International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 4S, 2025
https://www.theaspd.com/ijes.php

The Effect Of Natural Resources Rents On Human Development At Selected Southeast Asia Countries, 2000-2021

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ABSTRACT

This research analyses the effects of natural resource rents on human development in selected Southeast Asia countries. A panel of five countries have been selected for the period 2000–2021. The pooled OLS, fixed effects model (FEM), and random effects model (REM) were employed in the analysis. Based on the the Hausman test, FEM have been chosen, while to correct diagnostics problems, generalized least square (GLS) is more preferred. The results indicate that total natural resource rents have an impact on human development and this impact is negative. More specifically, forestry rents, mineral rents and natural gas rents also have negative impacts on human development, while coal and oil rents have positive impacts. To ensure long-term development, natural resource rents must be used efficiently to finance infrastructure, health and education. Economic diversification must be promoted to reduce dependence on resources, additionally governance institutions must be strengthened to promote transparency and sustainable resource management.

Keywords: Pooled OLS, fixed effect model, random effects model, generalized least square, natural resource rents, human development, Southeast Asia.

1. INTRODUCTION

Natural resources can be a fundamental determinant of a country's socio-economic development. The exploitation of natural resources can generate profits that can be used to accumulate physical and human capital, diversify the economy, and generally improve social welfare (Debonheur et al., 2024). However, natural resource abundance does not guarantee high economic growth and human development. The abundance of natural resources can lead to a “resource curse” for countries that rely heavily on them. Several studies have provided evidence that countries that rely on natural resources tend to perform worse than other countries on a number of human welfare indicators, such as life expectancy, education, child mortality, or levels of human development (Ross, 2001; Bulte et al., 2005).

Some main reasons are: First, windfall profits create fluctuations in government revenues that, if not properly managed, can lead to inflation and booms and busts in public spending (van der Ploeg & Poelhekke, 2009), or combine with institutional weaknesses such as poor governance and limited property rights protection, resulting in natural resource rents being concentrated in a small elite group rather than being reinvested in important areas such as education, health or infrastructure, leading to stagnant or declining HDI. Secondly, a sudden influx of revenue from natural resources can cause the local currency to appreciate, reducing the competitiveness of exports in other sectors, which can reduce employment opportunities and overall economic growth (Oberholzer, 2021), a phenomenon known as the Dutch disease. Third, due to profit-seeking behavior, the neglect of human development areas. Since

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governments can generate revenue from selling natural resources, they may have less motivation to invest in education and other aspects of human capital development (Salahodjaev et al., 2024). Fourth, the exploitation of natural resources can cause environmental degradation, such as pollution, defores tation, and biodiversity loss, which can harm public health, reduce the quality of life, and thus reduce human development (Simionescu et al., 2024). In addition, natural resources can have adverse effects on institutions and political situations such as the tendency to increase corrupt behavior. Or competition to appropriate rents may exacerbate existing tensions between ethnic groups or politically powerful factions, leading to armed conflict (Daniele, 2011).

This has been proven through a number of empirical studies. Nchofoung et al. (2021) based on a Tobit IV regression model on a sample of 107 developing countries, over the period 1996-2019, and show positive effects of resource rents in certain regions (e.g., oil-exporting countries and Latin America) but negative impacts in Africa and low-income countries. In addition, the impact of forest rents and mineral rents is negative, while in contrast total natural resources rents, oil and gas rents have positive impacts. Sinha & Sengupta (2019) study in 30 Asia-Pacific countries found that this effect was negative in the absence of globalization. But in the context of globalization, the effect of natural resource rents on HDI was reversed. Also study in the Asian region, specifically, in the ASEAN-5 countries, Hacıimamoğlu et al. (2024) revealed that both renewable energy consumption and natural resource rents reduce environmental degradation. Using OLS, quantile regression, and two-step system generalized method of moments (GMM) estimation, Debonheur et al. (2024) found that total natural resource rents have a negative impact on human development in 41 African countries. However, this negative impact is mitigated by food imports. Li et al. (2023) used a quantile regression model and a panel autoregressive distributed lag (ARDL) model and concluded that in N11 countries, natural resource rents have a negative impact on HDI, while in BRICS countries, the impact is positive. In particular, the development of information and communication technology has ameliorated the negative impacts while enhancing the positive impacts. Also from 51 BRI countries, Salahodjaev et al. (2024) found that when the share of total natural resource rents in GDP exceeds 42.8%, it leads to an increase in HDI. Chen et al. (2023) divided 44 developed economies into three groups of major oil, natural gas, and coal exporter economies and reveal that poor management of natural resource rents, i.e. failure to use these rents for growth investment purposes, could have a negative impact on HDI. Kaewnern et al. (2023) employed the Driscoll-Kraay, feasible generalized least square (FGLS), and GMM to investigate the impact of total natural resource rent, economic growth, renewable energy consumption, and research and development expenditure on the HDI in the top ten human development countries during 1996–2007, and found positive and statistically significant relationship of all these variables to HDI.

