# The Efficiency of Government Health Expenditure in ASEAN Countries

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## Article Information

## Abstract

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Inefficiencies in health expenditure result in an estimated 1–1.4% of global Gross Domestic Product (GDP) being wasted across various regions, presenting a significant challenge for countries striving to optimize healthcare spending. This study aims to assess the efficiency of government health expenditure in six ASEAN countries with the lowest per capita government health spending, using the Data Envelopment Analysis (DEA) method. In addition, Tobit regression is employed to identify factors that influence the efficiency of government health expenditure. The results indicate that most countries have not achieved maximum efficiency scores over the years, underscoring the need for improved budget management and reforms in health policy implementation. The Tobit regression analysis reveals that economic growth, urbanization rate, and the proportion of government health expenditure in current health expenditure have a positive and significant effect on efficiency scores. This suggests that increased public investment and urban development contribute to improved efficiency in healthcare spending. Conversely, total carbon emissions have a negative impact on efficiency, emphasizing the influence of environmental factors on health system performance.

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**INTRODUCTION**

Health is a fundamental component of national development, playing a critical role in enhancing both the quality of life and the economic productivity of a population (Wang & Wang, 2020) . The global health landscape remains complex, presenting ongoing challenges, with governments primarily responsible for ensuring that health systems meet the standards required to deliver a better quality of life (Ahmad & Hasan, 2016; Pinero de Plaza et al., 2023).

Government expenditure in the health sector plays a vital role in establishing and maintaining an effective and efficient health system. According to Garcia-Escribano et al. (2022), inefficiencies in health spending result in the wastage of approximately 1–1.4% of global Gross Domestic Product (GDP) across various economic regions. This poses a significant challenge for countries to manage health

expenditures efficiently to achieve optimal health outcomes, particularly for nations with relatively low healthcare spending, such as Southeast Asia. Data from the World Health Organization (WHO, 2023) show that Southeast Asia ranks the region with the second-lowest government health expenditure globally.

Since the establishment of the ASEAN Economic Community (AEC) in 2015, regional integration has encouraged the development of the health industry, aligning with the Universal Health Coverage (UHC) initiative promoted by the WHO as part of the Millennium Development Goals (Van Minh et al., 2014). Despite this progress, substantial disparities remain in government health expenditure among ASEAN member countries. Specifically, Indonesia, Vietnam, Laos, Timor Leste, Cambodia, and Myanmar are the six ASEAN countries with the lowest per capita government health spending.
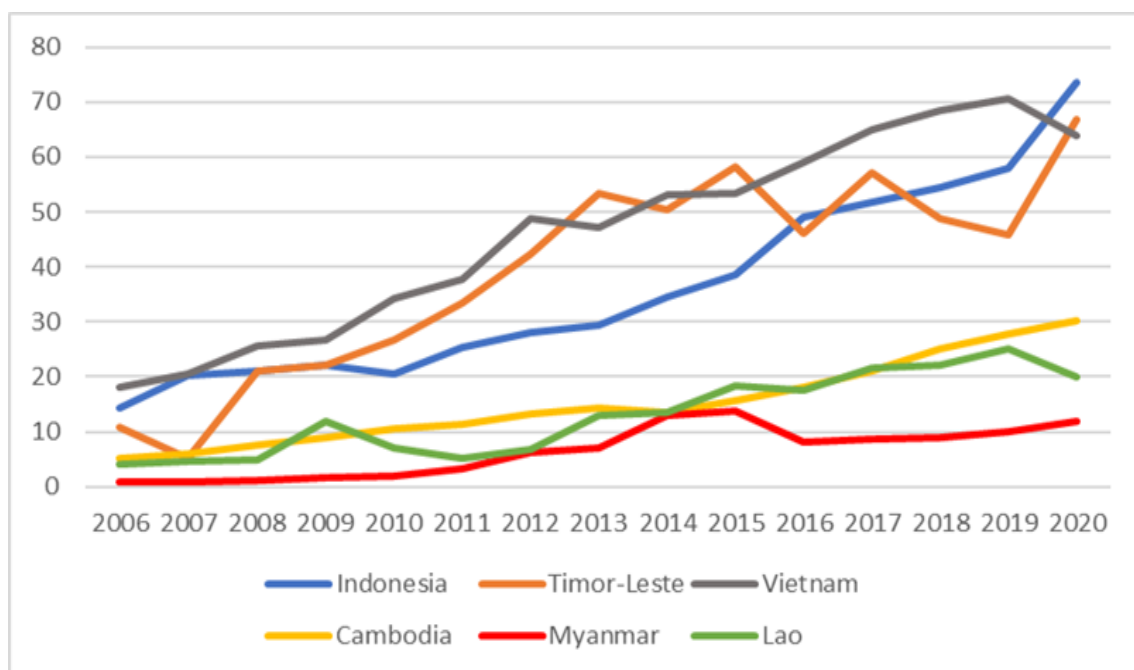


