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Indra Nurcahyo Sjarif
Ministry of Marine Affairs and Fisheries in Indonesia

Koji Kotani
International University of Japan

Ching-Yang Lin
International University of Japan

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IUJ Research Institute
International University of Japan

Exports and Economic Growth in Indonesia's Fishery Sub-Sector: Cointegration and Error-Correction Models

Indra Nurcahyo Sjarif* Koji Kotani† Ching-Yang Lin‡

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Abstract

This paper investigates the causal relationship between fishery's exports and its economic growth in Indonesia by utilizing cointegration and error-correction models. Using annual data from 1969 to 2005, we find the evidence that there exist the long-run relationship as well as bi-directional causality between exports and economic growth in Indonesia's fishery sub-sector. To the best of our knowledge, this is the first research that examine this issue focusing on a natural resource based industry, and the results shed light on the role of agriculture sector for economic growth in the developing countries.

Key Words: export growth, economic growth, fishery sub-sector, cointegration, error-correction models

JEL Classification: Q57, Q58

*Staff of Program Division, Directorate General of Fisheries Products Processing and Marketing, Ministry of Marine Affairs and Fisheries (e-mail: indra@dkp.go.id).

†Associate Professor, Graduate School of International Relations, International University of Japan (e-mail: kkotani@iuj.ac.jp).

‡Assistant Professor, Graduate School of International Relations, International University of Japan (e-mail: clin@iuj.ac.jp).

1 Introduction

The development of agriculture sector has been a core issue in developing countries. Studies suggest that the productivity growth of agriculture sector is responsible for the aggregate economic development (Gollin et al. (2002) and Restuccia et al. (2008)). However, it is not clear what contributes to the development of agriculture sector, *i.e.*, the engine of growth. Although explanatory variables such as institutional reasons, infrastructure development, and government's sectoral policy are discussed in the existing literature (Headey et al. (2010) and Thirtle (2003)), the channel *export-led growth* is less addressed. [1]In this study we explore this growth channel by examining the causal relationship between output growth and exports in the fishery sector in Indonesia.

The economic growth of fishery sub-sector in Indonesia appears to have been sustained for a sufficiently long time. This rapid growth may be attributed to an increase in its export, which has been considered a driving force to accelerate its development. On the other hand, fish export may also receive some feedback from the output growth in the fishery sub-sector itself, which definitely gives positive impact on the structure of production, availability of and accessibility to capital, technologies, and supply of skilled labors (Nikijuluw and Bahri (1999)).

To the best of our knowledge, this is the first study that examines this issue, focusing on a natural resource based industry such as fishery or agriculture. Therefore, it is expected that this paper makes a contribution to empirical literature. Although there are several techniques to investigate causality, this paper applies cointegration and error-correction models to test whether there is a long run nature and two-way

[1]Export-led growth have been widely discussed in the national level. See Michaely (1977), Balassa (1978), Feder (1983), Jung and Marshall (1985), Hsiao (1987), Darrat (1987), and Marin (1992)

causal relationship between fishery export and its economic growth. The advantage of this methodology is to enable us to provide a more comprehensive test of causality. More specifically, they allow the causality between two variables running from a general trend or equilibrium relationship, and can accommodate the presence of the cointegration properties in the model. Thus, the cointegration and error-correction models are appropriate for the type of causality analysis conducted in this paper.

We expect that this study could provide implications for Indonesian policy. In fact, the expansion of seafood and fish related exports has been a national strategy for economic growth in Indonesia, and public investments on fishery subsectors has been made to enhance the product quality, technology and supply chain to satisfy extensive buyers in the world trade environment (Nikijuluw and Bahri (1999)). Thus it is quite important to empirically examine the relationship between exports and economic growth of this fishery subsector for the purpose of evaluating what has been done in adapting to the changing trade environment.

It is well-known that the market environment of international trade has been liberalized over the last 20 years, and this situation is expected to apply to the fishery's subsector in Indonesia as well. Our results provide implications on whether Indonesian fishery subsector has been adapted to the liberalized world trade environment or not, as well as the governmental strategies taken for an expansion of fishery related exports have been successful or not.

