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Cointegration Analysis between Tuna and Skipjack Exports with Fisheries Gross Regional Domestic Product (GRDP) of Aceh Province

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Abstract

Fishery is one of the main sub-sector contributing the Aceh regional economics activities. Aceh fish production, especially Tuna and Skipjack keep increasing from 2014 to 2018. Therefore, there is a need to analyze the relationship between tuna and skipjack exports, and the Fisheries Gross Regional Domestic Product (GRDP) of Aceh Province in the last few years (2011-2019). The purpose of this study was to see how cointegration of the long-term and short-term between the export of tuna and skipjack commodities in Aceh province with the growth of fisheries Gross Regional Domestic Product (GRDP). The method used in this research is the Error Correction Model (ECM) analysis method with data processing using Stata SE-64 software. The results of the analysis show that there is a cointegration between the variable export value of tuna and skipjack commodities and the Gross Regional Domestic Product (PDRB) of Fisheries of Aceh Province both in the long and short terms.

Keywords: *Export; Tuna; Skipjack; GRDP; ECM*

Introduction

One sector that plays an important role in increasing the value of GRDP is fisheries. According to Hermawan (2017), the fisheries sector is able to push economic growth through the provision of raw materials, provision of employment, increasing farmers' income, supporting national development and increase foreign exchange through exports of fishery products. The continuous development of the fisheries sector is capable of increasing productivity, added value, expanding job opportunities and business efficiency. So that development in the fisheries sector is absolutely necessary in order to increase economic growth.

Aceh Province has a very good prospects to develop resources from fishery sub-sector. The contribution of the fisheries sub-sector to the GRDP of Aceh Province from 2014-2018 continues to increase. The contribution of the fisheries sub-sector to GRDP in agricultural sector was third in place after the plantation and food crops sub-sector for five years from 2014 to 2018.

Along with the increase in fish production in the period of 2014-2019, Aceh has the opportunity to become an exporter of fishery commodities. By exporting various fishery products, the fisheries sub-sector could be turned to one of the mainstay commodities, contributing to the growth of Aceh economy. Based on statistical data of Foreign Trade of Aceh Province (2015), Aceh's fishery commodities were exported to various countries, including Vietnam and South Korea. The export figure was better when compared to those of previous year, namely 2011, where Aceh fishery commodities were only exported to three destination countries, namely Malaysia, Thailand and Hong Kong. This achievement is in line with the KKP's Main Performance Indicators target in 2018, namely increasing GRDP growth in the fisheries sector by 11% and increasing the export value of fishery products (KKP, 2018).

In the fisheries sub-sector, especially in capture fisheries, Tuna is one of the main catch fisheries commodities considered as an economically important product. Its contributions to the country's foreign exchange earning from fishery sector is second only to shrimp, with a very significant growth in its exports value. The catching areas of tuna and skipjack in Indonesia spreads from east to west, including Makassar Sea, Banda Sea, Maluku Sea, Arafuru Sea, Papua Sea, Flores Sea, Sulawesi Sea, Indian Ocean, northern Aceh waters, North Sulawesi, Tomini Bay, Halmahera, and other marine waters (Hermawan, 2017).

Tuna is one of Aceh's mainstay fishery export commodities. Sea around Aceh has been considered as one of the catching areas for tuna and skipjack. The number of catches of Tuna in the Province continues to increase from 2013 - 2017. Therefore, Tuna occupies the top position of capture fishery export of economically viable commodities from Aceh Province, followed by White Pomfret, Black Pomfret and others, as listed in Table 1.

