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The Impact of Changes in External Factors on the World Vegetable Oil Market

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ABSTRACT

Vegetable oil is an important commodity that functions as food, feed and fuel. Palm oil, soybean oil, rapeseed oil and sunflower oil are the main vegetable oils (90%) traded on the world market. Changes in external factors allegedly affect the performance of exports and imports of each type of vegetable oil on the world market. This study aims to analyze the impact of changes in external factors (increase in world prices of crude oil and demand for vegetable oils) on the world trade performance of vegetable oil.Analysis using econometric models in the form of simultaneous equations consists of 45 structural equations and 8 identity equations which are estimated by the two stage least squares method using the annual data series 1991–2015. Simulation method with Newton method, the results of the study showed that the increase in world prices of crude oil has a positive impact on improving the performance of the trade in palm oil, rapeseed oil and sunflower oil, but the trade performance of soybean oil has declined. Imports of Chinese palm oil experienced the highest increase of 9.53%. Palm oil exports from Indonesia and Malaysia have increased, but the increase is smaller than the increase in palm oil imports from China, Europe, the United States and India so that the world price of palm oil is still increasing. The increasing gross domestic product (GDP) of the United States has the greatest impact on exports, imports and prices of world palm oil. While the increase in China's GDP has the most impact on imports and world prices of rapeseed oil.

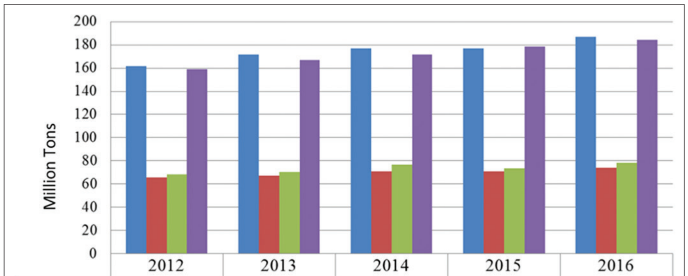
Keywords: Vegetable Oil, Trade, External Factors, Crude Oil
JEL Classification: F10

1. INTRODUCTION

The world vegetable oil trade is dominated (90%) by four types of oil, namely palm oil, soybean oil, rapeseed oil and sunflower oil. In line with the increasing world population growth and the development of the downstream program (especially fuel/fuel), the need for vegetable oils has also increased every year. In 2050 the projection of world vegetable oil per capita consumption reaches 25 kg, so that the total availability of vegetable oil is required at 230 million tons or an additional 60 million tons of production is needed in 2015 (Persaud and Maurice, 2006). The growth rate of vegetable oil consumption is higher than the rate of production growth as shown in Figure 1.

The trade in world palm oil crude palm oil (CPO) grew by 3.26% (OECD and FAO, 2015) above the average growth of vegetable oil (2.75%), whereas soybean oil experienced a decline due to drought in Argentina and Brazil (Mielke, 2015). The use of world vegetable oil as a raw material for biodiesel (fossil oil blending) has also increased every year in line with the biodiesel mandatory policy carried out by all exporting countries and importers of the world of vegetable oil (Calle et al., 2009). Palm oil is vegetable oil which has a higher production cost compared to other non-palm vegetable oils (Larson, 1996; Wisena et al., 2014; World Growth, 2015), so palm oil has an important role as one of the largest vegetable oil sources in the world. The European Union as a major importer of palm oil and as a rapeseed oil producer faces a dilemma of trade-offs between food, fuel and feed, resulting in a tug of interest

Figure 1: Development of world vegetable oil performance



	2012	2013	2014	2015	2016
Production	161.62	171.773	177.116	177.149	186.78
Import	65.49	67.23	71.06	70.97	74.04
Export	68.41	70.24	76.50	73.65	78.18
Consumption	159.20	166.77	171.62	178.26	184.17

Source: United State Department of Agriculture (2017)

between the food sector and the transportation sector.Likewise, the United States faces the problem of increasingly limited supply of soybean oil for energy raw materials. In terms of production the problem in vegetable oil is the decline in soybean oil production in the main producing countries, especially Argentina and the United States due to changes in weather and drought (Mielke, 2018). The pattern of world vegetable oil production has changed since 2013. Before the 1990s soybean oil had dominated the world vegetable oil market, but it had diminished until in 2013 the share of soybean oil was only 27%, while palm oil had reached 34%. In 2015, this share increased by 40% and soybean oil by 33% as a component of world vegetable oil.

Crude oil is a substitute commodity from vegetable oil, Palm oil, soybean oil, rapeseed oil and sunflower oil are raw materials in the chemical industry and energy in the form of biodiesel.

The novelty of this research is using an econometric method that builds the world vegetable oil trading model in a simultaneous equation system to analyze the impact of external factor changes on the world vegetable oil trade performance.

Based on the above background, the objectives of this study were (1) to analyze the performance of world vegetable oil trade, and (2) to analyze the impact of changes in external factors, namely the increase in world prices of crude oil and an increase in demand for vegetable oil on exports, imports and prices of palm oil, oil soybeans, rapeseed oil and sunflower oil which are each of the exporting countries, importers and the world.

2. LITERATURE REVIEW

The demand for world vegetable oils has an increasing trend every year as world population increases and the use of vegetable oils as industrial raw materials is increasingly important. The results of the OECD and FAO research (2015) concluded that in the 2012–2014 period the consumption of world vegetable oil for oleofood only reached 19 kg/capita. The highest per capita consumption is the United States and Canada (38 kg), EU (24 kg), China (22 kg), Indonesia (19 kg), and India (15 kg).If non-oleofood consumption is taken into account, the average consumption of new vegetable oils in the world reaches around 24 kg/capita/year. The results of this study are supported by Gabungan Pengusaha Kelapa Sawit Indonesia (GAPKI) (2015) which projects world consumption of vegetable oil per capita towards 2050 to reach 25 kg, so that it requires a total availability of vegetable oil of 230 million tons or an additional 60 million tons of production from 2015.

Mielke's study (2015) estimates that the total production of 17 types of vegetable oil and world fat reach 236 million tons in 2020. The increase in vegetable oil production is due to the increasing global demand along with the increase in the world's population, especially India and China. The total needs of the Chinese state can reach 34.29 million tons of oil and fat which is predominantly met from palm oil and soybean oil. While the consumption of Indian oil and fat are 15.2 kgs per capita from the total population of 1.24 billion. The economic growth of China and India is relatively more advanced than other countries in Asia and the population of around 50% of the world's population makes these two countries become palm oil demand drivers. During 1986–2015, Indian vegetable oil imports were dominated by palm oil (72%), soybean oil (19%), rapeseed oil 3% and sunflower oil by 6% (Palm Oil Agribusuness Strategic Policy Institute [PASPI], 2016).

Calle et al. (2009) conducted a study on world vegetable oil as a raw material for biodiesel. This study reveals that the demand for vegetable oil in the world is growing rapidly to support the bio energy (biodiesel) industry, especially in the United States, European Union, Brazil, China and India. The European Union became a major producer of biodiesel during the period 1999–2008 and has carried out mandatory biodiesel until 2020 for the transportation sector. Vegetable oil prices have increased in line with increasing demand, world oil prices, reduced stocks and climate change (drought).