The structure of the paper is as follows. Section II describes the performance of Indonesia's fishery sub-sector. Section III reviews the methodology and data sources related to the analytical tools. Section IV discusses the empirical results, and conclusions are presented in the last section.

2 Performance of Indonesia's Fishery Sub-Sector

Indonesia is the biggest archipelago country in the world, which consists of 17,508 small and big islands and has coastal line of 81,000 km. Due to the unique attributes in location, Indonesia is endowed with hundred of bays, seas, and straits. Totally, Indonesia has 5.8 million km^2 of marine water area, which consists of 3.1 million km^2 territorial waters and 2.7 million km^2 Exclusive Economic Zone (EEZ). The water areas which are around 75% of the Indonesian territorial are habitat for many commodities of fish and other aquatic organisms. The water areas are also potential for the fish farming's development (Nikijuluw and Bahri (1999)).

The latest potential estimation of marine fish resources shows that the territorial waters and EEZ contain around 6.4 million ton of fish that can be captured every year without disturbing the sustainability of the resources (Nikijuluw and Bahri (1999)). The production of marine capture fishery in 2004 was 4.32 million ton or 67.19% from the maximum sustainable yield (MSY) which is 6.4 million tons per year, while the capture of inland water fishery was 0.33 million ton. On the other hand, the production from aquaculture fishery was 1.47 million ton (MMAF (2005)). Total fish production has increased by about 4.57% per year in the last five years of 2000-20004 (See Table 1). Table 1 in general exhibits that the trajectory of production indicates an increasing trend, and will be expected to increase further in the future, although some attentions on production trend should be paid to the composition and spatial distribution.

Table 2 demonstrates GDP (Gross Domestic Product) and fisher's output for year 2001-2005 (measured in 2000 prices). The output of the fishery sub-sector during the last five years (2001 - 2005) exhibits a growth trend, and the the average is 5.67%. In 2001, the real fishery's GDP was Rp (Indonesian rupiah) 31,646 billions, increased up

Table 1: Volume and value of fishery production, 2000-2004

	2000	2001	2002	2003	2004	g (%)
Volume (Ton)	5,120,487	5,353,472	5,515,648	5,915,988	6,119,731	4.57
Capture	4125525	4,276,720	4,378,495	4,691,796	4,651,121	3.08
Marine fisheries	3,807,191	3,966,480	4,073,506	4,383,103	4,320,241	3.26
Inland openwater	318,334	310,240	304,989	308,693	330,880	1.04
Aquaculture	994,962	1,076,752	1,137,153	1,224,192	1,468,610	10.36
Mariculture	197,114	221,010	234,859	249,242	420,919	23.35
Brachishwater pond	430,017	454,710	473,128	501,977	559,612	6.84
Freshwater pond	214,393	222,792	254,625	281,262	286,182	7.6
Cage	25,773	39,340	40,742	40,304	53,695	22.09
Freshwater Cageculture	34,602	40,710	47,172	57,628	62,371	15.98
Paddy Field	93,063	98,190	86,627	93,779	85,831	-1.62
Value (Rp 1,000,000)	31,099,251	36,400,097	41,146,597	45,009,194	50,856,249	13.12
Capture	20052180	24,044,822	26,773,561	28,986,862	31,584,963	12.12
Marine fisheries	18,466,369	22,154,236	24,741,520	26,641,072	29,110,269	12.15
Inland openwater	1,585,811	1,890,586	2,032,041	2,345,790	2,474,694	11.91
Aquaculture	11,047,071	12,355,275	14,373,036	16,022,332	19,271,286	14.98
Mariculture	1,368,664	728,221	1,050,534	1,638,065	1,928,069	17.77
Brachishwater pond	7,464,326	8,162,860	9,557,847	10,365,072	13,773,112	16.94
Freshwater pond	1,311,677	2,237,334	2,557,042	2,719,707	2,064,461	16.78
Cage	168,886	264,958	292,360	315,592	494,151	32.94
Freshwater Cageculture	147,093	235,620	273,020	318,529	330,514	24.12
Paddy Field	586,425	726,282	642,233	665,367	680,979	4.56

to Rp 39,366.29 billions in 2005. This value is higher than the increasing percentage of national GDP, which is 4.96%. The share of fishery's output is on average 2.28% per year during the last 5 years. On average, the share also exhibits a growth treand.

