Questioning the sustainable palm oil demand: case study from French-Indonesia supply chain

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Abstract. Sustainable palm oil has been widely debated. Consuming countries insist certified sustainable produces palm oil, but in fact the absorption of the certified palm oil is still less than 60%. This raise questions about the sustainable palm oil demand. In this study, such a condition will be analysed in French-Indonesia supply chain case. Using monthly and quarterly data from 2010 to 2016 with Autoregressive Distributed Lag (ARDL) approach and Error Correction Model, demand influencing factors and price integration in each market of the supply chain is estimated. Two scenarios namely re-export and direct export models are considered in the Error Correction Model. The results show that France Gross Domestic Product, prices of France palm oil import from Indonesia, Malaysia, and Germany, and price of France groundnut import significantly influence the France palm oil import volume from Indonesia. Prices in each market along palm oil re-export France-Indonesia supply chain are co-integrated and converge towards long-run equilibrium, but not in the direct export supply chain. This leads to a conclusion that France market preferences in specific and EU market preferences in general need to be considered by Indonesian palm oil decision makers.

1. Introduction

In Europe palm oil is the most imported vegetable oil, which is used in large volumes by the food, personal care and biofuel industries. Palm oil does not only have the lowest selling price, but could also replace various ingredients in all of these industries [1-2]. Since 2010-2016, the total European consumption of palm oil has increased at an annual rate of around 40% [3]. In general the increase can be related to the increase in the technical use of palm oil as biofuel. However, the consumption of edible palm oil has been decreasing in the last few years due to environmental issues impact in producing countries. The Ministry of Foreign Affair stated that opportunities for exporters in developing countries are likely to be found in sustainable certified palm oil [4].

Sustainable palm oil has been widely debated. On one side consuming countries insist certification as a guarantee of sustainable produced palm oil, while on the other side producing countries ask premium prices to cover additional costs for producing the certified palm oil. In this case consumers are likely referred to manufacturers or multinational companies as palm oil is not consumer product, but rather is used as ingredients of many further processed consumer products. Food manufacturers and large multinational companies are likely have more influences to the supply chain. As profit oriented business, manufacturers and companies still consider price as one of the important factors in selecting types of vegetable oils [4]. Most of these vegetable oils are continuously imported in processed form, in which one to another appears to be substituted as raw materials in manufacturers and processing industries [2 & 5].

Among the European countries, France appears to have the most stringent requirement on certified palm oil, despite its insignificant share as palm oil importer. However, France is recorded as the third largest main destination of palm oil imported from other European hubs such as The Netherland, Germany or Italy [4]. Moreover, France is recorded as the second main economy in Western European that might strongly relate to other European countries' economy [6]. With these considerations, growers from Indonesia and Malaysia made efforts to produce certified palm oil. In 2015, Indonesia and Malaysia produce 6,444,156 and 5,105,806 ton certified palm oil respectively. However, from 2008-2014 on average only 39.74% of the certified palm oil is traded with premium prices [7], raising questions about the sustainable palm oil demand. Using France market as the proxy of sustainable palm oil demand, this study is conducted to answer (i) the influencing factors of France palm oil import volume from Indonesia (ii) prices co-integration in the Indonesian-France palm oil supply chain and (ii) adjustments of the short run dynamics towards the long run equilibrium.

2. Material and Methods

In this paper, the sustainable palm oil demand will be analysed in French-Indonesia supply chain case using monthly and quarterly data from 2010 to 2016. The series include Indonesia palm oil import price in France ($P_M^{PPO.Ind}$), Malaysia palm oil import price in France ($P_M^{PPO.Mal}$), Netherland palm oil import price in France ($P_M^{PPO.Neth}$), Germany palm oil import price in France ($P_M^{PPO.Ger}$), ground nut import price in France ($P_M^{GNut.Sen}$), France gross domestic product (GDP), Indonesia-France trade balance (trade_balance), Palm oil import volume in France from Indonesia (Q_M^{PPO}), palm oil export (FOB) price in Indonesia ($P_X^{PPO.Ind}$), crude palm oil (CPO) local price in North Sumatra (P_{Sumut}^{CPO}), fresh fruit bunches (FFB) price in schemed SH (P_{SSH}^{FFB}), FFB price in independent SH (P_{ISH}^{FFB}), Exchange rate (EUR/USD) (ER).

