International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2025, 15(6), 788-794.

The Social Cost of Growth and Energy Use in Newly Industrialized Countries: The Role of CO_2 Emissions and Renewable Transitions

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Received: 26 May 2025 **Accepted:** 28 September 2025 **DOI:** https://doi.org/10.32479/ijeep.21002

ABSTRACT

This study aims to analyze the factors influencing government spending in the health sector in ten newly industrialized countries. Focusing on economic, social, energy, and environmental aspects, this study aims to determine how variables such as economic growth, urbanization, fossil and renewable energy consumption, and carbon dioxide (CO_2) emissions contribute to the social costs of health. The methodology used is panel data analysis with multiple regression, using secondary data obtained from international institutions such as the World Bank and the IEA, processed using Stata 17 software. The results show that economic growth and urbanization significantly increase government spending in the health sector, while fossil and renewable energy consumption negatively affect the social costs of health. In addition, CO_2 emissions and coal consumption do not show a significant effect, emphasizing the importance of sustainable energy management. Based on these findings, recommended policies include increasing investment in renewable energy and environmentally friendly technologies, managing sustainable urbanization, and establishing energy policies that support efficiency and emission reduction. This step is expected to reduce social costs in the health sector while maintaining environmental sustainability, supporting the achievement of the Sustainable Development Goals (SDGs) and improving the quality of life of people in developing countries.

Keywords: Social Cost, Economic Growth, CO_2 Emissions, Fossil Energy, Renewable Energy
JEL Classifications: O11, O44, Q56

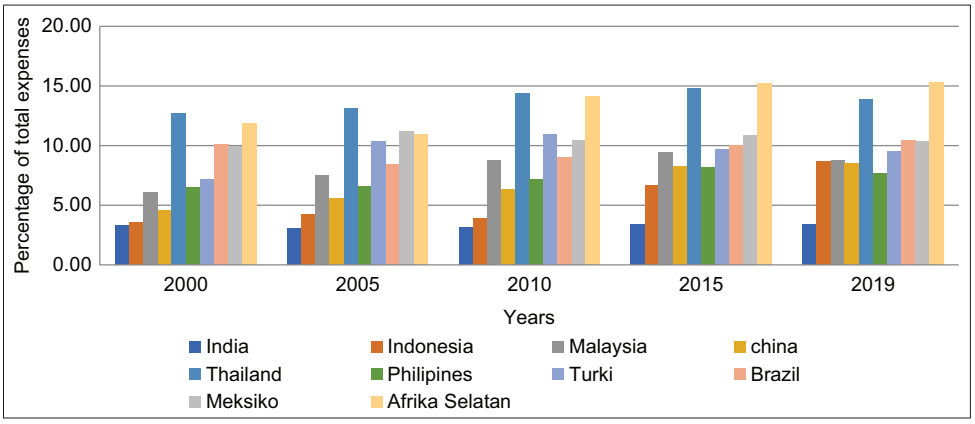
1. INTRODUCTION

The Sustainable Development Goals (SDGs) have become a development commitment for all countries, with an end date of 2030. Health is one of the goals specified in the third aim of the SDGs. A country's development relies heavily on its health. A healthy society will boost production and contribute to an increase in national wealth. As long as people in a country stay healthy, they will contribute more to productivity and economic prosperity. People who are frequently unwell, on the other hand, will have lower production levels. Consequently, it will have a detrimental influence on economic development (Yilmaz Gunduz, 2018).

Every country's health production function relies heavily on government health spending (social costs) (Au Yong et al., 2021). Since health is a vital component of human capital, governmental policy and investment on health care have grown in importance. An empirical account of government expenditure on health in newly industrialized countries, which is on the rise annually, is provided below.