Industry value added is an important component of GDP, especially in industrialized or resource-dependent economies. Exports of fuels (such as oil, natural gas, coal, and other energy sources) and exports of ores and metals can stimulate industrial growth, boost GDP growth by generating foreign exchange, and improve HDI by providing better employment opportunities, higher incomes, and the potential for investment in social services. However, if the revenues from these factors are not reinvested in social services or sustainable development, HDI may not improve significantly. While Sachs (2007) proposed that countries abundant in oil generally experience higher per capita income and consumption, longer life expectancy, lower child mortality rates, greater electricity consumption per person, and a more extensive network of paved roads compared to nations with limited oil resources. And Cotet & Tsui (2013) argues that infant mortality has decreased significantly in oil-rich countries. The results of Daniele (2011) in three resource-rich African countries show that lower human development is associated with higher dependence on ore and mineral exports. Blanco & Grier (2012) also argued that petroleum export have a significant negative impact on long-term human capital development.

While previous studies have extensively explored the relationship between natural resource rents and human development globally and regionally, there are still some gaps, especially in the five selected Southeast Asian countries context. First, existing studies have not focused specifically on Vietnam, Thailand, Malaysia, Indonesia and the Philippines as a collective group, despite their dependence on natural resources. This leaves a gap in analyzing the impact of natural resource rents and the specific HDI of these countries. And in particular, the impact of individual natural resource rents on HDI in the context

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of Southeast Asian countries. Second, no studies have integrated the role of industrial value added, fuel exports and ore/metal exports in shaping HDI. This limits understanding of how these economic activities interact with natural resource rents to influence development outcomes, especially in economies transitioning from resource dependence to industrialization.

The five Southeast Asian countries selected for this study include Vietnam, the Philippines, Malaysia, Indonesia, and Thailand. These are countries rich in natural resources. In addition, natural resource rents also play an important role in the economies of these countries. In particular, Vietnam's natural resource revenues mainly come from oil and gas, coal, timber, and some minerals. Vietnam ranks among the world's leading producers of anthracite (hard coal) and is the sixth-largest crude oil producer in the Asia-Pacific region (Tarp et al., 2007). The Philippines has the fifth-largest mining potential in the world with 30% of its area identified as having high mineral potential, including gold, nickel, copper, and chromite, as well as having extensive fishing and forestry resources (Torres, 2015). They also have extensive fishing and forestry resources. Malaysia is one of the largest oil and gas producers in Southeast Asia (Bhattacharya & Hutchinson, 2022). Oil and gas rents have historically been crucial to Malaysia's economic growth, contributing to both government revenues and export earnings. Malaysia is also the world's second-largest producer of palm oil, a major export commodity. The country also has significant reserves of minerals such as tin, bauxite, and gold (Salleh et al., 2024; Sheil et al., 2009). Indonesia is one of the world's largest coal exporters, and it also has significant reserves of copper, nickel, and gold. The coal sector has been a key driver of the country's economic growth. Indonesia also has abundant oil and natural gas resources. And like Malaysia, Indonesia is a major producer of palm oil (Tijaja & Faisal, 2014; Michel, 2024). Malaysia and Indonesia account for about 90% of the world's palm oil production (Ngan et al., 2022). Finally, Thailand is less dependent on natural resource rents than the countries above, but it still has significant resources, including tin, natural gas, and agricultural products.

This study work seeks to analyze the effects of total natural resource rents, and different types of natural resource rents on human development in five collected countries in Southeast Asia, including Vietnam, Thailand, Malaysia, Indonesia, and the Philippines. Moreover, this study also examines the influence of Industry (add value), fuel exports, and ores and metals exports on HDI. To our knowledge, no study has been conducted to specifically assess the impact of these factors on human development in these countries. In addition, this study also answers the question of whether the impact of natural resource rents differs at different levels of HDI.

The remainder of the paper is as follows: Section 2 presents the data, empirical model and methodology. Section 3 presents the results of the statistical analysis and discussion. Section 4 concludes the paper and policy implications.