France imports two main types of palm oil, which are crude palm oil (CPO) and processed palm oil (PPO) with HS Code 151110 (Palm oil and its fractions; whether or not refined, but not chemically modified) and 151190 (Vegetable oils; palm oil and its fractions, other than crude, whether or not refined, but not chemically modified), respectively. HS code 151190 (Crude palm oil for the manufacture of foodstuffs for human consumption) is chosen as it appears as the main imported palm oil with average share of 54.76% in 2010-2016 [8]. The data collected from European Statistics (Eurostat), International Trade Statistics Database (UN Comtrade), FAO, Statistics Indonesia (BPS), PASPI monitor, Estate Government Office (Dinas Perkebunan) North Sumatra Province, and St. Louis Fed's Economic Research Division. Consumers refer to the French importers as a number of EU processors stated that the additional premium price was not passed on end consumers. All the price data are measure in USD/kg, while the GDP is measure in billion USD, import volume is measure in thousand metric ton, and trade balance is measure in million USD.

Using monthly data from 2010-2016, stationarity of each variable is tested using the Augmented Dickey Fuller test by using the following equation.

$$\Delta Y_t = \propto + \rho Y_{t-1} + \sum_{j=1}^{n} \gamma Y_{t-j} + \mu_t \tag{1}$$

Y_t is the series data, ρ is the test coefficient and j is the lag length chosen from ADF test. The null hypothesis is Y_t has a unit root. Influencing factors of France palm oil import volume from Indonesia, co-integration and vector error correction model is tested with Autoregressive Distributed Lag Model (ARDL), which could be used if variable included in the equations are stationer at different level [9]

$$Y_t = \sum_{i=1}^{p} a_i Y_{t-i} + \sum_{i-1}^{n} c_i X_{t-1} + \varepsilon_t \tag{2}$$

Estimation of influencing factors of France palm oil import volume from Indonesia includes France gross domestic product (GDP), exchange rate (ER), prices of France palm oil import from Indonesia ($P_M^{PPO.Ind}$), Malaysia ($P_M^{PPO.Mal}$), The Netherlands ($P_M^{PPO.Neth}$), Germany ($P_M^{PPO.Ger}$) and price of

France groundnut import from Senegal ($P_M^{GNut.Sen}$). All of these countries are recorded as main exporters of France palm oil. The Netherlands accounts for over 60% of European re-exports of palm oil, while Germany follows with 24%. In addition, France is also recorded as the main importer of groundnut oil [4]. Except GDP, all data are in monthly base that are aggregated in quarterly data to run the following equation. The number of lag in price is selected by empirical consideration, which in fact producers' decision often influenced by the quarterly price information.

$$Q_M^{PPO} = f\left(GDP, ER, P_M^{PPO.Ind}, P_M^{PPO.Mal}, P_M^{PPO.Ger}, P_M^{PPO.Neth}, P_M^{GNut.Sen}\right) \tag{3}$$

Multicollinearity and linearity tests are conducted through Pearson Correlation and Ramsey Reset Test, respectively. Using ARDL approach, co-integration between prices along the supply chain is estimated for each level of the market namely (i) Netherland export price and France import price, (ii) France import price and Indonesia export price, (iii) Indonesia export price and Indonesia local mill price, (iv) Indonesia local mill price and Indonesia smallholder price. North Sumatra (Sumut) port (Belawan) FOB price is used as the representative of Indonesian export price. Smallholders' prices are differentiated between schemed and independent groups as in general the former receives Disbun prices, while the latter depends on their bargaining power [10-11].

Price integration along the Indonesia France supply chain us two possible scenarios namely (i) the re-export palm oil and (ii) the direct export palm oil. The former include (a) The Netherland or Germany palm oil (151190) export price to France, (b) France palm oil (151190) price imported from Indonesia, (c) Indonesia palm oil (151190) export price to France (Belawan FOB price), (d) Indonesia (Sumut) CPO local price, and (e) Indonesia (Sumut) schemed and independent Fresh Fruit Bunches (FFB) price. Using monthly data, the co-integrated prices in the Indonesia-France supply chain are then further estimated with VECM in order to analyse the short run dynamic and adjustment time needed to reach the long-run equilibrium. The VECM equations run separately for each of the co-integrated price. VECM is used to analyse the speed of adjustment of such integration.

$$\Delta Y_{it} = \alpha_i + \sum_{j=1}^{n} \beta_i \Delta Y_{jt-1} + \gamma_i \varepsilon_{it} + \varepsilon_t \tag{4}$$

ε_{it} is the residual series such that $\varepsilon_{it} = Y_{it-1} - \alpha_i - \beta_i Y_{jt-1}$, and γ_i shows the speed of adjustment. Short-run dynamics from the non-stationer series is shown by β_i, which will adjusted towards the Long Run Equilibrium if $\gamma_i < 0$. The more negative γ_i the faster the series converge to the Long Run Equilibrium.