**Figure 1.** Government Health Expenditure  in six ASEAN Countries from 2006-2020.
Sources: World Health Organization and World Bank, 2025 (Processed).

Figure 1 illustrates government health expenditure per capita in six ASEAN countries, measured in U.S. dollars (USD) over a specified period. Government health expenditure per capita refers to the average amount of public

health funding allocated by the government for each individual in a country. The graph indicates that all countries experienced a significant increase in government health expenditure over time. In 2020, Indonesia recorded the highest

expenditure at USD 73 per capita, while Myanmar had the lowest at only USD 11. This variation highlights disparities in fiscal capacity, policy priorities, and population size among these nations.

Despite ongoing efforts to increase spending and investment in healthcare, some ASEAN countries continue to struggle to meet the rapidly growing demands of the health sector. According to Singh et al. (2021), the region is at risk of falling short of achieving Sustainable Development Goal 3, which targets the reduction of premature mortality from non-communicable diseases (NCDs), largely due to inefficiencies in healthcare systems. This issue is also reflected in the persistently high infant mortality rates across the six ASEAN countries. As Dallolio et al. (2012) and Rosicova et al. (2010) noted, the infant mortality rate is a key indicator for assessing a country's health outcomes. World Bank data (2020 shows that the average infant mortality rate in these six countries reached 28.6 deaths per 1,000 live births—more than double the rate in the East Asia and Pacific region, which stood at 12.1 in the same year.

Given these limited resources, governments must allocate health expenditures efficiently and effectively to improve national health outcomes. Inefficiencies in spending may misallocate limited resources, thereby hindering progress in health sector development. Increased health expenditure may not necessarily translate into better health outcomes without efficiency improvements, potentially exacerbating disparities among countries. Therefore, exploring the efficiency of government health expenditure remains an important and timely subject for further research.

Several studies have explored efficiency in the health sector using the Data Envelopment Analysis (DEA) method to measure relative efficiency. For instance, Top et al. (2020) applied DEA to evaluate the efficiency of health systems in 36 African countries and found that 21 of them

had achieved efficient health systems. Similarly, Grigoli (2012) assessed the comparative efficiency of government spending in the health and education sectors using DEA and concluded that public spending on education was more efficient than health. In the context of China, Guo et al. (2021) analyzed the efficiency of government healthcare expenditure following the 2009 healthcare reform, employing DEA and Tobit regression. Their findings showed a notable improvement in average efficiency scores across provinces post-reform. Moreover, Tobit regression results indicated that GDP per capita, population density, and the new healthcare reform positively influenced efficiency, while urbanization had a negative impact.

Conversely, Dhaoui (2019) found that GDP per capita did not significantly affect health system efficiency, suggesting that factors such as resource allocation, governance quality, and healthcare system structure also play crucial roles in shaping efficiency outcomes. Jayasuriya and Wodon (2003) argued that urbanization positively affects health sector efficiency, as performance monitoring is often easier in urban areas due to improved access to healthcare facilities. Additionally, Athanassopoulos et al. (1998) found that population density had a weak negative effect on the efficiency of government health expenditure.

While previous studies have analyzed health expenditure efficiency in various regions, most have concentrated on developed countries, resulting in limited research focused on ASEAN nations—particularly those with low government health expenditure. To address this gap, the present study uses the DEA method to measure the efficiency of government health expenditure in six ASEAN countries with the lowest per capita public health spending. Furthermore, Tobit regression is employed to investigate factors that may influence efficiency. By focusing on developing countries and using 16 years of panel data, this study provides valuable insights

into the efficiency of healthcare expenditure in the ASEAN region.

