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THE EFFICIENCY OF PUBLIC EXPENDITURES FOR HUMAN DEVELOPMENT IN PAKISTAN: A CASE OF PUNJAB

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Abstract. The issue of government expenditure efficiency has recently attracted the interest of policymakers and academics all over the globe. Public expenditure is regarded an essential tool in a government's ongoing attempts to improve the provision of public goods and services to attain growth targets. With the rising demand for public spending, it is not appropriate to reduce public expenditures. Rising government expenditures may strain public resources, result in a tax burden and exert pressure on budgetary allocation leading to concern about evaluating the efficiency of public spending. The present study aims to evaluate the efficiency of public spendings in the health and education sectors in Punjab province from 2011-2018. In the first stage, this study employed a non-parametric data envelopment analysis technique. Various input and output-oriented efficiency scores are estimated using the DEA framework. The findings show that, on average, Punjab's government spends money more effectively on health care than education. This study also investigated the factors behind the variation in efficiency by using the Tobit regression model. The result of the regression model reveals that the availability of physical infrastructure in the health and education areas is associated with better outcomes, improving better human development spending. Inflation negatively and significantly affects spending

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efficiency in Punjab. Furthermore, there is strong evidence that tacking corruption increases performance and efficiency in both sectors.

Keywords: Public expenditure, efficiency, DEA

I. INTRODUCTION

Governments make expenditures (development and non-development) for providing goods and services to their masses to attain different social and economic objectives. Public spending can be used to tackle different economic problems like poverty, unemployment, health and education. However, the efficiency of these expenditures (inputs) is significant, not only for the size of the government but also in achieving macroeconomic stability and economic progress.

Governments can be considered producers, involved in producing various outputs by combining labour with several inputs. For example, governments invest in teachers to combat illiteracy. Similarly, governments finance healthcare facilities to enhance the life expectancy of their citizens. The governments that generate more outputs while spending less on inputs are thought to be more effective than the governments that produce fewer outputs while investing more on inputs, assuming all other factors remain the same (Verhoeven and Gupta, 2001). Efforts to evaluate the efficiency of public expenditure have become the focus of growing body of empirical literature, which suggests that monitoring the effectiveness of public spending would pave the way for future public policy reform. Fox (2002) pointed out that evaluation of the public sector is essential to keep the economy prosperous and promote growth. Thus, assessing the efficiency of these expenditures can provide a useful guide that is typically relevant to supporting growth in relation to the impediment.

The time has come to shift the emphasis from "how much money the governments spend" to "how efficient the governments are." In many countries worldwide, a fundamental economic problem is determining how to allocate limited government resources best to offer the most effective public services. Since the 1990s, the efficiency of public spending has become a critical problem (D'Inverno, Carosi and Ravagli 2018). In many countries, public spending has increased manifold.

Efficient public budget allocation is considered the primary tool for the economic development of any country. The increasing public expenditures may potentially strain public resources. It is essential to ensure that municipalities make the best use of public funds. Public spending must be utilized effectively for long-term growth. Therefore, it is essential to establish the criteria for evaluating the government's expenditure of public funds.

Human capital and physical capital play a vital role in economic growth. Human capital includes spending on health, education, and training. Many studies showed that expenditures on health and education constitute a significant constructive contribution to the government's priorities. These are two sectors where spending by the government is significant. Gupta et al. (1998) suggested that public spending on education and health could have a positive impact on human capital and ultimately boost economic growth. Razmi et al. (2012) described that higher spending on health would improve labour productivity and increase labour supply, resulting in an increase in productivity and economic growth. A high level of human capital can be regarded as the engine of economic development. The quality of human capital development in developing economies is critical in catching up to other countries in context of development. Spending on health and education are two of the most important national development objectives. Improved health and education are valuable investments that can help a family escape the poverty trap. Education had a significant impact on developing economies to assimilate advanced technology and to build the capacity to promote development. Furthermore, health is a prerequisite for greater productivity, and educational performance depends on it. Hence, the success of a nation's progress is measured not only by how fast its economy grows but also by the level of its human development.

Efforts to improve the living standard of humans should be supported by the authorities through the allocation of public spending on health and education. An increase in the allocation of public funds will enhance the population's productivity. Increased productivity can also promote human development, which can help reduce poverty. Internationally many studies examined the efficiency of public expenditures with different methods for different countries. The study of

Afonso and Aubyn (2005) analyzed the efficiency of public spending in health and education sectors for OECD economies using non-parametric techniques. Similarly, Herrera and Pang (2005) evaluated the efficiency of government expenditures on health and education in case of 140 developing economies using a non-parametric technique. Alvi and Wang (2011) measured the relative performance of public expenditure of ten OECD countries and seven Asian nations. Prasetyo and Zuhdi (2013) also investigated the efficiency of government expenditures per capita in the health and education sector. However, none of the studies has been found in the case of Pakistan. To enhance the standard of human development, the principle of efficiency of public funds ought to be considered. If the level of efficiency of public spending is high, then the public expenditures can be calculated as accurately as possible according to the intended target and ultimately is expected to improve the quality of human resources as well. Therefore, the present study evaluates the efficiency of development expenditures for human development in the case of Punjab Province. The study also highlights the institutional and economic factors that may affect the efficiency of public expenditure.

