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THE ROLE OF GOVERNMENT HEALTH EXPENDITURE IN TRANSLATING ECONOMIC GROWTH INTO HUMAN DEVELOPMENT: DYNAMIC PANEL ANALYSIS

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Abstract

This study addresses the empirical gap in understanding the impact of government health expenditure on the Human Development Index (HDI), particularly across countries with different income levels. Despite the general assumption that economic growth contributes to human development, evidence remains inconclusive regarding the role of government health expenditure in enhancing HDI. To investigate this, the study employs a System Generalized Method of Moments (System GMM) dynamic panel analysis using data from 151 countries over the period 2005–2019, controlling for economic growth, infant mortality rate, government effectiveness, income level, and GDP per capita. This methodology is chosen for its robustness in addressing endogeneity and capturing dynamic relationship in panel data. The results reveal that a one percent increase in government health expenditure as a share of GDP leads to an average increase of 1.07 points in HDI, with the impact significantly stronger in middle-income countries than in high-income countries. These findings highlight the diminishing marginal returns of government health expenditure with rising country's income level and underscore the importance of allocating sufficient government health expenditure in middle-income countries.

Keyword*: government health expenditure, economic growth, income-level heterogeneity, HDI, panel data analysis, system GMM.*

I. INTRODUCTION

Economic growth is often positively associated with long-term improvements in the Human Development Index (HDI) (UNDP, 1996). However, sustained economic expansion alone does not necessarily translate into higher levels of human development. As noted by the United Nations Development Programme (1990), it is essential for governments to effectively convert economic gains into tangible improvements in HDI components. Mukherjee and Chakraborty (2010) state that economic growth increases government tax revenues, enabling greater social expenditure on human development sectors, thereby promoting HDI. A well-structured government social expenditure (e.g., education, health, and social assistance) can sustain HDI in the long run, even when economic growth is unfavorable and income distribution is unequal (Haq, 1995). Recent studies also

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increasingly question the assumption that economic growth directly enhances HDI. Raghuvanshi and Verma (2024) argue that HDI, as a multidimensional measure, is not automatically improved by GDP growth alone. In some contexts, economic growth shows no significant impact on HDI due to structural inequalities and weak redistribution. This highlights the need for targeted government expenditure to advance HDI beyond conventional economic indicators.

According to annual data from the United Nations Development Programme (UNDP), the HDI of middle-income countries consistently lags behind that of high-income countries. Between 2005 and 2019, the average HDI for middle-income countries stood at 66.73, compared to 86.84 for high-income countries. Nevertheless, the HDI gap between these two groups narrowed modestly over the period, from 21.62 points in 2005 to 19.19 points in 2019. Interestingly, despite their lower HDI levels, middle-income countries exhibited higher average economic growth rates—4.05% compared to 2.58% in high-income countries. This divergence supports the argument presented in the UNDP Human Development Report (1990), which emphasized that economic growth alone does not automatically lead to improvements in human development outcomes. The role of government is therefore crucial in translating economic gains into tangible progress in health, education, and living standards. One contributing factor to the persistent HDI disparity may be the significantly lower government health expenditure in middle-income countries. From 2005 to 2019, these countries allocated an average of only 2.77% of their GDP to health, in contrast to 5.08% in high-income countries, highlighting a potential gap in government health expenditure critical to human development.

Although government health expenditure is widely recognized as a key driver of HDI, empirical evidence on its effectiveness remains inconclusive. Numerous studies have found a statistically positive and significant relationship between government health expenditure and HDI, suggesting that increased government health expenditure can enhance healthcare infrastructure, expand access to essential services, and improve population health, the factors that collectively contribute to higher HDI (Banik et al., 2022; Boyacioglu & Terzioglu, 2022; Razmi et al., 2012; Apriska et al., 2024; Febrianto & Esther, 2023; Lengkong et al., 2019; Pramesti et al., 2022; Simamora et al., 2024; Wardhana et al., 2021). These studies emphasize that government health expenditure not only improves life expectancy and reduces mortality but also indirectly supports economic productivity and educational attainment, which are integral components of HDI. For instance, Simamora et al. (2024) highlight that larger government health expenditure lead to more equitable healthcare services, particularly in underserved regions, thereby enhancing overall HDI. Similarly, Febrianto & Esther (2023) argue that targeted government health expenditure improves access to quality care and ensures better health outcomes, especially for vulnerable populations.

Conversely, other studies suggest that the relationship between government health expenditure and HDI may be statistically insignificant or even negative. Several studies have found that a substantial portion of government health expenditure is allocated to administrative expenses, such as salaries and operational costs, rather than to direct healthcare services, thereby diminishing the impact of such expenditure (Alif & SBM, 2021; Aulia et al., 2023; Maharda & Aulia, 2020; Muliza et al., 2017; Oktafiyana & Muliati, 2024; Widodo et al., 2020). This counterintuitive finding is often attributed to inefficiency in government health expenditure, including poor prioritization, weak accountability, and a lack of focus on preventive care. For instance, Muliza et al. (2017) emphasize that curative expenditures dominate government health expenditure in many regions, limiting their long-term impact on HDI. Similarly, Maharda & Aulia (2020) highlight that province with low HDI often allocate more government health expenditure but fail to achieve meaningful improvements due to ineffective government health expenditure. Pahlevi (2017) further argues that low governance quality and poor health status in certain regions exacerbate the

problem, as increased government health expenditure does not necessarily translate into better HDI outcome. These findings underscore the complexity and multifaceted nature of the relationship between government health expenditure and HDI, suggesting that the effectiveness of government health expenditure depends not only on its size but also on how well it is managed.

To address the empirical gap in the literature, this study aims to answer the following research questions: What is the effect of government health expenditure on HDI? This question is critical to understanding how fiscal policies, particularly in the health sector, can transform economic growth into tangible improvements in human development outcomes. In addition, this study also explores whether the impact of government health expenditure on HDI differs among groups of countries with different income levels. Specifically, this study seeks to answer the question: Does the effect of government health expenditure on HDI differ between middle-income and high-income countries? This question is important to understand the heterogeneity of policy effectiveness and to identify whether more targeted fiscal strategies are needed based on a country's income level.

The main objective of this research is to empirically examine the relationship between government health expenditure and HDI using a dynamic panel model approach. This study aims not only to identify the direct relationship between government health expenditure and HDI achievement but also to evaluate the extent to which the effectiveness of such expenditure varies among groups of countries based on income levels. In other words, this study aims to determine whether government health expenditure has a greater impact in middle-income countries compared to high-income countries. To comprehensively answer these questions, this study employs the System Generalized Method of Moments (System GMM) method, which is capable of addressing endogeneity issues and capturing dynamic interactions between variables in panel data. The analysis was conducted using data from 151 countries over the period from 2005 to 2019, making the results globally representative and highly relevant for cross-country human development policy discussions.

The distinct contribution of this research lies in its methodological innovation, namely by integrating dynamic panel analysis and interaction variables between national income levels and government expenditure in the health sector. Unlike previous studies that generally used static models or ignored stratification based on income levels, this study enriches the literature by empirically demonstrating that the marginal effect of health expenditure on HDI is much greater in middle-income countries compared to high-income countries. These findings have important policy implications, particularly in designing more effective and equitable health budget allocation strategies to accelerate human development.

The remainder of this paper is structured as follows: **Section 2** provides a comprehensive review of the existing literature. **Section 3** outlines the data sources and methodological framework employed in this study. **Section 4** presents the results of the empirical analysis. Finally, **Section 5** offers conclusions and proposes recommendations.

II. LITERATURE REVIEW

According to the UNDP (1996), there is a strong long-term relationship between economic growth and HDI. Ranis et al. (2000) argue that this relationship is mediated by two primary mechanisms: household and government activities. Economic growth enhances GNI, which subsequently increases expenditure by both households and the government. Mongan (2019) posits that economic growth provides the government with additional resources to augment social expenditure on education and health, encompassing both physical infrastructure and non-physical support such as subsidies and health

insurance. Ultimately, increased consumption in the health and education sectors fosters improvements in HDI.

Economic growth is indeed necessary for HDI, but it is not sufficient for achieving sustainable HDI growth (UNDP, 1990). The government must also translate economic growth into HDI growth through social expenditure. Economic growth and HDI have a bidirectional relationship which, although not automatically correlated, can be strengthened by appropriate government expenditure (Lugastoro, 2013). According to Ranis et al. (2000), the function of government expenditure on HDI can be expressed in three ratios: the government expenditure ratio, defined as the ratio of total expenditure of all levels of government to GDP; the human development allocation ratio, defined as the expenditure on human development sectors to total government expenditure; and the human development priority ratio, defined as the ratio of certain human development priorities to the total allocation of expenditure on human development sectors.

The UNDP (1990) identifies three typologies of HDI across countries. The first typology is sustainable HDI, referring to countries that can sustain HDI both sharply and gradually, such as South Korea, Malaysia, and Sri Lanka. The second typology is disrupted HDI, which describes countries experiencing a slowdown or reversal in human development, such as Jamaica, Kenya, and Zimbabwe. The third typology is missed HDI opportunity, which pertains to countries that fail to translate robust economic growth into human development, such as Brazil, Nigeria, and Pakistan. Several conclusions can be drawn from these HDI typologies. According to the UNDP (1990), a well-structured government social expenditure can sustain HDI in the long run, even when economic growth is unfavorable and income distribution is unequal. Furthermore, an effective structure of government social expenditure can have a dramatic impact on HDI in the short term, as demonstrated by Costa Rica and Chile.

