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Efficiency of Public Expenditure on Sports in India..

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Abstract
This study assesses the efficiency of public expenditure on sports across 28 states of India over the period 2019-2022 using data envelopment analysis and Malmquist productivity index. It uses two inputs (public expenditure on sports and population) and two outputs (total number of participants and total weighted medal counts). This study employs an output-oriented BCC model to assess technical efficiency, scale efficiency, and returns to scale. The analysis reveals that 9 states operate on efficiency frontier. The average technical efficiency across all states is 0.59, indicating that, on average, Indian states are moderately efficient and could improve their outputs by approximately 41 percent without increasing expenditure. The MPI analysis for 2019-2022 shows that 19 states recorded an overall improvement in total factor productivity. The cluster analysis identifies six distinct state typologies. This study has numerous policy implications as it contributes to the comparative analysis of sports system across Indian states.
Keywords: Efficiency, sports expenditure, sports performance, DEA, Malmquist productivity index

Introduction

Public expenditure on sports has increasingly gained attention to policy makers as they recognised its role in fostering human development, economic, social, and cultural progress of a region (Green, 2007; Papapdimitriou, 1998). In developing countries, sports policy aims to increase the mass participation of society in sports and to enhance the performance of elite sportspersons at international levels (Green, 2007; Sam, 2009). The scope of achievement of these aims is not just limited to the same, rather, it is supposed to produce some higher order outputs. Increased participation of society in sports aims to produce mass health benefits, cultural development, educational development, economic development, social coherence, and crime prevention (Crosnoe, 2002; England, 2013; Heinemann, 2005). Also, the recognition received due to international sports success gives a feeling of pride towards the nation, and leads to feel-good effect and demonstration effect. This further encourages the mass participation of people in sports (Allison & Monnington, 2002; Weed et al., 2015).

Over the past decade, the Government of India has introduced several initiatives to strengthen the sports ecosystem, for instance, the Khelo India programme, which aims to promote grassroots participation, talent identification and provide high quality infrastructure facilities (Singh & Bali, 2020). Despite these initiatives toward sports, an important question remains mainly unexplored, i.e., how efficiently are these financial resources being utilised across different states? Since, India still struggles with limited resources for public investments due to the country's low per capita income and high poverty rates. India still focuses on addressing basic issues like poverty, inequality, and unemployment, leading a limited scope for investment in areas like sports (Mukherjee & Badola, 2021). This raises concerns regarding the effectiveness of public spending and the presence of inefficiencies in resource utilisation. Thus, the efficiency of public expenditure on sports becomes an important topic of concern.

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The federal structure of India provides autonomy to state governments in implementing sports policies and allocating funds, resulting in considerable inter-state variation in both spending patterns and sporting outcomes. While some states consistently produce high-performing athletes and achieve superior medal tallies, others lag behind despite comparable or even higher levels of expenditure. This raises concerns regarding the effectiveness of public spending and the presence of inefficiencies in resource utilisation. Despite the growing body of literature on empirical assessments of spending efficiency, there remains a noticeable gap, particularly in the context of India. This paper aims to bridge that gap by evaluating the efficiency of public expenditure on sports in India. By applying Data Envelopment Analysis, this study investigates whether the allocated funds are being optimally utilised to achieve their intended outcomes or not. The findings of this research provide insights for public administrators to improve the performance of their sporting system.

Review of Literature

The whole concept of efficiency has been analysed even before the time of Adam Smith's (Daraio & Simar, 2007). However, the first meticulous effort to measure the efficiency has put forward by Koopmans (1951) and Debreu (1951) through their analytical approach and the first verifiable bear on by Farrell (1957) through his empirical study. Further, Shephard's model of technology and his distance function have made a salient contribution in the development of efficiency analysis (Daraio & Simar, 2007).

There is a profuse contribution of literature that examined the efficiency through techniques classified as parametric and non-parametric techniques. Parametric techniques assume a special functional form (to give relationship between inputs and outputs) that gives the maximum possible output as a function of certain inputs (Herrera & Pang, 2005). On the other hand, non-parametric techniques calculate frontier directly from the data without formation of specific function of inputs and technology (Farrell, 1957). Being psychological in nature, and high dependence on factors other than just public spendings, the quantification of the expected outcomes of sports policy is a challenge (De Bosscher et al., 2015). Due to this, rather than giving more emphasis on the efficiency of sports policy, the previous studies have mainly talked about relationship between sports outcomes and public spendings. In order to encourage the participation of individuals in sports and physical activities, it is widely assumed that public expenditure on providing adequate sports facilities and equipments, support to sports organisations like coaching and training institutes, lowering down of the threshold expenses of sports activities, and regular initiation of programmes for promotion of sports at regional and national level (Hoekman et al., 2017).

An empirical verification of the direct positive relationship between sport participation and sport-related public expenditure has been shown in recent studies (Downward et al., 2014; Dallmeyer et al., 2017). There are other studies as well which have supported this fundamental relationship between sport participation and sport-related public expenditure but impact has been identified differently under different conditions like the type and popularity of the sport, target audience, and, amount and consistency of the public expenditure (Humphreys & Ruseski, 2007; Lera-Lopez et al., 2016; Dallmeyer et al., 2018). Moreover, due to strict preferences of particular sports at some local regions, the relationship might not hold in some specific regional settings (Kokolakakis et al., 2014; Wicker & Downward, 2017).