Table 1.Economically Important Capture Fisheries Production 2013-2017 (Tons)

No	Kind of Fish	2013	2014	2015	2016	2017 (one data of KKP)
1	Tuna *)	3,862.4	3,698.4	6,545.0	7,302.3	19,403.2
2	Cone *)	2,041.2	1,764.1	524.1	552.0	361.8
3	Cob	22,504.8	21,355.2	30,836.5	29,749.4	75,406.2
4	Skipjack	10,909.3	10,604.3	12,084.0	12,932.3	6,543.1
5	Kwee *)	6,761.0	6,744.6	5,985.8	6,091.2	2,210.3
6	Snapper	4,420.7	4,700.0	5,248.7	6,072.0	18,786.8
7	White Pomfret *)	256.4	253.5	370.8	274.2	328.4
8	Black Pomfret *)	1,326.9	1,567.4	1,752.5	1,750.3	3,509.5
9	Stingray *)	734.7	738.3	426.2	542.0	1,937.7
10	Grouper *)	4,752.1	4,603.0	5,870.8	6,127.0	1,631.3

Information: * Export Commodity
Source: DKP Aceh (2018)

In 2015, total tuna production increased by 2,846.6 tonnes from the previous year. However, in 2016, the increase of tuna production goes down to only 757.3 tons. The highest production occurred in 2017, with 19,403.2 tonnes of Tuna caught in a single year. On the other hand, the amount of Skipjack tuna production, from 2013 to 2014 was relatively stable. Its production increased for two years from 2015 to 2016, and then tended to decrease (Table 1). Therefore, the export performance of tuna and skipjack tuna plays an important role in increasing the economic growth of Aceh's fisheries sector.

Research Method

This study used secondary data from the Central Bureau of Statistics as well as literature related to the problem defined. The data used in this study are time series, namely data on the Gross Regional Domestic Product (GRDP) of Aceh Province and the export value of tuna and skipjack commodities. This study used 2 variables, namely the Gross Regional Domestic Product (GRDP) of the Aceh Province Fisheries, and exports of tuna and skipjack commodities. The variables were analyzed using the ECM (Error Correction Model) method using the StataSE-64 software analysis model. Before entering the ECM testing phase, there are several steps that need to be done. The first stage is a stationary test which aims to determine whether the data used is stationary or not. The second stage of the cointegration test is to find out whether the tested variables are cointegrated or not. The third stage was carried out by a causality test to determine the direction of the cause and effect relationship between the tested variables. The final stage is the ECM test to correct errors that occur in short-term relationships, which are adjusted to long-term relationships. The stages of the analysis model in this study are as follows:

1. Stationary Check

This test is done by performing a unit root test or what is often called a Unit Root Test. To formulate the unit roottest, the Augmented Dickey-Fuller (ADF) test is described. The ADF test model formulations are :

$$\Delta x_t = a_0 + \gamma x_{t-1} + \sum_{i=1}^{p} a_1 \Delta x_{t-i+i} + \varepsilon_1 \qquad (1)$$

Where $\Delta x_t = x_t - x_{t-1}$, t is the time period, γ and a_i are the model coefficients, while ε_t is the Equation Error. The statistical hypothesis tested is Ho: $\gamma = 0$ (the x_t time series data is not stationary); H_1: $\gamma \neq 0$ (time series data are stationary). Data that is not stationary is then stationary through a differentiation process, which can be done several times (d times) until a stationary data pattern is selected. If there is data that is not stationary, a differentiation process will be carried out at the first-difference level to the next level, until data is stationary at the same level. The resulting output is in the form of statistical values and critical values of 1%, 5% and 10%. The formula used to find statistical values is:

$$t = \frac{\gamma\hat{} - \gamma Ho}{SE\gamma} \qquad (2)$$

If the t-statistical value is greater than t-critical, the decision is to reject H0 and if the t-statistic value is smaller than t-critical, then H0 cannot be rejected and shows that the data is not stationary.

2. Johansen Cointegration Test

The cointegration test in this study uses the Johansen (1995) method. The cointegration test is used to solve the problem of non-stationary time series data. As the basis for the cointegration approach is a number of time series data which deviates from the average in the short term, will move together towards equilibrium in the long term. In other words, if a number of variables have a long-term balance and are integrated with each other in the same order, it can be said that these variables are cointegrated (Gujarati, 2004).