## RESEARCH METHODS

This study aims to measure the efficiency of government health expenditure in six ASEAN countries: Indonesia, Vietnam, Laos, Timor-Leste, Cambodia, and Myanmar. The study analysis uses panel data over 15 years, from 2006 to 2020. A panel data model helps mitigate biased variables (Sevinc, et al., 2023). Similar to the study by Guo et al. (2021), this research employs the DEA method to measure the efficiency of government health expenditure and uses Tobit regression to analyze the factors influencing efficiency.

The DEA method is a non-parametric analysis developed by Charnes et al. (1978) to measure the relative efficiency of Decision Making Units (DMUs). This method evaluates efficiency by comparing the outputs and inputs produced by each DMU. The basic DEA model consists of two main models, the CCR-DEA and BCC-DEA models, which are recognized as the two most influential models (Seiford, 1996).

The CCR model, developed by Charnes et al. (1978), is based on the assumption of Constant Return to Scale (CRS). This model assumes that proportional changes in input result in proportional changes in output. In contrast, the BCC model, developed by Barnes, Charnes, and Cooper, is based on the assumption of Variable Return to Scale (VRS). The BCC model offers flexibility by allowing for different scale changes in each unit (Sherman, 1984).

This study applies the BCC model, which assumes that changes in input are not always directly proportional to changes in output. In addition, this study uses the output-oriented BCC-DEA model. This approach is considered more appropriate, given that inputs, such as government health expenditure per capita, are relatively inflexible and difficult to adjust (Ahmed et al., 2019). A similar approach appears in studies by Ahmed et al. (2019) and Pula & Elshani (2022). This model suits research involving countries with different economic scales, such as the six ASEAN countries. The BCC model can be defined as follows.

$$\text{Max } \theta \text{ ....................................... (1)}$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j X_{ij} \leq X_{i0} \quad i = 1, 2, \ldots, m \quad (2)$$

$$\sum_{j=1}^{n} \lambda_j Y_{rj} \leq \theta Y_{r0} \quad r = 1, 2, \ldots, s \quad (3)$$

$$\sum_{j=1}^{n} \lambda_j = 1 \quad \lambda_j \geq 0 \quad j = 1, 2, \ldots, n \quad (4)$$

Source: Banker, Charnes, & Cooper (1984)

In this study, $\theta$ represents the efficiency score with a value of $0 < \theta < 1$. Meanwhile, Xio represents the i-th input, and Yro represents the r-th output for each DMU, while j = 1,2,...n, refers to the number of DMUs (Chan & Karim, 2012). For data processing in this study, the DMUs are the six ASEAN countries. The efficiency scores of each DMU are compared based on the input and output produced during a certain period to measure the relative efficiency level among the countries. This study uses the total government health expenditure as the input variable. Meanwhile, the outputs consist of a reduction in infant mortality, maternal mortality, and tuberculosis incidence. The selection of these variables aligns with several previous studies that used similar input and output measures (Dian et al., 2017; El Husseiny, 2023; Pula & Elshani, 2022).

Considering the environmental and socio-economic factors that influence efficiency, this study also applies Tobit regression to identify the factors affecting the efficiency of government health expenditure. Previous studies have frequently combined the Tobit regression with the DEA method (Lin et al., 2021). Tobit regression, which was developed by James Tobin in 1958, is categorized as a censored regression model (Wooldridge, 2002).

Tobit regression is designed to handle dependent variables with value limits or constraints. Several previous studies (El Husseiny, 2023; Gong et al., 2019; Guo et al., 2021) have adopted Tobit regression to identify

factors influencing efficiency. This model is widely used in studies analyzing the determinants of efficiency (Carvalho et al., 2012; Yang et al., 2018). The Tobit model can be expressed as follows:

$$y_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 Urb_{it} + \beta_3 Gov_{it} + \beta_4 CO_{it} + \varepsilon_{it} \quad ..................(5)$$

In the model above, yi represents the efficiency score of government health expenditure, ranging from 0 to 1 in each country. Additionally, GDP refers to economic growth, which is measured by the annual growth rate of a country's GDP. Meanwhile, Urb represents the urbanization rate in each country. Gov denotes the percentage of government health expenditure as a share of current health expenditure, and CO represents total carbon emissions in each country, measured in 1.000 metric tons per capita. According to (Gong et al., 2019; Guo et al., 2021; Yadav et al., 2023), economic growth, urbanization rate, government health expenditure, and carbon emission influence the efficiency of health expenditure and the healthcare system. This study uses the STATA 15.0 to perform the analysis using the DEA method and Tobit regression. The following table is a summary of the variable description in this study.