3. Results and Discussion
The unit root test results show that the data are stationary at different levels, vary from I(0) to I(2).

Table 1. Unit Root Test Result

No	Variabel	Quarterly			Monthly		
		t-Statistic	Prob.*	Ordo	t-Statistic	Prob.*	Ordo
1	Palm oil import price in France from Indonesia ($P_M^{PPO.Ind}$)	-5.29	0.00	I(0)	-4.48	0.01	I(1)
2	Palm oil import price in France from Malaysia ($P_M^{PPO.Mal}$)	-4.21	0.01	I(2)	-4.02	0.01	I(0)
3	Palm oil import price in France from Netherland ($P_M^{PPO.Neth}$)	-4.31	0.01	I(2)	-8.46	0.00	I(0)
4	Palm oil import price in France from Germany ($P_M^{PPO.Ger}$)	-4.88	0.00	I(0)	-5.67	0.00	I(0)
5	Ground nut import price in France ($P_M^{GNut.Sen}$),)	-4.68	0.03	I(1)			

6	Palm oil import volume in France from Indonesia (Q_M^{PPO})	-4.70	0.00	I(0)			
7	France gross domestic product (GDP)	-4.06	0.02	I(1)			
8	Indonesia-France trade balance (TB)	-4.69	0.00	I(0)			
9	Exchange rate (USD/PKR) (ER)	-3.60	0.05	I(0)			
10	Other palm oil export (FOB) price ($P_X^{PPO.Ind}$)				-6.25	0.00	I(1)
11	CPO local price in North Sumatera (P_{Sumut}^{CPO})				-8.26	0.00	I(1)
12	FFB price in scheme SH (P_{ISH}^{FFB})				-7.87	0.00	I(1)
13	FFB price in independent SH (P_{SSH}^{FFB})				-8.52	0.00	I(1)

Showing high Pearson Correlation (0.88) with GDP, exchange rate series are excluded from the equation estimations. Correlation of palm oil prices imported from The Netherland and Indonesia is 0.77, while that of palm oil prices imported from Malaysia and Indonesia is 0.72. However, all are still maintained, since literature suggests that as a rule of thumb correlation of two series is considered highly collinear if R^2 of the series exceeds 0.90. Moreover, since the OLS estimators are still BLUE as long as collinearity is not perfect, it is often suggested that the results of the fitted model is still acceptable [12]. In this case, considering the empirical importance information all of the prices are maintained including in the regression. Ramsey RESET result with F test (2.13) less than F stat (4.10) justifies the usage of linear specification in the ARDL model[1]. F-Bounds and t-Bounds Tests with 11.24 and -3.43 values, respectively, reject the "No levels relationship" null hypothesis. With this co-integrated result, influencing factors of France palm oil import from Indonesia can be estimated using the ADRL result.

Table 2. ADRL Test Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Q_M^{PPO} (-1)	0.075	0.270	0.278	0.786
GDP	0.046	0.027	1.677	0.119
GDP(-1)	-0.101	0.024	-4.267	0.001
$P_M^{PPO.Ind}$	-15.079	8.016	-1.881	0.084
$P_M^{PPO.Ind}$(-1)	-21.518	9.217	-2.335	0.038
$P_M^{PPO.Mal}$	15.068	4.420	3.409	0.005
$P_M^{PPO.Neth}$	9.162	5.231	1.751	0.105
$P_M^{PPO.Ger}$	12.342	3.769	3.274	0.007
$P_M^{GNut.Sen}$	7.304	2.545	2.870	0.014
C	31.734	10.359	3.063	0.010
R-squared	0.834			
Adjusted R-squared	0.709			
F-statistic	6.690			

The ADRL estimation results reveal that last quarter, France palm oil imported from Indonesia price, France palm oil imported from Malaysia price, France palm oil imported from Germany, France palm oil imported from Netherland, and France ground nut oil import price significantly influence the France palm oil import volume from Indonesia. All the coefficient signs are as expected. The prices of France palm oil imported from Indonesia and Malaysia have the greatest influence to France palm oil import volume from Indonesia. The magnitude of both have coefficients are similar although with different signs. Each dollar per kg decrease in the France palm oil imported from Indonesia price will increase 15 tons palm oil import per month from Indonesia, while vice versa of those from Malaysia.

