Is it True the Palm Oil Damaging the Environment in Indonesia? (Johansion Cointegration Test and Variance Decomposition Approach)

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Abstract: The instability of the palm oil price is indicated caused by the discrimination prices through the issue and the regulation that stated the development of palm oil damaging the environment. Therefore, this study aims to look at how changes in global CPO prices, the price of CPO Indonesia, Indonesia's CPO production and the extensive areas that affect the environmental damage. To achieve the objectives, this study uses the Vector Error Corection Model (VECM) and Johansion Cointegration test and variance decomposition test approach Variance decomposition Test approach to prove the occurring of short-term and long-term as balance; moreover, to observe how big the response from palm oil in damaging the environment in Indonesia. The data is the monthly data from 2008 until 2017 which are gathered from FAO, WTO and Ministry of Environment of Republic Indonesia. The Study have discovered that the short- term balance of environmental damage index variable in a previous period and Indonesian CPO production variable in the previous period have positive influence to the environmental damage now. However, the Indonesia's CPO production variable in two previous period have negative influence to environmental damage now. In addition, the changes of global CPO prices, Indonesian CPO price, Indonesian oil palm production, the area of palm oil plantation and environmental damage have a long-term balance. Furthermore, the results of the variance decomposition test prove that changes in the price and production of Indonesian CPO give a shock on changes in the index of environmental damage.
Keywords: Palm Oil, Environmental Damage, Johansion Cointegration

Introduction

Fluctuations in the price of oil palm world is getting stronger, the decline in the last two years proves that the price development is less aligned on the palm oil producer countries. One of the causes of the instability is the existence of price discrimination from certain parties through regulation and negative issue that the development of palm oil cause environmental damage (Jean *et al.,* 2019). Then the world trend to shift from fossil energy to renewable energy drives global demand for palm oil and also the destruction of forests to create palm oil plantations which means it has a negative effect on the environment. Efforts to discriminate palm oil are very successful which can be seen from the negative response of the importer countries, thus causing the decline of palm oil demand (Alfonso *et al.,* 2013).

The action is as Europe strategy in the political business to win the trade. Normally, according to Wu *et al.,* (2017), the palm oil as the vegetable oil with the largest production in the world, the production cost is lower than other vegetables oils, the same finding is also obtained from the research by Guan & McKay (2014). In addition, according to Masruroh (2017), on the terms of productivity, one hectare of palm oil can produce 7 tons of oil, while soybean only produce 0.45 ton oil. Canola and sunflower productivity is 10 fold lower than the palm oil. Therefore, Indonesia as the largest palm oil producer in the world has a comparative advantage and export competitiveness of palm oil and other derived products in the world market (Rifai *et al.,* 2014).

Actually from the production point of view, coconut oil has a great positive impact. such as palm oil push region development (Villela *et al.,* 2014). Palm oil is also proven as a source of renewable energy that is environmentally friendly. Palm oil as the leading agricultural commodity in Indonesia (Jelsma *et al.*, 2019). Moreover, palm oil as a source of income for millions of farming families, as a source of income, employment providers, a trigger for the growth of new economic centers, and as a driver of growth and development of palm oil-based downstream industries (Nasution, 2016).

Furthermore, palm oil contributes to the development of the national economy to bring prosperity to the people in a fair manner (Widyaningtyas *et al.,* 2016). The role of palm oil for the development of the economy need to be maintained with the various solutions that have been conducted. For instance, strengthened the entrepreneurs and smallholders to apply certification Roundtable on Sustainable Palm Oil (RSPO) based on environment (Tong, 2017). Many studies are associated with palm oil and environmental damage, including Susanti & Maryudi (2016), who found that the area of palm oil had impact on the environmental damage. The similar findings from Thailand by Saswattecha et al., 2017, also stated that an increase of the palm oil production had a negative effect on environmental damage. Furthermore a study by Wicke *et al.,* (2011) in Indonesia and Malaysia for 30 years said that the expansion of palm oil plantation reduce forest land. Whereas Abdul-manan (2017) sees in terms of the findings of renewable energy encouraging demand for palm oil and also spurs the development of palm oil plantation which ultimately increases global agricultural commodity prices and endanger food security (Taghizadeh *et al.*, 2019).

Further studies were also conducted by Syahril *et al.,* (2019) that stated the volatility of the world CPO price, vast plantation area, marketing margin of coconut oil and environmental damage. From some of the empirical studies above most of them only take the plantation area, marketing margin and volatility of world CPO prices variables but there are no Indonesia palm oil production and Indonesian CPO prices variables yet. Therefore, this study specifically assess the short-term and long-term balance and how much the contribution of global CPO prices, Indonesian CPO prices, Indonesian palm oil production and the plantation areas relation to the environmental damage in Indonesia.

Methods

To achieve the objectives, this study uses the Vector Error Corection Model (VECM) and Johansion cointegration test and variance decomposition test approach variance decomposition Test approach to prove the occurring of short-term and long-term as balance; moreover, to observe how big the response from palm oil in damaging the environment in Indonesia. The data is the monthly data from 2008 until 2017 which are gathered from FAO, WTO and Ministry of Environment of Republic Indonesia.

