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Impact of Oil and Gas vs. Non-Oil and Gas Exports on Provincial Economic Growth: A Panel Data Analysis

Mona Afliana, Teuku Zulham, Suriani Suriani* and Miksalmina Miksalmina

Department of Economics, Faculty of Economics and Business, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia

* Correspondence: suriani@usk.ac.id

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Abstract

Economic growth in Aceh Province, Indonesia, is expected to fluctuate due to the unstable growth rates of both oil and gas and non-oil and gas exports. This study aims to investigate the impact of these exports on economic growth in Aceh Province. Utilizing secondary data from the Statistics of Aceh Province (BPS Aceh), the study employed the panel regression method, specifically the random effect model, analyzing data from 23 districts/cities in Aceh Province over the period 2011-2022. Estimation results indicate that oil and gas export growth have a negative effect, while non-oil and gas export growth exerts a positive effect on economic growth in Aceh Province, both of which show robust statistical significance. Based on these empirical findings, it is suggested that there should be cooperation between the government and investors in Aceh Province to maximize the processing of oil and gas commodities for export, as well as to improve the quality of non-oil and gas commodities exported so that, in the future, the demand for non-oil and gas exports can remain stable, fostering sustainable provincial economic growth.

Introduction

Economic growth is defined as the development of economic activities that contribute to the production of goods and services and the overall prosperity of society [1–4]. The economic growth experienced by a region fluctuates over time as the development process unfolds [5–7]. This fluctuation can be influenced by various factors including technological advancements, changes in government policies, fluctuations in global markets, and socio-economic conditions [8–10]. Moreover, the sustainability of economic growth is paramount, ensuring that it not only generates wealth but also improves the standard of living for all members of society while preserving environmental resources for future generations [11–14]. Achieving sustainable economic growth requires a comprehensive approach that addresses social, environmental, and economic dimensions simultaneously [15–19].

According to data from the Statistics of Indonesia publication, economic growth conditions in Indonesia remained above 4% from 2011 to 2019. However, negative growth occurred in 2020 due to the Covid-19 pandemic. In the subsequent years, recovery began, and by 2022, economic growth had returned to above 4%. From this observation, it can be concluded that barring any significant shocks to the economy, Indonesia's economic growth will be sustained at 4%.

Regional economic growth conditions in each province in Indonesia will certainly vary. Aceh Province has a fluctuating growth rate, determined by the economic development in the region or district/city. In 2022, Aceh Province's economy grew by 4.21% when considering oil and gas, and by 3.80% without considering them. However, in the fourth quarter of 2022, it was noted that economic growth with oil and gas was 5.60%, and without oil and gas, it was 5.92%. According to BPS Aceh, during 2011-2022, the GRDP of 23 districts/cities in Aceh Province varied, with some regions experiencing an increase in growth and others experiencing a

decrease. In several districts/cities, economic growth only reached $\pm 1\%$, indicating that GRDP growth was insignificant compared to the Aceh government's target of 4% economic growth. Differences in the level and rate of growth between regions naturally have underlying causes [20,21]. The amount of production [22,23], population [24,25], labor force [26–28], capital-to-labor ratio [26,29], and factor returns [30,31] primarily determine economic growth.

One of the primary determinants of economic growth is the extent of export contribution. Foreign trade, encompassing both exports and imports, stands as a significant factor causing variations in economic growth rates among regions. Exports are believed to boost economic growth (export-led growth) both in the short and long term [32]. According to the export sector, exports are divided into two types: oil and gas and non-oil and gas. Oil and gas exports are petroleum commodities, such as crude oil and oil processed as fuel. Non-oil and gas are commodities from the agricultural, mining, and plantation sectors. Based on export data in Aceh Province, the most superior commodities are coffee, tea, and spices, with an export amount of 33,751,058 USD. The cause of the decline in export commodities in Aceh Province is caused by various things, one of which is the export port used allegedly still through ports from other provinces. 30.56% of commodities from Aceh Province were sent or exported abroad through other provincial ports during August 2021. The largest commodities exported in 2021 through ports outside Aceh Province were the commodity groups of coffee, tea, areca nut, and spices.