Research on the impact of rising oil prices on the availability of domestic palm cooking oil is carried out by Hartoyo et al. (2011). This study uses time series data for the period 1984–2007. The results of the study stated that the increase in world crude oil prices during the 2003–2007 period encouraged an increase in the use of alternative fuels (biodiesel).Biodiesel production has increased with a growth of 39.25 per year and has an impact on the increase in world demand for palm oil which has led to increased export prices and domestic prices of palm oil in importing countries. In exporters, the increase in prices encourages the production and volume of palm oil to increase into the world market. The increase in exports is greater than the increase in production so the availability of palm oil decreases.

The results of the study by Hameed et al. (2016) stated that the prices of palm oil and substitute commodities and national income from importing countries were factors that significantly affected the demand for palm oil by the countries of Bangladesh, China, India, Japan, Korea and Pakistan. Another factor is the mandatory biofuel policy, trade policies and the exchange rate are also important factors in determining the demand for oil palm imports. Analysis of Indonesian palm oil exports to the European Union was carried out by Azizah (2015). This study concludes that Indonesia's CPO production and importer's gross domestic product (GDP) affect Indonesia's CPO exports in the European Union.

3. METHODOLOGY

3.1. Type and Data Source

The study used time series secondary data for the period 1991–2015 obtained from various agencies, namely the Central Statistics Agency (BPS), Directorate General of Plantations, Pusdatin Ministry of Agriculture, Bank Indonesia, The World Bank, Ministry of Trade of the Republic of Indonesia, Ministry of Industry Republic of Indonesia, Oil World Database, FAO Stat, UN Comtrade, Trade map, international trade center, United State Department of Agriculture, WTO, international monetary fund, Index Mundi, GAPKI (Indonesian Palm Oil Entrepreneurs Association), Association of Indonesian Biodiesel Producers, GIMNI (Indonesian Vegetable Oil Industry Association) and other related data sources such as journals and news in the mass media.

3.2. Data Analysis Method

The world vegetable oil trade model was built in the form of a simultany equation system consisting of 53 equations with 45 structural equations and 8 identity equations. The vegetable oil trade for each country analyzed is the total volume of exports and imports carried out to and from the world market without distinguishing the destination country of export and the origin of palm oil imports and the prices of exports and imports by countries of exporters and importers of vegetable oils and world prices. The structure of the model is arranged based on the type of vegetable oil to be analyzed, namely (1) palm oil blocks, (2) blocks of soybean oil, (3) rapeseed oil blocks and (4) sunflower oil blocks. Model estimation uses two stage least squares (2SLS) method. Data analysis used SAS/ETS software version 9.4.

Model validation is done with the aim to see if the model is sufficiently valid to be used for alternative simulations on the impact of changes in external factors. Validation criteria used are Root Mean Square Percent Error (RMSPE) and U-Theil. The smaller the RMSPE and U-Theil values, the better the model used for simulation (Sitepu and Sinaga, 2006).

Impact analysis which aims to analyze the performance of world vegetable oil trade is carried out by simulating historical policy scenarios for the period 2008–2015. The simulated policy instrument is a change in external factors in increasing world prices for crude oil and increasing demand for world vegetable oil. The increase in demand for vegetable oils was analyzed through an increase in GDP simulation of the major importers of world vegetable oil. The stage of the analysis procedure for econometric models is specification, estimation, validation and simulation (Hallam, 1990).

3.3. Model Specification

The specification of the world vegetable oil trade model is compiled based on the main exporters and importers in the world vegetable oil trade which is analyzed in the form of an equation system consisting of endogenous and exogenous variables. This variable relationship is built in the form of structural equality and identity.

3.3.1. Block palm oil

Indonesian palm oil exports:

$$QXSI_t=a_0+a_1PXSI_t+a_2QPSI_t+a_3TXSI_t+a_4ERI_t+a_5NTSE_t+a_6TREND+a_7QXSI_{t-1}+U_1 \quad (1)$$

Hypothesis: a_1, a_2, a_4, $a_6>0$; a_3, $a_5<0$; $0<a_7<1$.

Indonesian palm oil export prices:

$$PXSI_t=b_0+b_1PWS_t+b_2(1/TREND)+b_3PXSI_{t-1}+U_2 \quad (2)$$

Hypothesis: b_1, $b_2>0$; $0<b_3<1$.

Malaysian palm oil exports:

$$QXSM_t=c_0+c_1(PXSM_t-PXSM_t)+c_2ERM_{t-1}+c_3TXSM_{t-1}+c_4TREND_t+c_5QXSM_{t-1}+U_3 \quad (3)$$

Hypothesis: c_1, c_2, $c_4>0$; $c_3<0$; $0<c_5<1$.

Malaysian palm oil export prices:

$$PXSM_t=d_0+d_1PWS_t+d_2PXSM_{t-1}+U_4 \quad (4)$$

Hypothesis: $d_1>0$; $0<d_2<1$.

World palm oil exports (identity).

$$QXSW_t=QXSI_t+QXSM_t+QXST_t+QXSRW_t \quad (5)$$

China palm oil imports:

$$QMSN_t=e_0+e_1(PMSN_t-PMSN_{t-1})+e_2QDSN_t+e_3(TMSN_t-TMSN_{t-1})+e_4(1/TREND)+e_5QMSM_{t-1}+U_5 \quad (6)$$

Hypothesis: e_2, $e_4>0$; e_1, $e_3<0$; $0<e_5<1$.

Demand for Chinese palm oil:

$$QDSN_t=f_0+f_1PMSN_t+f_2PMKN_t+f_3PMRN_{t-1}+f_4PWM_t+f_5(GDPNt-GDPN_{t-1})+f_6SBN+f_7TREND_t+U_6 \quad (7)$$

Hypothesis: f_2, f_2, f_3, f_5, $f_4>0$; f_1, $f_6<0$.

Prices of Chinese palm oil imports:

$$PMSN_t=g_0+g_1PWS_t+g_2(TREND*ERN_t)+U_7 \quad (8)$$

Hypothesis: g_1, $g_2>0$.

Indian palm oil imports:

$$QMSD_t=h_0+h_1QDSD_t+h_2ERD_t+h_3QMSD_{t-1}+U_8 \quad (9)$$

Hypothesis: $h_1>0$; $h_2<0$; $0<h_3<1$.

Demand for Indian palm oil:

$$QDSD_t=i_0+i_1PMSD_t+i_2PWR_t+i_3SBD_t+i_4GDPD_t+i_5(PWM_t-PWM_{t-1})+i_6TREND_t+i_7QDSD_{t-1}+U_9 \quad (10)$$

Hypothesis: i_2, i_4, i_5, $i_6>0$; i_1, $i_3<0$; $0<i_7<1$.

Prices of Indian palm oil imports:

$$PMSD_t=j_0+j_1PWS_t+j_2TMSD+j_3(1/TREND)+j_4PMSD_{t-1}+U_{10} \quad (11)$$

European palm oil imports:

$$QMSE_t=i_0+i_1QDSE_t+i_2NTSE_t+i_3TREND+U_{11} \quad (12)$$

Hypothesis: i_1, $i_3>0$; $i_2<0$.

Demand for European palm oil:

$$QDSE_t=vv_0+vv_1PMSE_t+vv_2PDKE_t+vv_3PMBE_t+vv_4PDRE_t+vv_5GDPE+vv_6SBE_t+vv_7PWM_t+vv_8QDSE_{t-1}+U_{12} \quad (13)$$

Hypothesis: vv_2, vv_3, vv_4, vv_5, vv_5, $vv_7>0$; vv_1, $vv_6<0$; $0<vv_8<1$.

