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Indonesia Growth of Economics and the Industrialization Biodiesel Based CPO

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ABSTRACT

This study aimed to analyses the impact of palm oil-based biodiesel development on growth and poverty in Indonesia that combined with government policy using simultaneous equation econometric 2 SLS's models. The result shows that if the export tax, and government expenditure in industry increase; then domestic exchange rate (IDR) and interest rate decrease, those will give positive impact on economy growth and vice versa gives a negative impact to poverty. The simulation may apply to know the impact on economy growth, and poverty in Indonesia by the development. The study found that palm oil-based biodiesel development can create a growth and poverty in Indonesia and CPO biodiesel development can be synergized with the increasing export tax and government expenditure in industry, so growth and poverty-reducing in Indonesia will be better and qualify. However, government must maintain stability of exchange rate fluctuation because the impact can reduce CPO production industry.

Keywords: Crude Palm Oil, Energy, Industry, Economic growth, Poverty
JEL Classifications: E24, E27, C5, O31

1. INTRODUCTION

Recently, technological developments then allow agriculture to have a new role as a source of renewable energy. Where agriculture is able to provide energy in the form of fuel is often referred to as biofuel to drive machinery and equipment, both for household and industry. Agricultural products that produce biofuels can be used to replace the fossil fuels that are the main energy source worldwide (Raswant et al., 2008), one of which is Brazil, in 1970 has started using biofuel products as an energy alternative to petroleum. The high price of petroleum at the time has prompted Brazil to develop fuel from alcohol molasses, now popularly called bioethanol as an alternative fuel for fossil fuel replacement.

The development of bioethanol from molasses in Brazil molasses is supported by the availability of abundant sugarcane raw materials and has become a major export commodity in Brazil. With an initial cost of US $ 4 Billion and a series of government subsidies, up to now the program materials Brazil's bio-ethanol fuel has resulted in savings in excess of USD 100 billion and makes Brazil the world's largest bioethanol exporter (Raswant et al., 2008).

The successful development of bioethanol in Brazil in overcoming energy dependence derived from fossil fuels, especially petroleum, has built many countries in the world including Indonesia to start developing biofuels. To reduce dependence on energy derived from petroleum, the Government of Indonesia has prepared a series of policies related to control and regulation of energy sources, the use of alternative energy sources, the use of biofuel energy, and the establishment of the Biofuel Fuel National Team for the Acceleration of Poverty Alleviation and Unemployment (Laws of Republic of Indonesia, 2006).

Biofuels that can be developed in Indonesia one of them is biodiesel because it has a pretty good prospect given the availability of raw materials are quite abundant. Potential raw materials that can be utilized in the process of biodiesel production in Indonesia are palm oil. This is because Indonesia is currently a producer of coconut oil the largest palm in the world (APROBI, 2009).

Indonesia's palm oil production in 2009 reached approximately 21,511 million tons. Indonesia's domestic need for palm oil production for cooking oil, oleo chemicals and other downstream industries is around 6.2 million tons while the remainder is exported in the form of bulk palm oil (TAMSI-DMSI, 2010). Based on the above data, there is a potential of around 15.3 million tons of palm oil that can be processed and developed into palm oil derivative products in Indonesia without disrupting the supply for domestic food industry needs. The government has also provided development support the downstream palm oil industry in the form of clusters of downstream palm oil industry aimed at improving palm oil derivative products that can be produced in Indonesia (Prihandana, 2008).

The development of downstream palm oil industry including biodiesel is expected to increase the value added of palm oil products for Indonesia, which for the most part is only enjoyed by other countries. The development of downstream palm oil industry, including palm oil biodiesel can certainly increase the contribution of the agricultural sector to the Indonesian economy. Indonesia's agricultural sector has a significant contribution to the economy since the 1970s. With a share of about 41% of total gross domestic product (GDP), Indonesian agriculture in 1970 was able to absorb employment by 66.4% (Republic of Indonesia Central Bureau of Statistics, 2015). In addition to the high rate of poverty in Indonesia, another thing that also needs to be considered is the number of open unemployed. Economic growth above 5% since 2004, able to increase the number of people who work in 2004 is still 93.72 million people and in 2009 can be increased so it reached 104.49 million people, even to 121.02 million people in 2015 (Republic of Indonesia Central Bureau of Statistics, 2015).