Recent research by Shafiullah et al. [32] in Australia explained that exports are essential to economic growth. With the export-led growth theory, the more significant the export sector's contribution, the higher the economic growth. Idris et al. [33] examined trade openness that can stimulate economic growth. Borgersen & King [34] analyzed economic growth through the export supply side, where each sector has different productivity growth. Tang et al. [35] stated that unstable exports require policymakers to look for alternatives to support long-term economic growth. Meanwhile, Biramo Allaro [36] recommended strictly monitoring exports to achieve sustainable economic growth. Gokmenoglu et al. [37] found a long-term relationship between economic growth and exports. Ee [38], Ojide et al. [39] and Daoud & Basha [40] found that exports positively and significantly affect economic growth. In contrast, Zahonogo [41] asserts that excessive trade has a robust downward impact on economic growth. Jin & Jin [42] and Myovella et al. [43] found that export expansion has an insignificant effect on economic growth. The findings of these studies have yet to find the same consensus regarding the relationship between oil and gas and non-oil and gas exports and economic growth. Therefore, this study will specifically take all districts/cities in Aceh Province as the object of research.

Building upon the research background, problem justification, and identified gap, this study aims to examine the impact of oil and gas and non-oil and gas exports on economic growth in Aceh Province. It is observed that while oil and gas, as well as non-oil and gas exports, in Aceh Province continue to rise, the level of economic growth tends to remain unstable. Furthermore, previous research has not reached a consensus and may not necessarily be applicable to the specific conditions of economic growth in Aceh Province.

Materials and Methods

This study employs a quantitative approach to investigate the impact of oil and gas exports and non-oil and gas exports on economic growth in Aceh Province, Indonesia. The secondary data are collected from the Statistics of Aceh Province (BPS Aceh). Time series data in annual form were collected from 2011 to 2022, with 23 districts/cities in Aceh Province as the cross-section. Therefore, panel data were determined as the type of data that this study used. The panel regression method is employed to adjust to the data used in this study. The operational definition of variables is detailed in Table 1.

Table 1. Operational definition of variables.

Variable Status	Variable Name	Symbol	Definition of Variable	Unit of Measurement
Dependent	Economic Growth	EG	Economic growth at constant local currency unit (LCU)	Percent
Independent	Oil and gas exports	OGE	Oil and gas export growth	Percent
	Non-oil and gas exports	NOGE	Non-oil and gas export growth	Percent

The basic econometric model of this study is as follows:

$$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + e_{it} \tag{1}$$

Equation 1 is adjusted to match the symbols of the variables used in this study and is then shown as Equation 2.

$$EG_{it} = \alpha + \beta_1 OGE_{it} + \beta_2 NOGE_{it} + e_{it} \tag{2}$$

Where $\alpha, \beta, i, t,$ and e are the constant, coefficient, cross-section of districts/cities, year of observation, and the error term, respectively; EG is economic growth; OGE represents oil and gas exports, and NOGE is the symbol for non-oil and gas exports.

The panel data regression method requires several conditions before the regression results are analyzed as research outcomes. Some of these tests are designed to determine the best panel data estimation model, whether it is in the form of a Common Effect Model (CEM), Fixed Effect Model (FEM), or Random Effect Model (REM). Therefore, the Lagrange Multiplier, Chow, and Hausman tests must be conducted to select one of the three models. The Lagrange Multiplier (LM) test is used to choose a panel data model between CEM and REM. If the Lagrange Multiplier test results are significant, then REM is the preferred panel data model for analyzing the data. The Chow test or Likelihood Ratio test is employed to select a panel data model between CEM and FEM. If the Chow test yields significant results, then FEM is the optimal panel data model for analysis. Furthermore, the Hausman test is employed to select the panel data model between REM and FEM. If the Hausman test results are significant, then the preferred panel model for data analysis is FEM.

Results and Discussion

Descriptive Statistics

Descriptive statistics as presented in Table 2 shows the available information on economic growth, oil and gas exports, and non-oil and gas exports in all districts and cities in Aceh Province annually from 2011 to 2022. The descriptive statistics reveal that there are a total of 276 observations for each variable in this study. From 2011 to 2022, the average economic growth in all districts/cities in Aceh Province was 3.31%, with a minimum value of -20.33% and a maximum value of 13.22%, along with a standard deviation of 2.70. The average growth rate of oil and gas exports was 0.77%, with a maximum value of 15.09% and a minimum value of -37.66%. Similarly, the average growth rate of non-oil and gas exports was 1.63%, with maximum and minimum values of 46.46% and -43.65%, respectively.