Government spending on the health sector in newly industrialized countries overall increased till 2019 based on the empirical data shown in Figure 1. The empirical evidence raises the question of whether industrialization-related environmental variables or

Figure 1: Government expenditure on health sector in newly industrialized countries



Source: World Bank, 2023

income-related factors were responsible for the increase. Different countries have different levels of government expenditure on health, which is impacted by a variety of contextual factors such as economic situations and environmental challenges. The percentage of a country's total public expenditure that goes toward funding its health facilities is known as government spending on health (Haseeb et al., 2019).

The economy of a country will expand along with its rate of urbanization and industrialization, and if these trends continue, health spending (or social costs) will rise as well. Numerous research, however country-specific, have examined the connection between globalization, industrialization, urbanization, and health spending in OECD countries (Sagarik, 2016). 10 newly industrialized countries—Brazil, China, Mexico, India, Malaysia, the Philippines, Turkey, South Africa, Thailand, and Indonesia—have seen more rapid rates of industrialization than other developing countries, positioning them as the global hubs for manufacturing (Adebayo et al., 2022; Zhang et al., 2017). The economic development of newly industrialized countries has become a concern for researchers.

However, industrialization also accelerates urbanization and the use of fossil fuels, which degrades the environment. This is true despite the benefits of industrialization, which have fueled a nation's economic development and productivity. The repercussions of rising CO_2 emissions have a detrimental effect on human health and lead to higher government spending on the health sector (social costs) (Akbar et al., 2020).

In newly industrialized countries, societal expenses are trending upward, and it is vital to discuss these concerns. In an effort to be beneficial to researchers and the government in their role as public policy makers, this study attempts to examine how economic, social, and environmental activities affect societal costs in newly industrialized countries.

2. LITERATURE REVIEW

According to Wagner, when there is economic progress, the rise in government economic activity is consistent with private economic activity (Kesavarajah, 2012). Wagner offers three arguments in favor of the law boosting state action. First, modernization and industrialization will cause a growth in social functions as the country gets bigger. Second, density of people might also result in increased public expenses. Third, as the country develops, it is unavoidable that greater public spending will be required (Lamartina and Zaghini, 2011). The fundamental tenet of Wagner's law is that public expenditure as a percentage of GDP will rise as a result of the growing demand for public facilities brought on by urbanization, industrialization, and population density (Sagarik, 2016).

According to Peacock and Wiseman (1967), economic booms and recessions cause public spending to increase. They claimed that the income component generated under normal conditions determines the growth in government spending. National income rises as a result of economic development, and over time, rising government revenue causes spending to rise as well. Nonetheless, amid social unrest, there will be a pressing demand for increased government expenditure. It is unreasonable to anticipate that government expenditure would perpetually rise to cater to specific demands, such as those arising from social disruption or natural calamities (Edame and Eturoma, 2014). To finance increased government expenditure during periods of social disruption, they added, the government would raise tax rates and broaden the tax code. The public's tolerance for higher tax rates is growing (Ahmed and Eldemerdash, 2019). According to Peacock and Wiseman's theory, there are three effects or disruptions that lead to an increase in government expenditure. The first is the displacement effect, which describes how tax increases lead to a shift in expenditure from private to public sectors. Secondly, the inspection effect is a result of government intervention that is only observed during social unrest. Finally, a social disruption that causes the focus of private sector activity on government operations is known as the concentration effect.

Tresch (2002) claims that the humanist principles of the capitalist economy and the understanding of producer and consumer sovereignty shaped the development of public sector economics theory. In this economic system, achieving high levels of justice while fostering economic growth is the aim of government policy. High efficiency serves as a stand-in for growth in the economy, whereas justice has two components: justice as a process and

justice as a result (equity at the end). How the financial objectives are met reveals the nature of justice as a process. Justice is therefore an equal opportunity. In contrast, justice in the context of results is perceived from two perspectives: horizontal justice, or horizontal equity, and vertical justice, or vertical equity. Equal treatment of those who same economic circumstances, such as the same productivity, is referred to as horizontal justice. On the other hand, vertical justice is understood to mean treating individuals with varying economic characteristics differently.