The Study have discovered that the short- term balance of environmental damage index variable in a previous period and Indonesian CPO production variable in the previous period have positive influence to the environmental damage now. However, the Indonesia's CPO production variable in two previous period have negative influence to environmental damage now. In addition, the changes of global CPO prices, Indonesian CPO price, Indonesian oil palm production, the area of palm oil plantation and environmental damage have a long-term balance.

Result

1. Stationarity Test and Lag Length

The results showed Indonesian CPO prices variable, global CPO price, Indonesia plantation area and environmental quality index were stationary at 1 percent alpha and only Indonesian palm oil production stationary at 5 percent alpha. The test results showed that in models with LR, FPE, AIC, SC and HQ criteria were in order 2, proved the optimum lag to use was lag 2 . It was explained that all the variables in this equation were interplayed between variables in the same period but interrelated to the previous period. Then after the lag results were obtained, we continued the next test, namely the cointegration test.

2. Cointegration Testing

The cointegration test with the Johansen cointegration approach, such as stated by Dirga *et al.*, (2016), was to prove the existence of a long - term equilibrium relationship between variables that are not stationary, but have a stationary linear combination.

Table 1. Johansen Cointegration test results

Ho	Trace			Maximum Eigenvalue		
	Trace Statistic	Critical Value	Prob**	Max-Eig Statistic	Critical Value	Prob**
			Model 1			
r = 0*	97,78952	69,81889	0,0001	43,55134	33,87687	0,0026
r ≤ 1*	54.23818	47,85613	0,0112	34,07300	27,58434	0,0064
r ≤ 2	20.16518	29,79707	0,4117	11,46785	21,13162	0,6006
r ≤ 3	8.697330	15,49471	0,3941	7,871752	14,26460	0,3919
r ≤ 4	0,825579	3,841466	0,3636	0,825579	3.841466	0,3636

Description: * indicated cointegrated

The test results can be seen in table 1, that is said to be co-integrated with the proof of trace statistic value and the maximum eigenvalue is greater than the critical value. This means, this model has a long-term balance. In accordance with the test results proved that the very good model to use was VECM.

3. Analysis of Short-term Balance Palm Oil variable toward Environmental Damage in Indonesia

The result of this estimation to address issues if there are balance in short period between the Indonesian CPO prices, the global CPO prices, Indonesian palm oil production and the palm oil plantation area as well as environmental damage in Indonesian variables. From the estimation VECM results was obtained probability ECT value 0.0038, this value is smaller than the at 5 percent (ECT variable was significant). Therefore, this equation or model was valid and could describe the short-term dynamics (Suciptawati & Darmawan, 2016). In addition, the error correction parameter was 0.0089 which means there was an adjustment mechanism from short-term to long-term.

Table 2. Short-Term Estimation Results of Environmental Damage

Variable/lag	EQI	ICP	WCP	IPP	IPA
EQI (-1)	0.8656***	-118.1738	-48.0570	14.5592	-6053.5220
	(9.9184)	(0.7090)	(-1.0991)	(0.3586)	(-0.6031)
EQI (-2)	-0.0351	-147.7853	53.4399	4.9976	2788.9610
	(-0.4170)	(-0.9198)	(1.2679)	(0.1277)	(0.2883)
ICP (-1)	1.0E-06	0.3244***	-0.0001	-0.0004	6.6419
	(0.0245)	(4.0883)	(0.0056)	(-0.0201)	(1.3898)
ICP (-2)	-3.56E-05	0.1450	-0.0022	-0.0371*	2.6591
	(-0.8994)	(1.9206)	(-0.1135)	(-2.0195)	(0.5849)
WCP (-1)	-4.80E-06	1.1294**	0.2968**	0.0215	-56.5610**
	(-0.0258)	(3.1801)	(3.1852)	(0.2488)	(-2.6446)
WCP (-2)	-3.19E-05	1.1843**	-0.0135	0.0107	-7.5167
	(-0.1659)	(3.2257)	(-0.1401)	(0.1202)	(-0.3400)
IPP (-1)	0.0006**	1.3451***	0.1116	0.8975***	-124.99***
	(3.1306)	(3.7661)	(1.1901)	(10.3150)	(-5.8114)
IPP (-2)	-0.0005*	-1.3545***	-0.0363	-0.0044	120.08***
	(-2.34225)	(-3.6669)	(-0.3748)	(-0.0450)	(5.3982)
IPA (-1)	-5.85E-08	-0.0003	0.0001	0.0002	0.8749***
	(-0.0855)	(-0.2312)	(0.3270)	(0.4918)	(11.1138)
IPA (-2)	2.67E-07	0.0004	0.0002	0.0002	0.0729
	(0.3728)	(0.2709)	(0.6844)	(-0.5678)	(0.8852)