The standard deviation for oil and gas exports and non-oil and gas exports stands at 5.21 and 7.39, respectively. These statistics indicate that the standard deviation for both oil and gas exports and non-oil and gas exports is greater than their respective averages, implying significant deviations in the data and uneven distribution in their growth rates. High economic growth suggests that the districts/municipalities in Aceh Province experienced a substantial increase in economic activity compared to the preceding period, while low economic growth, particularly in 2015 in Lhokseumawe City, was attributed to the effects of a sluggish global

economy and low commodity prices, leading to a significant economic downturn. The fluctuations in oil and gas growth rates are predominantly influenced by the volume of oil and gas exported outside the region or country, whereas the growth rates of non-oil and gas exports are primarily determined by the production of goods and services subsequently exported.

Table 2. Descriptive statistics.

Variable	Mean	Median	Max.	Min.	Std. Dev.	Obs.
EG	3.31	4.04	13.22	-20.33	2.7	276
OGE	0.77	1.33	15.09	-37.66	5.21	276
NOGE	1.63	2.38	46.46	-43.65	7.39	276

Best Model Selection Test

Tests to determine the best panel regression model using the Chow test, Hausman test, and Lagrange Multiplier test must first be carried out. The results of the best model selection test are presented in Table 3.

Table 3. Results of Chow, Hausman, and Lagrange Multiplier test.

Test	Value Referral	Prob.	Conclusion
Chow Test	Cross-section Chi-Square	0.0000	FEM
Hausman Test	Cross-section random	0.2382	REM
Lagrange Multiplier Test	Cross-section Breusch-Pagan	0.0000	REM

The estimation results reveal that the Chow test was conducted to determine the optimal model between CEM and FEM. The Chow test in this study yielded a probability value of 0.0000, which is smaller than the 5% significance level. Hence, it can be inferred from these results that the Chow test is significant. The significance of the Chow test indicates a preference for the FEM model at least temporarily. Additionally, the Hausman test was employed to ascertain the most suitable estimation model between FEM and REM. The Hausman test results exhibited a probability value of 0.2382, exceeding the 5% significance level ($0.2382 > 0.05$). Consequently, the insignificance of the Hausman test led to the temporary selection of REM.

The discrepancy in the selection of the best model between the Chow test and the Hausman test necessitates the performance of the Lagrange Multiplier test. The Lagrange Multiplier (LM) test results indicated a Breusch-Pagan significance of 0.0000, which is smaller than 0.05 ($\alpha = 5\%$). When the LM test is significant, the preferred panel data regression model is REM. In summary, the test outcomes for selecting the optimal panel regression model suggest that among CEM, FEM, and REM, REM should be chosen for further analysis.

Panel Data Regression

Table 4 presents the estimation results of three panel data regression models: CEM, FEM, and REM. This study will focus on analyzing the estimation results from the REM, as it was selected as the best model during the model selection test.

The estimation results of the REM indicate that oil and gas export growth has a negative and significant effect on economic growth in Aceh Province at the 10% confidence level. This is evident from the test results, which show that the growth of oil and gas exports has a probability of 0.0645, smaller than 0.10, with a coefficient of -0.0544. It can be interpreted that when oil and gas export growth increases by 1%, economic growth will decrease by 0.0544% in Aceh Province.

Moreover, the effect of non-oil and gas export growth on economic growth in Aceh Province is positive and significant, with a probability of 0.0000, which is smaller than the 0.01 significance level, and a coefficient of 0.2544. This implies that when there is an increase in non-oil and gas export growth by 1%, it will cause economic growth to increase by 0.2544%.

Table 4. Results of panel data regression.