The structure of this paper is as follows: Section I introduces the problem and gives the motivation behind this study. Section II provides an overview of the literature that evaluates the effectiveness of public expenditures in relation to economic growth, followed by section III, which describes the data sources, variables, and methodology for estimating the efficiency of public spending. Section IV contains the findings. Section V concludes the study and gives recommendations for increasing the allocative efficiency of public expenditures.

II. LITERATURE REVIEW

Albassam (2020) analyzed the efficiency of government expenditures utilizing data from seventy-one countries from 1996 to 2017. Data were obtained from, Observatory of Economic complexity, IMF, UNDP and World Bank. The researcher suggested a model to explain the efficiency of expenditures. The model included in this empirical work consists of several variables, i.e., government effectiveness, public spending, economic growth, national debt, ECI, HDI and rate of unemployment. This study used the PLS-SEM to evaluate the efficiency of government expenditures. There is a strong and significant association between public

spending, controlling unemployment and human development. Results showed that economic complexity is the major predictor of public expenditure. Whereas economic growth and government effectiveness are weaker predictors of public funding. Economic complexity is highly linked to public spending; therefore, the government should consider spending more on knowledge management. This study contends that weakly efficient government work and slow growth of the economy are signs of inefficient government spending.

Jordi et al. (2020) calculates the efficiency of national health expenditures as it moves towards Universal Health Coverage, as well as the environmental variables associated with effective service delivery. For 172 nations, the study used double bootstrap DEA to explore that how efficient nations transform health spending into universal health coverage outputs. This study used 2015 WB and WHO data. The factors linked with effective progress towards UHC targets are identified. The average unbiased efficiency score is 85.7 percent. Further findings revealed that governing capability, income, and education are all strongly related to efficiency. If nations want to increase their health coverage outputs without exceeding their current budgets, they should evaluate their current efficiency and strive to imitate more efficient nations. Utilizing resources more efficiently is anticipated to have a favorable influence on UHC objectives and progress towards attaining the SDGs.

Indeewari and Ranasinghe (2018) evaluated the performance of public expenditures on universities in Sri Lanka. Data was collected from University Grants Commission (2017), Webometrics (2018, Jan) and from the study of (Ramanayake, Jayamanne, Ramyadevipriya & Perera, 2013). Recurrent expenditures, capital expenditures have been selected as input. In contrast, the outputs are total graduates, total postgraduates, employment rate and webometrics rank. This study used DEA technique to evaluate the efficiency scores. The results revealed that the universities are already operating at acceptable levels, on average. The authorities need to revise the method used for allocating funds to public universities (and other tertiary education institutions).

Javaid (2017) investigated the association between the efficiency of govt spending and fiscal size in 19 Asian developing economies. For that data were drawn from Asian Development Bank, WDI, Worldwide

Governance Indicators, Government Finance Statistics, Penn World Tables (PWT) version 09. They selected corruption control, regulatory quality and rule of law, HDI, life expectancy, infant mortality, electric power consumption, GDP, unemployment, stability of real GDP, inflation, Govt total expenditure as variables. In the first step this study constructed a public sector performance (PSP) index by employing the Principal Component Analysis (PCA) technique. To estimate the efficiency scores this study used the DEA Double bootstrap technique proposed by Simar and Wilson (1998, 2000). Government total expenditures (as percentage of GDP) were selected as and input while the PSP index was selected as an output. Findings revealed that medium-size govt are relatively more efficient as compared to large-size govt in all public policy areas. This study suggested that government should need to allocate more funds for those projects that create employment opportunities for the public.

Fonchamnyo and Sama (2016) analyzed the efficiency of public expenditure in health and education areas of "Chad, Central African Republic and Cameroon" during the period from 2000-2012. Data were taken from World Development Indicator (WDI). They selected life expectancy at birth, immunization, spending on health and education, enrolment, literacy rate, inflation, GDP, broad money, CPIA, trade openness, Corruption Perception Index (CPI) as variables. Firstly, this empirical study estimated the efficiency values by utilizing the non-parametric DEA technique. Secondly, the panel data fractional logit and tobit model of regression technique have been utilized to determine the factors that influence the efficiency score in these sectors. According to the findings of the estimation, Cameroon is more cost-effective than the aforementioned countries in terms of the amount of money it spends on health and education. Further, the findings of the study depicted that Chad has a lower level of public spending efficiency in the area of education, even though it spends more overall on education than other countries. The findings also revealed that the quality of financial and budgetary system has a significant positive impact on efficiency, whereas corruption negatively influences govt expenditure in the education as well in health areas. The findings indicated that actions should be taken to better the standard of financial control and fiscal allocation, as well as to fight corruption.

Atmanti (2016), by applying the DEA this research, evaluated the performance of public expenditures on human development in districts of Java from 2008 to 2012. The empirical paper utilized secondary time series data from BPS and the Ministry of Finance (Indonesia) on the yearly. The study used expenditures on health and education per capita and as an input factor whereas HDI with units per cent as an output variable. The results indicated that in some districts of Central Java, public spending on human development is more efficient than ninety percent.

Prasetyo and Zuhdi (2013) evaluated the performance of public expenditures in the subsidies, health and education sector, and transfer, for eighty-one economies from 2006-2010. Data was taken from the World Bank data base. The DEA method was utilized to estimate efficiency. This study used the following inputs and output indicators, i.e., public expenditures in both sectors as mentioned, subsidies, and transfer used as an input, while HDI was used as an output. This study found that only two countries, "Singapore and Zambia", succeeded in positive progress among the countries listed in the efficient frontier.