Empirical research on the relationship between government health expenditure and HDI has expanded considerably over the past few decades. A substantial body of literature supports a positive and statistically significant association, suggesting that increased investment in the health sector generally contributes to improved human development outcomes. However, findings across studies are not entirely consistent. Some research reports weak or even negative relationships, indicating that the effectiveness of health expenditure may vary depending on contextual factors such as the efficiency of resource allocation, the quality of governance, and the state of existing health infrastructure. Economic growth adds complexity to the relationship between government health expenditure and HDI. Although it can expand fiscal space for health investment, growth alone does not guarantee improved human development. The following sections explore these dynamics in greater depth.

Economic growth is recognized as a critical factor influencing HDI. Numerous empirical studies, including those by Amalia et al. (2022), Kuswanto (2021), Lugastoro (2013), Nuryani & Irawan (2022), Ranis et al. (2000), Sijabat (2022), and Wahyuningrum & Soesilowati (2021), have identified a significant and positive relationship between economic growth and HDI. Kuswanto (2021) finds that economic growth has a positive and significant impact on HDI in both the short and long term. The mechanism underlying this relationship is that economic growth enhances individuals' ability to meet their health and education needs, thereby increasing HDI. Additionally, Lugastoro (2013) asserts that economic growth provides the necessary resources for human development, enabling the achievement of higher growth potential.

Ranis et al. (2000) identify a reciprocal relationship between economic growth and HDI. They assert that robust economic growth enhances HDI, which in turn fosters further economic growth. The study emphasizes the crucial role of government in achieving sustainable economic growth and improving HDI. It advocates for the strategic allocation of economic growth resources towards human development sectors. While economic growth

is vital for HDI, it must be accompanied by efforts to enhance human development to ensure sustainability. Similarly, Lugastaro (2013) corroborates the existence of this reciprocal relationship, noting that a strong interconnection between economic growth and HDI mutually reinforces both. The study further elaborates that this relationship can be strengthened through proactive government intervention.

One of the key government interventions in the human development sector is through health expenditure. Several mechanisms illustrate how government health expenditure positively impacts HDI. Razmi et al. (2012) discovered, using the Granger causality test, that government health expenditure affects HDI via fostering the development of human capital, which is a crucial element of economic expansion. The study, which was carried out in Iran between 1990 and 2009, demonstrated that more government health expenditure leads to higher labor supply and productivity, two elements that are essential for economic expansion. Furthermore, such expenditure raises life expectancy, lowers mortality rates, and broadens educational opportunities—all of which have a direct effect on HDI improvement. According to a study by Boyacioglu and Terzioğlu (2022), government health expenditure also increases worker productivity, which propels GDP growth. According to their findings, government health expenditure indirectly affects HDI via raising GDP. Darwin (2022) also came to the conclusion that government health expenditure affects HDI directly and indirectly through economic growth.

Several studies, including those by Banik et al. (2022), Miharsani (2016), Nainggolan (2024), and Prasetyo et al. (2013), examine how the effectiveness and efficiency of government health expenditure influence its impact on HDI. Miharsani (2016) suggests that the size of government health expenditure should be accompanied by high level of effectiveness and efficiency to optimize its impact on HDI. Banik et al. (2022) also find that while the size of government health expenditure positively impacts HDI, this effect is contingent on the quality of governance. Their study identifies governance quality—measured by control of corruption, government effectiveness, voice and accountability, and regulatory quality—as critical to the efficacy of government health expenditure in improving HDI. Prasetyo et al. (2013) highlight several countries, such as Armenia, Australia, Bangladesh, Chile, and Georgia, that efficiently manage government health expenditure to maximize their HDI. Nainggolan (2024) argues that the failure of government health expenditure to achieve its intended outcomes is largely due to poor expenditure quality, which is shaped by factors such as prioritization, allocation, timing, accountability, and effectiveness. He further emphasizes that high-quality health expenditure is essential for reducing poverty and and enhancing HDI.

Numerous studies have examined the relationship between government health expenditure and HDI. Most of these studies have found a positive and significant correlation between health budget allocation and improvements in HDI. Research conducted by Apriska et al. (2024), Febrianto & Esther (2023), Lengkong et al. (2019), Pramesti et al. (2022), Simamora et al. (2024), and Wardhana et al. (2021) supports this conclusion. Wardhana et al. (2021) noted that among various sectors of government expenditures, such as the economy, infrastructure, health, and education, expenditures in the infrastructure and health sectors have the most substantial impact on HDI. This highlights the critical role of government health expenditure in human development. Simamora et al. (2024) also explained that larger government health budgets contribute to better and more equitable healthcare services. This provides the population with greater opportunities to live longer and healthier lives, which directly contributes to higher life expectancy, one of the key indicators of HDI. Furthermore, Febrianto & Esther (2023) emphasized that increased government health expenditure enhances public access to adequate healthcare services, improve the chances of living a healthy life, and ensure more targeted distribution of healthcare services, especially in remote areas.

However, studies such as those by Maharda and Aulia (2020), Muliza et al. (2017), and Widodo et al. (2020) find an insignificant relationship between government health expenditure and HDI. Maharda and Aulia (2020) examine 12 provinces with low HDI categories in Indonesia from 2010 to 2018 using fixed effect model (FEM) analysis. Their study explains that government health expenditure has a positive but insignificant relationship with HDI due to inefficient government health expenditure. The study reveals that the 12 provinces with lower HDI allocate more funds to government health expenditure than those with higher HDI scores. Despite this increased expenditure, these provinces experience higher infant mortality rates and poorer overall health outcomes. Muliza et al. (2017) use a random-effects model (REM) on 23 district panel datasets in Indonesia from 2010 to 2014. Their study explains that government health expenditure has an insignificant positive influence on HDI because most of the expenditure is used for curative rather than preventive functions. Therefore, although government health expenditure continues to increase, it is not accompanied by better health indicators that improve HDI.

The insignificant effect of health expenditure on HDI is also discussed by Muliza et al. (2017), who employed a Random Effects Model (REM) using panel data from 23 districts in Indonesia between 2010 and 2014. Their findings suggest that government health expenditure has a positive but statistically insignificant impact on HDI, primarily because the majority of the budget is allocated to curative rather than preventive healthcare services. As a result, although health budgets continue to increase, they do not necessarily translate into improved health indicators that contribute to HDI enhancement. Similarly, Alif and SBM (2021) argue that the limited impact of health expenditure may be due to the fact that only a portion of the allocated 10% government expenditure is directed toward actual healthcare services, with the remainder used for administrative costs such as salaries and operational expenses. Consequently, the annual increase in health expenditure does not significantly influence HDI outcomes. This pattern is consistent with findings from Aulia et al. (2023) and Oktafiyana & Muliati (2024), who also report that increases in health expenditure do not automatically lead to measurable improvements in human development indicators.

In contrast to the aforementioned studies, some research identifies a negative relationship between government health expenditure and HDI. Sijabat (2022), utilizing a REM on a panel dataset of 34 provinces in Indonesia from 2012 to 2020, argues that this negative relationship arises from government health expenditure being insufficient to support human development. The study further finds that while healthier individuals may have higher life expectancy, this does not necessarily translate to better job opportunities, despite increased productivity. Pahlevi (2017), employing Exploratory Data Analysis (EDA) on panel data from 33 provinces in Indonesia for the years 2008 and 2012, identifies two primary reasons for the negative relationship. First, the low effectiveness and efficiency of government health expenditure fail to address the appropriate issues. Second, the health status of the provinces plays a significant role; provinces with lower health status, which generally have a lower HDI, tend to spend more on health expenditure compared to those with higher health status. Fadila et al. (2024) conducted research at the local level, namely in Aceh Province, Indonesia. The results showed that the health sector had a significant negative impact on HDI in the region. One of the main causes that is thought to contribute to this finding is the decline in health budget allocations after the COVID-19 pandemic. Most of the health funding was focused on direct response to the impact of the pandemic, resulting in reduced average expenditure on health services in general.

III. DATA AND METHODOLOGY

This section elaborates on the data and methodology employed in this study to analyze the impact of government health expenditure on HDI.

A. Data

This study examines 151 countries consisting of 98 lower and upper middle-income countries and 53 high-income countries. The World Bank assigns the world's economies to four income groups - low, lower middle, upper-middle, and high. This income categorization enables a nuanced analysis of the impact of government health expenditure on HDI across various economic contexts. By including a diverse range of countries, the study aims to offer a comprehensive understanding of the differing effects of government health expenditure on HDI. **Table 1** presents the list of sample countries used in this study.

Table 1.
List of Sample Countries

The selection of these countries is meticulously based on the availability and completeness of the necessary variable data required for the research. This ensures that the analysis is robust and comprehensive.

