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Analysis of Macroeconomic Factors of Energy Consumption in Malaysia, Thailand and Indonesia

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Abstract: This paper examines the relationship between GDP, FDI and inflation rate and energy consumption by analyzing time-series data from Malaysia, Indonesia, and Thailand. Data sources include the World Bank, the Malaysia Energy Information (MEI), and the World Development Indicators (WDI) from 2003 to 2023 and were examined by multiple regression analysis. The findings show that energy consumption in Malaysia is significantly impacted by GDP, FDI, and the inflation rate. Energy usage in Indonesia is significantly influenced by both GDP and FDI. In contrast, the GDP and inflation rate are the main variables that have a major impact on energy use in Thailand. These findings have important implications for policymakers that provide insights into the trends in economic development across different countries. Policy makers must develop coordinated energy usage and economic policies to achieve resilient and long-lasting economic development.

Keywords: *FDI, GDP, Inflation, Energy*

1. Introduction

Energy usage is the quantity of energy utilized by individuals, industries or countries including the use of electricity, oil and natural gas, and renewable energy sources like solar, wind and hydropower. Energy has an important key in elevating global socio-economic growth and acting as a vital force in sustainable development and national wealth. A sharp rise in energy utilization in developing economies led to promoting societal growth, rapid economic expansion and quality of living standards (Ibrahiem, 2015).

Next, Sadiq (2023) claimed that GDP, FDI, and inflation rate have a significant in energy usage in China as an emerging country is boosting the GDP, increasing inflation and encouraging FDI,, which is driving increased energy consumption. Similarly, Sapuana (2020) found that FDI, GDP and inflation are related to each other in Yemen's economy. For example, a rise in FDI would boost the GDP expansion, increase inflation because of the higher consumer demand and production cost and finally, increase the energy usage in Yemen. Policymakers should be concerned about the relationship between these three variables before making policies related to economic policy and energy use for sustainable, competitive economic development and improving the standard of living of the people.

The main factor of a sustainable and resilient country is energy consumption, which is significantly impacted by macroeconomic variables like GDP, inflation and FDI. A growth in GDP often indicates more productivity, improved living standards, and increased industrial activity, which raises the need for energy usage. Additionally, FDI is important because it finances technological development, industrial expansion, and infrastructural projects, which increase energy consumption. Meanwhile, via influencing buying power, manufacturing prices, and general economic stability, inflation can have an indirect effect on energy usage. Policymakers, scholars, and investors who want to strike a balance between sustainable energy usage and economic growth must comprehend how GDP, FDI and inflation relate to energy use.

2. Literature Review

Foreign Direct Investment has an impact on Energy Consumption

Majumder (2019) indicated that FDI positively impacts domestic investment and energy usage in Bangladesh. In the case of Bangladesh, FDI has been concentrated in sectors such as manufacturing, textiles, telecommunications, and energy, which require significant infrastructure development and energy inputs. Additionally, FDI-driven industrial growth increases the demand for electricity and fuel, particularly in energy-intensive sectors. The construction of factories, export processing zones, and other production facilities raises national energy consumption. Azam (2019) and Zheng (2020) revealed that FDI positively impacts energy consumption in China. Foreign Direct Investment (FDI) brings in capital, advanced technology, and industrial

expansion, all of which contribute to increased energy consumption. In China, much of the FDI flows into energy-intensive sectors such as manufacturing, construction, and heavy industry. As foreign companies establish or expand their operations, they increase the demand for electricity, fuel, and other energy resources to support production processes, transportation, and infrastructure.

Inflation has an impact on Energy Consumption

Adi (2022) discovered that inflation significantly enhances electricity usage, a relationship that can be explained through multiple economic mechanisms. During periods of rising inflation, production costs such as labor and raw materials increase, leading firms to substitute labor with machinery and automation, which raises electricity demand. Talha (2021) suggests that consumer demand and production cost combined result in a significant relationship between inflation and energy consumption. Inflation influences energy consumption in Malaysia through its impact on both consumer behavior and production costs. When inflation rises, the prices of goods and services including energy tend to increase. The study highlights the importance of stable inflation for managing energy demand effectively.