Wang and Alvi (2011) measured the efficiency of government expenditure of ten OECD nations from 1981 to 2008 and seven Asian countries from 1986 to 2007. Data were drawn from World Bank, OECD, Transparency International, International Financial Statistics (IMF), ICSEAD, East Asian Economic Perspective 2008, and Asian Development Bank. The subsequent purpose of the paper is to determine the elements that influence the efficiency in fostering growth while raising public spending. To accomplish the 1st goal, the data envelopment method model has been employed to calculate the efficiency of public investment. Moreover, to achieve the 2nd goal, the extreme bounds technique in short, EBA method in connection with the tobit and truncated regression has been applied. According to the DEA results, Japan has the elevated efficiency rating in the Asian sample while New Zealand, the United States, and Germany have the highest scores in the OECD group. In the case of the OECD, the EBA method along with the Tobit model demonstrate that private sector operations have a strong negative association with government inefficiency, suggesting that raising the proportion of private economic operations in the economy

aids in lowering the inefficiency of government investment. The index of corruption demonstrates a weak impact on govt inefficiencies in the OECD sample, which contrasts sharply with the scenario of seven East Asian economies. The reason could be that the OECD countries under examination have a lower level of corruption. The findings of this research indicated that when increase in private economic activities then public spending performance appears to decrease. Further, their findings showed that government expenditure would be relatively effective during the recession period.

Hauner and Kyobe (2010) explored the efficiency of public expenditures in education and health sectors in 114 advanced and developing economies from 1980-2004. Government spending on health and education was selected as input variables, whereas primary and secondary school enrollment, DPT immunization, infant mortality, and the mortality rate of female adults were used as output variables. Data used in this study were obtained from OECD, WDI, WHO, AMECO, UNESCO, and IMF. The authors estimate PSE and PSP indicators and employed the DEA technique. The mean efficiency scores indicated that the existing level of educational output may be achieved with eighty percent of less public funding. In terms of health sector expenditure efficiency, however, nations waste an average of 80% of their public resources. The authors found that European nations have low health sector efficiency but a high effectiveness in education sector. Developing African nations like Ethiopia and Senegal have the lowest productivity levels. The United States and Germany spend the least efficiently on health care. Asia's developing nations have the greatest efficiency scores.

Herrera and Pang (2005) analyzed the efficiency spending by government on healthcare and education fields for one hundred and forty developing economies ranged from 1996-2002. They employed the DEA technique. And selected government expenditure per capita on health and education sector as the inputs. For the outputs they used life expectancy, immunization, and the DALE for health sector, whereas for education sector they used average years of school, primary and secondary school admissions (gross and net), first level complete, second level complete, literacy of youth and learning score. Data was collected from the Website of Crouch and Fasih (2004), Barro-Lee database, World Bank and WHO. In general, the results suggested that the least efficient nations might

reach significantly higher health and education output levels. Alternately, they may generate the current level of output while consuming almost 50 percent less inputs. It is essential to determine the institutional and economic elements that lead certain nations to deliver services more efficiently than others. They found that efficient expenditure was related to lower expenditures level. This study usually draw attention to the critical need to assess the efficiency of public expenditures.

Therefore, it is concluded that there is paucity of literature about measuring the efficiency of public expenditures and the determinants of public sector efficiency in Pakistan. To our knowledge, several studies measure the efficiency and effectiveness of public expenditures by using data envelopment analysis technique towards its objective output. These studies usually highlighted the critical need to assess the efficiency of public spendings and found that the hypothesis of a higher level of spending may not necessarily lead to higher efficiency. Literature concluded that when the government makes expenditures for the right purpose and in the right way, the amount required to optimize growth is lower. On the basis of the literature, the next chapter provides the theoretical framework of efficiency and effectiveness.

III. DATA AND METHODOLOGY

MEASURING THE EFFICIENCY OF GOVERNMENT SPENDING

Farrell (1957), in his study, identified the question of calculating efficiency and its significance for policymakers. As stated by Farrell, the efficiency of an institution comprises two components. One is technical efficiency (TE), and the other is allocative efficiency (AE). The physical effectiveness of input-output production transition is denoted by TE, while the most efficient use of input variables is denoted by AE. When measuring efficiency, two measures are frequently used, especially Farrell's technical efficiency. The first is the input-oriented measure (input reduction). Second is the output-oriented measure (maximize output).

There is immense literature that measures the efficiency of public expenditures, but there is no consensus regarding the most appropriate

methodology. Data Envelopment Analysis (abbreviated DEA) and Stochastic Frontier Analysis (SFA) are just two of the methods that can be used to analyze the efficiency of these public investments. DEA is a mathematical programming method, whereas stochastic frontier is an econometric technique.

Public sector efficiency can be analyzed by estimating the best practice frontier. Data envelopment analysis method is the most well famous non-parametric technique for evaluating efficiency. The DEA generates the best practice frontier using the given data on inputs and outputs. The frontier consists of one or more DMUSs with an efficiency score of 1, determined to perform efficiently. There are many advantages to using DEA, but there are two that make it particularly appropriate for analyzing the effectiveness of governmental spending. Firstly, it is possible to evaluate the efficiency by incorporating multiple input and outputs. Secondly, this method does not require any priori assumption due to its nonparametric nature.