Lower and Upper Middle-Income Countries:		
Albania	Gabon	Nicaragua
Algeria	Georgia	Nigeria
Angola	Ghana	North Macedonia
Argentina	Grenada	Pakistan
Armenia	Guatemala	Palau
Azerbaijan	Guyana	Papua New Guinea
Bangladesh	Haiti	Paraguay
Belarus	Honduras	Peru
Belize	India	Philippines
Benin	Indonesia	Russia
Bolivia	Iran	Saint Lucia
Bosnia and Herzegovina	Iraq	Saint Vincent and the Grenadines
Botswana	Jamaica	Samoa
Brazil	Jordan	Sao Tome and Principe
Bulgaria	Kazakhstan	Senegal
Cambodia	Kenya	Serbia
Cameroon	Kiribati	Solomon Islands
Cape Verde	Kyrgyzstan	South Africa
China	Laos	Sri Lanka
Colombia	Lebanon	Suriname
Comoros	Lesotho	Tajikistan
Congo	Malaysia	Tanzania
Costa Rica	Maldives	Thailand
Cote d'Ivoire	Mauritania	Tonga
Cuba	Mauritius	Tunisia
Dominica	Mexico	Turkey
Dominican Republic	Micronesia	Turkmenistan
Ecuador	Moldova	Tuvalu
Egypt	Mongolia	Ukraine
El Salvador	Morocco	Uzbekistan
Equatorial Guinea	Myanmar	Vanuatu
Eswatini	Namibia	Vietnam
Fiji	Nepal	

High-Income Countries:		
Antigua and Barbuda	Greece	Poland
Australia	Hungary	Portugal
Austria	Iceland	Qatar
Bahamas	Ireland	Saudi Arabia
Bahrain	Israel	Seychelles
Barbados	Italy	Singapore
Belgium	Japan	Slovak Republic
Brunei Darussalam	Korea, Rep.	Slovenia
Canada	Kuwait	Spain
Chile	Latvia	St. Kitts and Nevis
Croatia	Lithuania	Sweden
Cyprus	Luxembourg	Switzerland
Czechia	Malta	Trinidad and Tobago
Denmark	Netherlands	United Arab Emirates
Estonia	New Zealand	United Kingdom
Finland	Norway	United States
France	Oman	Uruguay
Germany	Panama	

The dependent variable in this study is the Human Development Index (HDI), obtained from the UNDP Human Development Report for 151 countries from 2005 to 2019. The explanatory variable is government health expenditure (GHEX), while the control variables include the economic growth rate (Y), infant mortality rate (MORT), government effectiveness (GEE), the country's income level (LVL), and GDP per capita (GDPPC). The selection of the 2005 to 2019 period in this study is based on several methodological and contextual considerations. First, this timeframe spans 15 years, allowing for a dynamic analysis of the relationship between government health expenditure and HDI, and capturing medium-term trends in human development and fiscal policy. Second, this period reflects a relatively stable global economic environment prior to the major disruption caused by the COVID-19 pandemic in 2020. Therefore, the data used represent development dynamics under normal conditions, free from the distortions of a global health crisis. Moreover, the availability of complete and consistent data for key variables such as HDI, government health expenditure, and control variables throughout 2005–2019 is a crucial technical consideration. With broad and high-quality data coverage, dynamic panel estimations like System GMM can be conducted more accurately and reliably. **Table 2** provides a summary of the variables used in the study. All explanatory and control variables are sourced from the World Bank Database.

Table 2.
Summary of Variables

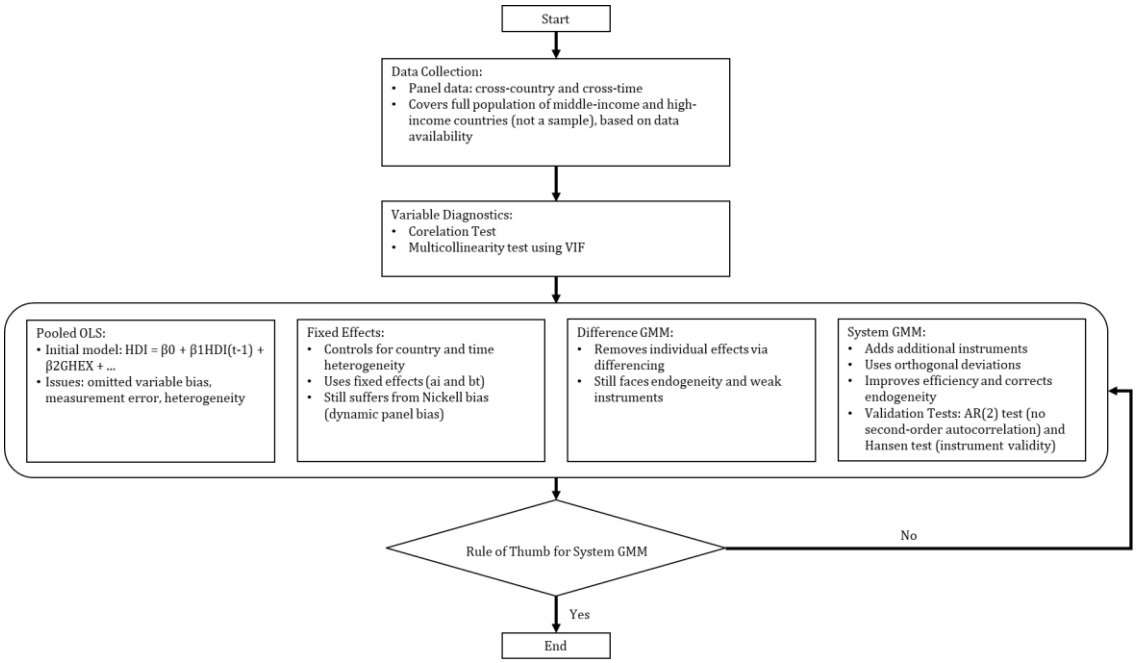
No.	Variable Code	Function	Short Definition	Sources
1.	HDI	Dependent Variable	Human Development Index (0-100)	Human Development Report, UNDP
2.	GHEX	Explanatory	Government health expenditure (% of GDP)	World Development Indicators (WDI), World Bank database
3.	Y	Control	Economic growth rate (annual %)	World Development Indicators (WDI), World Bank database

4.	MORT	Control	Infant mortality rate (per 1,000 live births).	World Development Indicators (WDI), World Bank database
5.	GEE	Control	Government effectiveness (-2.5 to 2.5)	World Development Indicators (WDI), World Bank database
6.	LVL	Control	Country's income level (dummy variable)	World Development Indicators (WDI), World Bank database
7.	GDPPC	Control	GDP per capita (1,000 US$)	World Development Indicators (WDI), World Bank database

B. Methodology

The quantitative approach used in this study allows for objective and methodical measurement of the variables under study. The study produces statistically testable and globally applicable results using panel data from reputable sources such as the World Bank and UNDP. By combining cross-section and time-series dimensions, the quantitative approach with panel data allows for richer analysis and controls for unobserved heterogeneity across economic units (Baltagi, 2021). To select the best regression model, this study used a number of models and conducted a number of tests. Specifically, regression models were built to investigate the relationship between HDI and GHEX. Pooled OLS, fixed effect, difference GMM, and system GMM approaches were used to estimate the model. The methodological flowchart of this study is depicted in **Figure 1** below.

Figure 1.
Methodological Flowchart



The first model used in this study is a basic regression model estimated using the pooled OLS method. This model aims to provide an initial picture of the relationship between the main variables studied, before further testing is carried out with a more complex approach. The form of the first regression model in this study is as follows.

$$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 GHEX_{i,t} + \beta_3 Y_{i,t} + \beta_4 MORT_{i,t} + \beta_5 GEE_{i,t} + \varepsilon_{i,t} \text{.....} \mathbf{(1)}$$

Equation (1) using pooled OLS might involve several biases, including omitted variable bias, measurement error, and heterogeneity (Hauk & Wacziarg, 2009). Omitted variables, such as country characteristics, could cause a correlation between the error term and the regressors, leading to bias. Pooled OLS also faces two types of heterogeneity issues across countries. The first type is observable heterogeneity, which relates to variables that affect HDI and might potentially be associated with GHEX, such as the GDP per capita of each country. The second type is unobservable heterogeneity, which is more troublesome, such as the budgeting procedures of each country (Stock & Watson, 2020). If omitted variable bias, measurement error, and heterogeneity do not exist, pooled OLS will be a consistent estimator (Hauk & Wacziarg, 2009). However, this assumption might be too strong since countries may have different characteristics that could affect the dependent variable, thereby causing bias if omitted.