As Nkomo (2017) said, poverty, unemployment and economic growth, especially in developing countries, are closely linked to availability and access to energy. If the supply or access to energy services is reduced there will be an increase in costs that can depress the economy, encouraging the increase poverty and unemployment and disrupt other development prospects.

Energy, whether in the form of lighting, heat, mechanical or electrical power, is central to society and plays a key role in the development perspective, especially for poor countries and countries is developing (Domac et al., 2005). Energy also has a very important role in the achievement of social, economic and environmental goals for the implementation of sustainable development and supports national activities (Schubert et al., 2007).

Source of fossil energy owned by Indonesia although varied (petroleum, gas, coal) but the amount is limited. Fossil energy reserves data from the Department of Energy and Mineral Resources (Prihandana, 2008) show that proven petroleum reserves of about 9 billion barrels and if produced an average of 500 million barrels a year, the reserves are expected to be exhausted by 2023. Natural gas with a reserve potential of 182 TSCFs with a production rate of 3 TSCF per year will be exhausted by 2065. Coal with a reserve of about 19.3 billion TCE and a rate of utilization of 130 million TCE per year will be exhausted in 2155.

Increased consumption of petroleum is not driven by economic growth that shows wasteful energy use in Indonesia. This is reflected in the high comparison between the growth of energy consumption compared with the growth of national economy or energy elasticity (Prihandana, 2008). The elasticity is about 1.84, a relatively high number, compared to the 0.10 and 0.26 energy elusions of Japan and the United States that are well known as efficient countries in energy use.

Indonesia which originally was a petroleum exporting country, since 2000 has officially turned into a petroleum importing country, where data from Pertamina (Indonesia Oil Company) showed net imports of Indonesian petroleum reached 0.336 million barrels per day in 2003 (Suryahadi et al., 2006). Net imports above are expected to continue increasing with the declining production of Indonesia's oil fields and the increasing consumption of Indonesian fuel oil, especially if there is no change in wasteful behavior in energy use in Indonesia.

The increase in international oil prices is quite a burden to the government budget, especially in the provision of subsidies related to fuel oil. Although the subsidy associated with fuel oil had dropped to 39.8 trillion IDR in 2005, in 2006 and beyond, the trend continued to rise. In 2008, with average oil price of 101.31 USD per barrel, the realization of fuel subsidy to be spent by the government reached139.1 trillion IDR, a large enough quantity for the size of Indonesia. Prihandana (2008) stated that if the price of petroleum ranging from 60 USD per barrel with subsidized policy does not change then the government must provide a minimum budget of about 89 trillion IDR only for fuel subsidy.

The high burden of subsidies can reduce the ability of the government to finance development programs in other important sectors such as health, education, basic services and infrastructure both in urban and rural areas (Dollar and Kraay, 2004). According to Suryahadi et al. (2006), and Islam and von Braun (2007), the decline in financing capability of these development programs has resulted in efforts by the government not to be optimal to boost productivity and economic growth that can reduce poverty and unemployment in Indonesia.

Given the world's proven oil reserves in 2004 estimated to be 1.27 trillion barrels, if no new finds are expected, the oil will be exhausted within the next 44.6 years (Prihandana, 2008). If it follows the law of demand and supply, it is estimated that the world oil price will continue to increase as demand increases petroleum to support economic growth while supply is relatively fixed. Suryahadi et al (2006) and Prihandana (2008) estimates that world oil prices will continue to increase even reaching USD 200 per barrel, if the price of oil reaches USD 200 per barrel or more then it is estimated that the budget burden the government must bear to reduce the impact caused by rising fuel prices to the poor and the Indonesian economy will be increasing in number.

After the economic crisis experienced by Indonesia in 1997–1998, the price of oil continues to increase, which encourages the rise of inflation and poverty in Indonesia and make economic growth decelerate? If the price of oil continues to increase, it is feared the performance of Indonesia's macroeconomic indicators will also decrease (Suryahadi et al., 2006). Poverty and inflation rates are feared to rise sharply while economic growth slows down and may return to negative levels such as the economic crisis of 1997–1998. If this happens then the impact will be bad for the Indonesian economy overall.