The constant return to scale model is the basic DEA model. The size of the decision-making units being evaluated is not considered because this model assumes that all unit's function at constant returns to scale (Bhat et al., 2001). The CRS- DEA model was initially designed by Charnes et al. (1978) based on Farrells work on productivity efficiency assessment. Additionally, they have also introduced the term Decision Making Unit (DMU). The DMU refers to any organization that transforms inputs into outputs. It includes production companies, governments, hospitals and schools etc., or generally, it may be any profit or non-profit public organization. The DEA variable returns to scale model, developed by Banker, Charnes, and Cooper in 1984 and used extensively in the 1990s, solves the DEA-CRS model's defect (Coelli, 1996). The BCC model is very suitable because in practice or real life the firms are functioning at increasing or decreasing RTS due to government rules, constraints on funding and imperfect competition etc. The VRS model is used to evaluate a nation's productivity in comparison to that of other countries of a comparable magnitude. The VRS-DEA more closely fits the data compared to CRS, leading to performance scores that are equivalent to or greater than those estimated using the CRS assumption.

Both the CRS and VRS models are utilized in the present research. The deterministic structure of DEA is one of its typical flaws. DEA considers all divergence from the best practice frontier to be instances of inefficiency this implies that whether they are under the control of policymakers or regardless of the causes of the inefficiency.

When applying DEA, the selection of orientation is another specification in addition to the option of returns to scale. A decision must be made regarding either to use an output or input oriented DEA. The potential input savings are identified by input-oriented DEA without affecting output levels. While maintaining the current amount of input use, an output-oriented DEA is the possibility of increasing output. The DMU will be recognized as inefficient from an output viewpoint if it is inefficient from an input orientation perspective. The selection of input-oriented DEA is based on control criteria, assuming the premise that policymakers have more control on expenditures (inputs), such as funds or public budgets, than outputs, such as GDP, inflation, unemployment rate and so on. Generally, in practice the assumption of input-orientation in hospital (spending) efficiency studies is that the cost (input) minimizing. This assumption has received much criticism in the literature, arguing that their objective is not minimizing cost (input) but improving lives through providing better health care facilities. Following the relevant literature, this study used both input and output-oriented DEA approach to provide robustness checks. The input and output-oriented efficiency scores can be obtained by solving the given mathematical programming procedure.

Input-oriented efficiency

$$\min_{\eta,\, \emptyset^{in}} \emptyset^{in}$$

Subject to:

$$Y_{ho} \leq \sum_{k=1}^{k} \eta_k \, Y_{ko}$$

$$\emptyset^{in} \, X_{hr} \geq \sum_{k=1}^{k} \eta_k \, X_{kr}$$

$$\eta_k \geq 0$$

$$\sum_{k=1}^{k} \eta_k = 1$$

Output-oriented efficiency

$$\max_{\eta,\, \emptyset^{out}} \emptyset^{out}$$

Subject to:

$$X_{hr} \geq \sum_{k=1}^{k} \eta_k \, X_{kr}$$

$$\emptyset^{out} \, Y_{ho} \leq \sum_{k=1}^{k} \eta_k \, Y_{ko}$$

$$\eta_k \geq 0$$

$$\sum_{k=1}^{k} \eta_k = 1$$

Where X_{hr} and Y_{ho} are the input r and output o, respectively that is produced by the decision -making unit h, and η_k are wights associated with k[th] DMU. The approach for input-oriented efficiency is similar. Given a set of constraints, the output efficiency linear programming problems generates an efficiency score for DMU h as large as possible. For each input type, the weighted sum of k DMUs' input cannot be exceeded DMU h's input. h's output multiplied by $\emptyset$ is smaller than the weighted sum of DMU's output. And k weights (one of each DMU) are nonnegative and add up to 1. The last constraint as mentioned above ensures a variable return to scale model, in which each decision-making unit is evaluated against other DMUs of similar size (Charnes et al, 1984). The invers of the maximized factor i.e., $1/\emptyset^{out}$ is the technical output efficiency scores ranges from 0 (inefficient) to 1 (efficient). The approach for input-oriented efficiency is similar to output-oriented DEA, except that the input-efficiency rating, which lies between 0 (completely inefficient) and 1 (completely efficient), is the minimized objective function (and not its inverse).

In the evaluation of public expenditure efficiency, firstly the basic DEA model has been employed to estimate the efficiency scores. The DEA approach is utilized using Data Envelopment Analysis (DEAP) computer program 2.1 Version which was designed by Coelli (1996). This program is also suggested by the World Bank.