Data Envelopment Analysis (DEA) has been used extensively in sports efficiency measurement due to its flexibility in handling multiple inputs and outputs, non-linear production processes, and the presence of multiple decision-making units (DMUs). The very first effort to assess the sports efficiency was put forward by Lozano et al. (2002). Lozano et al. (2002) evaluated the performance of countries at the Summer Olympics from 1992 to 2000 using DEA. The later studies have introduced several other variables and methodological modifications to better capture the nuances of internation sporting success (Churilov & Flitman, 2006; Lei et al., 2015; Nessel & Kościółek, 2022).

Methodology

Method

The method to estimate performance using frontier approaches can be categorised into two primary groups: parametric methods, such as Stochastic Frontier Analysis (SFA) (Aigner et al., 1977; Meeusen & van Den Broeck, 1977), and non-parametric methods, such as data envelopment analysis (Charnes et al., 1978). The non-parametric methods do not require assumptions about the functional form of the input-output transformation. These methods are particularly effective in handling multiple inputs and outputs. Conversely, parametric methods account for noise and environmental factors, mitigate the influence of outliers, and facilitate statistical inference (Murillo-Zamorano, 2004).

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This study uses Data Envelopment Analysis (DEA) as an empirical strategy to measure efficiency. It is a non-parametric statistical technique developed by Charnes et al. in 1978, based on the assumption of the existence of convex production frontier. In the DEA approach, the frontier is constructed through the Linear Programming method. The terminology that says 'envelopment' is based on the fact that the set of observations are being enveloped by the production frontier (Boussofiane et al., 1991). Since it is easy to handle multiple inputs and outputs while constructing efficiency using DEA, this technique has gained immense popularity among empirical studies measuring efficiency. Another advantage of this technique is that no prior specification is required related to the functional relationship between production inputs and outputs. Also, it is least affected by the problems of misspecification that can affect econometric models. Thus, the technique of DEA has made it possible to conduct statistical inference, hypothesis testing and estimate non-parametric efficiency estimators (Simar & Wilson, 2007). Further, this study employes the output-oriented BCC (Banker, Charnes, and Cooper, 1984) model, which assumes variable returns to scale (VRS).

The DEA method provides a static evaluation of the efficiency of DMUs. However, to evaluate the dynamic evolution of efficiency and its contribution to changes in total factor productivity (TFP), the Malmquist Productivity Index (MPI) is used (Chen & Ali, 2004). The MPI, originally introduced by Caves et al. (1982), is a widely adopted for measuring productivity changes and decomposing TFP into two primary components: technical efficiency change (TEC) and technological change (TC). TEC can be further divided into pure technical efficiency change (PEC), which reflects managerial efficiency, and scale efficiency change (SEC), which captures variations in operational scale (Färe et al., 1994; Kumar & Gulati, 2008).

In DEA method, technical efficiency ranges from zero to one, with a score of one indicating optimal efficiency. When using the MPI framework, values greater than one for TFP, TEC, TC, SEC, or PEC signify performance improvements, while values below one indicates deterioration. So, this decomposition allows for a detailed understanding of productivity dynamics, including shifts in technology and operational efficiency. The MPI allows multiple inputs and outputs, and flexibility in orientation.

Data Sources and Variables

The study used secondary data to assess the efficiency of public expenditure on sports. The study used public expenditure on sports and population (aged 3 to 23) as input variables, and total number of participants in Khelo India Youth Games and total weighted count of medals (gold = 3, silver = 2, and bronze = 1) in Khelo India Youth Games as output variables. The finance department of each state provides the data related to expenditure on sports, while the Khelo India initiative of the Ministry of Youth Affairs and Sports provides information on the number of participants and medals won. The Unified District Information System for Education (UDISE) provides the data related to projected population according to age group for each state. The study focuses on four distinct periods, primarily covering the years 2019 to 2022, to accurately assess the efficiency of public expenditure on sports.

Analysis

The main analysis is divided into two parts. The first part estimates the model for the given time period and compares their results to examine the differences in the technical efficiency of public expenditure on sports across the Indian states. Further, the average of efficiency score for all the four time periods are taken. The second part involves an intertemporal analysis of efficiency over four periods. This part examines three aspects: changes in position relative to the production frontier, shifts in the production frontier and sources of efficiency changes, and patterns of efficiency and productivity changes. A cross-sectional analysis is applied for this intertemporal research.

Results and Discussion

Table 1 presents the descriptive statistics of 28 DMUs for the year 2022. These statistics summarise the key characteristics of the data.

Table 1: Descriptive statistics of raw data for the most recent time period (2022)

Stat.	Input		Output	
	Public Expenditure on Sports	Population	Total Participants	Total Medals
Min	1901.17	243	23	1
Max	72796.85	101156	760	328
Range	70895.68	100913	737	327

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Mean	13174.75	18106.07	228.14	60.5
St. Dev.	13625.06	22001.02	189.43	79.55

Note: Public Expenditure on Sports is in Lakhs and Population is in '000s

Table 1 shows that there is high variability across all input and output variables as indicated by the large ranges and high standard deviations relative to their means. For instance, the public expenditure on sports ranges from 1901.17 lakhs to 72796.85 lakhs with a standard deviation of 13625.06. This indicates a huge dispersion in the expenditure made by different states. A similar pattern of variation is observed for the other input and output variables. There are wide disparities between the minimum and maximum values across observations. This variability suggests that some states has invested much more in sports than others, which could affect their outcomes (total participants and medal counts). Thus, this high degree of variability supports the validation of the VRS assumption of the proposed model in the study.