**Table 1**. Variables Description

| Data Envelopment Analysis (DEA) | | Description |
|---|---|---|
| **Input** | Government Health Expenditure | Total of government health expenditure in each country, measured in USD |
| **Output** | Infant Mortality Rate Decrease | Reduction in the number of infants dying before reaching one year of age, per 1,000 live births during a given period |
| | Maternal Mortality Rate Decrease | Reduction in the number of maternal deaths per 100.000 live births during a given period |
| | Tuberculosis Incidence Decrease | Reduction in the number of the estimated number of new and relapse tuberculosis cases arising per 100.000 population in a given year |
| **Tobit Regression** | | **Description** |
| Economic Growth | | The annual percentage increase of a country's GDP as a proxy for economic growth |
| Urbanization Rate | | Percentage of the country's population living in urban areas compared to the total population |
| Government Health Expenditure Percentage | | The proportion of government health expenditure relative to the current health expenditure |
| CO 2 | | Total carbon dioxide emissions from each country, which are measured in thousands of metric tons per capita |

Source: Data Processed, 2025

## RESULTS AND DISCUSSION

This study applies the DEA method to measure the efficiency of government health expenditure in six ASEAN countries. The analysis continues with Tobit regression to assess the factors influencing efficiency. The input variable used in this study is government expenditure in the health sector, measured in USD, while the output variables consist of the reduction in infant mortality rate, reduction in maternal mortality rate, and reduction in the number of tuberculosis (TB) incidences. For the Tobit regression, the dependent variable is the efficiency score of government health expenditure, and the independent variables consist of economic growth, urbanization rate, the percentage of government health expenditure, and carbon emissions. Table 2 presents a statistical summary of the variables used in this study.

**Table 2.** Summary Statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| HealthGov | 90 | 2.38e+09 | 4.04e+09 | 5247342 | 2.00e+10 |
| IMRdcrs | 90 | 1313.049 | 2773.241 | -9602.803 | 14474.57 |
| MMRdcrs | 90 | 93.31119 | 314.0913 | -1043.265 | 1427.037 |
| TBdcrs | 90 | 2043.836 | 3793.691 | -3818.296 | 22806.09 |
| GDPgr | 90 | 5.350008 | 4.472215 | -6.553719 | 29.92998 |
| Urban | 90 | 32.68812 | 9.619626 | 19.293 | 56.641 |
| HealthPerGov | 90 | 32.29967 | 14.4303 | 8.11 | 65.99 |
| LnCO2 | 90 | 9.685306 | 2.449243 | 5.449243 | 13.31346 |

Source: Processed by Author, 202

Table 2 provides a statistical overview of the variables used in this study. The statistics include measures such as the mean, median, minimum, maximum, and standard deviation for each variable. Government health expenditure (HealthGov) exhibits significant variation, with a large standard deviation indicating disparities in health funding across countries. The average government health expenditure is approximately USD 2.38 billion. The reduction in infant mortality (IMRdcrs) ranges from 14,474.57 to –9,602.8, while the reduction in maternal mortality (MMRdcrs) varies from 1,427.037 to –1,043.26, and the reduction in tuberculosis incidence (TBdcrs) ranges from 22,806.09 to –3,818.29. These variations suggest uneven progress in health outcomes over the years. Negative values for these indicators indicate instances where mortality or disease prevalence increased rather than decreased.

Economic and demographic factors are also included in the dataset. GDP growth (GDPgr) varied widely, with a minimum value of –6.55% and a maximum of 29.92%, reflecting periods of economic instability. The urbanization rate (Urban), which measures the percentage of the population residing in urban areas, has an average of 32.68%, with the lowest recorded value at 19.29% and the highest at 56.64%. The percentage of government health expenditure (HealthPerGov) ranges from 8.11% to 65.99%, with an average of 32.29%, indicating varying levels of health funding prioritization across countries. Additionally, LnCO2, representing the natural logarithm of total carbon emissions, has an average value of 9.68, with a minimum of 5.44 and a maximum of 13.31, suggesting substantial differences in environmental conditions among the countries. Overall, these statistics highlight key trends and disparities that are further examined in the analysis. The efficiency scores of government health expenditure in the six ASEAN countries are presented in Table 3.