Price of European palm oil imports:

$$PMSE_t=j_0+j_1PWS_t+j_2ERE_t+j_3TMSE_t+j_4(1/TREND)+U_{13} \quad (14)$$

Hypothesis: j_1, j_3, $j_4>0$; $j_2<0$

Palm oil imports from the United States:

$$QMSA_t=k_0+k_1PMSA_t+k_2QDSA_t+k_3TREND+U_{14} \quad (15)$$

Hypothesis: k_2, $k_3>0$; $k_1<0$.

Demand for US palm oil:

$$QDSA_t=yy_0+yy_1(PMSA_t-PMSA_{t-1})+yy_2PDRA_t+yy_3PDKA_{t-1}+yy_4PWB_t+yy_5GDPA+yy_6QDSA_{t-1}+U_{15} \quad (16)$$

Hypothesis: yy_2, yy_3, yy_4, $yy_5>0$; $yy_1<0$; $0<yy_6<1$

Prices of US palm oil imports:

$$PMSA_t=l_0+l_1PWS_t+l_2QMSA_t+l_3PMSA_{t-1}+U_{16} \quad (17)$$

Hypothesis: l_1, $l_2>0$; $0<l_3<1$.

World palm oil imports:

$$QMSW_t=QMSN_t+QMSD_t+QMSE_t+QMSA_t+QMSRW_t \quad (18)$$

The world price of palm oil:

$$PWS_t=m_0+m_1(QXSW_t-QXSW_{t-1})+m_2(QMSW_t-QMSW_{t-1})+m_3PWS_{t-1}+U_{17} \quad (19)$$

Hypothesis: $m_2>0$; $m_1<0$; $0<m_3<1$.

3.3.2. Soybean oil block

Export of argentinian soybean oil:

$$QXKG_t=n_0+n_1(PXKG_t-PXKG_{t-1})+n_2QPKG_t+n_3ERG_t+n_4QXKG_{t-1}+U_{18} \quad (20)$$

Hypothesis: n_1, n_2, $n_3>0$; $0<n_5<1$.

Export prices of argentinian soybean oil:

$$PXKG_t=o_0+o_1PWK_t+o_2QXKG_t+o_3TXKG_t+o_4PXKG_{t-1}+U_{19} \quad (21)$$

Hypothesis: o_1, $o_3>0$; $o_2<0$; $0<o_4<1$.

Export of Brazilian soybean oil:

$$QXKB_t=p_0+p_1(PXKB_t-PXKB_t)+p_2(PDKB_t-PDKB_{t-1})+p_3QPKB_t+p_4TXKB_t+p_5ERB_t+p_6QXKB_{t-1}+U_{20} \quad (22)$$

Hypothesis: p_1, p_3, p_5, >0; p_2, $p_4<0$; $0<p_6<1$

Export prices of Brazilian soybean oil:

$$PXKB_t=q_0+q_1PWK_t+q_2QXKB_t+q_3PXKB_{t-1}+U_{21} \quad (23)$$

Hypothesis: $q_1>0$; $q_2<0$; $0<q_3<1$.

Export of soybean oil from the United States:

$$QXKA_t=r_1PXKA_t+r_2QPKA_t+r_3TXKA_{t-1}+r_4(1/TREND)+r_5QXKA_{t-1}+U_{22} \quad (24)$$

Hypothesis: r_1, r_2, $r_4>0$; $r_3<0$; $0<r_5<1$.

The price of soybean oil exports from the United States:

$$PXKA_t=s_0+s_1PWK_t+s_2PXKA_{t-1}+U_{23} \quad (25)$$

Hypothesis: $s_1>0$; $0<s_2<1$.

World soybean oil export (identity):

$$QXKW_t=QXKG_t+QXKB_t+QXKA_t+QXKRW_t \quad (26)$$

Soybean oil imports from China:

$$QMKN_t=t_1PMKN_{t-1}+t_2QDKN_{t-1}+t_3QMKN_{t-1}+U_{24} \quad (27)$$

Hypothesis: $t_2>0$; $t_1<0$; $0<t_3<1$

Price of imports of Chinese soybean oil:

$$PMKN_t=u_0+u_1PWK_t+u_2TMKN_t+u_3(ERN_t-ERN_{t-1})+u_4PMKN_{t-1}+U_{25} \quad (28)$$

Hypothesis: u_1, $u_2>0$; $u_3<0$; $0<u_4<1$.

Import of soybean oil from Europe:

$$QMKE_t=v_1PMKE_{t-1}+v_2QDKE_{t-1}+v_3TMKE_{t-1}+ v_3QMKE_{t-1}+U_2 \quad (29)$$

Hypothesis: $v_2>0$; $v_1<0$; $0<v_3<1$.

Import prices of European soybean oil:

$$PMKE_t=x_0+x_1PWK_t+x_2(QMKE_t-QMKE_{t-1})+x_3TREND+x_4PMKE_{t-1}+U_{27} \quad (30)$$

Hypothesis: x_1, x_2, $x_3>0$; $0<x_4<1$.

Import of soybean oil from India:

$$QMKD_t=y_1PMKD_t+y_2QDKD_t+y_3TMKD_t+y_4(ERD_t-ERD_{t-1})+y_5TREND+y_6QMKD_{t-1}+U_{28} \quad (31)$$

Hypothesis: y_2, $y_5>0$; y_1, y_3, $y_4<0$; $0<y_6<1$.

Price of imports of Indian soybean oil:

$$PMKD_t=z_0+z_1PWK_t+z_2QMKD_{t-1}+z_3TREND+z_4PMKD_{t-1}+U_{28} \quad (32)$$

Hypothesis: z_1, $z_3>0$; $z_2<0$; $0<z_4<1$.

World soybean oil imports:

$$QMKW_t=QMKN_t+QMKD_t+QMKE_t+QMKRW_t \quad (33)$$

The world price of soybean oil:

$$PWK_t=aa_0+aa_1QXKW_t+aa_2QMKW_t+aa_3PWK_{t-1}+U_{29} \quad (34)$$

Hypothesis: $aa_2>0$; $aa_1<0$; $0<aa_3<1$.

3.3.3. Rapeseed oil block

Export of rapeseed oil from Canada:

$$QXRC_t=bb_0+bb_1(PXRC_t-PXRC_{t1})+bb_2QPRC_t+bb_3TREND+bb_4QXRC_{t-1}+U_{30} \quad (35)$$

Hypothesis: bb_2, $bb_3>0$; $bb_1<0$; $0<bb_4<1$.

Price of Canadian rapeseed oil exports:

$$PXRC_t=cc_0+cc_1\ PWR_t+cc_2\ TXRC_t+cc_3\ (ERC_t-ERC_{t-1})+cc_4PXRC_{t-1}+U_{31} \quad (36)$$

Hypothesis: cc_1, cc_2, $cc_3>0$; $0<cc_4<1$.

Export of European rapeseed oil:

$$QXRE_t=dd_0+dd_1PXRE_{t-1}+dd_2QPRE_t+dd_3ERE_t+dd_4QXRE_{t-1}+U_{32} \quad (37)$$

Hypothesis: dd_2, $dd_3>0$; $dd_1<0$; $0<dd_4<1$.

Export of European rapeseed oil:

$$PXRE_t=ee_0+ee_1\,PWR_t+ee_2(TXRE_t-TXRE_{t-1})+ee_3PXRE_{t-1}+U_{33} \quad (38)$$

Hypothesis: ee_1, ee_2, $ee_3>0$; $0<ee_4<1$.