Growth Domestic Product and its impact on Energy Consumption

Ibrahiem (2015) showed that Egypt's GDP had a sustained positive effect on renewable electricity consumption from 1980 to 2011. Economic growth typically increases energy demand, and Egypt responded by gradually expanding its renewable energy capacity to meet this need more sustainably. The study highlights the role of economic growth as a driver of renewable energy development, supporting both environmental sustainability and long-term energy planning. Hongyun (2021) revealed that electricity consumption rises as GDP increases in Zhejiang's economy, reflecting a relationship between GDP and energy demand. As GDP grows, industrial production, commercial activities, and household income typically increase which contributes to higher electricity usage.

3. Methodology

Population and Sampling

The population of this study comprises GDP, FDI, inflation rate and energy consumption data from Malaysia, Thailand and Indonesia. These countries were purposively selected to analyze the consequences of FDI, GDP, and inflation on energy utilization from 2003 to 2023. A final total of 360 data points of GDP, FDI, inflation rate and energy consumption from three countries were retrieved from the WDI, MEI, and World Bank.

Data Analysis Techniques

Regression analysis using SPSS to examine the statistical significance and strength of impact among selected variables. In this study, regression analysis helped identify whether independent variables such as GDP, FDI and inflation, and independent, energy consumption were significantly correlated and whether changes in one variable could predict changes in another. Using SPSS ensured accurate computation of coefficients, p-values, and R-squared values, providing a robust basis for concluding the nature and direction of the relationships.

4. Findings and Results

Regression Analysis

Table 1: Malaysia

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	t	Significance
1 (Constant)	-0.059	0.582	-0.101	0.920
FDI	0.114	0.026	4.402	0.000
GDP	7.510	0.0821	9.143	0.000
Inflation	-7.671	1.044	-7.349	0.000

Note: a. Dependent Variable: Energy
R-Square = 0.876, F value = 49.620, P value = 0.000

R-square is 0.876, meaning GDP, FDI, and inflation rate explain 87.6% of the changes in energy consumption in Malaysia. The F value was 49.620 and a p-value of 0.000. Independent variables have a strong impact on energy consumption, as supported by the findings of Hongyun (2021) and Adi (2022). GDP, inflation rate and FDI typically lead to increased industrial activity, urbanization, and higher living standards, which significantly boost the demand for energy in Malaysia.

Table 2: Thailand

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	t	Significance
1 (Constant)	3.050	0.789	3.865	0.001
FDI	-0.350	0.057	-0.531	0.601
GDP	7.498	1.782	4.208	0.000
Inflation	-7.832	2.402	-4.093	0.001

Note: a. Dependent Variable: Energy
R-Square = 0.73
F value = 18.940
P value = 0.000

The results suggest that the independent variables collectively explain 73.0% of the variation in energy consumption in Thailand. The findings reveal that GDP and inflation have a significant positive effect on energy consumption aligning with the findings of Talha (2022). This suggests that as the Thailand economy grows, increased industrial activity, higher household income, and greater infrastructure development, increase the inflation contribute to rising energy demand. However, the impact of FDI on energy consumption is found to be statistically insignificant.

Table 3: Indonesia

Model	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	t	Significance
1 (Constant)	0.654	0.661	0.989	0.334
FDI	0.100	0.056	1.792	0.088
GDP	2.346	0.840	2.794	0.011
Inflation	-0.023	0.021	-1.083	0.291

Note: a. Dependent Variable: Energy
R-Square = 0.444
F value = 5.589
P value = 0.000

Table 3 presents an R-squared value of 0.444, indicating a moderate level of explanatory power. GDP and FDI have a significant positive effect on energy consumption consistent with the findings of Ibrahiem (2015) and Zeng (2020). In contrast, inflation does not have a significant impact on energy consumption, as indicated by a p-value of 0.291.

5. Conclusion and Recommendations

This research looks at how energy utilization in Malaysia, Thailand, and Indonesia has changed over the past 20 years in relation to FDI, GDP, and inflation. The results showed that in all three nations, GDP has a major impact on energy usage. While inflation and energy consumption are significantly correlated in Malaysia and Thailand, FDI has a major impact on energy usage in Thailand and Indonesia. It is advised that future studies investigate how other macroeconomic factors, such as the money supply, government spending, and

international commerce, affect energy usage. Furthermore, toward the conclusion of the analysis, extending the research term can produce new or stronger findings.

Energy usage in less economically developed nations is typically more strongly influenced by macroeconomic issues. These results have significant policy implications since they provide insightful information on the patterns of economic development in various countries. Implementing integrated energy and economic strategies is crucial for nations to achieve resilient and long-lasting economic development. In order to ensure sustainable economic growth and national advancement, governments should create efficient plans to encourage energy efficiency.

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