2. Methodology

2.1. Data

The study use panel data collected from World Bank data and UNDP for five collected countries in Southeast Asia, including Vietnam, Thailand, Malaysia, Indonesia, and the Philippines, during the period 22 years (2000-2021). The variables are described in detail in Table 1 below.

Table 1. Description of variables

Variable	Definition	Unit measurement	Source
Dependend variable			
HDI	Human Development Index; This index ranges from 0 (lowest) to 1 (highest)	-	UNDP (2024b)
Independend variable			
GDP	Gross domestic product	Constant 2015 US$	
totalrents	Total natural resources rents	% of GDP	
forest	Forest rents	% of GDP	World Bank
coal	Coal rents	% of GDP	(2024)
mineral	Mineral rents	% of GDP	
gas	Natural gas rents	% of GDP	

oil	Oil rents	% of GDP
industry	Industry (including construction), value added	% of GDP
fuelexp	Fuel exports	% of merchandise exports
oresexp	Ores and metals exports	% of merchandise exports

(Source: Compiled by the authors)

Human development is most frequently proxied by the Human Development Index (HDI). We consider the HDI as the dependent variable. It is calculated based on three key dimensions of human development: education (Mean years of schooling for adults and expected years of schooling for children), health (Life expectancy at birth), and standard of living (Gross National Income - GNI per capita). The index ranges from 0 to 1, with 0 being considered the lowest levels of human development, and 1 the highest level of human development (Debonheur et al., 2024). The independent variables include GDP (Constant 2015 US$), total natural resources rents (% of GDP), forest rents (% of GDP), coal rents (% of GDP), mineral rents (% of GDP), natural gas rents (% of GDP), oil rents (% of GDP), industry (including construction), value added (% of GDP), fuel exports (% of merchandise exports), and ores and metals exports (% of merchandise exports). Natural resource rents are determined by calculating the gap between a commodity's market price and its average production cost. This involves estimating the price per unit of specific commodities and then deducting the estimated average costs associated with extraction or harvesting (World Bank, 2024).

2.2. Empirical model and estimation strategies

This study investigates an appropriate empirical model to explore the influence of natural resources rents on the HDI in selected Southeast Asia countries from 2000 to 2021. In this study, the static model is applied instead of the dynamic model, because the number of independent variables exceeds N, and the number of annual observations (T) for a given set of countries (N) is small. According to Jayaraman et al. (2021) in this case, three suitable approaches can be applied, namely OLS, FEM and REM.

Pooled regression OLS model

The functional form of the given variables is given below:

$$HDI = f\,(GDP, total, forest, coal, mineral, gas, oil, industry, fuelexp, oresexp) \qquad (1)$$

Variables are converted to natural logarithmic form to reduce the sharpness of data and deliver more consistent results (Kaewnern et al., 2023). The pooled OLS regression model is adjusted into a log-linear form as shown below:

$$lnHDI_{it} = \beta + \alpha_1 lnGDP_{it} + \alpha_2 lntotal_{it} + \alpha_3 lnforest_{it} + \alpha_4 lncoal_{it} + \alpha_5 lnmineral_{it} + \alpha_6 lngas_{it} + \alpha_7 lnoil_{it} + \alpha_8 lnindustry_{it} + \alpha_9 lnfuelexp_{it} + \alpha_{10} lnoresexp_{it} + \mu_{it} \qquad (2)$$

where i denotes countries (cross-section dimension) ranging from 1 to 5; and t represents the period 2000–2021 (time-series dimension); β represents the intercept of the model; α_i (i = 1, 2, ..., 10) show the slope parameters; μ_{it} shows the error term; lnGDP, lntotal, lnforest, lncoal, lnmineral, lngas, lnoil, lnindustry, lnfuelexp, lnoresexp denote the logarithm data of all variables.

In the OLS model, countries will have the same coefficient because it assumes homogeneity in all cross-sections (countries) and time series. Although in this study, countries have some common characteristics because they are from the same region, they also have their own characteristics. Therefore, homogenizing all countries will ignore the potential heterogeneity (Alshyab et al., 2021; Jayaraman et al., 2021).

