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The Impact of Natural Resources, Renewable Energy, and International Trade on Sustainable Economic Growth in APEC

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Abstract: This study analyzes the influence of natural resources, renewable energy consumption, and international trade on sustainable economic growth in 14 APEC member countries during the period 1995–2021. Using the fixed effect model (FEM) panel data regression method, the results show that these three variables have a positive and significant effect on sustainable economic growth. Natural resources provide the largest contribution, followed by renewable energy and international trade. These findings emphasize the importance of integrating sustainable resource management, clean energy transition, and green trade in supporting inclusive and environmentally friendly economic development in the APEC region.

Keywords: Sustainable Economic Growth, Natural Resources, Renewable Energy, International Trade, APEC.

INTRODUCTION

Sustainable economic growth in the APEC region now faces challenges from dependence on natural resources and global pressure to reduce carbon emissions. Countries like Indonesia and Australia remain reliant on fossil fuel exports, making their economies vulnerable to price fluctuations and global climate policies. Meanwhile, APEC countries like China and Canada are increasingly pushing the transition to renewable energy, increasing investment and exports of clean technologies like solar panels and electric vehicles (Irfan & Khan, 2026). However, challenges arise with policies like the European Union's Carbon Border Adjustment Mechanism (CBAM), which could hinder high-carbon exports from APEC countries if not accompanied by green reforms (Roshid et al., 2026). Furthermore, (Mahila Zahra et al., 2024) argues that economic growth depends not only on the availability of domestic resources but also on how effectively a country manages its external and financial sectors.

Environmental sustainability is fundamental to ensuring the needs of the present generation through the use of available resources (Arora, 2018). To meet the needs of future generations, nature provides the primary resources needed for the production of goods and services. Therefore, it is crucial to protect the environment and ensure that these resources are not depleted (Deka, 2024). The use of renewable energy not only plays a role in reducing dependence on fossil fuels but also increases energy efficiency and encourages innovation in green technology. A study by (Heriyono, Rohadin, 2024) shows that increased renewable energy consumption significantly reduces carbon emissions and strengthens green economic growth in the G7 countries findings relevant for application in the APEC region. Furthermore, international trade enables the transfer of clean technology and encourages the adoption of more sustainable production standards, while expanding markets for environmentally friendly products.

Sustainable economic growth is a top priority for many countries, including APEC members, as it not only pursues increased income and welfare but also preserves the environment and resources for future generations (Rizal, 2024). This view is reinforced by (Putri & Sari, 2024), who state that sustainable economic growth is a development process aimed at meeting present needs without compromising the capabilities of future generations, by focusing on increasing per capita income, long-term growth, and poverty reduction. Efforts to achieve sustainable economic growth include optimal and wise human resource management (Naima, 2021).

In support of this goal, Green Growth Theory, as presented in the book "Towards Green Growth," published by the OECD (2011), states that economic growth and environmental sustainability can go hand in hand through a transition to a low-carbon economy and efficient use of natural resources. Through this transition to a low-carbon economy and resource efficiency, countries can promote environmentally friendly development and remain economically competitive. This theory emphasizes the importance of investment in renewable energy, green technology innovation, and policy reform as a pathway to sustainable green growth.

One crucial element in the APEC context is the utilization of natural resources, which have significant potential to support economic development if managed sustainably (Azhar & Satriawan, 2018). Natural resources such as oil, gas, and mining can be a driver of growth if the proceeds are used to improve public sectors like education and infrastructure (LM Syuhada Ridzky et al., 2023). Natural resources have a dual role: as capital for economic growth (resource-based economy) and as a life support system. Based on this dual function, natural resources must always be managed in a balanced manner to ensure the sustainability of national development (Qur'an, 2018).

The use of technologies such as smart grids encourages efficiency and reduces energy intensity per unit of economic output. In this regard, the reciprocal relationship between energy consumption, technology, and economic growth is crucial (Azhar and Satriawan 2018). Equally important, international trade also contributes significantly to sustainable economic growth (Akpanke et al., 2024). Through the cross-border flow of goods, services, and technology, international trade accelerates the transfer of green innovations and creates a global market for environmentally friendly products. This encourages industry players to adopt more efficient and environmentally responsible production practices (Afriyanti et al., 2018)

METHOD

This study employed a quantitative research approach using secondary panel data to examine the effects of natural resource rents, renewable energy consumption, and international trade on sustainable economic growth in APEC member economies. The research object was sustainable economic growth, while the explanatory variables consisted of natural resource rents, renewable energy consumption, and international trade. The study covered fourteen APEC member economies, namely the United States, Australia, Canada, China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, Peru, the Philippines, Russia, Singapore, and Vietnam, during the period 1995–2021. Annual data were obtained from the World Bank database.