Fixed effects regression can be used to address heterogeneity problems (Hauk & Wacziarg, 2009). There are two types of fixed effects regression (Stock & Watson, 2020). The first is entity fixed effects regression, which captures country-specific factors that vary across countries but do not change over time, such as cultural views. The second is time fixed effects regression, which captures factors that are constant across entities (countries) but vary over time, such as global economic crises, pandemics, and climate changes. To eliminate the heterogeneity problem, this study estimates the model using both country and time fixed effects. The effects of these omitted variables are absorbed by including dummies for each country and year in the model. The term a*i* captures country fixed effects while the term b*t* captures time fixed effects. The model using fixed effects regression is as follows.

$$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 GHEX_{i,t} + \beta_3 Y_{i,t} + \beta_4 MORT_{i,t} + \beta_5 GEE_{i,t} + a_i + b_t + \varepsilon_{i,t} \text{.....} \mathbf{(2)}$$

Although fixed effects model can eliminate the heterogeneity bias, it still suffers from other sources of bias. This may arise from the incidental parameter problem specific to dynamic panels with fixed effects, also known as the Nickell (1981) bias. When applying OLS, $Y_{i,t-1}$ might be correlated with the fixed effects in the error term, which results in dynamic panel bias. For instance, if a country experiences an unexpected adverse HDI shock, this shock ends up in the error term. Specifically, it overstates the coefficient estimate for lag HDI by attributing predictive power from the fixed effects of the country (Rodman, 2009). To minimize such bias, Caselli et al. (2009) suggest using the generalized method of moments (GMM), as proposed by Arellano and Bond (1991), to address the heterogeneity and endogeneity of the differenced lagged HDI. The initial step in the GMM procedure is to take the first difference to eliminate individual effects. Thus, the model is as follows.

$$\Delta HDI_{i,t} = \beta_1 \Delta HDI_{i,t-1} + \beta_2 \Delta GHEX_{i,t} + \beta_3 \Delta Y_{i,t} + \beta_4 \Delta MORT_{i,t} + \beta_5 \Delta GEE_{i,t} + \Delta\varepsilon_{i,t} \text{.....} \mathbf{(3)}$$

Equation (3) eliminates country and time-specific effects. However, this model cannot resolve the endogeneity problem caused by the lagged dependent variable that remains correlated with the error term (Caselli et al., 2009). Additionally, various GMM methods still face issues related to weak instruments, which can bias GMM estimates in small samples (Hauk & Wacziarg, 2009). To address the problems of weak instruments and endogeneity, Blundell and Bond (1998) propose an alternative estimator that applies further restrictions to improve the properties of the difference GMM estimator through the system GMM estimator. The system GMM corrects for endogeneity by introducing more instruments to significantly improve efficiency and render the instruments uncorrelated (exogenous) with fixed effects (Arellano & Bover, 1995). Furthermore, system GMM uses orthogonal deviation, which, instead of subtracting previous observations from current observations, subtracts the average of all available future observations of a variable. Regardless of the number of gaps, these can be calculated for all observations except the last one for each individual, thus minimizing data loss (Arellano & Bover, 1995).

To analyze the consistency of the estimation and reduce endogeneity problems, omitted variable bias, and reverse causality issues that may arise from dynamic panel models, this study estimates the model using pooled OLS, fixed effects, difference GMM, and system GMM. Bond et al. (2001) explain the rule of thumb for difference and system GMM specifications. First, the dynamic model must be estimated using pooled OLS and fixed effects method. The pooled OLS estimate of β_1 should be considered as the upper bound estimate, while the corresponding fixed effects estimate should be considered as the lower bound estimate. Then, if the difference GMM estimate obtained is below or close to the fixed effects estimate, it indicates that the difference GMM estimate has a downward bias due to weak instruments and the system GMM estimator should be preferred instead.

Two tests are crucial for confirming the consistency of the GMM estimator. The first is the AR(2) test, which checks that the error terms do not exhibit second-order serial correlation. The second is the Hansen test for instrument validity, ensuring that the instruments are uncorrelated with the residuals. According to Roodman (2009), a p-value greater than 0.1 for both tests indicates that the GMM estimator results are consistent, meaning there is no second-order serial correlation and all instruments are valid. This study uses the Stata xtabond2 command, as suggested by Roodman (2009), and includes up to three lags of the endogenous variables based on economic considerations. The regression also includes a year dummy variable, which, according to Roodman (2009), helps to address the problem of correlation between the variables.

IV. RESULTS AND DISCUSSIONS

A. Summary Statistics

The sample period spans from 2005 to 2019, with 2,265 observations from 151 countries. The mean value of HDI over the entire sample is 73.72. Norway has the highest HDI at 96.20, while Senegal has the lowest at 41.90. The mean percentage of government health expenditure to GDP is approximately 3.58%, with the highest being 15.64% and the lowest 0.14%. **Table 3** presents the summary statistics of the variables employed in the analysis.

Table 3.
Summary Statistics
This table provides the summary statistics of the variables used in the analysis.

Variable	Observations	Mean	Std. dev.	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
HDI	2,265	73.72	12.95	41.90	96.20
GHEX	2,265	3.58	2.29	0.14	15.64
Y	2,265	3.54	3.95	-15.14	34.50
MORT	2,265	19.76	18.30	1.80	101.00
GEE	2,265	0.14	0.91	-2.14	2.43
GDPPC	2,265	15.20	19.64	0.22	123.68

This study computes pairwise correlations between independent variables to ensure there is no serious multicollinearity problem. Multicollinearity occurs when two or more independent variables have an exact linear relationship. If the correlation is greater than 0.8, severe multicollinearity may exist. **Table 4** presents the correlation matrix, showing no serious multicollinearity at the 5% significance level.

Table 4.
Correlation Matrix

The correlation of independent variables at the 5% significance level indicates that there is no serious multicollinearity, as there is no significantly high correlation between the variables.

	GHEX	Y	MORT	GEE	LVL	GDPPC
GHEX	1.0000					
Y	-0.2848*	1.0000				
MORT	-0.5406*	0.1997*	1.0000			
GEE	0.5658*	-0.2053*	-0.6699*	1.0000		
LVL	0.4811*	-0.1773*	-0.5615*	0.7842*	1.0000	
GDPPC	0.4940*	-0.1567*	-0.4975*	0.7705*	0.7466*	1.0000

In addition, this study also conducted a multicollinearity test using the Variance Inflation Factor (VIF) approach. According to Torres-Reyna (2007), multicollinearity can be indicated if the VIF value of a variable exceeds 10 or the tolerance value (1/VIF) is less than 0.10. A high VIF value indicates that the variable has a strong correlation with other independent variables in the model, which can affect the stability of the regression coefficient estimate. The VIF test results in this study are presented in **Table 5**. Based on these results, all variables have VIF values below 10 and tolerance values (1/VIF) above 0.10, which indicates the absence of multicollinearity problems in the regression model used.

Table 5.
Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
GEE	4.10	0.244063
LVL	3.02	0.331639
GDPPC	2.88	0.346922
MORT	1.98	0.505331
GHEX	1.67	0.598767
Y	1.09	0.914168
Mean VIF	2.46	

B. Empirical Results

As previously outlined in the methodology section, the System GMM is employed as the primary approach to estimate the relationship between government health expenditure and HDI in this study. The selection of this method is based on the dynamic characteristics of the panel data used, where current HDI levels are significantly influenced by their past values. Conventional estimation techniques such as pooled OLS and fixed effects are prone to bias due to potential correlations between explanatory variables and the error term, as well as cross-country heterogeneity. System GMM, as developed by Blundell and Bond (1998), addresses these issues by combining estimations in both level and first-difference forms, while also utilizing additional valid instruments to enhance the efficiency and consistency of the estimates. Furthermore, this method applies orthogonal deviations to minimize data loss resulting from differencing. Following the guideline proposed by Bond et al. (2001), the System GMM estimates in this study fall between those obtained from pooled OLS and fixed effects models, indicating that this method provides the most consistent and reliable estimates. Therefore, System GMM is selected to ensure that the analysis of the impact of government health expenditure on HDI is conducted in a robust and dependable manner.

This study provides a comprehensive analysis of the system GMM estimation results from three distinct specifications, each aiming to better understand how a country's income level influences the impact of GHEX on HDI:

a. Specification I: regression of the explanatory variable with some control variables (initial model). The following is the initial model used in this study:
$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 GHEX_{i,t} + \beta_3 Y_{i,t} + \beta_4 MORT_{i,t} + \beta_5 GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(4)**
b. Specification II: add to specification (I) each country's income level LVL (0: middle-income, 1: high-income) and its interaction term with the explanatory variable. The model of specification II is as follows:
$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 GHEX_{i,t} + \beta_3 LVL_{i,t} + \beta_4 GHEXLVL_{i,t} + \beta_5 Y_{i,t} + \beta_6 MORT_{i,t} + \beta_7 GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(5)**
c. Specification III: add to specification (I) each country's GDP per capita (GDPPC) and its interaction term with the explanatory variable. The model of specification III is as follows:
$HDI_{i,t} = \beta_0 + \beta_1 HDI_{i,t-1} + \beta_2 GHEX_{i,t} + \beta_3 GDPPC_{i,t} + \beta_4 GHEXGDPPC_{i,t} + \beta_5 Y_{i,t} + \beta_6 MORT_{i,t} + \beta_7 GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(6)**

This study estimates each specification using pooled OLS, fixed effects, difference GMM, and system GMM to help select the appropriate estimation method, based on the discussion in Bond et al. (2001). First, the dynamic model must be estimated using pooled OLS and the fixed effects method. The pooled OLS estimate of the coefficient of lagged HDI ($\beta 1$) should be considered the upper bound estimate, which is 0.89 (regression 1). The corresponding fixed effects estimate should be considered the lower bound estimate, which is 0.53 (regression 2). The difference GMM estimate obtained in regression 3, which is 0.40, is below the fixed effects estimate, indicating that the difference GMM estimate has a downward bias due to weak instruments. According to Roodman (2009), the system GMM provides a good estimate of the true parameters if it falls within the pooled OLS and fixed effects estimates. **Table 6** outlines the Rule of Thumb for Difference and System GMM, explaining why the System GMM estimator for Specification I is preferred.