The ARDL method was used by Zaidi and Saidi (2018) to investigate the short- and long-term effects of economic growth on health spending in Sub-Saharan African countries. They discovered that health spending is significantly positively impacted by GDP. Unfortunately, the scope of this study was restricted to Sub-Saharan African countries, therefore it cannot be generalized to other country groupings. In a similar vein, Chaabouni and Saidi (2017) analysis of the connection between health spending and economic growth backed up this claim. Although they did not take into consideration the factors of health spending, such as energy consumption and the environment, which were taken into account in this study, their findings indicated that economic development is a significant predictor of health expenditure of the sample countries.

It is crucial to comprehend how foreign direct investment (FDI) affects the standard of health. While FDI may be beneficial to a nation's economy, there are drawbacks as well. At the same time, while FDI is a key factor in globalization, economic growth, and modernization, recently industrialized nations are trying to draw in this kind of investment. FDI has a particular impact on technological development, productivity, growth, and new knowledge or skills. Foreign direct investment (FDI) has become a major factor in capital formation and knowledge transfer in developing countries. For host countries, foreign direct investment (FDI) is seen as a means of gaining access to cutting-edge technologies that would otherwise be costly and unattainable (Al-Kasasbeh et al., 2022; Sultana and Turkina, 2020; Totladze and Khuskivadze, 2021). However, the question of its effectiveness on health is debatable, and there is no understanding of the role of FDI in government spending on health that can help the economy, improve its ability to cope with major health crises such as Covid-19 and help it recover. Verma's study (2021) found that increased FDI inflows have increased government spending on the health sector in ASEAN countries.

Urbanization has been fueled by industrialization, which has also increased government spending on healthcare. According to a study by Kouassi et al. (2018), government investment on the health sector is positively impacted over time by rising urbanization rates. Mümin and Bakırtaş (2019) research findings demonstrate a favorable correlation between the impact of urbanization and government investment in the health sector. Additionally, Chen et al. (2019) reported that low environmental quality brought on by CO_2 emissions has resulted in major health issues and placed a significant financial strain on health systems across a number of countries. Ahmad et al. (2021) and Govdeli (2019), have also investigated the impact of CO_2 emissions on government expenditure on health, and their findings indicate a strong positive correlation between the two. It is reasonable to assume that rising CO_2 emissions are the reason behind the rise in government spending on the health sector.

A rise in energy consumption, particularly in the usage of fossil fuels, can lead to a number of health issues as well as environmental harm from overuse of energy. The use of natural resources, such as coal, gas, energy, and fossil fuels, disturbs environmental processes and results in a number of environmental and health issues (Haseeb et al., 2019). It was shown that higher energy consumption correlates with higher health expenditures in a country due to an increase in health problems and concerns over environmental pollution. Lean and Smyth (2010) offer supporting arguments about how energy consumption affects CO_2 emissions, which in turn lead to a number of health issues. From an ASEAN viewpoint, Saboori and Sulaiman (2013) research offers valuable insights into the connection between CO_2 emissions and energy consumption. This research focuses at energy consumption as a significant indicator of pollution in the environment, but it fails to examine at how energy use might directly lead to higher government spending on healthcare. Furthermore, the impact of new renewable energy consumption which is regarded as low-carbon energy on government expenditure in the health sector is covered in this article.

3. METHODS

To test the factors that influence government spending on the health sector (social costs), economic, social, energy, and environmental variables are used. The operational definition of each variable is presented in Table 1.

The independent variables of economic factors consist of; GDP, and FDI, and the social factor is UP. Where the gross domestic product (GDP) variable is used by Chaabouni and Saidi (2017); Zaidi and Saidi (2018), foreign direct investment (FDI) is used by Verma (2021), and urbanization or urban population (UP) is used by Mümin and Bakırtaş (2019); Shao et al. (2022).