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[1] Correct specification is one of the classical linear regression model assumptions for OLS estimation approach [13]

Positive coefficients are also found for those from the Netherland and Germany, which are the main hubs for palm oil import to European countries. Therefore, all of palm oil import from these countries can be considered as substitutes of that imported from Indonesia. The groundnut oil price positive sign shows its role also as a substitute of palm oil. Each dollar per kg increase in soybean oil price will increase 7,30 ton per month France palm oil import from Indonesia. Last quarter France GDP negatively influences its palm oil import from Indonesia, indicating the status of palm oil as an inferior good. Among all vegetable oils use in France, palm oil has the lowest selling price. In general European countries are known as one of the most interesting markets for premium vegetable oil worldwide. There are special high-quality oils, new exotic oils or oils with a healthy composition. In fact, most of the processed imported palm oil (HS 151190) are used in the food industry such as margarine, ice cream, confectionary, filled milk and cocoa butter substitute. Crude palm oils or known as red palm oil (HS 151110) can be divided into lower-priced and standard quality and higher-priced and high quality, which can be purchased in ethnic and health shops, respectively [4]. Price integrations in each market along the Indonesia-France supply chain, both in re-export and direct export chain can be seen in the following table.

Table 3. Co-integration Test Result

Price Series	Bounds Test		CointEq(-1)*	Prob.
	F	t		
$P_M^{PPO.Ind}$ - $P_M^{PPO.Neth}$	44.89***	-9.58***	-1.18	0.00
$P_M^{PPO.Neth}$ - $P_X^{PPO.Ind}$	1.13	-1.51	-0.00	0.13
$P_M^{PPO.Ind}$ - $P_X^{PPO.Ind}$	1.24	1.59	0.02	0.12
$P_M^{PPO.Ind}$ - $P_M^{PPO.Ger}$	33.11***	-8.21***	-0.70	0.00
$P_M^{PPO.Ger}$ - $P_X^{PPO.Ind}$	5.18**	-3.24**	-0.01	0.00
$P_X^{PPO.Ind}$ - P_{Sumut}^{CPO}	7.48***	-3.89	-0.42	0.00
P_{Sumut}^{CPO} - P_{SSH}^{FFB}	2.05	-2.04	-0.08	0.05
P_{Sumut}^{CPO} - P_{ISH}^{FFB}	3.75	2.76*	-0.18	0.00

*, **, *** show significance at 10%, 5% and 1% respectively

F and t bound tests results reveal the co-integration between series in the Indonesia-France palm oil supply chain. All series, except The Netherland - Indonesia ($P_M^{PPO.Neth}$ - $P_X^{PPO.Ind}$) export prices, France palm oil import price from Indonesia and Indonesia export price ($P_M^{PPO.Ind}$ – $P_X^{PPO.Ind}$), and local Indonesia and schemed smallholder FFB price (P_{Sumut}^{CPO} - P_{SSH}^{FFB}), are co-integrated. In addition, all speed of adjustment coefficients (CointEq(-1)) of the co-integrated series are negative and significant, indicating the converge towards the long run equilibrium. The speed of adjustment values range from 0.01 to 0.42. Indonesia export price (Belawan FOB) and Indonesia local price (P_{Sumut}^{CPO}) has the highest speed towards the equilibrium. Each month the series adjust 42% towards the long-run equilibrium, thus need about 2.38 month to fully be adjusted. Germany export price and Indonesia export price has the slowest speed, with only 1 % of adjustment per month. Therefore, in can be concluded that prices in each market along palm oil re-export France-Indonesia supply chain are co-integrated and converge towards long-run equilibrium, but not in the direct export supply chain. This might be partly explained by the wide options for the France vegetable oils consumption. There are at least 6 other countries besides Indonesia that continuously export palm oil to France. In addition, there are at least 3 other vegetable oils that can be seen as substitutions for France palm oil consumption.

4. Conclusion
France is still an important market for Indonesia palm oil export. France can obtain the palm oil directly from producing countries such as Indonesia and Malaysia or from other European importers such as The Netherlands and Germany. Although prices along the direct export supply chain are not co-integrated, that of the re-export is co-integrated and converged towards the long-run equilibrium.

As the second main economy in Western European that might strongly relate to other European countries' economy, such a condition indicates that France market preferences in specific and EU market preferences in general need to be considered by Indonesian palm oil decision makers.

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