Fixed Effects Model (FEM)

FEM allows for heterogeneity across subjects by allowing each cross section unit (in this case each country) to have its own intercept value. The subscript i and α_0 suggest that the intercepts of the five countries may be different, but each country's intercept does not vary over time (Bagchi, 2014; Altahtamouni et al., 2022). The model can be written as follows:

$$lnHDI_{it} = \alpha_{0i} + \alpha_1 lnGDP_{it} + \alpha_2 lntotal_{it} + \alpha_3 lnforest_{it} + \alpha_4 lncoal_{it} + \alpha_5 lnmineral_{it} + \alpha_6 lngas_{it} + \alpha_7 lnoil_{it} + \alpha_8 lnindustry_{it} + \alpha_9 lnfuelexp_{it} + \alpha_{10} lnoresexp_{it} + \mu_{it} \qquad (3)$$

The fixed effects model is more appropriate for modeling unobserved individual heterogeneity across economies and controlling for omitted variable bias. However, the fixed effects model cannot test for time-invariant causality of variables. On the other hand, the random effects model allows for random variation across countries and is uncorrelated with the explanatory variables. Therefore, it will use the entire dataset, produce unbiased coefficients, and provide lower standard errors of estimation (William, 2017).

Random Effects Model (REM)

Now we assume that α_{0i} is not fixed (like the case of FEM), it is a random variable with a mean value of α_0:

$$\alpha_{0i} = \alpha_0 + \varepsilon_i \quad (4)$$

where ε_i is the common error component. Substituting equation (4) into equations (3), we obtain:

$$lnHDI_{it} = \alpha_0 + \alpha_1 lnGDP_{it} + \alpha_2 lntotal_{it} + \alpha_3 lnforest_{it} + \alpha_4 lncoal_{it} + \alpha_5 lnmineral_{it} + \alpha_6 lngas_{it} + \alpha_7 lnoil_{it} + \alpha_8 lnindustry_{it} + \alpha_9 lnfuelexp_{it} + \alpha_{10} lnoresexp_{it} + \varepsilon_i + \mu_{it} \quad (5)$$

or:

$$lnHDI_{it} = \alpha_0 + \alpha_1 lnGDP_{it} + \alpha_2 lntotal_{it} + \alpha_3 lnforest_{it} + \alpha_4 lncoal_{it} + \alpha_5 lnmineral_{it} + \alpha_6 lngas_{it} + \alpha_7 lnoil_{it} + \alpha_8 lnindustry_{it} + \alpha_9 lnfuelexp_{it} + \alpha_{10} lnoresexp_{it} + \omega_{it} \quad (6)$$

where $\omega_{it} = \varepsilon_i + \mu_{it}$. Here, ε_i is the individual specific or cross-sectional specific error component, and μ_{it} is the panel-specific disturbance component with mean zero and variance σ_ε^2.

Selecting the suitable model specification for panel data analysis

Two tests are used to determine the suitable model. Specifically, F-Test is used to choose between OLS and FEM, while Hausman Test is used to choose between FEM and REM.

The hypotheses of F-test are as follows:

H_0: OLS is appropriate.

H_1: FEM is appropriate.

If p-value is larger than 0.05, H_0 is not rejected, and it is concluded that OLS is appropriate. If p-value is less than 0.05, H_0 is rejected, it's mean that FEM is appropriate.

The hypotheses of the Hausman (1978) test are as follows:

H_0: REM is appropriate.

H_1: FEM is appropriate.

If p-value is larger than 0.05, REM is appropriate. On the contrary, if p-value is less than 0.05, FEM is appropriate.

In addition, variance inflation factors (VIF) is applied to test multicollinearity, heterogeneity of variance was tested by Breusch-Pagan; serial correlation by Wooldridge test; and generalized least square (GLS) was used to perform diagnostics on the model if diagnostic problems existed (Wooldridge, 2003).

Appendix 1 reveals Pearson's correlation analysis among all variables under investigation. Correlation analysis shows a positive association between GDP, coal rents and HDI at 1% statistical significance, and a negative association between total natural resources rents, forest rents, natural gas rents, oil rents, industry (including construction) value added, fuel exports and HDI at 1% statistical significance. The correlation is low between most of the explanatory variables. However, correlations between total natural resources rents and oil rents, total natural resources rents and fuel exports, and oil rents and fuel exports are high, over 0.8. Since the coefficient of Pearson correlation results measures the pairwise correlation relationship between two variables without taking into account the influence of other variables in the regression model. In some cases, the correlation may decrease due to the presence of other explanatory variables (Padachi, 2006). Therefore, in this study, we will examine using FEM and REM to provide a better framework.

The F-test was conducted to determine whether the OLS or FEM is more suitable. The results, as presented in Table 2, indicate that the p-value is statistically significant at the 1% level. Consequently, the null hypothesis, which supports the use of OLS is rejected, that means the FEM is the appropriate model for the dataset.