Energy consumption, including the use of fossil energy: electricity consumption (EC), coal energy consumption (ECCL), oil energy consumption (ECOL). Renewable energy consumption (CRE) is the total use of renewable energy, used by researchers: Chen et al., 2019; Dritsaki and Dritsaki, 2023; Xing et al., 2019; Shahzad et al., 2020. Environmental factors use the CO_2 emission variable. The dependent variable is government spending in the health sector.

3.1. Data Analysis Techniques

This is a descriptive study using a quantitative methodology. Research that focuses on data analysis utilizing statistical methods using Stata 17 software. The analytical tool makes use of panel data regression, which combines time series and cross-section data. The benefits of employing panel data include the ability to give information and diverse outcomes, as well as regulate individual variety, because the samples utilized are relatively vast and have

distinct criteria. The research data for 2000-2019 in ten newly industrialized countries, namely: Brazil, China, Mexico, India, Malaysia, the Philippines, Turkey, South Africa, Thailand, and Indonesia.

The use of panel data regression to see the influence of independent variables, namely GDP, FDI, UP, CO_2, EC, ECCL, ECOL, and CRE on the dependent variable, namely government expenditure in the health sector (PHE) with the following regression equation model:

$$PHE = f(GDP + FDI + UP + CO_2 + EC + ECCL + ECOL + CRE) \quad (1)$$

$$PHE_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 FDI_{it} + \beta_3 UP_{it} + \beta_4 CO2_{it} + \beta_5 EC_{it} + \beta_6 ECCL_{it} + \beta_7 ECOL_{it} + \beta_8 CRE_{it} + e_{it} \quad (2)$$

$$PHE_{it} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 FDI_{it} + \beta_3 UP_{it} + \beta_4 lnCO2_{it} + \beta_5 lnEC_{it} + \beta_6 lnECCL_{it} + \beta_7 lnECOL_{it} + \beta 8 CRE_{it} + e_{it} \quad (3)$$

Panel data management uses three technical approaches: the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Using the Chow and Hausman tests, researchers tested the model selection on three different models. Furthermore, classical assumption testing is performed to determine whether a regression model may be employed or not in an observation. A model can be employed if it is the Best Linear Unbiased Estimator (BLUE) and fulfills the classical assumptions that prevent multicollinearity and heteroscedasticity.

4. RESULTS AND DISCUSSION

Based on the findings of the model test (Table 2), the results of the model selection test, which included the Chow test, Hausman test, and Lagrange Multiplier model test, concluded that the best model is the Random Effect Model (REM) with generalized least squares (GLS) estimate. As a result, it is unnecessary to verify the classical assumption to guarantee that the model is BLUE (Best Linier Unbiased Estimator). According to Gujarati and Porter (2012), GLS estimation is a BLUE estimate that does not need classical assumption testing.

Furthermore, the inter-variable estimate findings (Table 3) demonstrate that the following five factors have significant effects on government expenditure on health (social costs): GDP, UP, EC, ECOL, and CRE. Meanwhile, the factors FDI, CO_2, and ECCL have no significant effect on government health spending (PHE).

The test result F from Table 3, indicating the value of F a significance rate smaller than 0.05. This indicates that the variable is independent in models jointly affects the dependent variable (government expenditure of health sector). The T-Statistic test from Table 3 shows how much influence individual variables individually or partially in describing the dependent variables. Based on the results of the estimate the equation of study results regression is as follows:

Table 1: Definition of socio-economic variables

Variable	Definition	Unit
PHE	Government health sector expenditure	US$
GDP	Gross Domestic Product	US$ Constant 2015
FDI	Foreign direct investment	Percentage
UP	City population	Percentage
CO_2	Total CO_2 emissions	Metric Ton (Mt)
EC	Total electricity consumption	Terra Watt Hour (TWh)
ECCL	Coal energy consumption	Terrajoule (Tj)
ECOL	Oil energy consumption	Terrajoule (Tj)
CRE	Renewable energy consumption	Percentage