**Table 3**. Efficiency Score of Government Health Expenditure in six ASEAN Countries

| Year | Indonesia | Timor-Leste | Vietnam | Cambodia | Myanmar | Laos |
|---|---|---|---|---|---|---|
| 2006 | 0.842269 | 0.253518 | 0.305145 | 0.359185 | 0.375808 | 0.400435 |
| 2007 | 0.187795 | 1.000000 | 0.345877 | 0.2019 | 0.61391 | 0.679836 |
| 2008 | 0.388729 | 0.108234 | 0.343845 | 1.000000 | 1.000000 | 0.204649 |
| 2009 | 0.728074 | 0.098748 | 0.339804 | 0.095663 | 1.000000 | 0.174614 |
| 2010 | 0.885601 | 0.089517 | 0.404078 | 0.154272 | 1.000000 | 0.392074 |
| 2011 | 0.17946 | 0.028435 | 0.272015 | 0.193806 | 1.000000 | 0.228148 |

| Year | Indonesia | Timor-Leste | Vietnam | Cambodia | Myanmar | Laos |
|------|-----------|-------------|---------|----------|---------|------|
| **2012** | 1.000000 | 0.047452 | 0.336157 | 0.131738 | 0.915953 | 0.268779 |
| **2013** | 0.908121 | 0.012996 | 0.278271 | 0.178564 | 0.944756 | 0.07784 |
| **2014** | 0.395319 | 0.026645 | 0.355918 | 0.152135 | 0.808408 | 0.172421 |
| **2015** | 0.562885 | 0.004483 | 0.29567 | 0.246025 | 0.882224 | 0.044274 |
| **2016** | 0.374677 | 0.0262 | 0.31319 | 0.221852 | 0.79596 | 0.065315 |
| **2017** | 0.441625 | 0.006725 | 0.220498 | 0.221659 | 0.721288 | 0.040938 |
| **2018** | 0.651298 | 0.009436 | 0.324106 | 0.261015 | 0.88902 | 0.038126 |
| **2019** | 1.000000 | 0.024305 | 0.333411 | 0.27172 | 0.696489 | 0.055707 |
| **2020** | 1.000000 | 0.011886 | 0.385457 | 0.084832 | 1.000000 | 0.087728 |
| **Average Score** | **0.63639** | **0.116572** | **0.323563** | **0.251624** | **0.842921** | **0.195392** |

Source: Data Processed, 2025

Table 3 presents the efficiency scores of government health expenditure for six ASEAN countries from 2006 to 2020. The analysis shows varying efficiency trends across the years. In 2006, Indonesia recorded the highest efficiency score at 0.842269, while Timor-Leste had the lowest at 0.253518, indicating a disparity in the efficient use of government health expenditure among these countries. However, in 2007, Timor-Leste demonstrated remarkable progress by achieving a perfect efficiency score of 1, whereas Indonesia experienced a significant decline, dropping to 0.187795, suggesting challenges in resource allocation or policy implementation during that year.

From 2008 to 2015, Myanmar emerged as one of the most efficient countries, achieving perfect efficiency scores from 2008 to 2011 and recording an average score of 0.943918 during the period. In contrast, Timor-Leste experienced substantial inefficiencies, reaching its lowest point in 2015 with a score of 0.004483. Meanwhile, Cambodia and Indonesia each achieved their first perfect efficiency scores in 2008 and 2012, respectively. On the other hand, Vietnam and Laos consistently recorded relatively low-efficiency scores and did not reach a perfect score throughout the observed period. These variations suggest that while some countries successfully optimized their government health expenditure, others continued to face challenges in utilizing health budgets effectively.

In 2020, when the COVID-19 pandemic impacted health systems globally, it appeared to drive more efficient health expenditure in Indonesia and Myanmar, both of which achieved perfect efficiency scores. In contrast, Laos and Timor-Leste continued to face challenges in the health sector, maintaining low-efficiency scores. Over the years, Myanmar and Indonesia consistently led in efficiency, with average efficiency scores of 0.84 and 0.63, respectively. On the other hand, Laos and Timor-Leste consistently underperformed, recording average scores of 0.19 and 0.11, indicating a need for improved budget management and reforms in health policy implementation. Vietnam and Cambodia maintained relatively stable but low-efficiency scores, with average scores of 0.32 and 0.25, respectively.