Note: ( ) is T. Statistics and Significance 1%***, 5%** and10%*

4. Analysis of the Long-term Balance of Palm Oil Variables Against Indonesian Environmental Damage

Estimation results proved that in the long run the index of environmental quality, the price of Indonesian CPO, the price of World CPO and the area of oil palm have a long-term balance except for the variable of Indonesian CPO production. This can be seen in Table 3:

Table 3. Long-Term Environmental Damage Estimation Results

Variables	Coefficient	T. Statistics
ICP	0,0036	-3,75026***
WCP	-0,0076	-3,13334**
IPP	-8,04E-05	-0,00552
IPA	-2.05E-05	-4,91091***

Note: ( ) is T. Statistics Significance 1%***, 5%** dan 10%*

Then in detail could be concluded that in the long-term the Indonesian CPO prices has a negative effect on the environmental damage index at level of 1 percent by 0,0008, meaning that 1 percent of the increase in the Indonesian CPO price will reduce the current environmental damage index by 0.0036 percent. The global CPO prices also has a negative effect on the environmental damage index at 5 percent by 0.004, that 1 percent increase in the world CPO price will reduce the current environmental damage index by 0.0076 percent. Furthermore, it is different from the Indonesian palm oil total area variable which has a negative effect on the environmental damage index at 1 percent by 3.2E-06, meaning that 1 percent of the increase in the area of Indonesian oil palm will reduce the environmental damage index by 2.05E-05 percent.

5. Analysis of the contribution of palm oil variables in explaining the damage to Indonesia's environment.

Table 4 shows that in the first period, Indonesia's environmental quality index was explained by the Indonesian environmental quality index itself by 100 percent. Then in the second period the variables can explain well the environmental quality index variable itself which is equal to 98.38 percent. While the ICP variable explained by 6.48 percent, WCP 0.80, IPP 5.33 and IPA 0.53 percent. This means that the shocks that occur are more dominated by environmental quality index variables themselves.

Table 4. Variance Decomposition Test Results for Environmental Quality Index

VARIABLES	EQI		ICP		WCP		IPP		IPA	
EQI	(2)	98.38	(10)	10.41	(3)	3.32	(10)	2.83	(10)	2.79
ICP	(10)	6.48	(1)	91.13	(10)	4.13	(2)	1.78	(10)	6.05
WCP	(10)	0.81	(10)	41.91	(5)	94.33	(10)	0.80	(10)	2.58
IPP	(10)	5.33	(10)	6.33	(10)	2.83	(1)	98.52	(10)	14.26
IPA	(10)	0.53	(10)	6.49	(8)	0.29	(10)	1.34	(1)	99.31

Note: ( ) = period with the highest value

Discussion

This study began using the unit root test to ensure that all the data in a stationary condition (Richi *et al.*, 2012). The results of unit root tests using the Augmented Dickey Fuller (ADF) method proved that Indonesian CPO prices, global CPO prices, Indonesian palm oil production, plantation area and environmental quality indexes are not stationary at level or I (0). Then, the first difference or I(1) conducted using the Augmented Dickey-Fuller (ADF) methods. After all the data is stationer, the optimal lag length can be determined. Deciding the inaction or optimum lag is one very important step for estimating VAR (Nugroho, 2012) . This optimal lag length test aimed to eliminate the autocorrelation problem in the VAR system. This study used Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQ) to determine the optimum lag length (Poetry & Sanrego, 2011).

Estimation results can be seen in table 2, this finding shows that in the short-term the environmental damage index variable in the previous period had a positive effect on the current environmental damage index at 1 percent level of 0.0038, which meant 1 percent increase in the environmental damage index in the previous period will increase the current index of environmental damage now by 0.87 percent. This result was also similar with Indonesian palm oil production variable that in the previous period had a positive effect on the current environmental damage index at a 5 percent level of 0.0002, meaning 1 percent increase in Indonesia's palm oil production in the previous period will increase the current environmental damage index by 0.0006 percent. However, there was difference in Indonesian palm oil production variable in the two previous periods which negatively affected the current index of environmental damage at a 10 percent of 0,0002, which meant 1 percent increase in Indonesia's palm oil production in the previous two periods will reduce the current environmental damage index by 0,0004 percent.

Changes in world CPO prices can explain the shock at Indonesia's CPO price of 41.91 percent and also followed by the environmental quality index. This illustrates that there is a relationship between world CPO prices, Indonesian CPO prices and the environmental quality index. However, Indonesian CPO prices respond and shock is more dominant by itself, which is 91.13 percent. Then the world CPO price is explained by oneself at 94.33 percent, while that explained by the ICP variable iby 4.13 percent, EQI 3.32, IPP 2.83 and IPA 0.29 percent. This means that the shocks that occur are more dominated by environmental quality index variables.

Conclusion

The issue of palm oil discrimination developed and sponsored by other vegetable oil producing countries needs to be clarified through realistic and objective scientific studies. Therefore, the government needs to support optimal funding for the deepening of various scientific studies on the positive issues of palm oil.

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