Table 2: Gross domestic product of fishery at 2000 constant price, 2001-2005

	2001	2002	2003	2004	2005	g (%)
GDP	1,443,009	1,534,071	1,584,581	1,640,191	1,750,666	4.96
Fishery Output	31,646	33,728	37,407	39,029	39,366	5.67
Fishery Output/GDP	2.19	2.2	2.36	2.38	2.25	

The fishery's exports have a significant contribution as foreign exchange earnings. On average, the real fishery's export values show an upward trend, which is 9.77% per annum, although this growing average is lower than the national exports, which is 17.89% per annum (See Table 3). This reflects the fact that Indonesia should make more efforts to increase the competitiveness of their fishery's products in the markets. In addition, the introduction of some other fishery's commodities is very important in order to penetrate markets rather than only concentrate on tuna and shrimp as

the main export commodities.

Table 3: Real export value of fishery products, 2001-2005

	2001	2002	2003	2004	2005	g(%)
National Exports	63,835,259	61,523,946	62,399,457	59,957,154	106,536,519	17.89
Fishery Exports	1,816,157	1,643,832	1,599,709	1,482,228	2,350,497	9.77
Fishery/National	2.85	2.67	2.56	2.47	2.21	

We can see from Table 4 that the market structure of Indonesia fishery's exports tends to be more oligopsonistic. The main markets of Indonesia fishery's exports are Japan, USA, Europe Union, and Singapore, which occupy more than 80% of the market per year.

Table 4: Export value of fishery products by country of destination, 2001-2005

	2001	2002	2003	2004	2005	g(%)
Total	1,631,999	1,570,353	1,643,542	1,784,010	1,913,305	4.17
Japan	772,616	737,077	666,534	597,340	588,841	-6.49
China	17,712	25,511	70,093	71,371	66,038	53.28
Thailand	21,997	29,336	36,641	23,671	13,327	-5.21
Singapore	91,635	66,524	57,052	68,804	77,920	-1.95
Malaysia	35,947	38,378	36,885	39,376	34,382	-0.76
USA	318,962	328,109	365,665	527,809	591,627	17.69
Europe Union	187,574	115,780	162,648	197,753	325,493	22.10
Others	185,556	229,638	248,024	257,886	215,677	4.84

3 Data, Methodology and Empirical Results

We investigates the causality between fishery's exports and its economic growth in Indonesia using the cointegration and error-correction models. To examine the cointegration and error-correction models between those two variables, this paper follows the standard steps proposed by Engle and Granger (1987). First, we pretest the variables for their stationarity. We employ the augmented Dickey-Fuller (ADF) test, and use the Likelihood Ratio (LR) test, Akaike Information Criterion (AIC), and Schwarz Information Criterion (SIC) for confirmation. The second step is to examine if the

two series the natural logarithms of real fishery's output ($LGDP_t$) and real fishery's exports ($LEXP_t$) are co-integrated, This step verifies if there exits a long run equilibrium relationship between them over time. The cointegration can be examined by using the Engle-Granger cointegration test or Johansen and Juselius procedures, both of which are employed to check robustness of our results in cointegration. Lastly, we apply the error-correction models to examines the short run relationship.

We employ annual data on exports and GDP of Indonesia's fishery sub-sector. They were obtained from the Ministry of Marine Affairs and Fisheries, the BPS-Statistics Indonesia, and the Central Bank of Indonesia for a period from 1969 to 2005. The data were converted into the base year of 2000. The nominal values of GDP were deflated by the GDP deflator (2000=100) and the nominal values of exports were deflated by the export price index (2000=100) to express them in real terms. Those indices are from the International Financial Statistics (IFS) published by the International Monetary Fund (IMF).