Table 6.
Rule of Thumb for Difference and System GMM

This table shows the results of Pooled OLS, Fixed Effects, Difference GMM, and System GMM. Because Regression (4) lies between regression (1) and (2), the system GMM estimator for Specification I should be preferred.

	Pooled OLS (1)	Fixed Effects (2)	Difference GMM (3)	System GMM (4)
Variables	HDI	HDI	HDI	HDI
L.HDI	0.891***	0.531	0.400***	0.613***
	(0.0926)	(0.332)	(0.0431)	(0.0706)
GHEX	0.0246	-0.0458	-0.00723	1.067***
	(0.0280)	(0.0470)	(0.243)	(0.311)
Y	0.0488***	0.0353***	0.0278***	0.108**
	(0.00522)	(0.00885)	(0.0104)	(0.0437)
MORT	-0.0417	-0.106	-0.176***	-0.110***
	(0.0376)	(0.0707)	(0.0313)	(0.0353)
GEE	0.629	0.228	0.169	1.451**
	(0.546)	(0.207)	(0.140)	(0.649)
Constant	8.967	32.86		26.56***
	(7.393)	(22.34)		(5.670)
Observations	2,114	2,114	1,963	2,114
R-squared	0.983	0.989		
Number of Country_Dummy			151	151

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Specifications II and III follow the same rule of thumb as Specification I to assess whether the dynamic model provides a good estimation. In Specification II, the upper bound estimate of the lagged HDI ($\beta 1$) from pooled OLS is 0.876, while the lower bound estimate from fixed effects is 0.531. Additionally, the difference GMM estimate is 0.392, which is lower than the fixed effects estimate, consistent with the rule of thumb observed in Specification I. The system GMM estimate of 0.540 is considered a good estimate of the true parameters as it falls between the pooled OLS and fixed effects estimates. Similarly, the application of the rule of thumb in Specification III leads to the same conclusion as in Specifications I and II. The system GMM estimate in Specification III (0.579) is deemed a good estimate because it lies between the lower bound estimate from fixed effects (0.530) and the upper bound estimate from pooled OLS (0.878). Furthermore, the difference GMM estimate of 0.407 is lower than the pooled OLS estimate, consistent with the results from Specifications I and II.

Based on the rule of thumb results presented above, this study employs the system GMM methodology to conduct a thorough analysis of how government health expenditure influences HDI, aiming to uncover the extent and nature of this impact across different income levels of countries. The findings from the three specifications are comprehensively detailed in **Table 7.**

Table 7.
The Results of Dynamic Model Analysis for Specification I, II, and III

	(Specification I)	(Specification II)	(Specification III)
Variables	HDI	HDI	HDI
L.HDI	0.613***	0.540***	0.579***
	(0.0706)	(0.0876)	(0.0958)
GHEX	1.067***	1.355*	1.542**
	(0.311)	(0.754)	(0.744)
Y	0.108**	0.0865	0.0932
	(0.0437)	(0.0565)	(0.0623)
MORT	-0.110***	-0.114**	-0.0996*
	(0.0353)	(0.0473)	(0.0551)
GEE	1.451**	1.335**	1.136*
	(0.649)	(0.524)	(0.619)
LVL		6.311**	
		(2.546)	
GHEXLVL		-0.938	
		(0.694)	
GDPPC			0.192**
			(0.0853)
GHEXGDPPC			-0.0294*
			(0.0158)
Constant	26.56***	31.32***	26.58***
	(5.670)	(6.740)	(7.665)
Observations	2,114	2,114	2,114
Number of Countries	151	151	151

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Based on the series of regression analyses that have been conducted in this study, estimation results are obtained that describe the relationship between the variables studied quantitatively. These regression results are presented to provide a more comprehensive picture of the effect of government health expenditure on HDI, taking into account control variables such as economic growth, infant mortality rate, government effectiveness, and

country income level. The findings provide an important basis for answering the research questions and support the interpretation of the statistical and economic significance of each variable. The full results of the regression estimation of the three specifications are presented as follows.

a. Specification I:
$HDI_{i,t} = \mathbf{26.56} + \mathbf{0.61}HDI_{i,t-1} + \mathbf{1.07}GHEX_{i,t} + \mathbf{0.11}Y_{i,t} - \mathbf{0.11}MORT_{i,t} + \mathbf{1.45}GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(7)**

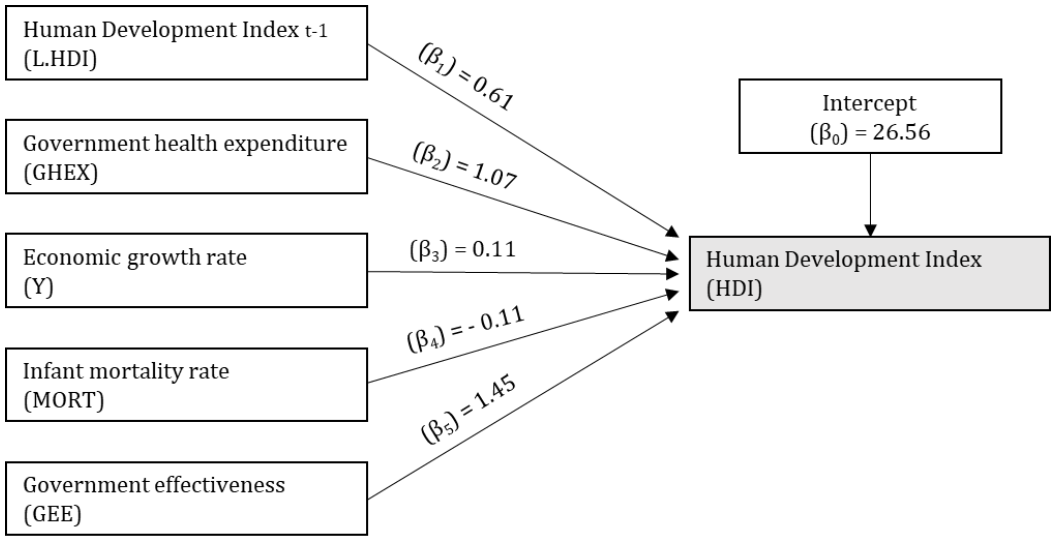
b. Specification II:
$HDI_{i,t} = \mathbf{31.32} + \mathbf{0.54}HDI_{i,t-1} + \mathbf{1.36}GHEX_{i,t} + \mathbf{6.31}LVL_{i,t} - \mathbf{0.94}GHEXLVL_{i,t} + \mathbf{0.09}Y_{i,t} - \mathbf{0.11}MORT_{i,t} + \mathbf{1.34}GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(8)**

c. Specification III:
$HDI_{i,t} = \mathbf{26.58} + \mathbf{0.58}HDI_{i,t-1} + \mathbf{1.54}GHEX_{i,t} + \mathbf{0.19}GDPPC_{i,t} - \mathbf{0.03}GHEXGDPPC_{i,t} + \mathbf{0.09}Y_{i,t} - \mathbf{0.10}MORT_{i,t} + \mathbf{1.14}GEE_{i,t} + a_i + b_t + \varepsilon_{i,t}$.....**(9)**

Note from Specification I that L.HDI and GHEX have positive and statistically significant relationships with HDI at the 1% significance level. The coefficient of L.HDI could be interpreted as about 60% of the current realization of the dependent variable (HDI) is influenced by the dependent variable in the past (HDI_{t-1}). For the explanatory variable, if the ratio of government health expenditure to GDP (GHEX) increases by one percentage point, HDI increases by 1.07 points. For the control variables, the coefficient on Y is positive and significant at 5% significance levels, indicating that a one percent increase in economic growth will increase HDI by 0.11 points. The coefficient on MORT is negative and significant at 1% significance levels. It indicates that a point increase in infant mortality rate will decrease HDI by 0.11 points. The other control variable is GEE which has positive and statistically significant relationships with HDI at the 5% significance level. The **Figure 2** presents a comprehensive summary of the regression results for Specification I.

Figure 2.
Conceptual Flowchart of Specification I

The regression coefficients in Specification I reflect the basic relationship between the independent variables and the dependent variable. These coefficients provide insight into the economic significance of each variable separately, without considering interaction effects.



The estimation results for Specification II exhibit the same pattern as those for Specification I presented in the previous paragraph. Note from Specification II that L.HDI

has a statistically significant positive relationship with HDI at the 1% significance level. The explanatory variable, GHEX, still has a statistically significant positive relationship with HDI but only at the 10% significance level. The coefficients on Y, MORT, and GEE are consistent with the results in Specification I. Meanwhile, LVL, the high-income country dummy, is positive and significant at the 5% level. The negative coefficient on GHEXLVL implies that the impact of GHEX is stronger in middle-income countries compared to high-income countries. However, the coefficient on GHEXLVL is insignificant, so further analysis is needed to explore how the relationship between HDI and GHEX varies with the country's income level. **Figure 3** presents a comprehensive summary of the regression results for Specification II.

