance is insignificant but GSDP per capita and mother's schooling have adverse effects on it. However, along with per capita GSDP and mothers' schooling interaction term, the

TABLE 4 Factors affecting public spending inefficiency of social sector

	Social sector inefficiency						
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
GOV	−2.0343* (−3.68)	−2.3942* (−5.10)	−2.3152* (−4.64)			−2.3717* (−4.74)	−2.2023* (−3.93)
PGSDP	−1.45E-06 (−1.14)			−4.14e-06* (−3.14)	−3.43e-06** (−2.01)	−2.07e-06** (−2.00)	
MS	−0.0059*** (−1.81)	−0.007** (−2.13)		−0.0095** (−2.54)			
GOV × MS			−0.013** (−2.04)				
PGSDP × MS					−1.14e-07** (−2.07)		
GOV × PGSDP							−4.07e-06** (−1.99)
Constant	1.4357* (6.34)	1.5446* (7.28)	1.5009* (6.70)	0.6303* (9.96)	0.5628* (7.74)	1.5653* (7.31)	1.4807* (6.23)
LR chi2	35.52*	34.26*	34.01*	24.85**	22.32*	36.71*	36.61*
N	26	26	26	26	26	28	28
Left-censored observations	4	4	4	4	4	5	5

Note: Figures in parenthesis are *t*-statistics, and *, **, and *** refers to 0.01, 0.05, and 0.10% level of significance, respectively.
Abbreviations: GOV, governance index; LR, likelihood ratio; MS, mother's schooling; *N*, number of observations; PGSDP, per capita GSDP.

TABLE 5 Factors affecting public spending inefficiency in education

	Education inefficiency						
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
GOV	−0.5451 (−1.21)	−1.1447** (−2.71)	−0.9526** (−2.10)			−0.7053 (−1.45)	−0.3039 (−0.55)
PGSDP	−2.69e-06** (−2.31)			−3.49e-06* (−3.37)	−2.66e-06*** (−1.68)	−3.99e-06* (−3.14)	
MS	−0.0078*** (−1.94)	−0.0117** (−2.61)		−0.0089** (−2.54)			
GOV × MS			−0.0243** (−2.62)				
PGSDP × MS					−1.26e-07*** (−1.68)		
GOV × PGSDP							−8.44e-06* (−3.26)
Constant	0.6501* (3.55)	0.8360* (4.41)	0.7448* (3.74)	0.4380* (9.10)	0.3751* (6.69)	0.7209* (3.59)	0.5355** (2.38)
LR chi2	30.42*	25.29*	25.58*	29.02**	27.20*	27.76*	28.81*
N	26	26	26	26	26	28	28
Left-censored observations	10	10	10	10	10	11	11

Note: Figures in parenthesis are *t*-statistics, and *, **, and *** refers to 0.01, 0.05, and 0.10% level of significance, respectively.
Abbreviations: GOV, governance index; LR, likelihood ratio; MS, mother's schooling; *N*, number of observations; PGSDP, per capita GSDP.

TABLE 6 Factors affecting public spending inefficiency in health

	Health inefficiency						
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
GOV	0.0610 (0.31)	−0.2675 (−1.34)	−0.2253 (−1.06)			−0.1104 (−0.520	0.0329 (0.13)
PGSDP	−1.43e-06*** (−3.09)			−1.35e-06* (−3.52)	−1.14e-06** (−2.39)	−1.64e-06* (−3.22)	
MS	−0.0021** (−2.03)	−0.0036** (−2.64)		−0.0020** (−2.02)			
GOV × MS			−0.0066** (−2.53)				
PGSDP × MS					−2.76e-08* (−1.92)		
GOV × PGSDP							−3.28e-06* (−3.28)
Constant	0.1413*** (1.80)	0.2407** (2.72)	0.2176** (2.30)	0.1655* (9.75)	0.1507* (7.80)	0.2067** (2.38)	0.1373 (1.38)
LR chi2	24.20*	16.46*	16.20*	24.10**	23.67*	18.53*	18.80*
N	20	20	20	20	20	21	21
Left-censored observations	3	3	3	3	3	3	3

Note: Figures in parenthesis are *t*-statistics, and *, **, and *** refers to 0.01, 0.05, and 0.10% level of significance, respectively.
Abbreviations: GOV, governance index; LR, likelihood ratio; MS, mother's schooling; *N*, number of observations; PGSDP, per capita GSDP.

interactions between governance and mothers' schooling, and governance and per capita GSDP are negative and significant, explaining that although directly governance does not affect the health efficiency, the combination of governance with the mother's schooling and per capita GSDP will improve the efficiency of the health sector.