Efficiency of Public Expenditure on Sports for year 2022

In the first step, we examine the efficiency scores for the year 2022. The outcomes of this model are presented in the Table 2.

Table 2: Technical efficiency of public expenditure on sports for year 2022

DMU	e_1	rank	slack PE	slack P	slack NP	slack M	Peer groups	Scale	RTS
Andhra Pradesh (AP)	0.38	22		0		21.84	MP(0.06) MN(0.15) TN(0.18)	0.85	-1
Arunachal Pradesh (AR)	1	1	4514.83	53.84		16.17	MN(0.5)	0.91	1
Assam (AS)	0.31	24		0		22.18	MP(0.1) MN(0.18) TN(0.03)	0.8	-1
Bihar (BR)	0.53	14		20547.8		33.9	HP(0.07) TN(0.45)	0.89	-1
Chhattisgarh (CG)	0.49	15		0.0004		33.83	MP(0.11) MN(0.31) TN(0.07)	0.81	-1
Goa (GA)	1	1	0		0		GA(1)	1	0
Gujarat (GJ)	0.32	23		0		47.76	HR(0.01) MP(0.22) UT(0.09)	0.74	-1
Haryana (HR)	1	1	0	0			HR(1)	0.54	-1
Himachal Pradesh (HP)	1	1		0		0	HP(1)	1	0
Jharkhand (JH)	0.41	20		0.0007		25.84	MP(0.04) MN(0.14) TN(0.23)	0.85	-1
Karnataka (KA)	0.49	16		0.0013		0.27	HR(0.18) MP(0.24) UT(0.06)	0.65	-1
Kerala (KL)	0.74	10		0			HR(0.2) MP(0.12) MN(0.13) UT(0.28)	0.63	-1
Madhya Pradesh (MP)	1	1		0			MP(1)	0.84	-1
Maharashtra (MH)	1	1		0			MH(1)	0.86	-1
Manipur (MN)	1	1	0	0	0		MN(1)	1	0
Meghalaya (ML)	0.27	25	3253.56	0		14.3	MN(0.25) UT(0.02)	0.89	1
Mizoram (MZ)	0.61	12	645.266	44.28		10.8	MN(0.2)	0.84	1
Nagaland (NL)	0.17	28	180.312	2.15		8.2	MN(0.13)	0.99	1

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Odisha (OD)	0.47	17		0			MP(0.2) MN(0.22) UT(0.05)	0.86	-1
Punjab (PB)	0.64	11		0.001			HR(0.15) MP(0.08) MN(0.04) UT(0.36)	0.64	-1
Rajasthan (RJ)	0.44	19		0.0019			HR(0.02) MP(0.37) MH(0.04) MN(0.02)	0.79	-1
Sikkim (SK)	0.56	13	739.283	8.8173		3.88	MN(0.11)	0.94	1
Tamil Nadu (TN)	1	1		0			TN(1)	0.98	-1
Telangana (TS)	0.47	18		0.0032		8.78	MP(0.16) MN(0.29) UT(0.02)	0.86	-1
Tripura (TR)	0.1	29	249.243	0.00001		5.49	MN(0.09) UT(0.01)	0.88	1
Uttarakhand (UT)	1	1		0		0	UT(1)	0.83	-1
Uttar Pradesh (UP)	0.19	26	728.806	11248.8	44.42		MH(0.19)	0.74	1
West Bengal (WB)	0.39	21	21014.3	0.0011		13.88	HR(0.05) MP(0.34)	0.19	-1

The efficiency scores of public expenditure on sports across Indian states for the year 2022 reveal a high variation in performance. Total 9 states stand out with the highest efficiency scores, reaching the maximum value of 1, indicating optimal use of resources in these states. The remaining 19 states are classified as inefficient. Their efficiency scores vary from as low as 0.1 in Tripura to 0.74 in Kerala. This suggests that some states, like Tripura, could potentially increase their sporting achievement by up to 90% without extra spending on sports, while Kerala could increase their sporting achievement by up to 26% with no extra spending. Additionally, the average efficiency score across all states is 0.59. This indicates that, on an average, states are moderately efficient in utilising their sports expenditure.

The output slacks represent further increments in outputs that each state could achieve, beyond the proportional improvements indicated by their DEA efficiency scores. The analysis of output slacks indicates that several states could not only spend less without sacrificing participation rates or medal counts, but also increase sports medal counts (in fifteen states) if they improved their efficiency. However, only Uttar Pradesh have further room for improvement in increase in number of participants. Further, peer groups represent the set of efficient states that serve as benchmarks for inefficient states. These peers are identified as the best-practice frontiers that inefficient units should emulate to improve their output performance. Peer groups provide critical reference points by illustrating how an inefficient state's outputs can be increased to reach the efficiency frontier. Each peer is assigned a weight indicating its influence in forming a composite efficient benchmark for the underperforming state (Ramón et al., 2020). For all states, the peer groups are presented in the table 4.4.

The analysis of non-decreasing and non-increasing model variants reveals the scale economies present across Indian states. Most states operate decreasing returns to scale (DRS), indicating states are operating at a scale too large to be efficient, and reducing its scale could improve output efficiency. However, Goa, Himachal Pradesh and Manipur exhibit clear decreasing returns to scale (DRS), while Arunachal, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Uttar Pradesh show increasing returns to scale (IRS). These findings highlight how scale characteristics interact critically with public expenditure on sports and population to shape efficiency outcomes.