DATA

DEA is the non-parametric technique designed by Charnes and Banker (1984). DEA broaden by Richmond and Lynde (1999) to the evaluate productivity efficiency in time-series data. It is important to mentioning that data envelopment analysis is a mathematical method to solving linear problems focused to analyzing (in) efficiency of several DMUs as well as for the same DMU (for example, Punjab Province) over a period of time. The concept seems to be fascinating since each DMU in each period will be regarded as it were a different DMU. With the help of this process, the present study compares the DMU to itself over different periods and determine how its efficiency changes. In this study the government is considered as a producer or DMU employing various inputs (expenditures) to produce outputs for public. The preset study used

inputs that are administered by the policymakers, i.e., development expenditures on health and education (in millions) sector in Punjab. Similarly, this study uses Literacy Rate, primary school enrollment (in numbers), secondary enrollment (in numbers), infant mortality rate, and full immunization coverage (In percent) as an output factor. The study uses data from 2011 to 2018 based on the availability of data of enrolments provided by Pakistan Education Statistics 2017-18. The data of development expenditures in Punjab are obtained from the website of Finance Division. Whereas the data of primary and secondary enrollment are obtained from, Pakistan Education Statistics published by Academy of Educational Planning and Management (AEPAM). And the dataset of Infant Mortality Rate, and Full Immunization Coverage are collected from PSLM Survey reports, and MICS Punjab, respectively.

IV. RESULTS AND DISCUSSION

As described in the above section, the main two inputs used in this study are development expenditure on the health and education sector in Punjab. The inputs are employed in the production process to produce a certain number of outputs, including primary and secondary enrollment, literacy rate, immunization coverage and infant mortality.

TABLE 1

Descriptive Analysis

	Variables	Mean	Std. Dev.	Min	Max
Inputs	Education Expenditure	26143.38	12549.73	9323	44910
	Health Expenditure	21124.88	15237	3815	44906
Outputs	Literacy Rate	62.25	1.832251	60	65
	Primary Enrollment	5765614	1656155	4969416	9845045
	Secondary Enrollment	1154253	403547.3	447079	1902747
	Infant Mortality	71.88	8.01	60	82
	Immunization Coverage	60	10.49	47	77
Environmental Variables	Number of teachers	234931.8	23209.5	217735	289415
	Availability of Boundary Wall	41276.88	1388.139	39284	43396
	Classroom Availability	45533.88	3013.329	43231	50874
	Number of beds in Hospitals	445.875	26.17762	405	477
	Inflation	6.4925	3.217522	2.53	11.92
	Corruption Perception Index	29.625	2.559994	26	33

Table 1 presents the summary statistics of various outputs, inputs (expenditures) and environmental variables from 2011-2018. During the research period, the average development expenditures on education and health are 26143 and 21124, respectively. Average literacy in Punjab is about 62 percent during the study period. The mean value of infant mortality and immunization coverage are 71.88 and 60, respectively.

ESTIMATING TECHNICAL EFFICIENCY USING DEA

The technical efficiency scores for each type of public expenditure (i.e., healthcare and education) have been estimated in the first stage. To determine the TE of total government expenditure in these two areas, we present all outputs and inputs into the DEA model in the second step. The outcomes of input-oriented and output-oriented TE scores for education and health are presented in the table below. Table 2 displays DEA TE scores of public investments on education and health under constant and variable returns to scale.

In the education sector the input-oriented TE scores shows that during the fiscal year 2012-2013, the Punjab government is efficient under constant returns with mean efficiency score of 0.532. DEA- CRS provides the same results under output-oriented in the case of education efficiency. However, the results are different under variable returns, showing mean efficiency score of 0.775, higher than CRS. Under VRS input-oriented, the Punjab government is efficient during 2010-11, 2012-13, and 2017-18 with an efficiency score of 1, meaning that the Punjab government has achieved higher number of enrolments in schools using a smaller proportion of resources. The overall average efficiency score is 77 percent. This statement is intended to imply that the government of Punjab should be able to maintain the current level of output while utilizing only around 77 percent of the inputs that they are using currently. The remaining resources are used inefficiently.

In the case of output-oriented, the average education spending efficiency is higher than in the case of input-oriented. The results of output-oriented TE scores are provided in table 3. The mean output efficiency rating of 0.98 depicts that the Punjab government produces 2 percent fewer outputs with the same input level. In other words, the provincial government produced 98 percent of outputs with the existing

resources (2 percent of output can be further enhanced). Regarding health spending efficiency under the CRS, the Punjab government was only efficient during 2010-11. The average efficiency score is 0.36. Under both orientations (input and output), the results are the same in the case of CRS. In the VRS model, Punjab's government is more efficient in spending in the health sector than in the education sector. The average efficiency score is 93 percent. This indicates that they should be able to produce the same amount of output using approximately 93% of the inputs on average. The remaining resources are used ineffectively. If considering the output orientation, the average health spending efficiency is greater than the case of input. The results of output TE scores are provided in table 3. The average output-oriented TE rating of 0.99 shows that the Punjab government produces 1 percent fewer outputs with the same input level. However, the government is very close to achieving a higher efficiency level. Overall, health spending efficiency is better than in the education sector.

TABLE 2

Input-Oriented Technical Efficiency

	Education		Health	
Years	CRSTE	VRSTE	CRSTE	VRSTE
2010-2011	0.986	1	1	1
2011-2012	0.423	0.425	0.401	1
2012-2013	1	1	0.369	0.791
2013-2014	0.313	0.314	0.381	1
2014-2015	0.429	0.840	0.286	1
2015-2016	0.407	0.789	0.188	0.861
2016-2017	0.283	0.835	0.140	0.840
2017-2018	0.411	1	0.139	1
Mean	0.532	0.775	0.363	0.936

Note: CRSTE, VRSTE is Constant, and Variables Return to scale technical efficiency, respectively.