3.1 Unit Root Test

Table 5 presents the results of unit root tests for $LGDP_t$ and $LEXP_t$ by using the Augmented Dickey-Fuller (ADF) test. The null hypothesis is not rejected at any level of significance, while the null hypothesis is rejected under the first difference of all variables, and thus the series are stationary in order one, I(1).

Table 5: Results of unit root test by using ADF test

	Level		First Difference	
Variables	$LGDP$	$LEXP$	$\Delta LGDP$	$\Delta LEXP$
Intercept	0.347079	-1.313176	-3.906388*	-4.995746*
Intercept and time trend	-1.412633	-2.965085	-4.061348**	-4.914400*

Notes: *, **, and *** denote statistical significance at the 1%, 5%, and 10% levels, respectively.

3.2 Cointegration Tests

The cointegration test examines the long-run equilibrium relationship between the two variables, $LGDP_t$ and $LEXP_t$. First, we apply the Engle-Granger two-step cointegration procedure. The results are presented in Table 6, which also include the slope coefficients and Cointegration Regression Durbin Watson (CRDW) statistic. Based on the ADF test applied to residuals of the cointegration equations, the results suggest the presence of cointegration between the two variables. The null hypothesis, which suggests that the residual series have a unit root, is rejected at 1% level of significance. The CRDW statistic is consistent with these results as well. Thus, the results imply there exists a long-run equilibrium relationship between fishery's exports and its economic growth.

Table 6: Results of Engle-Granger two-step cointegration test

Cointegration equation	Slope	CRDW	Calculated ADF for residual
LGDP =f(LEXP)	0.240986	0.352447***	-3.137382*
LEXP =f(LGDP)	3.652309	0.369100***	-3.925174*

Notes: *, **, and *** denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Second, Johansen cointegration method is also applied to confirm robustness of the above results. The optimum lag length is selected using the FPE criterion which suggests the optimum lag length of one. This FPE criterion is also confirmed by using LR test, AIC, and SIC criterion which recommend the same lag length. The paper also chooses only the intercept in the cointegrating equation. From the results of the Johansen cointegration test, which is presented in Table 7, the trace and max-eigen value statistics indicate one cointegrating equation at the 10% level of significance. So, we find the evidence that there is cointegration between real fishery's GDP and its exports variables, which supports the existence of a long-run relationship between real exports and economic growth in Indonesia's fishery sub-sector.

Table 7: Results of Johansen cointegration test

Null Hypothesis	Eigenvalue	Trace Statistic	10%Critical Value	5% Critical Value
r=0	0.322624	13.63353	13.42878	15.49471
r1	1.16E-07	4.07E-06	2.705545	3.841466

Trace test indicates 1 cointegrating equation(s) at the 10% level Max-eigenvalue test indicates 1 cointegrating equation(s) at the 10% level

Although the results show that those variables are cointegrated, we cannot say that there is causal relationship between the variables at this point. Therefore, an error-correction model is estimated to obtain the causality between real fishery's exports and its economic growth.

3.3 Error-Correction Models

Given that the optimum lag length and the results of cointegration test, an error-correction model is estimated to investigate the short-run dynamic relationship between exports and economic growth. From Table 8, the coefficient of error-correction term in the $LGDP_t$ equation has the negative sign and statistically significant, suggests that there be a movement back to the equilibrium relationship. It also means that if real fishery's economic growth exceeds the long-run equilibrium relationship, the error-correction term will help to move the real fishery's economic growth back to the original equilibrium. Respectively, if the real fishery's economic growth is lower than the long-run equilibrium level, the error-correction term will help to shift the real fishery's economic growth toward the long-run equilibrium relationship.

The coefficient value on φ_{t-1} in Table 8 implies that 11.5% of the deviation between economic growth and the long-run equilibrium value is reduced every year and the adjustment will take 8.7 years. With respect to the short run effects, the coefficient value and its statistic on $\Delta LEXP_{t-i}$ in Table 8 provides the evidence that

there is no short-run effect of real fishery's exports on the economic growth. On the one hand, the coefficient and its statistic on $\Delta LGDP_{t-i}$ in Table 8 reveals that one percentage increase of the real fishery's GDP in the previous one year will lead to an increase in the real current GDP by 0.38%.