Export of world rapeseed oil (identity):

$$QXRW_t=QXRC_t+QXRE_t+QXRRW_t \quad (39)$$

Import of United States rapeseed oil:

$$QMRA_t=ff_0+ff_1QDRA_t+ff_2QMRA_{t-1}+U_{34} \quad (40)$$

Hypothesis: $bp_2>0$; $0<bp_2<1$.

Prices of imported rapeseed oil from the United States:

$$PMRA_t=gg_1PWR_t+gg_2TMRA_t+U_{35} \quad (41)$$

Hypothesis: gg_1, $gg_2>0$.

Import of Chinese rapeseed oil:

$$QMRN_t=hh_0+hh_1(PMRN_t-PMRN_{t-1})+hh_2(QDRN_t-QDRN_t)+hh_3TREND+hh_4QMRN_{t-1}+U_{36} \quad (42)$$

Hypothesis: hh_2, $hh_3>0$; $hh_1<0$; $0<hh_2<1$.

Price of Chinese rapeseed oil imports:

$$PMRN_t=ii_0+ii_1PWR_t+ii_2(ERN-ERN_{t-1}/ERN_{t1}*100)+ii_3TMRN_t+ii_4PMRN_{t-1}+U_{37} \quad (43)$$

Hypothesis: $ii_3>0$; ii_1, $ii_2<0$; $0<ii_4<1$.

Import of world rapeseed oil (identity):

$$QMRW_t=QMRA_t+QMRN_t+QMRD_t+QMRRW_t \quad (44)$$

World prices of rapeseed oil:

$$PWR_t=jj_0+jj_1(QXRW_t-QXRW_{t-1})+jj_2QMRW_t+jj_3PWR_{t-1}+U_{38} \quad (45)$$

Hypothesis: $jj_2>0$; $jj_1<0$; $0<jj_3<1$.

3.3.4. Sunflower oil block

European sunflower oil exports:

$$QXBE_t=kk_0+kk_1(PWB_t-PWB_{t-1})+kk_2QPBE_t+kk_3(ERE_t-ERE_{t-1})+kk_4TREND_t+kk_5QXBE_{t-1}+U_{39} \quad (46)$$

Hypothesis: kk_1, kk_2, kk_3, $kk_4>0$; <0; $0<kk_5<1$.

Export prices of European sunflower oil:

$$PXBE_t=ll_0+ll_1QXBE_t+ll_2PWB_t+ll_3TXBE_t+ll_4TREND+ll_5PXBE_{t-1}+U_{40} \quad (47)$$

Hypothesis: $ll_2, ll_3, ll_4>0; ll_1<0; 0<ll_5<1$.

Export of world sunflower oil (identity):

$$QXBW_t=QXBE_t+QXBA_t+QXBRW_t \quad (48)$$

Import of European sunflower oil:

$$QMBE_t=mm_0+mm_1PMBE_{t-1}+mm_2ERE_{t1}+mm_3TREND+mm_4TMBE_{t-1}+mm_5QMBE_{t-1}+U_{41} \quad (49)$$

Hypothesis: $mm_3, mm_4>0; mm_1, mm_2<0; 0<mm_5<1$.

Prices of European sunflower oil imports:

$$PMBE_t=nn_0+nn_1PWB_t+nn_2QMBE_t+nn_3PMBE_{t-1}+U_{42} \quad (50)$$

Hypothesis: $cf_1, cf_1>0; 0<cf_3<1$.

Import of Indian sunflower oil:

$$QMBD_t=oo_0+oo_1(PWB_t-PWB_{t-1})+oo_2QPBD_t+oo_3QDBD_t+ch_4ERD_{t-1}+oo_5QMBD_{t-1}+U_{43} \quad (51)$$

Hypothesis: $oo_3>0; oo_1, oo_2, oo_4<0; 0<oo_5<1$.

Import of world sunflower oil (identity):

$$QMBW_t=QMBE_t+QMBD_t+QMBS_t+QMBRW_t \quad (52)$$

The world price of sunflower oil:

$$PWB_t=pp_0+pp_1QXBW_{t-1}+pp_2QMBW_t+pp_3PWB_{t-1}+U_{44} \quad (53)$$

Hypothesis: $pp_2>0; pp_1<0; 0<pp_3<1$.

Description:
TREND: Technology level (trend).
TXRE: Export tax for European rapeseed oil (%).
ERI: Indonesian exchange rate (Rp/US$).
TXBE: European sunflower oil export tax (%).
TXSI: Indonesian palm oil export tax (%).
TMBE: European sunflower oil import tariff (%).
ERM: Malaysian exchange rate (MYR/US$).
NTSE: Dummy Non Tariff imports from European palm oil.
TXSM: Malaysian palm oil export tax (%).
SBE: European credit interest rates (%).
QXST: Thai palm oil exports (000 tons).
TMSE: Tariff for European palm oil imports (%).
QMRD: Import of Indian rapeseed oil (000 tons).
TMKE: Import tariff for European soybean oil (%).
ERG: Argentine exchange rate (ARS/US$).
GDPN: Chinese per capita income (US$).
GDPG: Argentine per capita income (US$).
TMSN: Chinese palm oil import tariffs (%).
TXKG: Argentine soybean oil export tax (%).
ERN: Chinese exchange rate (CNY/US$).
ERB: Brazil exchange rate (BRL/US$).
TMKN: Import tariff for Chinese soybean oil (%)
GDPB: Brazil per capita income (US$).
TMRN: China rapseed oil import tariff (%).
TXKB: Export tax on Brazilian soybean oil (%).
SBN: China credit interest rate (%).
GDPA: United States per capita income (US$).
SBD: Indian credit interest rate (%).
TXKA: United States soybean oil export tax (%).
TMSD: Tariffs for the import of Indian palm oil (%).
ERC: Canada exchange rate (CAD/US$).
ERD: India exchange rate (IND/US$).
GDPC: Canada per capita income (US$).
GDPD: Indian per capita income (US$).
TXRC: Canadian rapeseed oil export tax (%).
TMKD: Import tariff for Indian soybean oil (%).
TMRA: Tariff on the import of US rapeseed oil (%).
PWB: World sunflower oil prices (US $/tons).
ERE: European exchange rate (EUR/US$).
TMBD: Import rates of Indian sunflower oil (%).
GDPE: European/EU-28 (US $) per capita income
QXST: Thai palm oil exports (tons).

3.4. Model Identification and Estimation

Model identification is done before the estimation process. Model identification criteria are based on the requirement condition (order condition) and adequacy requirements (rank condition) with the formula (K - M) > (G - 1) (Koutsoyiannis, 1977). The world vegetable oil trading model is built in the form of a simultaneous equation system that has undergone a process of respecification. The model consists of 53 equations (G), namely 45 structural equations and 8 identity equations. Endogenous variables are 53 and predetermined variables are 101 so that the total variables in the model are 172 (K). The maximum number of variables (endogenous and exogenous) in an equation is 8 variables (M). The results of model identification are (172-8) > (53–1) and the model shows overidentification (Koutsoyanis, 1977; Intriligator et al., 1996). The model is estimated using the 2SLS method.