Variables are sourced from the International Energy Agency and the World Bank

Table 2: Model selection test results

Test	F probability test	Chi-square probability test
Chow	0.0000	
Hausman		0.6274
Lagrange multiplier		0.0000

Source: Data processed with Stata17

Table 3: Panel data regression estimation results

Variable	Model 1 (REM)	Model 2 (CEM)	Model 3 (FEM)
LnGDP	3.905467	−4.135474	4.437333
	(0.001***)	(0.000***)	(0.000***)
FDI	0.0210402	−0.2295705	0.0283785
	(0.734)	(0.098*)	(0.652)
UP	0.2093599	0.092829	0.2292118
	(0.000***)	(0.000***)	(0.000***)
$LnCO_2$	1.412504	−8.718446	1.453807
	(0.310)	(0.000***)	(0.316)
LnEC	−4.187658	4.719386	−4.753502
	(0.000***)	(0.000***)	(0.000***)
LnECCL	0.3400515	2.419937	0.3093937
	(0.219)	(0.000***)	(0.270)
ECOL	−2.548846	5.194598	−2.983745
	(0.022**)	(0.000***)	(0.012**)
CRE	−0.0592883	−0.1483258	−0.0673783
	(0.008***)	(0.000***)	(0.005***)
C	−61.26257	39.28801	−67.12649
	(0.014)	(0.001)	(0.010**)
R Square	0.5443	0.6292	0.5456
Prob F	0.0000	0.0000	0.0000

*Significant at 10%; **Significant at 5%; ***Significant at 1%

Source: Data processed with Stata17

$$PHE = -61.26257 + 3.905467LnGDP + 0.0210402FDI + 0.2093599UP + 1.412504LnCO_2 - 4.187658LnEC + 0.3400515LnECCL - 2.548846ECOL - 0.0592883CRE$$
$$(0.001***) \quad (0.734) \quad (0.000***) \quad (0.310) \quad (0.000***) \quad (0.219) \quad (0.022**) \quad (0.008***) \quad (4)$$

Economic growth proxied by Gross Domestic Product (GDP) has a positive and significant effect on government spending on the health sector (social costs) in newly industrialized countries. This study implies that rising economic growth in newly industrialized

countries will result in increased government spending on health sector (social costs). In theory put forward by Wagner, public spending is an endogenous factor driven by national income growth factors. This result is in line with the findings of Zaidi and Saidi (2018) which show that economic growth (GDP) in Sub-Saharan African countries has a significant positive impact on health spending. Additionally, Dritsaki and Dritsaki (2023)'s findings demonstrate that GDP per capita, a proxy for economic growth, significantly positively affects health spending across all G7 nations. It may thus be explained by the empirical finding that rising living standards and longer life expectancies in the community accompany the rise of GDP in newly industrialized countries, which lowers the chance of mortality.

Urbanization proxied by the number of urban residents has a positive and significant effect on government spending in the health sector in newly industrialized countries. This demonstrates that increasing levels of urbanization in newly industrialized countries increase government spending on the health sector (social costs). Wagner's thesis demonstrates how government spending rises with economic growth, urbanization, and industrialization. From the perspective of developing countries, these results are consistent with those of Mümin and Bakırtaş (2019) and Sasana et al. (2019), who found a positive correlation between the effect of urbanization and government expenditure on health (social costs). Moreover, research by Shao et al. (2022) indicates that health care spending in China's Eastern and Central areas is positively and significantly impacted by urbanization. The population flow from rural to urban areas is mostly concentrated in the Eastern and Central regions, where faster industrial development has created more job opportunities and made these areas more appealing to rural residents looking to migrate to cities. This has also encouraged higher spending on health care.