Table 2. Specification test results

Test summary	Prob.	Evaluated	Decision
1. F-test	0.0000	OLS or FEM	FEM
2. Hausman Test	0.0000	REM or FEM	FEM
3. Bresuch-Pegan test	0.0000	Heteroskedasticity or not	Present heteroskedasticity
4. Wooldridge test	0.0011	Serial correlation or not	Present autocorrelation

Source: Authors' calculations (2024)

The Hausman test has been applied in order to check whether to focus on FEM or REM results. According to the results given in Table 2, p-value is 0.0000. The rejection of the null hypothesis in the Hausman test suggests that FEM is more suitable than REM. Therefore, the analysis will be based on the results from the FEM.

The Breusch-Pagan test for heteroskedasticity and the Wooldridge test for serial correlation yield Prob > chi^2 = 0.0000 and Prob > F = 0.0011, respectively. These results indicate the presence of heteroskedasticity and autocorrelation in the model. To be precise, the study will apply generalized least square (GLS) in order to correct the diagnostics.

In the following, we will divide the HDI into two groups according to level, the group with HDI < 0.7 (including group 4 - low human development and group 3 - medium human development) and group 2 with HDI ≥ 0.7 (including group 1 - very high human development and group 2 - high human development) to compare the impacts of explanatory variables on HDI between these two groups.

3. Results and Discussion

Table 3 shows the descriptive statistics of the research variables of five Southeast Asia countries, over the 22 years period. Regarding HDI, countries and territories in the world are divided into 4 groups: group 1 - very high human development with HDI ≥ 0.800; group 2 - high human development with 0.700 ≤ HDI < 0.800; group 3 - medium human development with 0.550 ≤ HDI < 0.700; and group 4 - low human development with HDI < 0.550 (UNDP, 2024a). The average value of HDI is 0.6543, belonging to group 3 - medium human development, in which the highest value of HDI is 0.8010 and the lowest is 0.4070. The average value of GDP is 350.00 (constant 2015 billion US$). The average value of all natural resources rents is 5.3646 % of GDP, in which oil rents account for the largest proportion of 2.3926 % of GDP, followed by forest rents (1.1701 % of GDP), natural gas rents (0.9913 % of GDP), coal rents (0.4168 % of GDP), and the lowest is mineral rents with a proportion of 0.3938 % of GDP. The average value of industry (including construction) value added is 38.1771 % of GDP. Finally, the average value of fuel exports and ores and metals exports is 3.1702 and 11.8282 % of merchandise exports respectively.

Table 3. Descriptive statistics of variables (Obs 110)

Variable	Units	Mean	Std. error	Min	Max
HDI	-	0.6543	0.0085	0.4070	0.8010
GDP	Constant 2015 billion US$	350.0000	21.0396	93.5000	1,070.0000
Total	% of GDP	5.3646	0.3783	0.3648	13.9197
Forest	% of GDP	1.1701	0.1043	0.1645	4.9300
Coal	% of GDP	0.4168	0.0655	0.0003	3.7163
Mineral	% of GDP	0.3938	0.0520	0	2.6550
Gas	% of GDP	0.9913	0.0866	0.0008	3.4527
Oil	% of GDP	2.3926	0.2261	0.0104	9.0447
Industry	% of GDP	38.1771	0.4669	28.3999	48.5303
Oresexp	% of merchandise exports	3.1702	0.2433	0.4364	10.6518
Fuelexp	% of merchandise exports	11.8282	0.9381	0.8449	33.8641

Source: Authors' calculations (2024)

When comparing by country (Appendix 2), there is a significant increase in the HDI and GDP of the 5 selected Southeast Asia countries in the period 2000-2021. For the GDP index, Indonesia's GDP increased by nearly 2.7 times, and it is the country with the highest GDP continuously compared to the other 4 countries in the period 2000-2021. Meanwhile, Thailand's GDP increased by nearly 2 times, the Philippines increased by almost 2.7 times, and Malaysia increased by about 2.4 times. Although Vietnam has the highest GDP growth rate compared to the remaining countries (an increase of almost 3.6 times), this country has the lowest GDP in the research period.

Although Thailand's GDP is lower than Indonesia's and has the slowest growth rate compared to the other countries, its HDI is the highest in all years of the study period, and it was ranked in the group of countries with very high HDI (greater than or equal to 0.8) in 2019. In contrast, Malaysia's HDI is in the low human development group in most years of the study period. The remaining three countries have HDI indexes ranging from 0.6 to more than 0.7.