A census sampling approach was adopted by including all selected APEC member economies with complete data availability throughout the observation period. Sustainable economic growth (SG) was measured using annual GDP growth, natural resource rents (NR) were measured as total natural resource rents (% of GDP), renewable energy consumption (REC) was measured as the percentage of total final energy consumption, and international trade (IT) was measured as trade openness (% of GDP). These indicators were selected because they are internationally recognized and consistently reported by the World Bank, ensuring data comparability across countries.

The empirical analysis was conducted using panel data regression. Three estimation models, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), were estimated to identify the most appropriate specification. The Chow and Hausman tests were employed for model selection, while heteroscedasticity and multicollinearity tests were performed to evaluate the validity of the regression assumptions. The empirical model is specified as follows:

$$SG_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 REC_{it} + \beta_3 IT_{it} + \varepsilon_{it}$$

where *SG* denotes sustainable economic growth, *NR* represents natural resource rents, *REC* refers to renewable energy consumption, *IT* indicates international trade, β represents the estimated coefficients, and ε is the error term. All statistical analyses were performed using EViews 12.

RESULTS AND DISCUSSION

Results

Prior to hypothesis testing, several diagnostic tests were conducted to ensure that the panel regression model satisfied the required statistical assumptions. The heteroscedasticity test indicated that all independent variables had probability values greater than 0.05, suggesting that the regression model was free from heteroscedasticity problems. Furthermore, the multicollinearity test showed that the correlation coefficients among the independent variables were below the threshold value of 0.80, indicating that no serious multicollinearity existed in the model. These results confirm that the estimated regression model is statistically reliable for further analysis.

Table 1 presents the descriptive statistics of the research variables based on 378 observations. Sustainable economic growth (SG) has a mean value of 4.0014 with a standard deviation of 3.7486, indicating moderate variability. Natural resource rents (NR) have a mean value of 4.0376 and a standard deviation of 4.6955. The skewness and kurtosis values suggest

that both variables exhibit slight deviations from a normal distribution but remain within an acceptable range for further analysis

Table 1. Descriptive Statistic

	SG	NR	REC	IT
Mean	4.001403	4.037601	15.35503	4.288843
Median	4.290098	2.052939	8.400000	4.089388
Maximum	14.51975	21.50270	64.90000	6.092712
Minimum	-13.12673	0.000169	0.000000	2.796678
Std. Dev.	3.748567	4.695532	15.36649	0.823214
Skewness	-0.822758	1.250907	0.922026	0.689203
Kurtosis	5.322665	3.825788	2.875294	2.547864
Sum	1512.530	1526.213	5804.200	1621.183
Sum Sq. Dev.	5297.511	8312.102	89020.66	255.4856
Observations	378	378	378	378

Source: Eviews12, (2025)

Model selection was performed using the Chow and Hausman tests, both of which indicated that the Fixed Effect Model (FEM) was the most appropriate estimation technique. The model produced an R-squared value of 0.8897, implying that approximately 88.97% of the variation in sustainable economic growth among APEC member economies could be explained by natural resource rents, renewable energy consumption, and international trade. The F-statistic probability of 0.0000 further confirms that the overall regression model is statistically significant.

Table 2. Panel Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.561029	0.420321	6.093025	0.0000
NR	0.286194	0.028383	10.08313	0.0000
REC	0.039213	0.012740	3.077951	0.0022
IT	0.005389	0.002266	2.377676	0.0179

Effects Spesification

Statistic	Value	Statistic	Value
R-Squared	0.889735	Mean dependent var	0.428437
Adjusted R-squared	0.884848	S.D. dependent var	3.360055
S.E. of regression	1.012959	Sum squared resid	370.4173
F-statistic	182.0579	Durbin-Watson stat	1.694438
Prob (F-statistic)	0.000000		

Cross Section Effect

Country	Effect
USA	-0.409175
AUS	-1.796533
CAN	-1.349968
CHN	5.062410
HKG	-1.806892
IDN	-0.448722

JPN	-1.900520
KOR	1.284350
MYS	-2.332241
PER	0.021137
PHL	7.070391
RUS	-4.818072
SGP	0.157573
VNM	1.266262

Best Model Testing

Test	Prob	Selected Results
Chow Test	0.0000	
Hausman Test	0.0443	

Source: Eviews12, (2025)

In a table 2, shows that all independent variables have positive coefficients, indicating their positive contribution to sustainable economic growth. Natural resource rents (NR) have the largest coefficient ($\beta = 0.286194$), suggesting that a 1% increase in natural resource rents is associated with a 0.286% increase in sustainable economic growth. Renewable energy consumption (REC) also has a positive effect ($\beta = 0.039213$), indicating that greater renewable energy utilization supports sustainable economic growth. Similarly, international trade (IT) has a positive coefficient ($\beta = 0.005389$), implying that increased trade openness contributes positively, although with a relatively smaller effect. Overall, these findings suggest that economies with effective natural resource management, greater renewable energy adoption, and stronger international trade integration tend to achieve higher levels of sustainable economic growth.