Electricity consumption with a proxy of total electricity consumption has a significant negative effect on government spending in the health sector in newly industrialized countries. Increasing electricity consumption reduces government spending in the health sector (social costs). This outcome can be explained by the fact that basic utilities like lighting, clean water supply, cooling, ventilation, space heating, and communication need electricity to function, as do essential medical devices like vaccine refrigerators, surgical emergency equipment, laboratories, and diagnostics (World Health Organization, 2023). As a result, rising electricity consumption demonstrates that improving access to electricity can lower government spending on health sector (social costs). This is supported by Pan et al. (2021)'s findings, which show that increased electrification leads to an increase in life expectancy. Overall, it demonstrates that access to electricity has a statistically and economically significant effect on public health.

Oil energy consumption has a negative and significant effect on government health sector spending in newly industrialized countries, implying that increasing oil energy consumption does not affect public health and can thus lower government health sector expenditure (social costs). This finding can be explained by the fact that proper energy consumption and energy efficiency lead to a higher quality of life, despite the fact that pollution, adverse weather, and excessive energy consumption in some countries have a short-term impact on public health. It is evident that oil energy consumption promotes the country's overall growth. This statement is supported by the findings of Xing et al. (2019) where a greater priority for the government to strengthen the control of pollutant emissions by increasing the efficiency of energy consumption for clean production, rather than by reducing the scale of its use in low- and middle-income countries. However, it should be highlighted that this article does not advocate for the government to continue encouraging fossil energy consumption, but rather that the benefits of such consumption now exceed the negative consequences on public health.

Renewable energy consumption has a significant negative influence on government health-care spending (social costs) in newly industrialized countries. This condition demonstrates that rising renewable energy consumption decreases government health-care expenditures. This may be explained by the fact that renewable energy is low-carbon energy, therefore its usage has no negative influence on environmental quality or public health. This is consistent with Raihan et al. (2022)'s findings, which show that increasing the usage of renewable energy in Bangladesh's total energy mix can help the country lower health care expenses. Furthermore, Shahzad et al. (2020), Ullah et al. (2020) found that renewable energy consumption had a negative influence on government health sector spending.

The further result is that foreign direct investment (FDI) has no major impact on government spending in the health sector. This finding contradicts Verma's (2021) research, which indicated that rising FDI inflows increased government investment in the health sector in the ASEAN countries. This finding might be the most recent knowledge, as there is limited research on the link between FDI and government spending in the health sector. The study's next result is that CO_2 emissions and coal energy consumption (ECCL) have no significant effect on government health-care spending (social costs). This finding is consistent with that of Au Yong et al. (2021) who found that CO_2 emissions and energy consumption has no significant influence on government spending in the health sector in ASEAN countries. However, coal energy usage has an indirect effect on health spending due to environmental harm (Akbar et al., 2020).

5. CONCLUSION

This study offers numerous key discoveries, which are as follows: First, economic growth has a significant impact on growing government expenditure on the health sector (social costs) in newly industrialized countries between 2000 and 2019. Economic growth may be attained by increasing government expenditure on the health sector, which would help to enhance public health and create sustainable development. Second, Urbanization in newly industrialized countries has contributed to increased government spending on health care (social costs). The rate of urbanization makes urban areas increasingly dense, slum-like, and harmful

for public health conditions, generating demand for health financing. Third, Electricity consumption promotes greater access to electricity, including the operation of medical devices, which are critically required to enhance public health. Increasing energy usage improves access to electricity and can reduce government spending on health (social costs).

The next finding, proper energy consumption and efficiency contribute to improving the quality of life, despite pollution. It is undeniable that oil energy consumption plays a positive role in the overall development of the country. The positive effects of fossil consumption at the current stage are greater than the negative effects on public health. So that the consumption of fossil energy, namely oil energy, can save government spending on the health sector.

The consumption of renewable energy has been shown to lower the burden of government expenditure on healthcare (social costs). Renewable energy is low-carbon energy, therefore utilizing it has no negative influence on environmental quality or public health. Governments in newly industrialized countries can continue to enhance their usage of renewable energy to ensure that the development process does not cause public health issues.

This research was supported by the Education Fund Management Institute, Ministry of Finance of the Republic of Indonesia. The authors gratefully acknowledge the support provided.

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