The results of the estimation for the three models OLS, FEM and GLS are presented in Table 4. While the coefficients of *lncoal, lnoil, and lngdp* are positive in most models, the coefficients of *lntotal, lnforest, lnmineral, lngas, lnindustry, lnoresexp, and lnfuelexp* are negative in most models (except for the coefficients of *lnforest, lnoresexp, and lnfuelexp* which are positive in the FEM model).

Table 4. Estimation results of OLS, FEM and GLS

Dependent variable: lnHDI

Variable	(1) OLS		(2) FEM		(3) GLS	
	Coefficient	**Std. error**	**Coefficient**	**Std. error**	**Coefficient**	**Std. error**
lntotalrents	-0.057***	0.021	-0.080***	0.013	-0.039**	0.018
lnforest	-0.082***	0.012	0.013	0.014	-0.062***	0.012
lncoal	0.025***	0.004	0.008**	0.003	0.023***	0.004
lnmineral	-0.012***	0.003	-0.006***	0.002	-0.007***	0.003
lngas	-0.032***	0.009	-0.008	0.006	-0.024***	0.008
lnoil	0.080***	0.013	0.022**	0.009	0.046***	0.012
lngdp	0.134***	0.015	0.127***	0.016	0.138***	0.015
lnindustry	-0.528***	0.057	-0.134*	0.069	-0,441***	0.060
lnoresexp	-0.038***	0.011	0.059***	0.011	-0.054***	0.012
lnfuelexp	-0.028***	0.010	0.032***	0.008	-0.016*	0.009
_cons	-1.894***	0.395	-3.319***	0.573	-2.344***	0.403
N	110		110		110	

Note: ***, **, * at the 1%, 5%, and 10% statistical significance, respectively.

Source: Authors' calculations (2024)

The econometric estimation based on a GLS has revealed the negative and statistical significance between total natural resources rents and HDI. If total natural resources rent increases by 1%, HDI will decrease by 0.039%, and this effect is statistically significant at the 1% level.

Similarly, at the 1% statistical significance, a 1% increase in mineral rents and natural gas rents are associated with a 0.007%, and 0.024% decrease in HDI, respectively. A negative correlation between the total natural resource rents and specific rents for forestry, mineral, and natural gas with HDI suggests that higher rents for these resources are associated with lower human development (HDI), and vice versa. In some cases, natural resource wealth may not lead to higher human development and may even contribute to stagnation or decline in HDI if the country falls victim to the "resource curse" or fails to manage its resources effectively. This is because the wealth generated from natural resources will not translate into human development benefits but instead may lead to economic instability, poor governance, environmental degradation, and social inequality, all of which impede progress in key human development areas such as education, health care, and living standards.

Especially with forestry that provides livelihoods for millions of people, especially in rural areas. Forestry rents are an important source of income, particularly for local communities dependent on timber, non-timber forest products, and forestry-based industries. The negative relationship between forestry rents and HDI shows the unsustainable forestry practices, such as deforestation, overexploitation, resource depletion in these countries. For example, despite regulations and state control, illegal activities persist, driven by demand for timber and weak enforcement, Indonesia and Malaysia have faced challenges with illegal logging in areas like Sumatra and Borneo, leading to the depletion of forest resources and biodiversity. Deforestation rates are high due to land conversion for agriculture, palm oil plantations, and urbanization.

On the contrary, with coal rents and oil rents, at the 1% statistical significance, a 1% increase in coal rents and oil rents leads to increases by 0.023 % and 0.046% in HDI. The positive and statistically significant relationship between these rents and HDI reflects the effective use of natural resource wealth to improve social welfare, economic opportunities, and overall human development in these countries. Many of these countries are net exporters of coal and oil, and the revenues from these exports contribute significantly to national income. The government policies may be directed towards ensuring that the benefits of resource rents are reinvested in human development sectors such as education, healthcare, and poverty alleviation. For instance, the oil and gas industry in Malaysia contributes about 40% of the country's total revenue and is also a major contributor to various subsidy programs (Lee, 2013).

This result is similar to the study of Nchofoung et al. (2021) in Africa, high income, lower-middle income, lower-income, and least-developed countries, Debonheur et al. (2024) in 41 African countries, Li et al. (2023) in N11 countries, and Sinha & Sengupta (2019) for 30 Asia-Pacific countries from 1996–2016 in the absence of globalization.