3.5. Validation and Model Simulation

Model validation is done in order to see if the model is sufficiently valid to conduct alternative simulations of policy impacts (changes). Validation criteria used are RMSPE and Theil's Inequality Coefficient) (U-Theil). RMSPE is the average square of the proportion difference between the estimated value and the observation value of a variable. If the RMSPE value is smaller then the model estimate or variable is more valid. The smaller the RMSPE and U-Theil values the better the model is used for simulation (Sitepu and Sinaga, 2006). The U-Theil statistics value is always between 0 and 1, if U = 0, then the model is historically perfect, whereas if U = 1 then the estimation of the model is naive (Pindyck and Rubinfield, 1998).

The results of the validation of the world vegetable oil trade model show that the RMSPE value is smaller than 30% as much as 79.41% endogenous variables and 93% endogenous variables with U-Theil values smaller than 0.3. This shows that during the historical simulation period for the period 2008–2015 the predicted value of the endogenous variable was close enough to its actual value. Therefore, the model is good enough to be used to simulate the impact of changes in external factors on the performance of world vegetable oil trade.

Alternative simulation scenarios are as follows: (1) Increasing in world crude oil prices by 30%, (2) increasing in India's GDP by 5%, (3) increasing in China's GDP by 5%, (4) increasing in European GDP by 5% and (5) increasing in US GDP by 5%.

4. RESULT AND DISCUSSIONS

4.1. Performance of World Vegetable Oil Trading

The main sources of world vegetable oil production are palm oil (40.20%), soybean oil (32.60%), repeseed oil (17.80%) and sunflower oil (9.40%). During the period 2008–2015, exports of sunflower oil had the highest growth (9.15%) while palm oil was the lowest (3.3%). This shows that palm oil is absorbed more by domestic processing industries of exporters (Indonesia, Malaysia, Thailand). On the import side, rapeseed oil showed the highest growth growth (5.76%) followed by sunflower oil (4.67%) and palm oil (4.03%).

Table 1 showed the average share of vegetable oil on the world market based on major exporters and importers during the period 2008–2015. Indonesia is a major exporter of palm oil with a share of 43.49%, followed by Malaysia (35.34%) and Thailand (3.70%). India, China and the European Union are the main importers of world palm oil. The mandatory biodiesel policy and the increasing population of each importing country have an impact on the world vegetable oil market.Soybean oil is produced in America area while rapeseed oil and sunflower oil in the Americas and the European Union. The main importing countries of the four types of vegetable oils are India, China, Europe and the United States. All types of vegetable oil can be used as raw material for biodiesel, but palm oil which has greater competitiveness due to higher productivity, lower prices, low carbon emissions and the nature of renewable energy (sustainability) (Mukherjee et al., 2014 and PASPI, 2016).

Palm oil is a substitute for soybean oil in America and rapeseed oil in Europe, so that the price of vegetable oil is mutually influential (Buyung et al., 2017). Currently India is developing biodiesel from palm oil so that its imports increase by 6.60% per year and become the largest importer with a 19.25% share. The rate of increase in Indian soybean imports is 3.24%, still smaller compared to palm oil. China's palm oil imports grew by only 0.63% per year, while soybean imports dropped dramatically by 15% per year. Palm oil imports by Europe grew by 4.51% per year, but soybean imports decreased by 2.34% per year. The main countries for Indonesia's palm oil export destinations are India, China, Europe and the United States. Indonesia's palm oil exports to Europe are dominated by derivative products (80%) and CPO by 20%. Compared to Malaysia, Indonesia is still superior in terms of production and exports since 2006. The average growth of Malaysian palm oil production and exports is 2.53% and 3.56% annually.

The main sources of world vegetable oil production are 40.20% palm oil, 32.6% soybean oil, 17.80% repeseed oil and 9.40% sunflower oil. This change shows the share of palm oil rose 1.30%, while the other three vegetable oils declined. Table 2 shows that the four types of vegetable oils show trade performance in terms of exports and imports to and from a positive world market with growth increasing every year in the period 2008–2015. From the export side, sunflower oil has the highest growth while the lowest palm oil. This shows that palm oil is absorbed more in domestic exporters (Indonesia, Malaysia, Thailand). While on the import side, rapeseed oil showed the highest growth growth followed by sunflower oil and palm oil.

The four types of vegetable oil are substrates. Palm oil is a substitute for soybean oil in America and rapeseed oil in Europe.

Table 1: Share of world vegetable oil exports and imports 2008–2015

Vegetable oil	Exporter countries	000 ton	Percentage	Importer country	000 ton	Percentage
Palm oil	Indonesia	19221.44	43.49	India	7359.16	19.25
	Malaysia	15620.59	35.34	China	6148.50	16.09
	Thailand	1636.13	3.70	European Union	6117.63	16.01
	Rest of the world	7722.29	17.47	United States of America	1104.25	2.89
	World	44200.44		Rest of the world	17491.09	45.76
				World	38220.63	
Soybean oil	Argentina	4604.63	46.86	China	1586.03	18.09
	Brazil	1555.00	15.83	European Union	1229.74	14.03
	United States of America	1054.88	10.74	India	1032.25	11.77
	The rest of world	2611.00	26.57	The rest of world	4919.64	56.11
	world	9825.50		World	8767.65	
Rapeseed oil	Canada	2315.75	35.79	United states of america	1396.25	39.51
	European Union	2473.27	38.22	China	875.38	24.77
	The rest of world	1682.21	26.00	India	126.75	3.59
	world	6471.23		The rest of world	1135.88	32.14
				World	3534.25	
Sunflower oil	Uni Eropa	2079.45	34.20	European Union	2527.27	37.00
	Unitedstate of america	51.71	0.85	India	884.45	12.95
	The rest of world	3949.10	64.95	Egypt	742.00	10.86
	world	6080.25		The rest of world	2676.61	39.19
				World	6830.33	

Source: Processed data

Table 2: Performance of world vegetable oil trading, 2008–2015

Vegetable oil	Volume (000 ton)								Growth (%)
	2008	2009	2010	2011	2012	2013	2014	2015	
Palm oil									
Export	38340	41509	40264	42679	46534	50041	46625	47611	3.33
Import	32879	34210	35406	37389	40309	40096	42433	43043	4.03
Soybean oil									
Exsport	9183	9173	9659	8521	9358	9464	11099	12147	3.71
Import	9137	8712	9488	7967	8494	9251	10073	11749	3.17
Rapeseed oil									
Exsport	4515	4990	6065	6164	6717	7184	7802	8334	8.22
Import	2440	2926	3307	4008	3895	3806	3913	3979	5.76
Sunflower oil									
Exsport	4543	4496	4529	6468	5552	7773	7388	7893	9.15
Import	5007	6112	5980	6573	8794	8649	6255	7273	4.67

Source: FAOSTAT (various years, processed)

Each of these vegetable oil prices influence each other (Buyung et al., 2017) which also affects each type of vegetable oil. If there is an increase in the price of one of the vegetable oils, the demand for other types of vegetable oil will increase.

Currently India is developing biodiesel from palm oil so that its imports increase by 6.60% per year and become the largest importer with a 19.25% share. The rate of increase in Indian soybean imports is 3.24%, still smaller than palm oil. Chinese imports grew by only 0.63% per year, while soybean imports dropped dramatically by 15% per year. Palm oil imports by Europe experienced a growth of 4.5% per year, but soybean imports decreased by 2.34%.