Therefore, to reduce the impact of rising petroleum prices on the Indonesian economy, then the government has developed a national energy macro policy (Vedenov et al., 2006). In general, the macro policy national energy is directed to ensure the national energy supply for supporting the sustainable national development and becoming a guide national energy management in the framework of efforts to meet national energy security. National energy macro policy above mandating the implementation of energy diversification in the form of energy development primarily renewable alternatives with considerable potential at Indonesia, where one of them is biofuels. Based on the policy, the government of Indonesia can set a target of proportion of national energy use by 2025 (Prihandana, 2008) with reference to the initial conditions in 2004 so that the proportion of national energy use can reduce the use of petroleum (from 52.5% in 2004 to 20% in 2025) and encourage the use of other energy sources (more than 5% in 2025).

Since the development of biofuels started in 2004 in Indonesia, there have been many biodiesel industries in various regions in Indonesia. APROBI (2009) has recorded up to 2009, has operated 18 biodiesel companies in Indonesia with the total installed capacity of approximately 3,184.311 kl/year. Of the installed production capacity of the biodiesel industry from the oil palm, only about 10% or 318,431 kl/year is used. The low utilization of installed production capacity of the biodiesel industry from palm oil is caused by the barrier of selling price of biodiesel from oil palm which is not profitable for a producer.

Development of biodiesel from oil palm as part of development of biofuels in Indonesia, the last few years has been plagued by the problem of domestic biodiesel selling prices that have to compete with subsidized diesel oil. Government subsidy on diesel oil (2,000 IDR/l) causes the selling price of biodiesel to be not competitive and also not feasible, especially to be marketed in the country.

Increased demand for biodiesel from palm oil and the development of the biodiesel industry from oil palm in Indonesia will have an impact on Indonesia's macroeconomic indicators (Siregar and Sugino, 2008). The expansion of biodiesel from oil palm is expected to help raise farmers' income in rural areas by increasing the price of fresh fruit palm fruit bunches. Increase farmers' incomes can improve the welfare of farmers, thereby affecting the decline of poverty in rural Indonesia, which is the source of raw materials for biodiesel from palm oil (Hartoyo et al., 2009).

The development of biodiesel industry from oil palm is expected to increase the substitution of fossil fuels, especially for diesel oil so as to reduce the burden of imported fuel oil. With abundant raw material potential, biodiesel development from palm oil can also be directed to meet export markets (Kennedy et al., 2002). According to Aktar et al. (2008), the development of biodiesel from palm oil that can reduce import burden, increase export and increase the value of agricultural and industrial production results in an increase in national output or economic growth that can open up many employment opportunities so as to absorb many people who are not working so the unemployment rate is reduced.

Therefore, from the explanation of the background and the problem has been put forward, therefore the purpose of this study will analyze the impact of biodiesel development from palm oil to poverty, and economic growth in Indonesia (Table 1 [on appendix]). The main limitation in this research is related to the unavailability of complete data for biodiesel from palm oil in Indonesia. So the data of biodiesel from palm oil in this research only use production data of palm olein and stearin as a raw material of biodiesel from palm oil as the indicator of biodiesel production from palm oil. This is due to the incompleteness of other data associated with palm olein and stearin such as data the price of palm olein and stearin as well as data related to other downstream palm oil products.

This study differs from previous research because this study examines the impact of biodiesel development of palm oil on several macroeconomic indicators, especially economic growth, and poverty in Indonesia at once while in previous research only examines its impact on one of the indicators especially the impact on poverty (Hartoyo et al., 2009). Particularly for poverty, this study in addition to seeing its overall impact also differentiates its impact assessment on rural poverty and urban poverty.

2. LITERATURE REVIEW

Research on poverty and unemployment has done enough. Son and Kakwani (2004) conducted a study on the relationship between economic growth and poverty using the elasticity of poverty. The elasticity of poverty estimates the percentage change in poverty caused by 1% change in per capita income. The results show that pro-poor economic growth has a greater impact on poverty reduction.

Yudhoyono (2004) on his research found the agricultural and rural development as an effort to overcome poverty and unemployment through analysis of the political economy of fiscal policy using econometric model approach. The results show that government spending on infrastructure has a positive effect on reducing unemployment and urban poverty, while poverty reduction in rural areas is influenced by agricultural expenditures.