On the other hand, although GDP has a positive and statistically significant impact on HDI, however industry value added, fuel exports, and ores and metals exports have a negative and statistically significant relationship with HDI. The positive relationship suggests that higher GDP might be contributing to better human development outcomes, such as improved healthcare, education, and living standards, all of which are components of HDI. As countries grow economically, they may have more resources to invest in these areas, leading to higher HDI. But the correlation does not imply causation, so while GDP is associated with HDI, other factors may also be influencing this outcome, e.g., government policies, investments in social welfare, international aid, etc. This suggests that while these sectors contribute to GDP, their negative externalities and lack of inclusivity may explain the negative relationship with HDI in these countries.

Table 5. Estimation results of FEM - split sample

Dependent variable: lnHDI

Variable	**HDI < 0.7**		**HDI ≥ 0.7**	
	(1) **Coefficient**	(2) **Std. error**	(3) **Coefficient**	(4) **Std. error**
lntotal	-0.074***	0.014	-0.049**	0.018
lnforest	0.004	0.017	0.055***	0.011
lncoal	0.011***	0.004	-0.004	0.005
lnmineral	-0.008***	0.002	0.003	0.002
lngas	-0.004	0.007	0.035***	0.010
lnoil	0.014	0.014	0.003	0.007
lngdp	0.106***	0.025	0.205***	0.014
lnindustry	-0.177**	0.085	-0.172**	0.064
lnoresexp	0.061***	0.014	0.014	0.010
lnfuelexp	0.025*	0.013	0.009	0.012
cons	-2.610**	0.832	-5.086***	0.417
N	76		34	
AIC	-338.1912		-247.7138	

Note: ***, **, * at the 1%, 5%, and 10% statistical significance, respectively.

Source: Authors' calculations (2024)

The results in Table 5 show that the impacts of GDP on the HDI were all significance positive and with an increase in the quantile level, the estimated value of the coefficient gradually increased. In this sense, a 1% increase in GDP leads to increases of 0.106% (Column 1) and 0.205% (Column 3) in the HDI. Conversely, total natural resources rents, and industry value added are found to have a negative and statistically significant effect on the HDI in both low HDI and high HDI, but it decreases with the increase of HDI. For example, a 1% increase in total natural resources rents results in decreases of 0.074% (Column 1) and 0.049% (Column 3) in the HDI. Regarding other variables, if HDI < 0.7, coal, ore and metal export rents improve HDI. While if HDI ≥ 0.7, forest and gas rents positively affect HDI.

4. CONCLUSION

This paper examines the effects of natural resource rents on human development in five selected Southeast Asia countries for the period 2000–2021. To do this, we used the pooled OLS, fixed effects model (FEM), random effects model (REM), and generalized least squares (GLS) to correct diagnostics problems. The results of the GLS model show that while total natural resources rents, forestry rents, mineral rents, and natural gas rents are harmful, coal rents and oil rents are enhancing inclusive human development. Additionally, while GDP has a positive and statistically significant impact on HDI, industry value added, fuel exports, and ores and metals exports have a negative and statistically significant relationship with HDI. On the other hand, resource rents (total natural resources rents, mineral rents) tend to have different impacts depending on the level of development. For lower-HDI countries, reliance on resource rents generally hinders development, while in higher-HDI countries, specific resources (e.g., forestry, natural gas) may contribute positively. Structural factors (industry, fuel exports, ore exports) also have varying effects based on HDI levels, the reliance on fuel exports and ore exports being improved HDI in lower-HDI contexts, while industrial reliance being detrimental in both levels.

Since natural resources are finite and non-renewable, the economic benefits from these resources should be used for long-term development purposes. Thus, natural resource rents should be used efficiently to finance objectives such as infrastructure, health and education. In addition, economic diversification should be promoted to reduce the economy's dependence on natural resources. And governance institutions should be strengthened, transparency should be promoted, law enforcement should be strengthened, and sustainable resource management practices should be implemented to minimize the environmental impact of resource exploitation. Policymakers should also pay more attention to the management of private parties involved in the exploitation and use of natural resources. Furthermore, efforts should focus on supporting market reforms, strengthening anti-corruption measures, and imposing penalties on rent-seeking behaviors.