Intertemporal Analysis

The calculation of efficiency scores for each time periods (2019-2022) individually enables an analysis of whether states consistently maintain their relative positions on the efficiency frontier during each period. Table 3 presents the efficiency scores for various states in India based on the proposed models of the study. The efficiency scores reveal how efficiently public expenditure on sports boosts performance in terms of athlete participation and medal outcomes across four years.

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Table 3: Evolution of Technical Efficiency

DMU	2019	2020	2021	2022
AP	1	0.1326	0.3442	0.384
AR	0.597	1	0.4933	1
AS	0.209	1	0.1971	0.3099
BR	0.3315	0.3200	0.3868	0.5272
CG	0.5734	0.6122	0.8312	0.4902
GA	0.8237	0.6620	0.9741	1
GJ	0.3394	0.2995	0.2396	0.3159
HR	1	1	1	1
HP	0.7945	1	1	1
JH	0.8105	0.5495	0.6605	0.4081
KA	0.6050	0.5051	0.4571	0.4875
KL	0.7216	0.5292	0.3994	0.7353
MP	0.4322	0.4366	0.2867	1
MH	1	1	1	1
MN	1	1	1	1
ML	0.1193	0.5846	0.3203	0.2667
MZ	1	1	1	0.6097
NL	0.0961	0.1014	0.1143	0.1727
OD	0.2994	0.4179	0.4438	0.4736
PB	1	0.9389	0.5393	0.6389
RJ	0.666	0.8723	0.5053	0.4396
SK	0.2016	0.2556	0.5533	0.5644
TN	0.7819	0.5272	0.5754	1
TS	0.3915	0.4664	0.3393	0.4731
TR	0.1987	0.3665	0.8387	0.1011
UT	0.5145	0.5104	0.2400	1
UP	1	0.6489	0.5924	0.189
WB	0.2097	0.2559	0.2943	0.3856

States such as Haryana, Maharashtra and Manipur consistently exhibit high efficiency scores in most years, indicating sustained effective use of sports-related public expenditure. For example, Haryana scored 1 in overall efficiency for all years with slight decline to 0.87 in 2022, showing a marginal fall but overall strong consistency. Some states showed a gradual upward trend in efficiency scores. For example, Madhya Pradesh improved from 0.43 in 2019 to 0.83 in 2022. However, Meghalaya and Nagaland are examples with consistently low or moderate scores throughout the period, reflecting challenges in optimising resources for sports development. For instance, Nagaland remained below 0.20 efficiency in all years.

The Malmquist Productivity Index (MPI) and its Components

Table 4 and table 5 presents the Malmquist productivity index and its components for the entire period (2019-22) and its sub-periods (2019-20, 2020-21, and 2021-22). The TFPC represents the relative growth of total output with respect to the increase in inputs. The value greater than 1 denotes improvement and value less than 1 denotes deterioration in the output growth. The results over the entire period (2019–22) demonstrate a clear heterogeneity in TFPC across the states. 19 states recorded an overall improvement in TFPC (TFPC > 1), and the most remarkable gains in total productivity were registered by Odisha (4.13), Madhya Pradesh (3.97), Meghalaya (2.43), and Bihar (2.40). This indicates significant advancement in productivity and efficient use of resources. On the other hand, 10 states experienced a deterioration in TFPC, with the most severe decline in productivity seen in Uttar Pradesh (0.29), Mizoram (0.38), and Andhra Pradesh (0.45). Further, 22 out of 29 states exhibited a technological change (TC) greater than 1 over the 2019–2022 period. This suggests most of the Indian states have an outward shift of the production frontier.

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Table 4: Components of Malmquist Productivity Index (PTEC, SEC, and TC)