In the model, variables are said to be co-integrated if the variables have a long-term balance and integrate with each other in the same order. To see the long-term relationship between these variables, a statistical test was performed:

$$\lambda_{trace} = T \sum_{i=k+1}^{n} (1 - \lambda_1) \quad (3)$$

Where:
K= 0,1, ...n-1
T= The number of observations used
λi = the estimated value of the ith eigenvalue of the matrix Π
r = the vector sum of the cointegration vectors in the null hypothesis
The hypothesis used in the test λ_{trace}, is , H0:r ≤ 0 or there is no cointegency relationship, H0: r ≤ 1 or there is at most one cointegritation equation, H0: r ≤ n-1 or there is at most n-1 cointegritation equation.

3. Granger Causality Test

The causality test was first proposed by Engel and Granger. The purpose of Granger causality is to see the causality or reciprocal relationship between two variables, so that it can be seen whether these two variables statistically influence each other (two-way or reciprocal relationship) have a unidirectional relationship or have absolutely no relationship (do not influence each other). A causality relationship can occur between two variables, if a variable x, namely the economic growth of fisheries projected in the fisheries GRDP of Aceh Province, is influenced by variable x1, namely the export value of Tuna and Cakalang Aceh Province. The Granger causality test aims to see the past effect of a variable on the present condition of another variable. The equation model used for the Granger causality test can be written as follows:

The relationship between the export value of tuna and skipjack (ETC) and fisheries GRDP (GRDP)

$$\Delta ETC_t = a_0 + \sum_{i=1}^{n} \beta_{ETC}\, \Delta \mathrm{ETC}_{t-1} + \sum_{i=1}^{n} \beta_{EETC}\, \Delta GRDP_{t-1} + \pi_1\, ect_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta GRDP_t = a_0 + \sum_{i=1}^{n} \beta_{GRDP}\, \Delta \mathrm{GRDP}_{t-1} + \sum_{i=1}^{n} \beta_{ETC}\, \Delta ETC_{t-1} + \pi_1\, ect_{t-1} + \varepsilon_t \quad (5)$$

ETC_t = Export value of tuna and skipjack in period t (Rp)
ETC_{t-1}- = Export value of tuna and skipjack tuna in the previous period (Rp)
$GRDP_{t-}$ = Fishery GRDP of Aceh Province in the t-period (Rp)
$GRDP_{t-1}$ = Fishery GRDP of Aceh Province in the previous (Rp)
$a_0, \beta_{PG}, \beta_{PE}$ = Coefficient
ect = *Error Correction Term*

4. ECM Test (*Error Correction Model)*

Error Correction Model applied in econometric analysis for time series data because of the ability of ECM to cover many variables to analyze long-term economic phenomena and to study the consistency of empirical models with econometric theory, as well as in an effort to find solutions to non-stationary time problems and spurious regression in econometric analysis (Maski and Sastri, 2004).
The relationship between the export value of tuna and skipjack (ETC) and fisheries GRDP (GRDP)

$$\Delta ETC_t = a_0 + \sum_{i=1}^{n} \beta_{ETC}\, \Delta \mathrm{ETC}_{t-1} + \sum_{i=1}^{n} \beta_{EETC}\, \Delta GRDP_{t-1} + \pi_1\, ect_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta GRDP_t = a_0 + \sum_{i=1}^{n} \beta_{GRDP}\, \Delta \mathrm{GRDP}_{t-1} + \sum_{i=1}^{n} \beta_{ETC}\, \Delta ETC_{t-1} + \pi_1\, ect_{t-1} + \varepsilon_t \qquad (7)$$

Note

ETC_t = Export value of tuna and skipjack in period t (Rp)
ETC_{t-1}- = Export value of tuna and skipjack tuna in the previous period (Rp)
$GRDP_{t-}$ = Fishery GRDP of Aceh Province in the t-period (Rp)
$GRDP_{t-1}$ = Fishery GRDP of Aceh Province in the previous period (Rp)
$a_0, \beta_{PG}, \beta_{PE}$ = Coefficient
ect = *Error Correction Term*

Result and Discussion

In this study, using two variables, namely the variable export value of tuna and skipjack (ETC) and fishery GRDP (GRDP) with the type of time series data. The data used starts from 2011-2019. The export value of tuna and skipjack is the value obtained from the export price of tuna and skipjack tuna against the total export of tuna and skipjack for one year which is calculated in rupiah obtained from the Aceh Provincial Statistics Agency. Fishery Gross Regional Domestic Product (GRDP) of Aceh Province is the amount of added value for goods and services produced by various fishery production units in the territory for a period of one year. The variables were calculated in rupiah.