Source: Author's estimations through DEA Software

TABLE 3

Output-Oriented Technical Efficiency

	Education		Health	
Years	CRSTE	VRSTE	CRSTE	VRSTE
2010-2011	0.986	1	1	1
2011-2012	0.423	0.951	0.401	1
2012-2013	1	1	0.369	0.995
2013-2014	0.313	0.956	0.381	1
2014-2015	0.429	0.995	0.286	1
2015-2016	0.407	0.992	0.188	0.986
2016-2017	0.283	0.991	0.140	0.988
2017-2018	0.411	1	0.139	1
Mean	0.532	0.986	0.363	0.996

Source: Author's calculations through DEA Software

Table 4 summarizes input and output efficiency ratings for development expenditures when education and health are considered at the same time. We look at one input (the sum of health and education development expenditures) and five outputs (Secondary enrolment, literacy rate, primary school enrolment, infant mortality rate, and full immunization). The study by Quertani et al. (2018) also summarized the output efficiency scores of public spending taking into account infrastructure, health, and education at the same time. Then, one input (the total amount that the government spends on infrastructure, health care, and education) and five outputs (life expectancy, infant mortality, the number of children enrolled in primary and secondary school, energy consumption per person, and telephones per 100 habitats, electricity transmission capacity) are taken into account.

TABLE 4

Technical Efficiency of Public Expenditure over the Period

	Input Oriented		Output Oriented	
Years	CRSTE	VRSTE	CRSTE	VRSTE
2010-2011	1	1	1	1
2011-2012	0.456	1	0.456	1
2012-2013	0.745	1	0.745	1
2013-2014	0.394	0.738	0.394	0.996
2014-2015	0.428	1	0.428	1
2015-2016	0.353	0.988	0.353	0.997
2016-2017	0.262	0.893	0.262	0.994

	Input Oriented		Output Oriented	
Years	CRSTE	VRSTE	CRSTE	VRSTE
2017-2018	0.292	1	0.292	1
Mean	0.492	0.952	0.492	0.998

Source: Author's calculations through DEA Software

Determinants of Public Spending Efficiency in Punjab Province

After estimating efficiency in the first step using DEA, researchers usually run a second step whereby determinants of efficiency are measured, which makes sense and provides more information than just doing the first step. Based on the efficiency scores of public expenditures in Punjab, this study also investigates the factors affecting the efficiency of these expenditures.

In the empirical literature, there are numerous techniques to consider. Given that the efficiency scores for the dependent variable are continuous and lies over a discrete interval (ranging 0 to 1), it would be feasible to use a Tobit (censored) regression technique to examine the relationship between the efficiency scores and other variables (Herrera and Pang, 2005). The tobit regression technique has been applied to determine elements that may affect the efficiency of public expenditure by following studies (Hauner and Kyobe, 2008; Afonso et al., 2013; Chan and Karim, 2012; Dobdinga et al., 2016).

The models are as follows:

Econometric Models

$$\text{VRSTE Input} = \alpha 0 + \alpha 1\ \text{Not it} + \alpha 2\ \text{Bw it}, + \alpha 3, \text{Bih it} + \alpha 4\ \text{Infit}, + \alpha 5\ \text{CPIit} + \epsilon \text{it}$$

$$\text{VRSTE Output} = \alpha 0 + \alpha 1\ \text{Not it}, + \alpha 2\ \text{Aoc it}, + \alpha 3\ \text{Infit}, + \alpha 4\ \text{CPIit} + \epsilon \text{it}$$

Where,

VRSTE= Various TE scores obtained from DEA

NOT= Number of teachers

BW= Availability of boundary wall

Aoc= Availability of classrooms

Bih= Number of beds in hospitals

Inf= Inflation rate

CPI= Corruption perception index

Exogenous factors that are beyond the control of decision makers play an essential role in determining public expenditure efficiency if taking them into account could lead to improvement in efficiency. The input-oriented model depicts the assumption that policymakers have greater control over input choices. Therefore, the dependent factor in the given model is the efficiency scores estimated by the DEA procedure in the initial step.

Data on the number of beds in hospital is collected from Punjab Health Statistics (2021), published by the Bureau of Statistics. Data on the number of teachers, availability of boundary walls, and classroom availability are collected from Pakistan Education Statistics, whereas data of inflation and Corruption Perception Index (CPI) are obtained from the website of World Bank and transparency international respectively.

TABLE 5

Description of Institutional and Exogenous Variables

Variables	Description	Expected Signs
Number of teachers	Number of teachers in primary and secondary schools in Punjab	+
Availability of Boundary Wall	Total number of boundary walls in primary and secondary schools in Punjab	+
Classroom Availability	Number of classrooms in primary and secondary schools in Punjab	+
Number of beds in Hospitals	Total number of beds per million population in Punjab hospitals	+
Inflation	The rate at which prices increase over a specific period	-
Corruption Perception Index	Measure the level of corruption in an economy (100 is very clean, and 0 is highly corrupt)	-

Source: Author's rendering

TABLE 6

Factors Affecting Expenditure Efficiency Scores

Variables	Model 1 Input Oriented	Model 2 Output Oriented
Constant	-2.753551* (0.030)	1.000536* (0.000)
Number of teachers	5.46e-06* (0.009)	1.47e-07* (0.010)
Availability of Boundary wall	.0001422* (0.004)	-
Availability of Classrooms	-	7.41e-07*** (0.099)
Beds in hospitals	.0050894* (0.015)	-
Inflation	-0.0619635* (0.006)	-.0014052* (0.020)
CPI	-0.1793582* (0.004)	-.0020679* (0.016)