Overall, it finds that governance has a larger impact than per capita GSDP and mothers' schooling on the efficiency of the education sector and the social sector. However, it is the per capita GSDP and mothers' schooling that plays a vital role in improving the efficiency of the health sector. Therefore, economic size, quality of

governance, and mothers' schooling matter for improving the efficiency of overall social sector expenditure.

6 | CONCLUDING REMARKS AND POLICY IMPLICATIONS

Achieving the MDGs have remained an unfinished agenda for most of the Indian states. At the same time, since most social sector programs are tailored as per (a) the needs of the regions, (b) the extent of backwardness, and (c) social groups, the public expenditure pattern is largely focused on addressing development gaps. However, what is intriguing is that the returns from such expenditures differ from region to region. To understand such divergences, assessing the efficiency of public expenditures becomes crucial. This study tries to quantify the efficiency of public expenditures on education, health, and overall social sector in 27 major states in India. By considering the relevant data for three-time points, 2002–2003, 2008–2009, and 2015–2016, and by using DEA, the study brings out some interesting results. The study tries to understand the overall outlay-output-outcome linkage in the social sector.

For the analysis of education, gross enrolment ratio for school education and higher education (two outputs), and public expenditure to GDP ratio and non-education expenditure to GDP ratio (two inputs) are used as outputs and inputs, respectively. The results for input-oriented, output-oriented, and non-oriented approaches show some mixed results. Overall, the states such as Goa, Gujarat, Haryana, Himachal Pradesh, Maharashtra, Tamil Nadu, and Tripura are found to be efficient in 2015. In the health sector, two outputs namely infant survival rate and life expectancy, and two inputs, that is, health expenditure to GDP ratio and non-health expenditure to GDP ratio are considered in the DEA set up. It finds that three states, namely Haryana, Maharashtra, and Kerala, are most efficient, while states such as Jammu and Kashmir, Uttar Pradesh, Himachal Pradesh, Bihar, and Andhra Pradesh are found to be least efficient. Similarly while analyzing the social sectors, our results suggest that Goa, Maharashtra, and Punjab are the most efficient states.

Overall, it shows that the Western states are more efficient in public spending than the other regions. Most of the northeastern regions and the eastern Indian states are inefficient in public spending. The South Indian states are relatively better compared to the Central Indian states. Further, many states are spending their resources more efficiently on education than compared to health and overall social sector public spending. What drives such divergences across the states, in terms of efficiency? A simple econometric analysis suggests that good governance has a negative and significant impact on the inefficiency of public spending. Further, the results also show that governance has a larger impact than economic growth and mother's schooling on the efficiency of the education sector and the social sector. Economic growth along with mother's schooling matter more for improving efficiency in the health sector.

To sum up, the findings of this study suggest that there is a wide variation in public expenditure efficiency across the states. This variation could be due to the extent of good governance, economic growth as well as the mother's schooling in the states. It implies that higher budgetary allocations on the social sector alone might not translate into an improvement in their social outcomes. While the analysis in the paper is exploratory, it clearly suggests that public policy needs to focus equally on outcomes and not just on outlay-based polices. Further, the analysis suggests that the quality of governance becomes more crucial in the outlays-outcomes framework, and the governments need to emphasize this issue if one needs to reduce the development gaps.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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ENDNOTES

[1]See Afonso, Schuknecht, & Tanzi, 2010; Dutu & Sicari, 2016; Gupta, Verhoeven, & Tiongson, 2002; Herrera & Pang, 2005; Rajkumar & Swaroop, 2008; Sutherland, Price, & Gonand, 2010.

[2]There is also another strand of literature that suggests that the objective of the state was not always necessary to improve efficiency (Acemoglu, Ticchi, & Vindigni, 2011; Besley, Pande, Rahman, & Rao, 2004; Keefer & Khemani, 2005; Khemani, 2004, among others). Rather, given the efficiency level, the elected governments that is rent-seeking could increase social sector expenditure depending on the election cycles, ruling party ideology, etc. However, the focus of this article is to understand what determines efficiency (or what the "state capacity" is) rather than understanding what determines the extent of public expenditure.

[3]Any such assessments will help in understanding whether some regions lag behind others due to lack of resources, efficiency issues in using resources, or both.

[4]See Gupta, Clements, & Tiongson, 1998 and Krueger & Lindahl, 2001.