The coefficient of error-correction term in the $LEXP_t$ equation of Table 9 exhibits the negative sign and statistical significance. In this case, the disequilibrium in real fishery's exports is reduced by 26.9% a year and gone after 3.7 years. The output also suggests that real fishery's economic growth causes its exports in the long-run while there is no evidence that supports the short-run effect from real fishery's economic growth to exports (See the coefficients and their statistic on $\Delta LEXP_{t-i}$ and $\Delta LGDP_{t-i}$ in Table 9).

Table 8: Estimates of error-correction model (**??**)

$$\Delta LGDP_t = \alpha_0 + \lambda\varphi_{t-1} + \sum_{i=1}^{m} \alpha_{1i}\Delta LGDP_{t-i} + \sum_{i=1}^{m} \alpha_{2i}\Delta LEXP_{t-i} + \epsilon_{1t}$$

Variables	Coefficients	t-statistics
Constant	0.029786	1.93272***
φ_{t-1}	-0.115112	-1.77221***
$\Delta LGDP_{t-1}$	0.382053	2.43358*
$\Delta LEXP_{t-1}$	-0.012958	-0.42127

Table 9: Estimates of error-correction model (**??**)

$$\Delta LEXP_t = \gamma_0 + \kappa\phi_{t-1} + \sum_{i=1}^{m} \gamma_{1i}\Delta LEXP_{t-i} + \sum_{i=1}^{m} \gamma_{2i}\Delta LGDP_{t-i} + \epsilon_{2t}$$

Variables	Coefficients	t-statistics
Constant	0.157256	2.00545***
φ_{t-1}	-0.269593	-2.83099*
$\Delta LEXP_{t-1}$	0.160103	1.02303
$\Delta LGDP_{t-1}$	0.265092	0.33187

In summary, we have identified that there exists the long-run equilibrium relationship between real fishery's exports and its economic growth in Indonesia, and the cointegrating equations estimated from Engle-Granger procedures shown in table 6 are as follows:

$$LGDP = \underset{(0.31^*)}{18.46} + \underset{(0.01^*)}{0.24} \cdot LEXP$$

$$LEXP = \underset{(5.33^*)}{-64.96} + \underset{(0.23^*)}{3.65} \cdot LGDP$$

The real fishery's export increases the real GDP. If one percentage increase in the real fishery's export, hold everything else constant, will increase the real fishery's economic growth by 0.24%. Similarly, the real fishery's GDP increases the real exports. One percentage increase in the real fishery's GDP, hold everything else constant, will lead to an increase in the real fishery's exports by 3.65%.

The paper's objective is to examine the causal relationship between fishery's export and its economic growth. The results provide the evidence that there is a bi-directional causality between exports and economic growth in Indonesia's fishery sub-sector. This is based on the statistical significance of the error-correction terms from both economic growth and export equations. Following Jones and Joulfaian (1991), the error-correction terms, φ_{t-1} and ϕ_{t-1}, represents the long-run effect of one variable on another while the changes of the lagged independent variable describe the short-run causal effect. The output also gives information that there is no causality in the short-run since the short run changes in past value of fishery's exports did not have any impact on short-run changes in current fishery's GDP and vice versa.

4 Conclusion

This paper has examined the causal relationship between fishery's exports and its economic growth in Indonesia by performing the cointegration and error-correction models. First, the cointegrating equations indicate that there exists cointegration between fishery's exports and its economic growth in Indonesia which means that there is a long-run equilibrium relationship between those variables. Second, based on the significance of the coefficients of the error-correction terms from both economic growth and export equations, there exists a bi-directional causality between exports and economic growth in Indonesia's fishery sub-sector in the long-run.

To sum up, such feedback relationship between fishery's export and its economic growth implies the development of agriculture sector (through increasing exports) has positive effects on aggregate economy. Such results shed light on the role of agriculture sector in economic growth in the developing countries. Furthermore, our result implies that a national strategy taken for expanding seafood and fish related exports has been successful with respect to public investment on enhancing technology, fish product quality and supply chain, and fishery subsector in Indonesia has been adapted to a change in the world trade liberalization.

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