Note: ***, **, and * represent significant statistically at 10 percent, 5 percent and 1 percent, respectively.
Source: Author's rendering

The results from Table 6 demonstrates that the number of teachers and classroom availability have a positive impact on enhancing efficiency, indicating that sufficient classrooms and fewer students per teacher allow teachers to focus more on the needs of individual students. Similarly, the availability of boundary walls also positively and significantly impacts spending efficiency in the education sector. Due to the current state of law and order, the availability of a boundary wall is gaining importance. This is especially important for female educational institutions, where a boundary wall is required (Pakistan Education Statistics). In the health sector, the number of beds also has a positive and significant impact on increasing the efficiency of public spending.

Inflation significantly negatively affects public expenditure efficiency in Punjab for both areas implying that during times of high public funding, efficiency reduced and may be consider for the economic instability caused by increased prices.

Both health and education sectors are adversely affected by corruption, which has a substantial negative impact on efficiency. Controlling corruption is a very crucial factor in determining efficiency, as corruption breeds waste. Additionally, it is generally agreed that corruption is detrimental to economic development, and there is substantial proof that reducing corruption improves educational and healthcare efficiency.

Results of the regression concluded that the availability of physical infrastructure in the health and education areas is associated with better health and education outcomes, improving better human development spending.

V. CONCLUSION AND POLICY IMPLICATIONS

The present study attempted to evaluate the efficiency of public expenditures in the health and education sectors and to determine various factors that may influence the efficiency of these spendings in Punjab province for the period 2011-18. In this study, the non-parametric Data Envelopment Analysis (DEA) technique has been applied to estimate the efficiency of government expenditures in Punjab province. The key benefit of this method is that the inefficiency scores can be estimated without having to specify the frontier function, which is typically not known. Various scores of technical efficiencies from estimating the efficiency of public spending in the health and education sectors are calculated.

The constant return to scale input-oriented efficiency score in the education sector shows that the Punjab government is weakly efficient with mean efficiency score of 0.532. DEA- CRS provides the same results under output-oriented in the case of education efficiency. However, the results are different under variable returns, showing mean efficiency score of 0.775, higher than CRS. Under VRS input-oriented, the Punjab government is efficient during 2010-11, 2012-13, and 2017-18 with an efficiency score of 1, meaning that the Punjab government has achieved higher enrolments of numbers in schools using a minor share of expenditures or resources. The mean efficiency score is 77 percent. The Punjab government is only effective regarding CRS from 2010 to 2011, with an average efficiency score of 0.36. In the case of CRS, the output is the same for input and output orientations. According to the VRS model,

Punjab's government spends money more effectively on health care than on education. The efficiency rating is 93 percent on average. The average health spending efficiency is higher in the case of output orientation than it is in the case of input. Combine statistics show that the Punjab's government spending on education is less effective than spending on health.

In the secondary step of the research, after estimating the TE scores, this study also investigated the factors behind the variation in efficiency by using the Tobit regression technique. The results showed that the availability of physical infrastructure in the education and health sectors is associated with improving better human development spending. Whereas inflation harms public spending expenditure efficiency in Punjab for both sectors. Similarly, corruption has also negative impact on efficiency in both sectors. Furthermore, there is strong evidence that tackling corruption increases performance and efficiency in both sectors.

Considering the findings of the analysis, it is recommended that policymakers and the government of Punjab may develop strategies to enhance the efficiency of public expenditure in the health and education fields. The provincial government should allocate more funds towards programs that create employment opportunities for the public. Proper evaluation, monitoring, and reviewing of future public projects should be done to avoid repeated and unnecessary investments. Moderate government expenditures seem to be vital in achieving greater efficiency. Therefore, the government should minimize unnecessary expenditures and create fiscal space for sectors that improve human development and economic performance. To enhance the efficiency of the education sector, the provincial government should finance increasing the teacher's education and by providing availability of other infrastructure like toilet facilities, furniture, boundary wall; these factors are also necessary for increasing enrolment. Similarly, to enhance the efficiency of public outlay on health sector, the number of doctors, nurses, beds, and other infrastructure is also essential, so these factors should be considered. Investment in preventive care has also shown a high cost-benefit ratio. The combined findings of this study suggested that government should strive for a corruption-free society and more accountability in budgetary and financial management. Corruption and misappropriation of local

resources by an official, the maintenance of law and order, and the enforcement of property rights should be controlled to ensure good administration. This can be achieved through the strengthening of institutional practices and deterring political influence and implementation of transparency measures. Price stability is also required to promote economic stability and enhance the efficiency of public spending.

When looking at formulating effective policies that ensure efficient government spending, policymakers can take the example of countries that have shown progress through such policies. This can be done through benchmarking practices to identify international best practices that can be applied to the local context. Adopting efficiency metrics to measure and evaluate system metrics guarantees that policymakers are well-informed about the cost-effectiveness of their initiatives and that government expenditure is optimized. Spatial Analysis can be used to determine regional disparities and allocate resources accordingly to ensure equitable public spending across populations and regions. In addition to investment in capacity building, training and healthcare resources, performance-based funding can improve efficiency of organizations.