4.1. Impact of Increasing World Prices of Crude Oil

In the last three years the world price of crude oil has increased. At the end of 2016, the price of crude oil (U.K Brent) was still around 37 $ US per barrel but at the end of May 2018 the world price of crude oil had more than doubled to around 76 $ US per barrel.

Table 3 shows a simulation of a 30% increase in world price of crude oil. Increasing world prices of crude oil have an impact on increasing import of palm oil by all importing countries. The country of China gave the largest increase in palm oil imports by 9.53%, followed by the United States, Europe and India which increased by 1.17%, 1.09% and 0.52% respectively. %. Indonesian and Malaysian palm oil exports also increased by 0.36% and 0.02% respectively, but the increase was smaller than the increase in world imports of palm oil so that the world price of palm oil still increased by 0.38%. This shows that industries that use palm oil as raw materials have developed well in line with the development of the biodiesel industry in all countries that are exporters and importers of palm oil. Crude oil is a substitute commodity from palm oil in China. The change in the increase in imports is greater than the increase in exports so the world price of palm oil is still increasing.

Increased imports of palm oil in all importing countries caused imports of soybean oil from the importing country to also decline. India experienced the largest reduction in soybean oil imports by 7.37%, followed by Europe and China, each of which decreased by 5.72% and 0.09%, so that world imports also decreased by 0.97%. The decline in imports caused the world price of soybean oil to also decrease by 0.65%. The export volume of soybean oil from each of the exporting countries (Argentina, Brazil and the United States) also decreased so that world exports decreased by 0.0054%. The trade performance of soybean oil has decreased if the world price of crude oil has increased by 30%. The decline in exports, imports and prices of each of the exporting and importing countries has caused a decline in the trading volume of soybean oil on the world market.

Simulating an increase in world prices of crude oil improves the trade performance of rapeseed oil. Rapeseed oil imports increased with a larger percentage compared to rapeseed oil exports so that world prices still increased even though it was only 0.93%. The same thing happened to the sunflower oil market, trade performance has increased. World imports are increasing as well as exports are increasing in a relatively small amount but the world price of sunflower oil is still increasing.

The price of world palm oil has a correlation with the price of crude oil. The empirical test results show that there is a strong correlation between world crude oil prices and world palm oil prices with a correlation coefficient of 0.81 (Purba, 2012). This means that the increase in world oil prices will be followed by an increase in the world price of palm oil, and vice versa, the decline in fuel prices will also be followed by a decline in the world price of palm oil. The movement of world crude oil prices, especially diesel prices, affects the world price of palm oil because some palm oil is used for biodiesel production.

4.2. Impact of Increased Demand for Vegetable Oil

To analyze the impact of the increase in demand for vegetable oil on the world vegetable oil market, a simulation of an increase in per capita income from each importing country was carried out. The simulation scenario that was carried out was an increase in per capita income of the major importers of vegetable oil by 5%.

Table 4 shows the results of simulation of the increase in per capita income of each world vegetable oil importing country. The simulation of an increase in Indian per capita (GDP) income (S1) has a direct impact on increasing imports of all types of vegetable oils, namely palm oil, soybean oil and sunflower oil. The increase in palm oil imports showed the highest change, which was 2.08% followed by sunflower oil and soybean oil by 1.51% and 1.32% respectively. The importing countries of Europe and the United States also experienced an increase in imports of palm oil, soybean

Table 3: Crude oil price improvement simulation results

Variable	Unit	Basic value	Δ Simulation (%)
Indonesian export palm oil	000 ton	20316.67	0.1164
Indonesian palm oil export price	US$/ton	1873.28	0.3616
Malaysian export palm oil	000 ton	11515.57	0.0188
Malaysia palm oil export price	US$/ton	1879.55	0.3554
World export palm oil	000 ton	41190.65	0.0627
China's palm oil import	000 ton	4654.94	9.5363
China's palm oil import price	US$/ton	2117.42	0.3791
India's palm oil import	000 ton	7097.85	0.5246
India's palm oil import price	US$/ton	1376.41	0.2204
Eropa's palm oil import	000 ton	5889.55	1.0936
Eropa's palm oil import price	US$/ton	950.39	0.2517
USA's palm oil import	000 ton	85582.20	1.1685
USA's palm oil import price	US$/ton	16463.44	0.0364
World palm oil import	000 ton	120708.65	0.4534
World palm oil price	US$/ton	2012.41	0.3762
Argentina's soybeans oil export	000 ton	4914.63	−0.0040
Argentina's soybeans oil export price	US$/ton	939.71	−0.1793
Brazil's soybeans oil export	000 ton	1430.34	−0.0026
Brazil's soybeans oil export price	US$/ton	510.33	−0.4991
USA soybeans oil export	000 ton	1074.66	−0.0285
USA soybeans oil export price	US$/ton	1029.92	−0.2401
World soybeans export	000 ton	10030.64	−0.0054
China's soybeans oil import	000 ton	1692.89	−0.0942
China's soybeans oil import price	US$/ton	1040.79	−0.4184
Eropa's soybeans oil import	000 ton	1204.90	−5.7202
Eropa's soybeans oil import price	US$/ton	1185.41	−0.3360
India's soybeans oil import	000 ton	1187.61	−7.3773
India's soybeans oil import price	US$/ton	985.31	−0.1553
World soybeans oil import	US$/ton	9005.03	−0.9729
World soybeans oil price	000 ton	967.83	−0.6583
Canada's rapeseed oil export	000 ton	1847.57	0.0227
Canada's rapeseed oil export price	000 ton	1303.87	0.3941
Eropa's rapeseed oil export	000 ton	2477.49	0.4451
Eropa's rapeseed oil export price	000 ton	1344.66	0.3803
World rapeseed oil export	000 ton	6007.28	0.1906
USA rapeseed oil import	000 ton	1706.21	4.1743
USA rapeseed oil import price	US$/ton	1331.07	0.7270
China's rapeseed oil import	000 ton	664.64	0.1550
China's rapeseed oil import price	000 ton	2413.42	0.2557
World rapeseed oil import	000 ton	3633.48	1.9885
World rapeseed oil price	US$/ton	974.36	0.9294
Eropa's sunflower oil export	000 ton	24111.15	0.0006
Eropa's sunflower oil export price	000 ton	486.85	0.1421
World sunflower oil export	000 ton	28111.96	0.0006
Eropa's sunflower oil import	US$/ton	2539.72	0.0394
Eropa's sunflower oil import price	US$/ton	1083.86	0.0702
India's sunflower oil import	000 ton	900.40	0.8625
World sunflower oil import	1 ton	8170.54	0.0950
World sunflower oil price	US$/ton	1275.62	0.1154

Source: Processed data

oil, rapeseed oil and sunflower oil. On the contrary with China, this simulation has an impact on the decline in imports of palm oil and soybean oil. Because the increase in imports of all types of vegetable oil is greater than the decline in imports, the world price of vegetable oil is still increasing. The world price of sunflower oil increased by 0.20% exceeding the increase in prices of soybean oil, palm oil and rapeseed oil by 0.11%, 0.01% and 0.02% respectively.

The simulation of India's GDP increase has a positive impact on vegetable oil exporters because the volume of exports of palm oil, soybean oil, rapeseed oil and sunflower oil has increased despite a relatively small percentage. This increase in exports was driven by rising world prices of each type of vegetable oil.