DMU	Pure technical change (1)				Scale efficiency change (2)				Technological change (3)			
	2019-20	2020-21	2021-22	2019-22	2019-20	2020-21	2021-22	2019-22	2019-20	2020-21	2021-22	2019-22
AP	0.13	2.60	1.12	0.38	0.88	1.09	1.02	0.98	0.86	1.24	1.07	1.19
AR	1.59	0.52	2.03	1.68	1.01	0.97	0.96	0.94	0.73	1.23	1.41	0.92
AS	4.78	0.20	1.57	1.48	1.35	0.94	0.85	1.08	0.87	1.23	0.89	1.28
BR	0.97	1.21	1.36	1.59	1.35	0.91	1.01	1.25	0.83	1.33	1.09	1.21
CG	1.07	1.36	0.59	0.85	1.21	0.95	0.88	1.01	0.83	1.34	1.08	1.20
GA	0.80	1.47	1.03	1.21	1.00	0.85	1.20	1.02	0.73	0.80	1.24	1.14
GJ	0.88	0.80	1.32	0.93	1.54	0.61	1.29	1.20	1.03	1.47	1.06	1.28
HR	1.00	1.00	1.00	1.00	1.01	1.00	0.54	0.55	1.05	1.38	1.06	1.32
HP	1.11	1.00	1.00	1.11	1.13	1.00	1.00	1.13	0.82	1.32	1.09	1.17
JH	0.68	1.20	0.62	0.50	1.34	0.89	0.96	1.15	0.89	1.34	1.08	1.19
KA	0.83	0.90	1.07	0.81	1.01	0.66	1.04	0.69	1.16	1.49	0.88	1.31
KL	0.73	0.75	1.84	1.02	1.55	0.94	0.67	0.99	0.83	1.28	1.03	1.28
MP	1.01	0.66	3.49	2.31	1.38	0.96	0.98	1.30	1.05	1.39	0.91	1.32
MH	1.00	0.91	1.10	1.00	0.97	0.75	1.25	0.91	1.30	1.22	0.73	1.30
MN	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.16	1.28	1.45	1.31
ML	8.38	0.32	0.83	2.24	0.72	1.05	1.61	1.23	0.66	0.99	1.42	0.89
MZ	1.00	1.00	0.79	0.79	1.00	1.00	0.64	0.64	0.61	0.80	1.46	0.74
NL	1.05	1.13	1.54	1.83	1.29	0.96	1.05	1.29	0.54	0.94	1.80	0.87
OD	1.40	1.06	1.07	1.58	2.50	0.88	1.00	2.21	0.74	1.33	1.06	1.18
PB	0.94	0.57	1.18	0.64	1.41	0.91	0.71	0.91	0.86	1.19	1.41	1.25
RJ	1.31	0.58	0.87	0.66	1.14	0.93	0.88	0.94	1.15	1.37	1.06	1.33
SK	1.00	1.00	1.00	1.00	1.27	2.16	0.95	2.62	0.64	0.77	1.43	0.74
TN	0.67	1.09	1.74	1.28	0.91	0.89	1.42	1.16	1.03	1.40	1.06	1.30
TS	1.19	0.73	1.39	1.21	1.16	0.89	0.98	1.00	1.06	1.35	1.06	1.26
TR	1.84	2.29	0.12	0.51	1.06	0.82	1.40	1.21	0.68	0.93	1.60	0.94
UT	0.99	0.47	4.17	1.94	1.04	0.99	0.86	0.88	0.92	1.18	1.60	1.21
UP	0.65	0.91	0.32	0.19	1.36	0.70	1.20	1.15	1.05	1.35	0.88	1.35
WB	1.22	1.15	1.31	1.84	1.49	0.58	0.55	0.48	1.08	1.39	1.38	1.24

Table 5: Technical Efficiency Change and Total Factor Productivity Change

DMU	Technical efficiency change (4) = (1)x(2)				Total factor productivity change (5) = (3)x(4)			
	2019-20	2020-21	2021-22	2019-22	2019-20	2020-21	2021-22	2019-22
AP	0.12	2.82	1.14	0.38	0.10	3.50	1.22	0.45
AR	1.60	0.51	1.95	1.58	1.17	0.62	2.76	1.45
AS	6.45	0.19	1.33	1.60	5.58	0.23	1.19	2.05
BR	1.31	1.10	1.38	1.98	1.09	1.46	1.50	2.40
CG	1.30	1.29	0.52	0.87	1.08	1.72	0.56	1.04
GA	0.80	1.25	1.23	1.24	0.59	1.01	1.52	1.42
GJ	1.36	0.49	1.70	1.12	1.40	0.71	1.80	1.44
HR	1.01	1.00	0.54	0.55	1.06	1.38	0.57	0.72
HP	1.26	1.00	1.00	1.26	1.03	1.32	1.09	1.48
JK	0.54	2.36	0.47	0.60	0.39	2.41	0.74	0.57
JH	0.91	1.08	0.59	0.58	0.81	1.44	0.64	0.69
KA	0.85	0.60	1.11	0.56	0.98	0.89	0.97	0.73
KL	1.14	0.71	1.24	1.00	0.95	0.91	1.27	1.29
MP	1.39	0.63	3.42	3.00	1.46	0.88	3.11	3.97
MH	0.97	0.68	1.37	0.91	1.27	0.84	1.00	1.18
MN	1.00	1.00	1.00	1.00	1.16	1.28	1.45	1.31
ML	6.06	0.34	1.34	2.75	4.02	0.33	1.91	2.43
MZ	1.00	1.00	0.51	0.51	0.61	0.80	0.74	0.38

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NL	1.36	1.08	1.61	2.37	0.73	1.02	2.90	2.07
OD	3.49	0.94	1.07	3.50	2.57	1.24	1.14	4.13
PB	1.32	0.52	0.84	0.58	1.14	0.62	1.19	0.73
RJ	1.50	0.54	0.77	0.62	1.72	0.74	0.81	0.82
SK	1.27	2.16	0.95	2.62	0.82	1.66	1.37	1.93
TN	0.62	0.98	2.47	1.49	0.63	1.37	2.62	1.93
TS	1.38	0.64	1.36	1.21	1.46	0.87	1.45	1.52
TR	1.95	1.88	0.17	0.62	1.33	1.74	0.27	0.58
UT	1.03	0.47	3.58	1.72	0.94	0.55	5.72	2.07
UP	0.88	0.64	0.38	0.22	0.92	0.87	0.34	0.29
WB	1.82	0.67	0.72	0.88	1.98	0.93	1.00	1.09

Despite widespread technological progress, the catch-up effect was highly mixed. The catch-up effect or technical efficiency change captures movements toward or away from the best-practice frontier. Only 14 states showed an improvement in TEC (TEC > 1). This implies that for several underperforming states, the deterioration of total productivity was primarily driven by lack of technical efficiency rather than a lack of technological advancement. The similar divergence between technological progress and technical efficiency change has been seen in the health and education expenditure literature (Mohanty & Bhanumurthy, 2018). Further, the SEC was also a major limiting factor across the states. Over the 2019–22, only 15 states recorded an SEC greater than 1, indicating that the majority of Indian states are struggling to operate at their most productive scale size.