Krongkaew et al. (2006) had studied economic growth, employment and its linkages to poverty reduction in Thailand using macro and micro analyzes. The results show that high economic growth during the period 1988-1996 in Thailand was able to reduce the poverty rate from 32.6% to 11.4% and increase employment opportunities that can absorb many unemployed in Thailand.

Selim (2006) conducted a study on the linkages of working poverty and pro-poor economic growth in Bangladesh, Bolivia and Ethiopia using descriptive analysis. The results show that economic growth is slower or less is the cause of the slow growth of employment in Bangladesh, Bolivia and Ethiopia. To grow employment, agricultural growth, rural non-farm activities, labour-based exports, industrialization and manufacturing, support small enterprises and urban informal sectors, work for women, infrastructure programs and safety nets. To integrate the poor in the growth process, what is needed is investment in human capital, improving access to social services and increasing access to productive resources.

Aktar et al. (2008) found the impact economic growth and foreign direct investment towards a decrease in unemployment rates in Turkey using the vector auto regression (VAR) and cointegration approach. The results show that foreign direct investment in Turkey did not create much new jobs during the study period although Turkish exports were able to attract a lot of foreign direct investment. The model of export-based economic growth is not appropriate for Turkey because the economic growth that occurred was not able to overcome unemployment problems that occurred in Turkey.

Research on energy and biofuel development among others was conducted by Nkomo (2017) conducting research on the linkage between energy use, poverty and economic development in the Southern African development community (SADC) countries, using a descriptive analysis model of available quantitative data. The results show that most of the populations in the SADC countries do not have access to basic energy services and supplies and low economic growth unable to increase people's incomes, improve family living standards and reduce poverty.

Peskett et al. (2007) also found the impacts development of biofuels on agriculture and poverty reduction in OECD countries using descriptive analysis models. The results show that the development of biofuels has the potential to have an important role in reducing poverty through employment effects, broader growth multipliers and the effects of energy prices. The distributional effect of biofuel development is crucial, between producers and consumers, between surplus countries and food/feed/energy deficits.

Based on Susila and Munadi (2008), using a combination of econometric model and simulation model utilizing the results of previous research found the impacts of CPO biodiesel development to poverty in Indonesia The results showed that the development of biodiesel based on crude palm oil has a positive effect on the crude palm oil industry but negatively affects the domestic cooking oil industry and generally can reduce the number of poor people although relatively small.

Arndt et al. (2008) conducted a study on the impact of biofuel development on poverty and economic growth in Mozambique using a computable general equilibrium model of analysis. The results show that biofuel development in the form of bioethanol and biodiesel provides an opportunity to increase production in Mozambique, encourage economic growth, improve prosperity and reduce poverty in Mozambique. The thing to note is the intensity of workers related to the production method used, because of the model indicates that the degree of employee intensity has the potential to affect the distribution of income.

Lopez (2008) mentioned that the development of biodiesel from palm oil is influenced by the price of oil palm oil and petroleum prices and most of the Malaysian oil palm biodiesel industry (92 licenses) are not operating due to high and palm oil price fluctuations. The results show to develop the biodiesel industry from oil palm, the Malaysian government provides subsidies and incentives. If the entire biodiesel industry of Malaysian palm oil is fully operational, they can produce 2.7 million tons per year using 3 million tons of palm oil, mostly for export markets.

Hartoyo et al. (2009) did a study on the impact of changes in demand for crude palm oil as an alternative (vegetable) fuel against food availability and related policies using simultaneous econometric model equations. The results show that the development of biodiesel from palm oil does not cause stability the availability of food in domestic is disrupted so it is feasible to be improved. Development of biodiesel from palm oil in the world can also increase the export of palm oil as a raw material of biodiesel, thus increasing the country's foreign exchange.

3. METHODOLOGY

This research is an explanatory research, using an econometric method (Koutsoyiannis, 1977; Intriligator et al., 1996). The variables to be used in this study include those related to palm oil, raw materials of olein-stearin biodiesel, diesel fuel, poverty, price index, fiscal and monetary policy, aggregate demand and supply and macroeconomic balance.

While the hypothesis to be tested in this research are: (1) Development of biodiesel from palm oil in Indonesia can improve farmers' welfare so as to reduce poverty in rural areas, and (2) biodiesel development of palm oil in Indonesia can increase national production which impact on output increase or create economic growth and create jobs and reduce unemployment in Indonesia.