The simulation of increasing European GDP (S2) has an impact on the increase in imports of palm oil, soybean oil and sunflower oil by the three main importing countries, namely Europe, China and the United States. While the import of sunflower oil in India has decreased by 0.01%, but the total import of world vegetable oil has increased. In terms of vegetable oil exports, if European GDP increases, it will cause palm oil exports by Indonesia and Malaysia so that the world's total palm oil exports will increase. The increase in world imports of palm oil by 0.18% is greater than the total increase in world exports which is only 0.02% so that the world price of palm oil is still increasing by 0.15%. The same condition occurs in soybean oil where the increase in world imports exceeds the increase in exports so that the world price of soybean oil also increases. Increasing world prices of soybean oil have resulted in increased prices for soybean oil exports in Argentina, Brazil and the United States.

Different changes occur in the trade of rapeseed oil. The simulation of an increase in European GDP caused Canada's exports to decline by 0.002% but European rapeseed oil exports increased by 1.15%, so that total world exports increased by 0.47%. Rapeseed oil imports also increased by 0.03%, but the total effect of exports reduced prices by more than the effect of world total imports so that the world price of rapeseed oil declined by the world price of rapeseed oil by 0.09%.

The increase in world prices of rapeseed oil has little impact (0.0009%) on world exports of rapeseed oil, but world imports have declined with a larger amount (0.002%) so that the world price of sunflower oil is still decreasing by 0.016%.

The simulation results of an increase in China's GDP (S3) have a major impact on the increase in China's palm oil imports by 32.56%. This shows that palm oil is an important vegetable oil for China which can be used as food, industry and biodiesel. This increase in imports led to an increase in world exports of palm oil (1.23%), which caused the world price of palm oil to also increase by 1.02%. In palm oil exporting countries, the impact of this simulation increases the volume of Indonesian palm oil exports by 0.98% and Malaysia by 0.05%, so that the world's total exports increase by 0.17%. From the results of this simulation it can be seen that palm oil from Indonesia has great potential in the Chinese vegetable oil market. The impact of this simulation on the performance of the trade in soybean oil, rapeseed oil and sunflower oil has the same direction as the European GDP increase simulation as previously stated.

The simulation of increasing US GDP (S4) has the greatest impact on the performance of the trade in palm oil compared to simulations of an increase in GDP of India, Europe and China. The simulation results show that US palm oil imports increased by 5.05% while India, Europe and China palm oil imports decreased by 0.05%, 1.71% and 0.34%, respectively, so that world imports of palm oil still increased quite significantly (3.50%). From the results of this simulation it can be said that US palm oil imports play an important role in the world market of palm oil. The increase in the GDP of the United States had a positive impact on the volume of

Table 4: Results of simulation of increase in vegetable oil demand

Variable	Unit	Basic value	Changes in simulation results Δ (%)			
			S1	S2	S3	S4
Indonesian palm oil production	000 ton	29996.50	0.0051	0.0650	0.4402	1.2591
Indonesian export palm oil	000 ton	20316.67	0.0036	0.0464	0.3148	0.8995
Indonesian palm oil export price	US$/ton	1873.28	0.0111	0.1443	0.9826	2.7949
Malaysian palm oil production	000 ton	19055.28	0.0000	0.0006	0.0040	0.0115
Malaysian export palm oil	000 ton	11515.57	0.0006	0.0075	0.0510	0.1450
Malaysia palm oil export price	US$/ton	1879.55	0.0109	0.1418	0.9656	2.7467
World export palm oil	000 ton	41190.65	0.0019	0.0250	0.1695	0.4842
China’s palm oil import	000 ton	4654.94	−0.0011	−0.0879	32.5655	−1.7095
China’s palm oil import price	US$/ton	2117.42	0.0116	0.1513	1.0300	2.9299
India’s palm oil import	000 ton	7097.85	0.2252	−0.2654	−0.2727	−0.0530
India’s palm oil import price	US$/ton	1376.41	2.0877	2.1764	2.7345	3.9411
Eropa’s palm oil import	000 ton	5889.55	0.0124	4.1064	−0.1181	−0.3368
Eropa’s palm oil import price	US$/ton	950.39	0.0077	0.1005	0.6840	1.9456
USA’s palm oil import	000 ton	85582.20	0.0155	0.0150	0.0124	5.0552
USA’s palm oil import price	US$/ton	16463.44	0.0012	0.0133	0.0909	4.8383
World palm oil import	000 ton	120708.65	0.0139	0.1810	1.2319	3.5045
World palm oil price	US$/ton	2012.41	0.0115	0.1501	1.0221	2.9073
Argentina’s soybeans oil export	000 ton	4914.63	0.0007	0.0001	0.0002	0.0006
Argentina’s soybeans oil export price	US$/ton	939.71	0.0321	0.0022	0.0027	0.0038
Brazil’s soybeans oil export	000 ton	1430.34	0.0005	0.0000	0.0000	0.0001
Brazil’s soybeans oil export price	US$/ton	510.33	0.0895	0.0061	0.0077	0.0110
USA soybeans oil export	000 ton	1074.66	0.0051	0.0003	0.0004	0.0006
USA soybeans oil export price	US$/ton	1029.92	0.0430	0.0029	0.0037	0.0053
World soybeans export	000 ton	10030.64	0.0010	0.0001	0.0002	0.0004
China’s soybeans oil import	000 ton	1692.89	−0.0059	0.0059	0.0059	0.0006
China’s soybeans oil import price	US$/ton	1040.79	0.0750	0.0051	0.0064	0.0092
Eropa’s soybeans oil import	000 ton	1204.90	−0.0083	0.0830	0.0008	0.0017
Eropa’s soybeans oil import price	US$/ton	1185.41	0.0602	0.0041	0.0052	0.0074
India’s soybeans oil import	000 ton	1187.61	1.3225	0.0904	0.1136	0.1637
India’s soybeans oil import price	US$/ton	985.31	0.0278	0.0019	0.0024	0.0034
World soybeans oil import	US$/ton	9005.03	0.1744	0.0119	0.0150	0.0216
World soybeans oil price	000 ton	967.83	0.1180	0.0081	0.0101	0.0145
Canada’s rapeseed oil export	000 ton	1847.57	0.0001	−0.0024	0.0040	0.0504
Canada’s rapeseed oil export price	000 ton	1303.87	0.0012	−0.0419	0.0695	0.8746
Eropa’s rapeseed oil export	000 ton	2477.49	0.0004	1.1530	−0.0027	−0.0343
Eropa’s rapeseed oil export price	000 ton	1344.66	0.0011	−0.0405	0.0671	0.8441
World rapeseed oil export	000 ton	6007.28	0.0002	0.4748	0.0001	0.0014
USA rapeseed oil import	000 ton	1706.21	0.0109	0.0568	0.3605	9.0498
USA rapeseed oil import price	US$/ton	1331.07	0.0022	−0.0773	0.1282	1.6135
China’s rapeseed oil import	000 ton	664.64	0.0034	0.0110	0.9024	−0.2235
China’s rapeseed oil import price	000 ton	2413.42	0.0008	−0.0272	0.0451	0.5674
World rapeseed oil import	000 ton	3633.48	0.0058	0.0287	0.3343	4.2087
World rapeseed oil price	US$/ton	974.36	0.0028	−0.0989	0.1639	2.0628
Eropa’s sunflower oil export	000 ton	24111.15	0.0007	0.0011	0.0000	1.E-05
Eropa’s sunflower oil export price	000 ton	486.85	0.2499	−0.0018	0.0000	−2.E-05
World sunflower oil export	000 ton	28111.96	0.0006	0.0009	0.0000	1.E-05
Eropa’s sunflower oil import	US$/ton	2539.72	0.0004	0.0008	0.0004	4.E-04
Eropa’s sunflower oil import price	US$/ton	1083.86	0.1230	0.0092	0.0009	0.0018
India’s sunflower oil import	000 ton	900.40	1.5125	−0.0111	−0.0111	−0.0002
World sunflower oil import	1 ton	8170.54	0.1667	−0.0024	−0.0012	−0.0001
World sunflower oil price	US$/ton	1275.62	0.2024	−0.0157	−0.0078	−0.0008

Source: Processed data. Description: S1: Indian GDP rose 5%; S2: European GDP rose 5%; S3: China’s GDP rose 5%; S4: US GDP rose 5%. GDP: Gross domestic product

exports of Indonesia and Malaysia so that total exports increased by 0.48%. However, the effect of the increase in imports which increased prices more than increased exports prompted a sharp increase in world prices of palm oil by 2.90%. This simulation has the greatest impact on increasing the world price of palm oil.