Patterns of Efficiency and Productivity Evolution

The average efficiency levels and changes in total factor productivity between 2019 to 2022 are analysed to identify how efficiency and productivity evolve over time (see Figure 1). Based on these measures, six distinct state clusters have been identified.

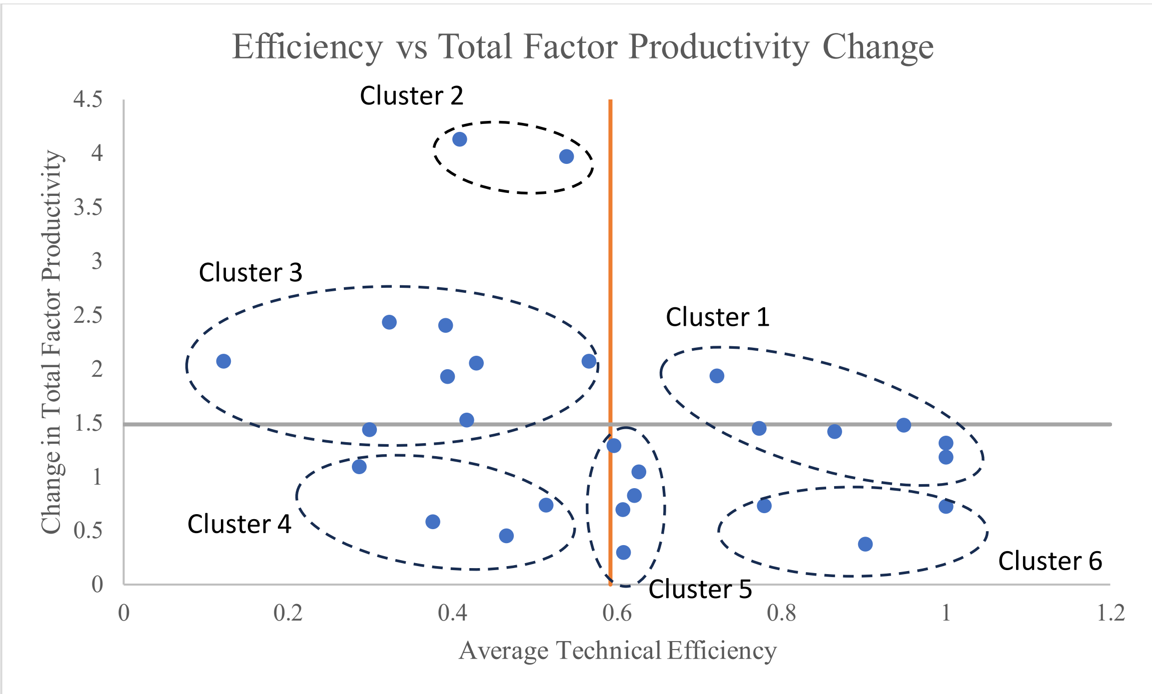

Fig 1: Average technical efficiency vs total factor productivity change over 2019-2022

Cluster 1: displays high efficiency and stable productivity change (like Himachal Pradesh and Goa) indicating consistent and well-managed resource use over the period.

Cluster 2: consists of states with low efficiency but very high productivity change (Madhya Pradesh and Odisha), suggesting substantial improvements in productivity despite starting from a less efficient baseline.

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Cluster 3: includes states with low efficiency and rising productivity change (like Bihar and Meghalaya), reflecting gradual progress in productivity while efficiency levels remain limited.

Cluster 4: characterised by low efficiency and low productivity change (like Arunachal Pradesh and Tripura), signifying persistent challenges in both resource use and output growth.

Cluster 5: comprises states with average efficiency but low productivity change (like Jharkhand and Kerala), indicating moderate performance without dynamic improvement.

Cluster 6: contains states with high efficiency and low productivity change (like Haryana and Mizoram), representing systems that efficiently use resources but with limited productivity gains in the period considered.

Conclusion and Policy Implications

The application of output-oriented BCC model, two-stage DEA model, and Malmquist productivity index have helped us to understand patterns and evolution of efficiency of public expenditure on sports in Rajasthan, as well as other states of India, over the period of time. The descriptive statistics of raw data has shown a high variability and dispersion among the variables, which supported the validation of the VRS assumption of BCC model. The output-oriented BCC model has demonstrated a huge heterogeneity of the efficiency scores among Indian states. For the year 2022, 9 states were efficient with efficiency score of 1, and out of 9 efficient states, 8 states were fully efficient and Arunachal Pradesh was weakly efficient. Most of the states were operated at diminishing returns to scale. Rajasthan ranked 19th position in terms of technical efficiency, with efficiency score of 0.44. It also operated under diminishing returns to scale. The peer groups for Rajasthan were Haryana, Madhya Pradesh, Maharashtra, and Manipur. For all four periods, the overall efficiency of Rajasthan was 0.6208, and ranked 11 among the all the 28 states.