Figure 3.
Conceptual Flowchart of Specification II

The regression coefficients in Specification II reflect the relationship between the independent variables and the dependent variable by considering the effect of country income level. These coefficients provide insight into the economic significance of each variable separately, as well as showing how the effect of government health expenditure may differ between middle- and high-income countries through interaction effects.

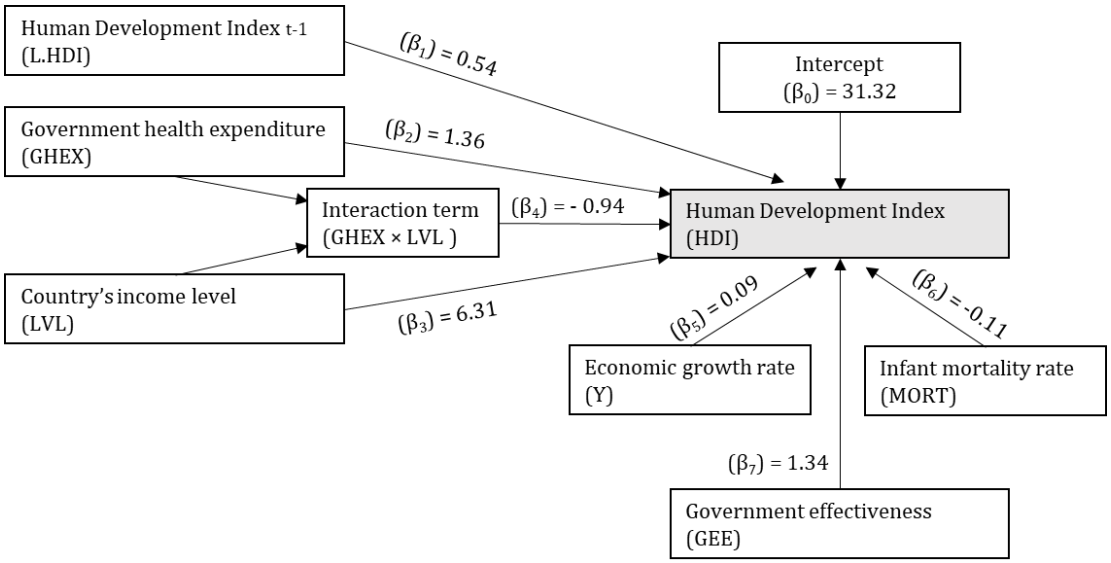
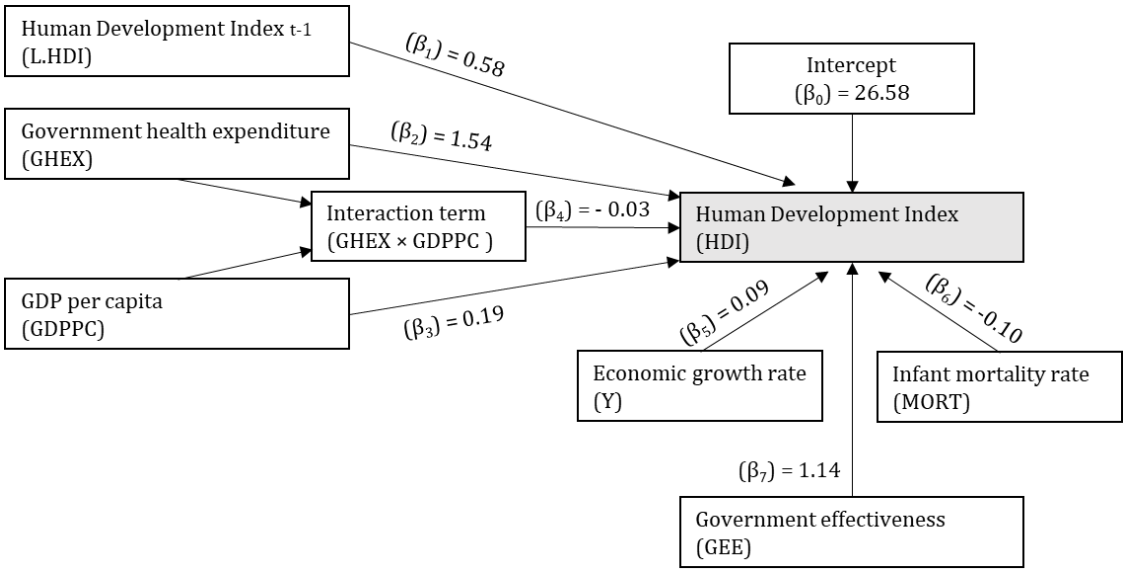


Table 6 also shows the estimation results for Specification III. The coefficients on the independent variables in Specification III are consistent with the previous two specifications. The new variable, GDPPC, has a positive and significant relationship with HDI at the 5% significance level. The coefficient on GDP is consistent with the coefficient of LVL in Specification II, implying that higher-income countries will, on average, have higher HDI, holding other independent variables constant. The coefficient on GHEXGDPPC is negative and significant at the 10% significance level, which implies that the impact of GHEX on HDI is stronger in middle-income countries than in high-income countries. **Figure 4** presents a comprehensive summary of the regression results for Specification III.

Figure 4.
Conceptual Flowchart of Specification III

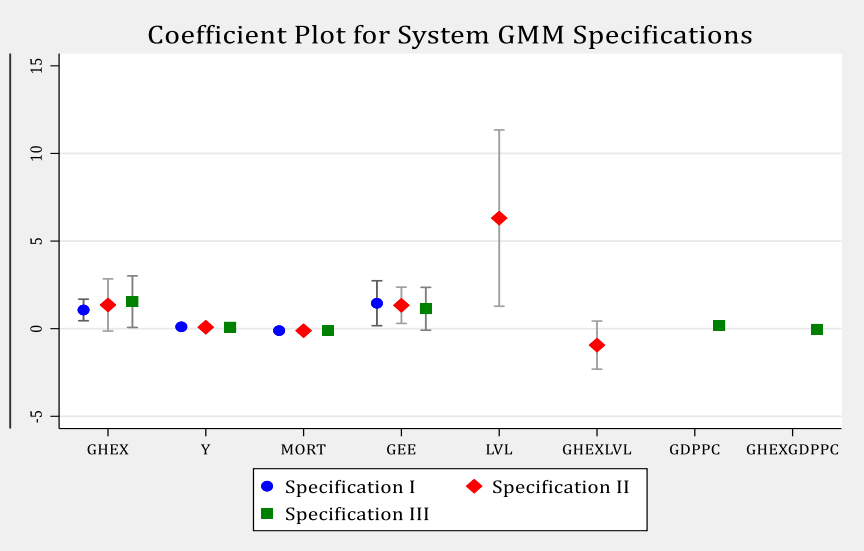
The regression coefficients in Specification III show the relationship between the independent variables and HDI by considering the interaction between government health expenditure and income per capita. The model shows that the impact of health expenditure on HDI varies depending on the income level of the country. The negative interaction

between GHEX and GDP per capita indicates that the effect of government health expenditure is greater in middle-income countries than high-income countries.



In summary, **Figure 5** below illustrates the effect of various variables on HDI based on three specifications of the System GMM model. The plots show that GHEX has a positive and significant coefficient in all specifications, signaling that an increase in government health expenditure consistently increases HDI. This effect is even greater in specifications that consider the interaction with income. The Y variable also shows a positive effect on HDI, albeit with a much smaller coefficient, signaling that economic growth contributes to HDI, but not as strongly as government health expenditure. In contrast, MORT has a negative coefficient, meaning that high infant mortality reduces HDI. GEE shows a significant positive effect, confirming the importance of government effectiveness in supporting human development. Meanwhile, interaction variables such as GHEXLVL and GHEXGDPPC have negative coefficients, which reinforces the finding that the effect of government health expenditure on HDI tends to decrease in countries with higher incomes. Overall, this plot confirms that effective government health expenditure policies are crucial in improving people's quality of life, especially in middle-income countries.

Figure 5.



C. Discussion of Results

According to the results above, government health expenditure has a positive and significant impact on HDI. This finding aligns with studies by Apriska et al. (2024), Banik et al. (2022), Febrianto and Esther (2023), Mirahsani (2016), Lengkong et al. (2019), Pramesti et al. (2022), Razmi et al. (2012), Simamora et al. (2024), and Wardhana et al. (2021), all of which support this conclusion. Mirahsani (2016) states that countries with higher government health expenditures tend to have better HDI outcomes, while those with lower expenditures experience lower HDI. Banik et al. (2022) assert that government health expenditure reduces infant mortality, increases life expectancy, boosts productivity, expands the workforce, and enhances educational opportunities—all of which contribute positively to HDI. Simamora et al. (2024) explain that increased government health expenditure contributes to the provision of higher-quality and more equitable healthcare services. This improved access enables populations to lead longer and healthier lives, thereby directly enhancing life expectancy, a fundamental component of HDI. Razmi et al. (2012) suggest that human capital accumulation not only promotes HDI but also economic growth which further improves HDI. In other words, government health expenditure has a direct impact on the health indicators, and indirect impact on education and economic indicators.