In line with the increase in palm oil imports, the simulation results also increased US rapeseed oil imports by a very large amount of 9.05%, but China’s rapeseed oil imports decreased by 0.57% so that world total imports still increased by 4.21%. This increase in world imports has the effect of increasing the world price of rapeseed oil in a fairly large percentage (2.06%). The increasing world price of palm oil and rapeseed oil has led to increased imports of soybean oil as a commodity. The increase in world imports is greater than the increase in world exports of soybean oil so that the world price of soybean oil is still increasing (0.01%). The increase in US GDP also has an impact on the increase in soybean oil exports even though in a relatively small amount it encourages increasing world exports of soybean oil. On the contrary, the trading performance of the sunflower oil simulation has the effect of reducing world prices.

5. CONCLUSION

The increase in world prices of crude oil increases the world export and import of palm oil, but the increase in world imports exceeds the increase in exports thus pushing up the world price of palm oil. The highest palm oil imports are carried out by China, followed by countries, America, Europe and India. If the exporting and importing countries have a goal to develop industrial processed products from palm oil, then it can be done when the world price of crude oil increases. The trade performance of rapeseed oil and sunflower oil is also getting better if there is an increase in world crude oil prices, but the trade performance of palm oil has the biggest positive impact compared to other vegetable oils. Conversely, the performance of the trade in soybean oil deteriorates in the event of an increase in world prices of crude oil.

The increase in China's GDP has the biggest impact compared to the GDP of other importing countries on world imports of palm oil. Palm oil is an important vegetable oil for China which can be used as food, industry and biodiesel. The increase in the GDP of the United States has the greatest impact on the performance of vegetable oils compared to the increase in GDP of European and Indian countries. If the United States's GDP increases by 5%, it will increase the import of rapeseed oil from the United States from the world market. The United States has the greatest impact on imports of rapeseed oil compared to other importers so that world prices continue to increase in the largest percentage. The increase in the GDP of the United States also has the greatest impact on the trade performance of palm oil compared to simulations of an increase in GDP of India, Europe and China. Indonesian and Malaysian palm oil exports are increasing and followed by an increase in the world price of palm oil. From the results of this simulation it can be said that US's palm oil imports play an important role in the world market of palm oil.

REFERENCES

Azizah, N. (2015). Analisis ekspor crude palm oil (CPO) Indonesia di uni eropa tahun 2000-2011. Economics Development Analysis Journal, 4(3), 330-337.

Buyung, N.S., Raja, M., Muhammad, N. (2017), The analysis of factor affecting CPO export price of Indonesia. European Journal of Accounting and Finance Research, 5(7), 17-29.

Calle, F.R., Luc, P., Arnaldo, W. (2009). A Global Overview of Vegetable Oils, with Reference to Biodiesel. A Report for the IEA Bioenergy Task 40. London, UK: Imperial College.

Gabungan Pengusaha Kelapa Sawit Indonesia (GAPKI). 2015. Sawit Memberikan Kontribusi Devisa Negara dan Penghidupan Masyarakat. Diunduh 10 Desember 2015pada. Available from: http://www.swa.co.id.

Hallam, D. (1990). Econometric Modelling of Agricultural Commodity Market. London: Routledge.

Hameed, A.A., Fatimah, M.A., Emmy F.A. (2016), Assesing dynamics of palm oil import demand: Te case of six Asian countires. Journal of Food Products Marketing, 22(8), 949-966.

Hartoyo, S., Eka I.K.P., Novindra, H. (2011). The impact of rise of fuel price on palm oil domestic demand. Jurnal Ekonomi dan Pembagunan Indonesia, 11(2), 169-179.

Intriligator, M., Bodkin, R., Hsiao, C. (1996), Econometric Models, Techniques, and Applications. 2nd ed. United States of America (US): Prentice-Hall Inc.

Koutsoyiannis, A. (1977), Theory of Econometrics: An Introductory Exposition of Econometrics Methods. 2nd ed. London (UK): The Macmillan Press Ltd.

Larson, D.F. (1996), Indonesia's Palm Oil Sub Sector, Policy Research Working Paper 1654. The World Bank International Economics Department Commodity Policy and Analysis Unit.

Mielke, T. (2015), Global Supply, Demand and Price Outlook of Oils and Fats. Presentation at 18st Annual Convention of NIOP.

Mielke, T. (2018), Global Supply, Demand and Price Outlook on Palm and Lauric Oils, Impacts from Argentina Drought. [Paper]. Kuala Lumpur: Presentation at Palm Oil Conferebce.

OECD and FAO. (2015), Agricultural Outlook 2012-2021. Paris: OECD.

Palm Oil Agribusuness Strategic Policy Institute (PASPI). (2016), Evaluasi dampak kebijakan pungutan ekspor terhadap perubahan daya saing minyak sawit Indonesia dan implikasinya pada era MEA. Monitor Isu Strategis Sawit, 2(6), 314-318.

Persaud, S., Maurice, R.L. (2006). The Role of Policy and Industry Sructure in India's Oilseed Markets. Economic Research Report Number 17.

Pindyck, R.S., Rubinfeld, D.L. (1998), Econometric Models and Economic Forecasts. 4th ed. New York (USA): McGrawHill Inc.

Purba, J.H. (2012), Dampak Pajak Ekspor Crude Palm Oil Terhadap Industry Minyak Goreng Indonesia. Bogor (ID): Institut Pertanian Bogor.

Mukherjee, P., Benjamin, K.S. (2014), Palm oil-based biofuels and sustainability in Southeast Asia: A review of Indonesia, Malaysia and Thailand. Renewable and Sustainable Energy Reviews, 37, 1-12.

Sitepu, R.K., Sinaga, B.M. (2006). Aplikasi Model Ekonometrika, Estimasi, Simulasi Dan Peramalan Menggunakan Program SAS. Bogor (ID): Institut Pertanian Bogor.

United State Department of Agriculture (USDA). (2017), Oilseeds and Products: World Market and Trade. Washington, DC: USDA.

Wisena, B.A., Daryanto, A., Arifin, B., Rina, O. (2014), Sustainable development strategy and the competitiveness of Indonesian palm oil industry. International Journal of Managerial Studies and Research, 2(10), 102-115.

World Growth. (2015), Palm Oil Trade Barries a Priority Issue World Growth. Tersedia Dari. Available from: http://www.worldgrowth.org.