<i>Dependent: EG</i>					
Model	Variable	Coefficient	Std. Error	t-Statistic	Prob.
CEM	C	2.9212	0.1246	23.428*	0.0000
	OGE	-0.0581	0.0300	-1.9317***	0.0544
	NOGE	0.2668	0.0212	12.568*	0.0000
	R-Squared	0.4433		F-statistic	108.73*
	Adjusted R-Squared	0.4393		Prob. F-statistic	0.0000
	FEM	C	2.9511	0.1170	25.214*
	OGE	-0.0524	0.0301	-1.7414***	0.0828
	NOGE	0.2459	0.0214	11.484*	0.0000
	R-Squared	0.5541		F-statistic	12.997*
	Adjusted R-Squared	0.5111		Prob. F-statistic	0.0000
REM	C	2.9388	0.1907	15.403*	0.0000
	OGE	-0.0544	0.0293	-1.8560***	0.0645
	NOGE	0.2544	0.0207	12.236*	0.0000
	R-Squared	0.4231		F-statistic	100.12*
	Adjusted R-Squared	0.4189		Prob. F-statistic	0.0000

Note: *** and * indicate statistically significant at 1% and 10% confidence levels, respectively.

Additionally, the growth of oil and gas and non-oil and gas exports collectively affects economic growth in Aceh Province. This interpretation is derived from the probability value of the F-statistic, which is 0.0000, smaller than 0.05. Furthermore, it was observed that the R-squared value of this study was 0.4231. This indicates that 42.31% of the variation in changes in the rise and fall of economic growth in Aceh Province can be explained by the growth of oil and gas and non-oil and gas exports, while the remaining 57.69% is explained by other variables not examined in this study.

The classical assumption test was not conducted because the model chosen in this study is a random effect model that assumes the Generalized Least Squares (GLS) estimate has been weighted and addresses the potential problem of not meeting the classical assumption test that may occur in the model [44].

Discussion

This study yields two main results. Firstly, it examines the effect of oil and gas export growth on economic growth in the province. The findings reveal a negative and significant effect, which is concerning given that exports in any form should ideally contribute positively to economic growth. This adverse impact on economic growth may be attributed to suboptimal oil and gas production practices in Aceh Province, where commodities are exported in raw form without undergoing processing. Consequently, these commodities are processed in other regions, and Aceh Province subsequently purchases the processed oil and gas at a higher price, leading to a trade deficit. Furthermore, fluctuations in oil and gas prices contribute to instability in demand, further exacerbating the negative impact on export growth and economic growth in Aceh Province. These findings are consistent with prior research conducted by Ramadhan et al. [45], Kartika [46], and Nopiana et al. [47].

Secondly, the study explores the effect of non-oil and gas export growth on economic growth in Aceh Province. The results demonstrate a positive and significant effect, indicating that non-oil and gas exports have played a crucial role in bolstering economic growth. This suggests that the production of non-oil and gas commodities in Aceh Province has been effectively exported, either in high quality or after processing into semi-finished or finished goods. Given the positive outcomes, it is imperative to sustain the growth of non-oil and gas exports, as any decline in their growth could potentially lead to a decrease in economic growth. Improving the quality of non-oil and gas commodities would stimulate demand and likely result in increased imports from outside Aceh Province. Many non-oil and gas commodities in Aceh Province are considered

superior, particularly those from the mining and plantation sectors, thereby exerting a significant influence on economic growth. These findings align with previous research conducted by Hardi et al. [48], Gunawan et al. [49], and Rinta & Suhartono [50].

Conclusions

This study aims to see the effect of oil and gas exports and non-oil and gas export growth on economic growth in Aceh Province by applying panel data from 23 districts/cities as a cross-section from 2011 to 2022 as a time series, which is analyzed using the panel data regression method. This study's best panel data regression model is the random effect model. Through the analysis of the results of the random effect model on the panel data regression method, there are several conclusions from this study, namely: 1) oil and gas export growth have a negative and significant effect on economic growth in Aceh Province, and 2) non-oil and gas export growth has a positive and significant effect on economic growth in Aceh Province.

Based on the results found, this study provides suggestions and recommendations. Firstly, it is expected that the government and investors can work together so that oil and gas exports in Aceh Province can contribute positively to economic growth by maximizing the production of oil and gas commodities. For example, processing these commodities before exporting could be prioritized. The government can strive for the absence of barriers to the distribution of oil and gas commodities from Aceh Province. Secondly, the positive effect of non-oil and gas export growth on economic growth indicates that non-oil and gas exports in Aceh Province are already in good condition for economic growth. Thus, the people of Aceh can focus on increasing the production of non-oil and gas commodities that can be exported. This can be achieved by increasing the quantity and quality of non-oil and gas goods and services. Consequently, it will increase the demand for non-oil and gas commodities from outside Aceh Province, thereby boosting economic growth.

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