The MPI has evaluated the dynamic evolution of efficiency and its contribution to change in TFP. Over the years, only 14 states showed an improvement in TEC. Including Rajasthan, several underperforming states has deterioration of total productivity. The primary reason for this deterioration was lack of technical efficiency rather than a lack of technological advancement. 22 out of 29 states exhibited TC greater than 1 over the 2019–2022 period. Most of the Indian states have an outward shift of the production frontier. Further, 15 states recorded an SEC greater than 1. Rajasthan was placed in Cluster 5 (average efficiency with low productivity change) in the MPI cluster analysis, which indicates moderate but stagnant performance without dynamic improvement.

These findings have numerous policy implications that will assist the government and school authorities, and community stakeholders at the state and national levels. The key finding of DEA analysis is that states do not necessarily need to increase public expenditure on sports, rather, it should utilise the existing resources more efficiently. The priority for policymakers should be to adopt a result-oriented approach to budget allocation. The peer groups suggest to employ the institutional mechanisms, athlete development pathways, and resource allocation strategies of these states. These types of comparative policy analysis strategies are even adopted at international level sports system (Kučera et al., 2023; Wu et al., 2010).

Author contributions

CRediT: **Utkarsh Berwal**: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing; **Sarala Dasari**: Conceptualization, Supervision, Writing – review & editing; **Saurabh Kumar**: Conceptualization, Supervision, Writing – review & editing.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Disclosure statement

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References

1. Aigner, D., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. Journal of Econometrics, 6(1), 21–37. https://doi.org/10.1016/0304-4076(77)90052-5
2. Allison, L., & Monnington, T. (2002). Sport, prestige and international relations. Government and Opposition, 37(1), 106-134. https://doi.org/10.1111/1477-7053.00089
3. Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management science, 30(9), 1078-1092. https://doi.org/10.1287/mnsc.30.9.1078
4. Boussofiane, A., Dyson, R. G., & Thanassoulis, E. (1991). Applied data envelopment analysis. European journal of operational research, 52(1), 1-15. https://doi.org/10.1016/0377-2217(91)90331-O
5. Caves, D. W., Christensen, L. R., & Diewert, W. E. (1982). The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity. Econometrica, 50(6), 1393–1414. https://doi.org/10.2307/1913388
6. Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European journal of operational research, 2(6), 429-444. https://doi.org/10.1016/0377-2217(78)90138-8
7. Chen, Y., & Ali, A. I. (2004). DEA Malmquist productivity measure: New insights with an application to computer industry. European Journal of Operational Research, 159(1), 239–249. https://doi.org/10.1016/S0377-2217(03)00406-5
8. Churilov, L., & Flitman, A. (2006). Towards fair ranking of Olympics achievements: The case of Sydney 2000. Computers & Operations Research, 33(7), 2057-2082. https://doi.org/10.1016/j.cor.2004.09.027
9. Crosnoe, R. (2002). Academic and Health-Related Trajectories in Adolescence: The Intersection of Gender and Athletics. Journal of Health and Social Behavior, 43(3), 317–335. https://doi.org/10.2307/3090207
10. Dallmeyer, S., Wicker, P., & Breuer, C. (2017). Public Expenditure and Sport Partici-pation: An Examination of Direct, Spillover, and Substitution Effects. International Journal of Sport Finance, 12(3), 244-264. https://doi.org/10.1177/155862351701200305
11. Dallmeyer, S., Wicker, P., & Breuer, C. (2018). The relationship between sport-related government spending and sport and exercise participation: the role of funding size, period, and consistency. International Journal of Health Promotion and Education, 56(4-5), 237-247. https://doi.org/10.1080/14635240.2018.1452623
12. Daraio, C., & Simar, L. (2007). Advanced robust and non-parametric methods in efficiency analysis: Methodology and applications. Springer Science & Business Media.
13. De Bosscher, V., Shibli, S., Westerbeek, H., & Van Bottenburg, M. (2015). Successful elite sport policies: an international comparison of the sports policy factors leading to international sporting success (SPLISS 2.0) in 15 nations. Meyer & Meyer Sport.
14. Debreu, G. (1951). The Coefficient of Resource Utilization. Econometrica, 19(3), 273–292. https://doi.org/10.2307/1906814
15. Downward, P., Lera-Lopez, F., & Rasciute, S. (2014). The correlates of sports participation in Europe. European journal of sport science, 14(6), 592-602. https://doi.org/10.1080/17461391.2014.880191
16. England, S. (2013). Economic value of sport in England. London: Sport England.
17. Färe, R., Grosskopf, S., & Lovell, C. A. K. (1994). Production frontiers. Cambridge University Press.
18. Farrell, M. J. (1957). The measurement of productive efficiency. Journal of the Royal Statistical Society: Series A (General), 120(3), 253-281. https://doi.org/10.2307/2343100
19. Green, M. (2007). Olympic glory or grassroots development?: Sport policy priorities in Australia, Canada and the United Kingdom, 1960–2006. The international journal of the history of sport, 24(7), 921-953. https://doi.org/10.1080/09523360701311810
20. Heinemann, K. (2005). Sport and the welfare state in Europe. European journal of sport science, 5(4), 181-188. https://doi.org/10.1080/17461390500344347
21. Herrera, S., & Pang, G. (2005). Efficiency of public spending in developing countries: an efficiency frontier approach (Vol. 3645). World Bank Publications.