Discussion

The empirical findings demonstrate that natural resource rents significantly promote sustainable economic growth in APEC economies. This result suggests that countries with abundant natural resources can achieve higher economic growth when resource revenues are managed efficiently and allocated toward productive sectors such as infrastructure development, industrial diversification, and human capital investment. The findings support the Resource-Based View (RBV), which argues that valuable and strategically managed resources can become a source of long-term competitive advantage. They also indicate that natural resource abundance does not necessarily lead to the resource curse when supported by appropriate institutional management.

Renewable energy consumption also has a positive and significant influence on sustainable economic growth. The result confirms that the transition toward cleaner energy contributes not only to environmental sustainability but also to long-term economic performance. Renewable energy improves energy efficiency, reduces dependence on fossil fuels, and encourages technological innovation, thereby supporting green economic development. This finding is consistent with the Green Growth Theory, which emphasizes that economic growth and environmental sustainability can be achieved simultaneously through investments in renewable energy and green technology.

International trade is likewise found to contribute positively to sustainable economic growth. Greater trade openness enables countries to expand export markets, increase foreign investment, and accelerate the transfer of environmentally friendly technologies. In the context

of APEC, trade integration facilitates the diffusion of innovation and enhances production efficiency, allowing member economies to strengthen both economic competitiveness and environmental sustainability. These findings are consistent with Ricardo's Comparative Advantage Theory, which explains that international trade increases welfare by allowing countries to specialize according to their comparative advantages.

Taken together, these findings indicate that sustainable economic growth in APEC economies cannot be achieved through a single policy instrument. Instead, it requires an integrated development strategy that combines sustainable natural resource management, accelerated renewable energy adoption, and international trade expansion. Such policy integration enables countries to maintain economic growth while simultaneously improving environmental quality and long-term economic resilience.

The novelty of this study lies in its integrated empirical analysis of natural resource rents, renewable energy consumption, and international trade within a single panel data framework for APEC member economies. While previous studies generally examined these determinants separately, this research demonstrates that all three variables jointly and positively contribute to sustainable economic growth. This integrated perspective provides stronger empirical evidence for policymakers seeking to balance economic development with environmental sustainability in the Asia-Pacific region.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study examined the effects of natural resource rents, renewable energy consumption, and international trade on sustainable economic growth across fourteen APEC member economies during the period 1995–2021. The findings demonstrate that all three variables positively and significantly influence sustainable economic growth, indicating that efficient natural resource management, greater utilization of renewable energy, and stronger international trade integration collectively contribute to achieving long-term economic sustainability. Therefore, the research objective of identifying the determinants of sustainable economic growth in APEC economies has been achieved.

This study contributes to the literature on sustainable economic development by providing empirical evidence that economic growth and environmental sustainability should not be viewed as conflicting objectives. Instead, sustainable development can be promoted through the integration of natural resource management, renewable energy transition, and international trade policies within a unified analytical framework. These findings enrich the empirical evidence supporting sustainable growth strategies and provide a broader understanding of the interaction among economic, environmental, and trade-related factors in regional economic cooperation.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the analysis was limited to fourteen APEC member economies during the 1995–2021 observation period; therefore, the results may not fully represent the conditions of all APEC economies or other regional economic organizations. Second, the study focused only on three explanatory variables—natural resource rents, renewable energy consumption, and international trade—while other factors that may influence sustainable economic growth, such as institutional quality, technological innovation, environmental regulations, carbon emissions,

and human capital, were not incorporated into the empirical model. Third, the study employed a static panel data approach using the Fixed Effect Model, which primarily estimates contemporaneous relationships and does not explicitly capture dynamic or long-term adjustment effects among the variables. Consequently, the findings should be interpreted within the scope and limitations of the research design.

Recommendations

Future research is encouraged to expand the scope of the study by including additional APEC member economies or other regional economic organizations to improve the generalizability of the findings. Extending the observation period and incorporating more recent data would also provide a better understanding of the long-term dynamics of sustainable economic growth. Furthermore, future studies should consider including other relevant variables, such as institutional quality, technological innovation, environmental regulations, carbon emissions, human capital, and financial development, to develop a more comprehensive analytical framework for sustainable economic development. In addition, the application of alternative analytical approaches, including Structural Equation Modeling (SEM), dynamic panel data models, System Dynamics, Artificial Intelligence, or longitudinal analysis, may provide deeper insights into the complex relationships among natural resource management, renewable energy transition, international trade, and sustainable economic growth.

Author Contributions

All authors made significant contributions to this study. These contributions included research conceptualization, development of the theoretical framework, data collection, data analysis, interpretation of results, manuscript preparation, scholarly revision, and final approval of the manuscript for publication. All authors confirm that they have read and approved the final version of the article.

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