1. Data Stationary Test Results

The initial stage in analyzing the effect of exports on the GDP growth of fisheries is to test the stationarity of the data. To test whether the data is stationary, you can use the Augmented Dickey Fuller Unit Root Test (ADF) test. The purpose of checking the data stationary is to avoid the occurrence of irregular regression or questionable regression. The data stationary test in this study was carried out on the fisheries GDP variable, tuna and skipjack export value. The results of the stationarity test can be seen in Table 2 below.

Tabel 2. Data Stationary Test Results

Variables	Level ADF Test	Differentiation ADF Test	Information ADF Test
GRDP	-2,829	-2,630	Stationary in the 2nd order
Eksport Value	-3,638	-3,000	Stationary in the 1st order
Critical Value	1%	5%	10%
	-3,750	-3,00	-2,60

Source: Processed (2020)

The results of the stationarity test show that the fisheries GRDP variable is not stationary at level (zero order) and level (order 1) so it is necessary to carry out a differentiation process and in order 2 it is shown in the statistical value on the ADF test which is -2.829 less than 10% critical value, namely - 2,630 which means that the fisheries GRDP variable is stationary in order 2. Whereas for the variable value of tuna and skipjack exports is not stationary at the level (zero order) so it is necessary to carry out a differentiation process level I (Order I) and show a statistical value of -3.638 smaller than 5% critical value is -3,000 so it can be concluded that the variable export value is stationary in Order I.

Based on the results of the stationarity test, the export value variable of tuna and skipjack tuna and fishery GRDP have stationary time series data. If the data is not stationary, then the analysis cannot be continued at the next stage, because it will produce an unreliable regression. If the data is stationary, it can be continued in the next step, namely the Johansen cointegration test.

2. The Results of the Johansen Method Cointegration Test

After the data is transformed into stationary data, the next step is cointegration test using the Johansen method. The cointegration test is carried out to estimate whether there is a long-term relationship between the two variables. The results of the cointegration test can be seen in the table 3 below.

Tabel 3. Johansen Cointegration Test Results on Fishery GRDP and Export Value of Tuna and Skipjack tuna

Rank	Eigenvalue	Trace Statistic	5% Critical Value
r=0		217,2324	15,41
r=1	1.0000	0.9705*	3,76
r=2	0.14935		

Source: Processed, 2020

Information: * significant at α = 10%; ** significant at α = 5%; *** significant at α = 1%

The results of the Johansen method cointegration test on fishery GRDP and export value of tuna and skipjack tuna show the decision to reject Ho, which means there is cointegration at the 95% confidence level shown in the trace statistic value, which is 217.2324, which is greater than the critical value, which is 15.41. There is a cointegration relationship between the variable value of tuna and skipjack exports and the PDRB of Fisheries in Aceh Province. The existence of cointegration shows that there is a long-term relationship between the variable value of tuna and skipjack exports and the PDRB of Fisheries in Aceh Province.

3. Granger Causality Test Results

The Granger Causality Test was used to see the relationship between the variable export of tuna and skipjack tuna with the GRDP of Fisheries in Aceh Province. Does the export value of tuna and skipjack cause the growth of the PDRB of Fisheries in Aceh Province, or the growth of the PDRB of Fisheries of the Province of Aceh which causes the growth of tuna and skipjack exports. The test results can be seen in Table 4 below.