The results concerning the economic growth show positive impact on HDI for the estimation in all specifications. This outcome is in line with the study by Kuswanto (2021) and Mukherjee and Chakraborty (2010). Kuswanto (2021) states that economic growth has a direct impact on HDI through an increase in per capita income. Economic growth will increase per capita income so that people's ability to meet their needs increases. This in turn will increase HDI. Additionally, Mukherjee and Chakraborty (2010) state that economic growth can increase the government's contribution to the human development sector. Through economic growth, the government can generate more taxes so that the fiscal space is greater to finance government social expenditure on human development sectors. In other words, economic growth increases the resources for household and government to spend in human development sectors, thus increasing HDI.

The other control variables in this study also show strong relationships with HDI. The coefficient on government effectiveness is significant and positive in all specifications, indicating that countries with more effective governments tend to have higher HDI. This result is consistent with previous studies by Banik et al. (2022), Nainggolan (2024), and Prasetyo et al. (2013). Banik et al. (2022) state that government health expenditure will not significantly improve HDI without good governance. Nainggolan (2024) also argues that government health expenditure often fails to achieve its intended outcomes due to poor spending quality, which depends on factors such as prioritization, allocation, timing, accountability, and effectiveness. He further emphasizes that high-quality health expenditure is essential for reducing poverty and enhancing HDI. The infant mortality rate variable shows an opposite impact on HDI in all specifications. Pahlevi (2017) explains that countries with high infant mortality rate are generally countries with low health status, which refers to countries with low HDI.

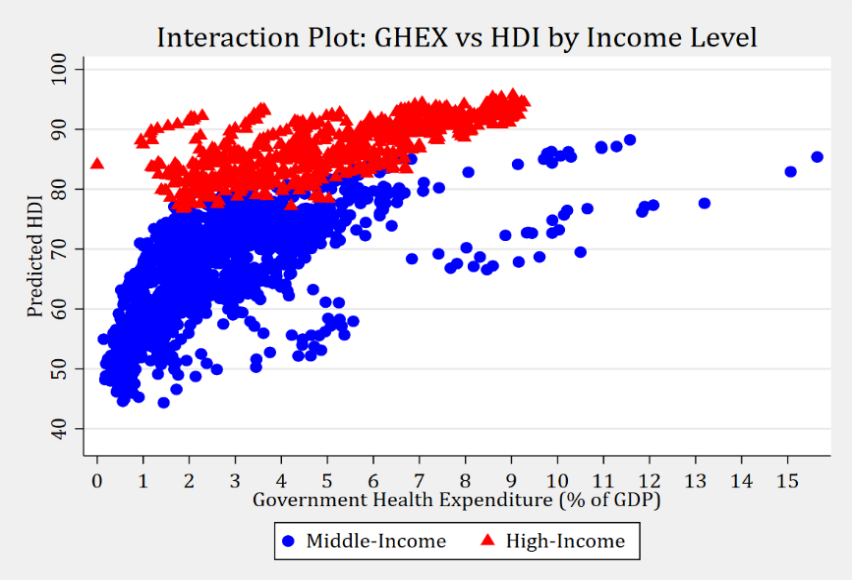
The level of HDI also depends on the country's income level, which in this study is analyzed using LVL dummy variables and GDP per capita. Both independent variables show a significant and positive impact on HDI for all estimations in all specifications. This outcome is in line with the study by Alijanzadeh et al. (2016) and Ranis et al. (2000). Alijanzadeh et al. (2016) state that countries with higher national income will increase people's life expectancy through the provision of more comprehensive immunization programs, more medical technology, and better health services. Ranis et al. (2000) explain that countries with higher national income tend to have better education levels. Therefore,

higher national income means higher health and education status so that higher national income is strongly associated with higher HDI.

The result concerning the interaction term between GDP per capita and government health expenditure is the most interesting. The results show that the interaction term has a negative coefficient and is statistically significant for all estimations. The negative coefficient on the interaction term implies that the impact of government health expenditure is higher in countries with lower income levels. This outcome is in line with the study by Bunnag (2018) and Ranis et al. (2000). According to Ranis et al. (2000), low-income people tend to consume more human development items than high-income people, such as food, beverages, education, and health. Thus, government assistance has a greater impact on HDI for the poor because additional disposable income will be directly used to increase consumption of human development items. This phenomenon is called the convergence hypothesis. Additionally, Bunnag (2018) explains the convergence hypothesis that countries with lower per capita income will grow faster in economy and HDI until they reach the level of rich countries.

Reinforcing the findings of the convergence hypothesis, **Figure 6** presents an Interaction plot that depicts the predicted relationship between GHEX and HDI, differentiating countries by income level. The blue dots represent middle-income countries, while red triangles represent high-income countries. The horizontal axis shows the amount of government health expenditure, while the vertical axis shows the predicted HDI value from the regression model in specification II. From this figure, it can be seen that high-income countries generally have a higher HDI than middle-income countries, even at the same level of health expenditure. However, if the distribution of points in the middle-income countries shows a steeper slope, it indicates that increased government health expenditure has a greater impact on HDI in middle-income countries. In other words, any additional government health expenditure in middle-income countries is likely to have a more significant increase in HDI than in high-income countries. This finding supports the hypothesis that government health expenditure has a stronger effect in countries with lower income level. Therefore, providing policy implications that increasing government health expenditure in middle-income countries can be an effective strategy to improve HDI.

Figure 6.



V. CONCLUSION

This study examines the impact of government health expenditure on HDI using a dynamic panel approach through System GMM estimation on 151 countries over the period 2005 to 2019. The results consistently show that government health expenditure has a positive and statistically significant effect on HDI. Specifically, a 1% increase in government health expenditure as a proportion of GDP results in an average increase of 1.07 points in HDI. This positive and significant relationship between government health expenditure and HDI reinforces the findings of several previous studies, including by Apriska et al. (2024), Banik et al. (2022), Febrianto and Esther (2023), Pramesti et al. (2022), Simamora et al. (2024), and Wardhana et al. (2021). This study also found that economic growth, government effectiveness, and low infant mortality rate also contribute positively to HDI. In addition, the findings from the interaction variables show that the effect of government health expenditure is larger in middle-income countries, indicating a decline in marginal outcomes in countries with higher income level.

In addition to government health expenditure, economic growth has also been shown to contribute positively to the improvement of HDI. Economic growth not only increases per capita income, but also expands the government's fiscal capacity to finance human development sectors such as education, health, and social protection. This finding is in line with studies conducted by Kuswanto (2021) and Mukherjee and Chakraborty (2010). However, the results of this study show that the direct impact of economic growth on HDI is relatively smaller than that of government health expenditure. This indicates that while economic growth is important, its impact on HDI will not be optimal without strategic and targeted government intervention in allocating resources to sectors that directly affect quality of life, such as the health sector. The importance of government intervention in promoting HDI growth has also been explained by UNDP (1990).

In addition, government effectiveness and infant mortality also show a strong relationship with HDI. Countries with good governance tend to be able to manage and allocate government health expenditure more effectively, resulting in higher human development achievement. This finding reinforces the results of previous studies by Banik et al. (2022) and Nainggolan (2024). Conversely, high infant mortality rates are an indicator of weak basic health services, which directly reduce HDI scores. Regarding infant mortality, Pahlevi (2017) explains that countries with high infant mortality rates generally have low health status, which contributes to low HDI. Furthermore, a country's income level, measured through both income level and GDP per capita, has also been shown to significantly affect HDI. Countries with high incomes generally have greater access to quality health and education services, which are key components in the formation of HDI.

The most prominent finding of this study is that the impact of government health expenditure on HDI is greater in middle-income countries compared to high-income countries. The negative and significant interaction coefficient between government health expenditure and income level suggests a decline in the marginal returns to government health expenditure as national income increases. This supports the convergence hypothesis proposed by Bunnag (2018), which states that lower income countries have greater HDI growth potential if supported by appropriate policy interventions. In this context, increasing government health expenditure in middle-income countries is a highly relevant and effective strategy to accelerate human development and reduce HDI gap between countries.

Although the System GMM approach used in this study is quite robust and supported by comprehensive data covering 151 countries over a 15-year period, this study still has some limitations. First, the analysis is conducted at the national aggregate level, which may obscure important within-country disparities in the effectiveness of government health expenditure and HDI outcomes. Future research may benefit from using subnational or

regional level data to capture more local dynamics. Second, this study focuses on total government health expenditure as a proportion of GDP without disaggregating by function (e.g., preventive vs. curative services) or demographic group (e.g., children, productive age, elderly). This limits the ability to assess which type of government health expenditure is most effective in improving HDI. Third, while this study has included some key control variables such as economic growth, infant mortality rate, and government effectiveness, other potentially influential factors, such as education expenditure and the level of inequality, have not been explicitly modeled. Furthermore, this study used data before the COVID-19 period. While the results support the findings of previous studies conducted both before and after the pandemic, future research could explore the relationship between government health expenditure and HDI in the post-pandemic period. Thus, further studies can provide a more comprehensive understanding of the effectiveness of government health expenditure on HDI in the context of the global crisis.