[5]The expenditures on social sector at the central government level is more than 8 % of GDP, whereas at the state governments level they spend between 4 and 19% of their GSDP in 2015–2016. Source: Data Bank compiled from Finance Accounts of respective states and National Account Statistics, Central Statistics Office (CSO).

[6]See Reserve Bank of India (2018) on State Finances that suggest "Given the funding constraints on states' budgets and rising borrowing costs, improving efficiency of public expenditures holds the key to achieving the Fiscal Responsibility and Budget Management targets" (p. 2).

[7]There are few more studies such as Clements (2002) for EU and Ollivaud (2017) in the case of Indonesia.

[8]Telangana is officially created on June 2, 2014, hence it is not included. Sikkim is excluded because of data inconsistencies where it was found that in some years the total expenditure as a share of GSDP is more than 100%. As DEA methods are sensitive to measurement errors, statistical noise and outliers, which can distort efficiency scores. Union Territories are not included due to low reporting and data availability.

[9]Social sector expenditure is calculated by adding all the expenditure under the budgetary heads of "Social Services" and "Rural Development." Education expenditure includes expenditure on "Education, Sports, Arts and Culture" (budget head). Health expenditure includes expenditure on "Medical and Public Health," and "Family Welfare." The above measurement of social sector, education, and health expenditure are used throughout the article.

[10]Parametric techniques like SFA postulate a functional form for the production function, which allows for the presence of both stochastic errors and inefficiency. It also requires an explicit distributional assumption for estimating the production function. These conditions are not necessary in the DEA.

[11]It can be a company, a government body, a country, a state, an organization, etc.

[12]There are three ways to improve the performance of "O". One is to reduce its input to reach "M" or "Q" on the frontier, and the other is to increase its output to reach "N" on the frontier. As a result, DEA models will have three orientations: input-oriented, output-oriented, and non-oriented.

[13]The input and output-oriented DEA provide the same results under constant returns to scale but give different values under variable returns to scale. However, both input, output and non-oriented approaches identify the same set of efficient/inefficient DMUs.

[14]It is total public expenditure less education expenditure.

[15]Following the suggestion by an anonymous referee, we have also estimated the efficiency of education by using two outputs of learning outcome provided by ASER Survey, that is, percentage of children who can read text and percentage of children who can do division, and two inputs such as education expenditure to GDP ratio and non-education expenditure to GDP ratio through DEA. It is noted that these learning outcome for Goa and Jammu and Kashmir states are not available. Thus, the efficiency is calculated for rest of the states. However, we find almost similar efficiency scores that we got here, which can be available upon request.

[16]It is total public expenditure less health expenditure.

[17]It is directly interpretable as the ratio of children survived the first year to the number of children died; which increases with a better health status.

[18]Life expectancy data is available only for 17 states in 2002–2003 and 2008–2009. Therefore, the analysis is done for 17 states in 2002–2003 and 2008–2009, for 20 states in 2015–2016.

[19]Analysis for 2002 and 2008 are not carried out as the data for the social sector outcome are not available.

[20]It is a composite index constructed by using more than 19 major socio-economic indicators (for details, see Chatterjee et al., 2015).

[21]It is total public expenditure less of social sector expenditure. Social sector expenditure is calculated by adding all the expenditures under the budgetary heads of "Social Services" and "Rural Development".

[22]Number of states in India is only 29, although the sample is small for Tobit analysis, and we had to limit the analysis to 26 states for which the data is available and this could be a limitation of this analysis.

[23]Public Affairs Index (PAI) is taken as the proxy for governance index for different states, which is estimated by Public Affairs Centre (PAC). PAI is a data driven platform to rank the 30 states and Union territories of India on the governance. PAI ranked the states of India on the basis of 10 broad themes, focusing on 68 individual indicators. The PAI score of 2016 is taken as the proxy for governance index.

[24]The empirical analysis is carried out for the efficiency scores from output-oriented approach. The analysis for input-oriented efficiency score is not justified because of its properties (reducing inputs that is, cutting expenditure here). Because of the current expenditure as a share of GDP is already low compared to other developing countries. Similarly, the analysis using non-oriented efficiency score is not being done because of its properties (simultaneously increasing output and reducing inputs). The empirical analysis has been done only for the recent year, that is, 2015–2016 due to its policy relevance as past year DEA analysis is done only to track the trends in public expenditure efficiency. The Tobit analysis is carried out separately for education, health, and social sector.

[25]The analysis using interraction term is carried out for testing both direct and indirect effects of the selected variables on the efficiency of all sectors.

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