LIMITATIONS AND FUTURE RESEARCH

This study has potential limitations, and there is space for additional research on the phenomenon in the future. This study focused on the Punjab province rather than on Pakistan's economy. Using a panel data approach, there is a need to assess the relative efficiency of public expenditures of other provinces, i.e., (Balochistan, Khyber Pakhtunkhwa, and Sindh). Various other economic, institutional, and environmental factors could be explored for the variation in the efficiency of public outlay. The impact of Covid-19 outbreak has not been accounted for in this study. New resulting data in relation to public spending efficiency and comparison of the impact and output of the pandemic with per capita healthcare spending in future studies can lead to effective public policy reform. A Study may also be conducted to determine the efficiency of public spending by including low-income countries.

REFERENCES

Afonso, A., & Aubyn, M. S. (2005). Non-parametric approaches to education and health efficiency in OECD countries. Journal of Applied Economics, 8(2), 227-246.

Afonso, A., Jalles, J. T., & Venâncio, A. (2020). Government spending efficiency, measurement and applications: a cross-country efficiency dataset. REM Working Paper, 0147 2020.

Afonso, A., Schuknecht, L., & Tanzi, V. (2005). Public sector efficiency: an international comparison. Public Choice, 123(3), 321-347.

Afonso, A., Schuknecht, L., & Tanzi, V. (2010). Public sector efficiency: evidence for new EU member states and emerging markets. Applied Economics, 42(17), 2147-2164.

Albassam, B. A. (2020). A model for assessing the efficiency of government expenditure. Cogent Economics & Finance, 8(1), 1823065.

Atmanti, H. D. (2016). EFFICIENCY OF GOVERNMENT SPENDING FOR HUMAN DEVELOPMENT SOME DISTRICTS IN CENTRAL JAVA DURING 2008–2012. Journal of Developing Economies, 1(2), 1-7.

Bhat, R., Verma, B. B., & Reuben, E. (2001). Data envelopment analysis (DEA). Journal of health Management, 3(2), 309-328.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429-444.

Coelli, T. (1996). A guide to DEAP version 2.1: a data envelopment analysis (computer) program. Centre for Efficiency and Productivity Analysis, University of New England, Australia, 96(08), 1-49.

Cooper, W. W., Seiford, L. M., & Tone, K. (2006). Introduction to data envelopment analysis and its uses: with DEA-solver software and references. Springer Science & Business Media.

D'Inverno, G., Carosi, L., & Ravagli, L. (2018). Global public spending efficiency in Tuscan municipalities. Socio-Economic Planning Sciences, 61, 102-113.

Dutu,R. & Sicari,P.(2020). Public Spending Efficiency in the OECD: Benchmarking Health Care, Education, and General Administration. Review of Economic Perspectives,20(3) 253-280. https://doi.org/10.2478/revecp-2020-0013

Farrell, M. J. (1957). The measurement of productive efficiency. Journal of the Royal Statistical Society: Series A (General), 120(3), 253-281.

Fonchamnyo, D. C. and M. C. Sama (2014). Determinants of public spending efficiency in education and health: evidence from selected CEMAC countries. Journal of Economics and Finance, 40(1), 199-210.

Fox, K.J. (2002). Performance assessment in the public sector. In: KJ. Fox, ed., efficiency in
the public sector. Boston: Kluwer Academic Publishers.

Gupta, S., & Verhoeven, M. (2001). The efficiency of government expenditure: experiences from Africa. Journal of Policy Modeling, 23(4), 433-467.

Hauner, D. abd Kyobe, A. (2008). Determinants of Government Efficiency. IMF Working
Paper.

Hauner, D., & Kyobe, A. (2010). Determinants of government efficiency. World Development, 38(11), 1527-1542.

Herrera, S., & Pang, G. (2005). Efficiency of public spending in developing countries: an efficiency frontier approach (Vol. 3645). World Bank Publications.

Javaid, M. F. (2017). Expenditure efficiency and fiscal size: An empirical evidence from developing Asian countries. Pakistan Economic and Social Review, 55(1), 247-269.

Jordi, E., Pley, C., Jowett, M., Abou Jaoude, G. J., & Haghparast-Bidgoli, H. (2020). Assessing the efficiency of countries in making progress towards universal health coverage: a data envelopment analysis of 172 countries. BMJ Global Health, 5(10), e002992.

Lynde, C., & Richmond, J. (1999). Productivity and efficiency in the UK: a time series application of DEA. Economic Modelling, 16(1), 105-122.

Ouertani, M. N., Naifar, N., & Ben Haddad, H. (2018). Assessing government spending efficiency and explaining inefficiency scores: DEA-bootstrap analysis in the case of Saudi Arabia. Cogent Economics & Finance, 6(1), 1493666.

Prasetyo, A. D., & Zuhdi, U. (2013). The government expenditure efficiency towards the human development. Procedia Economics and Finance, 5, 615-622.

Razmi, M. J., E. Abbasian, S. Mohammadi, 2012. Investigating the Effect of Government Health Expenditure on HDI in Iran. Journal of Knowledge Management, Economics and Information Technology, Vol. 5.

Wang, E. C., & Alvi, E. (2011). Relative efficiency of government spending and its determinants: Evidence from East Asian countries. Eurasian Economic Review, 1(1), 3-2.