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22. Hoekman, R., Breedveld, K., & Kraaykamp, G. (2017). Providing for the rich? The effect of public investments in sport on sport (club) participation of vulnerable youth and adults. European Journal for Sport and Society, 14(4), 327-347. https://doi.org/10.1080/16138171.2017.1421510
23. Humphreys, B. R., & Ruseski, J. E. (2007). Participation in physical activity and government spending on parks and recreation. Contemporary economic policy, 25(4), 538-552. https://doi.org/10.1111/j.1465-7287.2007.00079.x
24. Kokolakakis, T., Lera-López, F., & Castellanos, P. (2014). Regional differences in sports participation: The case of local authorities in England. International journal of sport finance, 9(2), 149-171. https://doi.org/10.1177/155862351400900204
25. Koopmans, T. C. (1951). Efficient Allocation of Resources. Econometrica, 19(4), 455–465. https://doi.org/10.2307/1907467
26. Kučera, J., Zimková, E., Nemec, J., & Nemec, M. (2023). A comparative analysis of the efficiency of public funding policies for sports in the European Union. Cogent Social Sciences, 9(2), 2280335. https://doi.org/10.1080/23311886.2023.2280335
27. Kumar, S., & Gulati, R. (2008). An examination of technical, pure technical, and scale efficiencies in Indian public sector banks using data envelopment analysis. Eurasian Journal of Business and Economics, 1(2), 33–69. Retrieved from https://www.ejbe.org/index.php/EJBE/article/view/11
28. Lei, X., Li, Y., Xie, Q., & Liang, L. (2015). Measuring Olympics achievements based on a parallel DEA approach. Annals of Operations Research, 226, 379-396. https://doi.org/10.1007/s10479-014-1708-1
29. Lera-López, F., Wicker, P., & Downward, P. (2016). Does government spending help to promote healthy behavior in the population? Evidence from 27 European countries. Journal of public health, 38(2), e5-e12. https://doi.org/10.1093/pubmed/fdv071
30. Lins, M. P. E., Gomes, E. G., de Mello, J. C. C. S., & de Mello, A. J. R. S. (2003). Olympic ranking based on a zero sum gains DEA model. European Journal of Operational Research, 148(2), 312-322. https://doi.org/10.1016/S0377-2217(02)00687-2
31. Lozano, S., Villa, G., Guerrero, F., & Cortés, P. (2002). Measuring the performance of nations at the Summer Olympics using data envelopment analysis. Journal of the Operational Research Society, 53(5), 501-511. https://doi.org/10.1057/palgrave.jors.2601327
32. Meeusen, W., & van Den Broeck, J. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error. International Economic Review, 18(2), 435–444. https://doi.org/10.2307/2525757
33. Mohanty, R. K., & Bhanumurthy, N. R. (2018). Assessing public expenditure efficiency at Indian states. National Institute of Public Finance and Policy, New Delhi, NIPFP Working Paper, 225. Retrieved from https://www.nipfp.org.in/media/medialibrary/2018/03/WP_2018_225.pdf
34. Mukherjee, S. and Badola, S. (2021). Public financing of human development in India: a review. Indian Journal of Human Development, 15(1), 62–81. https://doi.org/10.1177/09737030211005043
35. Murillo-Zamorano, L. R. (2004). Economic efficiency and frontier techniques. Journal of Economic Surveys, 18(1), 33–77. https://doi.org/10.1111/j.1467-6419.2004.00215.x
36. Nessel, K., & Kościółek, S. (2022). The total sporting arms race: benchmarking the efficiency of public expenditure on sports in EU countries. European Sport Management Quarterly, 22(6), 833–855. https://doi.org/10.1080/16184742.2020.1833956
37. Papadimitriou, D. (1998). The impact of institutionalized resources, rules and practices on the performance of non-profit sport organizations. Managing leisure, 3(4), 169-180. https://doi.org/10.1080/136067198375950
38. Ramón, N., Ruiz, J. L., & Sirvent, I. (2020). Cross-benchmarking for performance evaluation: Looking across best practices of different peer groups using DEA. Omega, 92, 102169. https://doi.org/10.1016/j.omega.2019.102169
39. Sam, M. P. (2009). The public management of sport: Wicked problems, challenges and dilemmas. Public management review, 11(4), 499-514. https://doi.org/10.1080/14719030902989565
40. Simar, L., & Wilson, P. W. (2007). Statistical inference in nonparametric frontier models: recent developments and perspectives. Oxford University Press, p. 421-521.

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41. Singh, G., & Bali, A. (2020). Play India Youth Games (Khelo India): Scheme for Promotion of Sports in India. Indian Journal of Physiotherapy and Occupational Therapy, 14(2), 61-66. https://doi.org/10.37506/ijpot.v14i2.2609
42. Weed, M., Coren, E., Fiore, J., Wellard, I., Chatziefstathiou, D., Mansfield, L., & Dowse, S. (2015). The Olympic Games and raising sport participation: a systematic review of evidence and an interrogation of policy for a demonstration effect. European sport management quarterly, 15(2), 195-226. https://doi.org/10.1080/16184742.2014.998695
43. Wicker, P., & Downward, P. (2017). Exploring spillovers between government quality and individual health production through sport and physical activity. European Sport Management Quarterly, 17(2), 244-264. https://doi.org/10.1080/16184742.2016.1257038
44. Wu, J., Zhou, Z., & Liang, L. (2010). Measuring the performance of nations at Beijing Summer Olympics using integer-valued DEA model. Journal of Sports Economics, 11(5), 549-566. https://doi.org/10.1177/1527002509352619.

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