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REFERENCES

Alijanzadeh, M., Asefzadeh, S., & Moosaniaye Zare, S. A. (2016). Correlation Between Human Development Index and Infant Mortality Rate Worldwide. *Biotechnology and Health Sciences*, *3*(1).

Alif, M., & SBM, R. (2021). Analysis of government health spending allocation and its effectiveness on HDI improvement. *Indonesian Journal of Public Finance*, 9(1), 67–80.

Amalia, N. A., Wulandari, S., Mentari, E. C., Mutiara, I., & Dalimunthe, J. W. (2022). Analysis of Factors Affecting the Human Development Index in Increasing Indonesian Economic Growth in North Sumatra Province. *Journal of Social Research. 1*(12), 508-516.

Apriska, A., Nugroho, B., & Sari, D. (2024). The impact of health expenditure on human development in Indonesia. *Journal of Development Economics*, 15(2), 123–135.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, *58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-components Models. *Journal of Econometrics*, *68*(1), 29–51.

Aulia, N., Prasetyo, A., & Lestari, D. (2023). Evaluating the effectiveness of health budgets on human development outcomes in Indonesia. *Journal of Development and Social Policy*, 11(3), 142–158.

Baltagi, B. H. (2021). *Econometric analysis of panel data (6th ed.)*. Springer Nature.

Banik, B., Roy, C. K., & Hossain, R. (2023). Healthcare expenditure, good governance and human development. *EconomiA*, *24*(1), 1–23.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*, 115–143.

Bond, S., Hoeffler, A., & Temple, JRW. (2001). *GMM Estimation of Empirical Growth Models*. Economics Discussion Paper 01/525, University of Bristol.

Boyacioglu, E. Z., & Terzioglu, M. K. (2022). Do Health Spending and Economic Growth Matter in Development? Evidence from Turkey. *Journal of Research in Economics, Politics & Finance*, *7*(SI), 19–32.

Bunnag, S. (2018). *Income and HDI Convergence in the Mekong Economies: Regional Development Revisited*. Saitama University.

Caselli, F., Esquivel, G., & Lefort, F. (1996). Reopening the convergence debate: A new look at cross-country growth empirics. *Journal of Economic Growth, 1*(3), 363–389.

Chatterjee, S., & Hadi, A. S. (2012). *Regression Analysis by Example*. Wiley.

Darwin, D., Madris, & Fatmawati. (2022). The Influence of Government Expenditure in the Health Sector, Education Sector, Capital Expenditures on the Human Development Index in South Sulawesi Province. *Enrichment: Journal of Management, 12*(5), 3758-3767.

Deb, S. (2015). *Gap between GDP and HDI: Are the Rich Country Experiences Different from the Poor?.* IARIW-OECD Special Conference.

Fadila, M., Ferayanti, Weri, & Zulkifli. (2024). The effect of district government education and health sector expenditure on the Human Development Index (HDI) in Aceh Province. *Jurnal Ilmiah Mahasiswa Ekonomi Pembangunan (JIM EKP)*, 9(3), 167–181.

Febrianto, R., & Esther, M. (2023). Government health spending and its effect on HDI: Evidence from Indonesian provinces. *Indonesian Journal of Public Policy*, 12(1), 45–60.

Gaye, A. (2007). *Access to Energy and Human Development*. Human Development Report Office.

Grimm, M., Harttgen, K., Klasen, S., & Misselhorn, M. (2008). A Human Development Index by Income Groups. *World Development*, *36*(12), 2527–2546.

Haq, M. ul. (1995). *Reflections on human development: How the focus of development economics shifted from national income accounting to people-centred policies, told by one of the chief architects of the new paradigm*. Oxford University Press.

Hauk, W. R. Jr., & Wacziarg, R. (2009). A Monte Carlo study of growth regressions. *Journal of Economic Growth 14*, 103–147.

Kuswanto. (2021). The Impact of Economic Growth on the Human Development Index in Jambi Province in 2004-2019. *Asian Journal of Economics, Business and Accounting*, *21*(12), 22–28.

Lengkong, J., Putra, A., & Wulandari, S. (2019). Public expenditure and human development: A regional analysis. *Economic and Social Review*, 8(3), 201–218.

Maharda, J. B., & Aulia, B. Z. (2020). Government Expenditure and Human Development in Indonesia. *Jambura Equilibrium Journal*, *2*(2), 81-94.

Mirahsani, Z. (2016). The Relationship Between Health Expenditures and Human Development Index. *Journal of Research & Health, 6*(3), 373-377.

Mongan, J. (2019). The Effect of Government Spending on Education and Health on the Human Development Index in Indonesia. *Indonesian Treasury Review: Jurnal Perbendaharaan, Keuangan Negara Dan Kebijakan Publik*, 4(2), 163-176.

Mukherjee, S., & Chakraborty, D. (2010). Is there any relationship between Economic Growth and Human Development? Evidence from Indian States. *Munich Personal RePEc Archive.*

Muliza, M., Zulham, T., & Seftarita, C*. (2017).* Analysis of the Effect of Education Expenditure, Health Expenditure, Poverty Level and Gnp on Hdi in Aceh Province. *Jurnal Perspektif Ekonomi Darussalam, 3(1), 51–69.*

Muliza, R., Hanafiah, M., & Siregar, D. (2017). Government health expenditure and its impact on human development: Evidence from Indonesian districts (2010–2014). *Journal of Regional Policy Studies*, 6(2), 101–115.

Nainggolan, E. (2024). The quality of government spending and its impact on poverty and human development in Indonesia. *Journal of Public Sector Economics*, 13(1), 55–70.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica, 49*(6), 1417-1426.

Nuryani, H. S., & Irawan, E. (2022). The Effect of Unemployment, Economic Growth and Poverty Levels on the Rate of Human Development Index in Sumbawa Regency in 2012-2021. *International Journal of Innovative Science and Research Technology*, *7*(6), 493-498.

Lugastoro, D. P. (2013). *Analysis of the Influence of PAD and Balancing Funds on the Human Development Index of Districts/cities in East Java*. Universitas Brawijaya.

Oktafiyana, R., & Muliati, S. (2024). Public health expenditure and HDI: A provincial-level analysis in Indonesia. *Southeast Asian Economic Review*, 12(1), 55–70.

Pahlevi, M. (2017). *Impact of Governance and Government Expenditure on Human Development in Indonesia*. Institute of Social Studies.

Pramesti, N., Hidayat, T., & Yusuf, R. (2022). Health budget allocation and human development outcomes in Indonesia. *Southeast Asian Journal of Economics,* 10(4), 89–104.

Prasetyo, A. D., & Zuhdi, U. (2013). The Government Expenditure Efficiency towards the Human Development. *Procedia Economics and Finance*, *5*(2013), 615–622.

Raghuvanshi, A., & Verma, R. (2024). *Reassessing the link between economic growth and human development*: A multidimensional perspective. Journal of Development Studies, 60(2), 123–140. https://doi.org/10.xxxx/jds.2024.12345

Ranis, G., Stewart, F., & Ramirez, A. (2000). Economic Growth and Human Development. *World Development*. *28*(2), 197-219.

Razmi, M. J., Abbasian, E., & Mohammadi, S. (2012). Investigating the effect of government health expenditure on HDI in Iran. *Journal of Knowledge Management, Economics, and Information Technology*, 5, 1–8.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, *9*(1), 86-136.

Sijabat, R. (2000). The Impact of Health Spending, Education Spending and Economic Growth on Human Development: A Provincial Panel Analysis. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*. *5*(4), 29584-29598.

Simamora, L., Dewi, K., & Arifin, M. (2024). Health services, budget, and life expectancy: A study on Indonesian districts. *Journal of Health and Society*, 7(1), 33–50.

Statistics Indonesia. (2021). *Statistical yearbook of Indonesia 2020***.** BPS-Statistics Indonesia.

Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* (4th ed.). Pearson Education.

Todaro, M. P., & Smith, S. C. (2015). *Economic development*. Twelfth Edition. Pearson.

Torres-Reyna, O. (2007, December). *Linear regression using Stata (v. 6.4)*. Princeton University. Retrieved from http://www.princeton.edu/~otorres/

UNDP. (1990). *Human Development Report* 1990. Oxford University Press.

UNDP. (1996). *Human Development Report* 1996. Oxford University Press.

Wahyuningrum, F., & Soesilowati, E. (2021). The Effect of Economic Growth, Population and Unemployment on HDI. *Efficient: Indonesian Journal of Development Economics*, 4(2), 1217-1229.

Wardhana, D., Santoso, H., & Lestari, F. (2021). Sectoral government spending and its influence on HDI in Indonesia. *Journal of Regional Development*, 9(2), 77–93.

Widodo, P., Irawan, L. A., Oktavianti, I. N., & Anisa, L. (2020). Government Spending on Education, Health, and Minimum Wages as Predictors of Human Development Index: Study of Selected Provinces of Indonesia. *International Journal of Advanced Economics*, *1*(2), 95–101.