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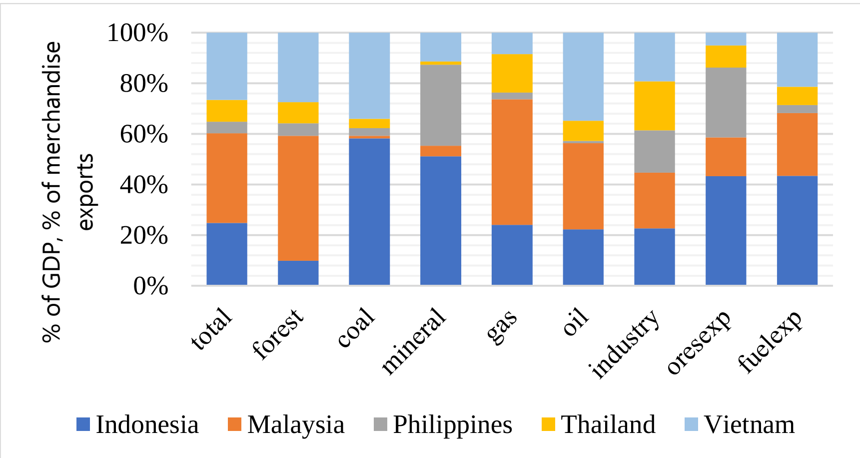
International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 4S, 2025
https://www.theaspd.com/ijes.php

Appendix A. Matrix of correlations

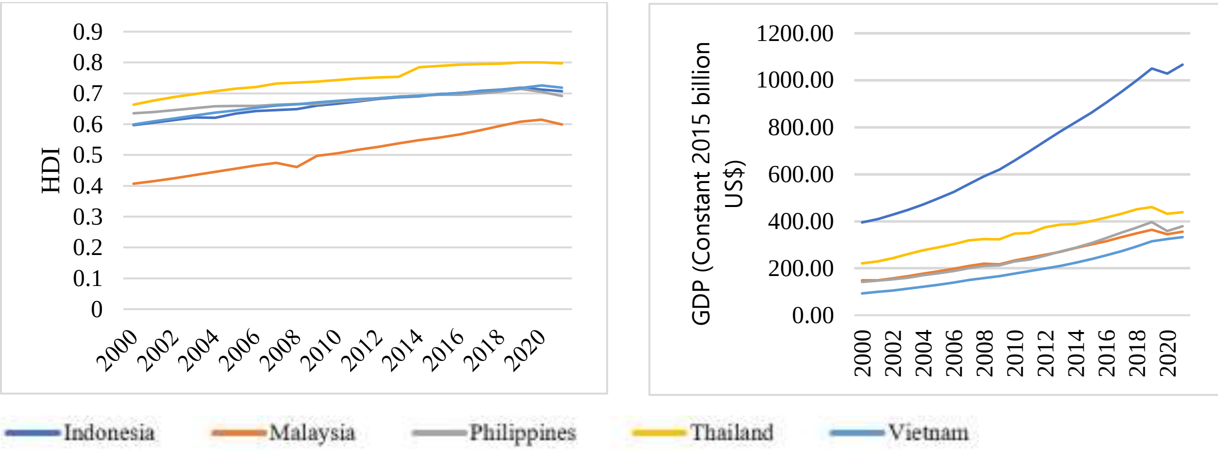
	(1) lnhdi	(2) lngdp	(3) lntotal	(4) lnforest	(5) lncoal	(6) Lnmineral	(7) lngas	(8) lnoil	(9) lnindustry	(10) lnoresexp	(11) lnfuelexp
(1)	1.0000										
(2)	0.4073***	1.0000									
(3)	-0.5866***	-0.0896	1.0000								
(4)	-0.7193***	-0.4143***	0.7947***	1.0000							
(5)	0.4717***	0.4000***	0.2056**	-0.1968**	1.0000						
(6)	-0.0146	0.1473	0.1313	-0.1558	0.5454***	1.0000					
(7)	-0.4532***	0.2075**	0.7284***	0.5829***	-0.0668	-0.234**	1.0000				
(8)	-0.449***	-0.1067	0.9403***	0.7686***	0.2213**	0.0009	0.7532***	1.0000			
(9)	-0.5505***	0.1565	0.7493***	0.5415***	0.0948	0.061	0.686***	0.7573***	1.0000		
(10)	0.0965	0.6954***	-0.1405	-0.4785***	0.2341**	0.4176***	0.001	-0.3030***	0.0198	1.0000	
(11)	-0.377***	0.2213**	0.8453***	0.5033***	0.3604***	0.1971**	0.6398***	0.8148***	0.7342***	0.1473	1.0000

Note: ***, ** at the 1%, and 5% statistical significance, respectively.
Source: Authors' calculations (2024)

Appendix B.



a, Proportion of total natural resources rents, forest rents, coal rents, mineral rents, natural gas rents, oil rents, industry value added, fuel exports, ores and metals exports of 5 selected Southeast Asia countries in 2021



b, HDI and GDP of five selected Southeast Asia countries in the period 2000-2021

Source: Authors' calculations (2024)