In addition to the DEA method, this study also employs Tobit regression analysis to assess the determinants of efficiency. The dependent

variable in the regression is the efficiency level of government health expenditure, while the independent variables include GDP per capita growth (GDP), urbanization level (Urbanization), the percentage of government health expenditure in current health expenditure (GovPHealth), and carbon emissions (CO2). The Tobit regression results are presented in Table 4

**Table 4.** Tobit Regression Results

| Variable | Coef. | Std. Err. | z | P\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| GDPgr | 0.0068748 | 0.0052049 | 1.32 | 0.187 | -0.0033266 | 0.0170762 |
| Urban | 0.0266267 | 0.0046871 | 5.68 | 0.000 | 0.0174403 | 0.0358132 |
| HealthPerGov | 0.0046662 | 0.0023084 | 2.02 | 0.043 | 0.0001418 | 0.0091906 |
| LnCO2 | -0.1059369 | 0.0172324 | -6.15 | 0.000 | -0.1397117 | -0.0721621 |
| Cons | 0.3625667 | 0.1654815 | 2.19 | 0.028 | 0.0382289 | 0.6869045 |

Source: Data Processed, 2024

Table 4 presents the estimation results using Tobit regression. The analysis indicates that economic growth positively affects the efficiency of government health expenditure. Higher economic growth contributes to a more effective allocation of government health funds, thereby enhancing expenditure efficiency across countries. This finding aligns with Wagner's Law (1883), which posits that government expenditure tends to rise with economic growth, leading to increased efficiency in public spending. Similar results have been reported in previous studies (Han Huawei, 2010; Guo et al., 2021; Lionel, 2015; M. Wang & Tao, 2019).

Furthermore, the urbanization rate and the share of government expenditure in total health expenditure also show significant positive effects on efficiency. This outcome is consistent with findings from earlier research (Dhaoui, 2019; El Husseiny, 2023; Gong et al., 2019; M. Wang & Tao, 2019; Zhongfang, 2013). Theoretically, regions with higher levels of urbanization tend to benefit from economies of scale in healthcare provision, as urban areas often operate with greater efficiency, thereby improving the effectiveness of government spending (Zhongfang, 2023; Guo et al., 2021).

The proportion of government health expenditure similarly plays a critical role in determining efficiency, reflecting the government's commitment to the health sector. Increased allocation of public resources enables improvements in service quality, broader healthcare access, and stronger preventive health initiatives, ultimately enhancing expenditure efficiency (M. Wang & Tao, 2019).

Conversely, carbon emissions have a significant negative impact on efficiency. Environmental degradation and unhealthy living conditions compel governments to divert more resources toward mitigating health issues caused by pollution. Previous studies by Jakovljevic et al. (2020), Lionel (2015), and Yadav et al. (2023) also emphasized the long-term relationship between carbon emissions and the efficiency of health expenditure. Elevated carbon emissions adversely affect public health through respiratory and cardiovascular diseases, neurological disorders, eye irritation, and chronic conditions such as cancer. This underscores the need to integrate environmental and healthcare policies to reduce the health burden of pollution and enhance the overall efficiency of public health spending.

Overall, the findings highlight a strong interconnection between economic, social, and environmental factors in determining the efficiency of government health expenditure. While economic growth and urbanization facilitate more efficient resource allocation, environmental challenges—especially carbon emissions—remain significant obstacles to achieving sustainable and efficient public health financing.

## CONCLUSION

This study primarily examines the efficiency scores of government health expenditure in six ASEAN countries from 2006 to 2020. The results indicate that most countries did not achieve maximum efficiency throughout the observed period. The average efficiency score across all countries and years is 0.39, reflecting a relatively low level of efficiency and underscoring the need for improved budget management and reforms in health policy implementation. Tobit regression analysis further reveals that a country's economic growth does not significantly influence efficiency scores. In contrast, the urbanization rate, carbon emissions, and the percentage of government health expenditure relative to current health expenditure exhibit significant impacts on efficiency. Overall, the findings emphasize the importance of reforming health expenditure management, prioritizing health sector investments, and addressing environmental challenges to improve the efficiency of government health spending in the six ASEAN countries with relatively low-efficiency scores.

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