Table 4. Granger Test Results Fishery GRDP and Export Value of Tuna and Skipjack tuna

Parameter		**GRDP**	**Export Value**	**Causility Result**
Relationship (β)				One-way relationship (EV → GRDP)
Fishery GRDP	t-1	0.095*	0.039**	
export value of skipjack tuna	t-1	0.757	0.013**	

Source: Processed, 2020

Information: * significant at α = 10%; ** significant at α = 5%; *** significant at α = 1%

Based on the results of the causality test, the results show that the fisheries GRDP variable shows the value (β) of the fisheries GRDP at t-1, which is 0.095 * significant at α = 10%. Meanwhile, the value (β) of the export value is not significant. This means that the GDP growth of Aceh Province Fisheries cannot affect the export value of tuna and skipjack. Furthermore, the variable value of tuna and skipjack exports shows that the value (β) of the GDP of fisheries t-1 is 0.039 ** significant at α = 5% and the value (β) of the export value of tuna and skipjack t-1 is 0.013 ** significant at α = 5%. This means that the export value of tuna and calang affects the GDP growth of fisheries in Aceh Province. So that in the equation between the GRDP of Fisheries and the export value of tuna and skipjack tuna only has a one-way relationship, namely the export value of tuna and skipjack tuna affects the GDP growth of fisheries in Aceh Province.

4. Error Correction Model (ECM) Test Result

Table 5. VECM Estimation of Fishery GRDP and Export Value of Tuna and Skipjack

Estimation Parameter		**Fishery GRDP**	**Export value of tuna and skipjack**
Long Run Equilibrium Relationship (β)		1	-0,002**
Adjustment Speed (α)		-0,068	4.833
Short term relationship (Γ)			
GRDP of Fisheries	t-1	-0,400	-3.402*
Export value of tuna and skipjack	t-1	-0.002	-0,986***

Source: Processed, 2020

Information: * significant at α = 10%; ** significant at α = 5%; *** significant at α = 1%

This equation indicates that the cointegration equation model is good. A good cointegration equation is expressed as an indication of a long-run equilibrium between GDP growth of fisheries in Aceh Province and the export value of tuna and skipjack tuna.

The results of this equation also explain that when the prediction of the integration equation is positive, then the GRDP of Fisheries is above the equilibrium line because the GRDP coefficient is positive and calculated from the velocity (α) of the GRDP of fisheries is -0.068. This means that when the GRDP of Fisheries is in equilibrium, the export value of tuna and skipjack will adjust to equilibrium with a speed of 4,833.

This research shows that there is a cointegration between the export value of tuna and skipjack to the PDRB of fisheries in Aceh Province because the value received from the export of tuna and skipjack can increase the growth of fisheries GRDP of Aceh Province. This is consistent with research conducted by Ginting (2017), where exports affect Indonesia's economic growth. In fact, the ECM results show that both in the long and short term, in addition to export investment, it has a positive and significant effect on economic growth. This research is also in line with research conducted by Syofya (2017), that is, export activities have a positive impact on Indonesia's economic development in terms of the trade sector that drives other sectors, especially the agricultural sector, manufacturing industry, services and other sectors. The summary of the results of this study is also in line with Haryati & Hidayat (2014), Long-term relationship between economic growth and exports in Malaysia, Japan and South Korea. The relationship that occurs between exports and economic growth, is a relationship that has a positive effect. Manufacturing exports and imports of capital goods positively and significantly affect GDP. All variables also have a positive sign (Sumiarti, 2015). In line with Sumiarti (2015), Salomo & Hubarat (2007) in Ginting, found that in the long run, exports had a significant effect on economic growth.

Other research that supports this study was Abou-Stait (2005), who tested the ELG hypothesis with a sample in Egypt using the Granger-causality test method and found that exports led to economic growth. Likewise, Kim & Lim (2005), who use the vector error correction model (VECM) approach, state that exports have an effect on economic growth in Korea.

Other researcher that supports this research was the one conducted by Saimul (2012), with the VAR method. The results showed that non-agro export shocks had a positive effect on Indonesia's macroeconomic performance, in the sense that it could increase economic growth and net exports both in the short term and in the long term. long.

Conclusion

Based on the results of the discussion, it shows that there is a cointegration equation between the export of tuna and skipjack commodities and the fisheries GDP of Aceh province. This equation has a one-way relationship. This means that the export value of tuna and skipjack commodities affects the growth of fisheries GDP in Aceh Province. This equation also has long-term and short-term relationships.

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