Using the simultaneous equation (Intriligator et al., 1996; Lisna, 2007; Susila and Munadi, 2008; and Hartoyo et al., 2009), the model to be formulated consists of 7 equation blocks that are grouped into three main blocks: Palm oil and fuel product blocks, economic indicator blocks, and blocks of production and demand, and the linkage of biodiesel development from palm oil to poverty, and economic growth. Oil palm and fuel product blocks consist of palm oil sub-blocks, biodiesel blocks, and diesel fuel sub-blocks. The economic indicator block consists of poverty blocks and wage sub-blocks. Production and demand blocks consist of national production sub-blocks, aggregate demand sub-blocks and macroeconomic indicator sub-blocks.

3.1. Block of CPO and Fuel Production

The equation for oil palm blocks consists of equations palm oil production, palm oil consumption, domestic price palm oil, export prices of palm oil and coconut oil exports palm oil. The equation for oil palm blocks refers to the equation research results Hartoyo et al. (2009), and Susila and Munadi (2008) with necessary adjustments, where QCPOt, and QCPOt-1are the CPO Indonesia production of current and previous year; DCPOt respectively to the CPO at current Domestic price; PTBSt, PMGRt, PXPOt and WOILt are TBS crude palm price, palm oil price, price of CPO export, and international petroleum price; CCPOt, and CCPOt-1are consumption of CPO at current and previous year; export CPO, and tax at current year (XTAXt, and XCPOt); including exchange rate (ERt). Thus, the equation will result the Domestic CPO demand at current year (CCPOt). Using expected parameter:

$a1, a3>0; a2<0;0<a3<1 \; b1,b2<0; b3,b4,b5>0; 0<b6<1$

$c1,c3,c4>0; c2<0 \; d1,d2,d4>0; d3,d5<0 \; e1,e3<0;e2>0$

One of the adjustments made is adding the olein and stearin production variables (QOLt, and QSTt); as a variable affect the equation of domestic consumption of palm oil. Enhancement use of olein and stearin for biodiesel feedstock and other downstream industries will increase domestic consumption of palm oil. The equation can be formulated are as follows:

$$QCPOt = a0+a1DCPOt+a2PTBSt+a3CCPOt+a4QCPOt\text{-}1+U1t \quad (1)$$

$$CCPOt = b0+b1DCPOt\text{-}1+b2PXPOt+b3PMGRt+b4QOLt+b5QSTt+b6CCPOt\text{-}1+U2t \quad (2)$$

$$DCPOt = c0+c1PXPOt+c2QCPOt+c3CCPOt+c4PTBSt+U3t \quad (3)$$

$$PXPOt = d0+d1WOILt+d2XTAXt+d3XCPOt+d4DCPOt+d5PXPOt\text{-}1+U4t \quad (4)$$

$$XCPOt = e0+e1PXPOt+e2ERt+e3XTAXt+U5t \quad (5)$$

The equation for the olein-stearin block of biodiesel feedstock uses the olein and stearin production (QOLt, and QSTt) equations due to the limited historical data held for biodiesel from palm oil. Olein and stearin are palm oil derivative products, which are the raw material for producing biodiesel from palm oil in Indonesia.

Based on Hartoyo et al. (2009), which uses the biodiesel production function in the United States as the basis for linking biodiesel production with petroleum prices (WOILt), and Lopes (2008) research which states that biodiesel production from palm oil is also affected by the price of palm oil (QMGRt), and the price of oil so that the production of olein (QOLt), and stearin (QSTt) as biodiesel feedstock from oil palm is assumed to be influenced by the price of palm oil (DCPOt), and the price of oil. Production of olein previous year (QOLt-1), stearin at previous year (QSTt-1), and CPO domestic price are used as indicators of biodiesel development of palm oil, where the expected parameter is:

$f1<0;f2,f3>0;0<f4<1 \; g1<0;g2,g3>0;0<g4<1$

Therefore, based on these assumptions, the equations that can be formulated are as follows:

$$QOLt = f0+f1DCPOt+f2WOILt+f3QMGRt+f4QOLt\text{-}1+U6t \quad (6)$$

$$QSTt = g0+g1DCPOt+g2WOILt+g3QMGNt+g4QSTt\text{-}1+U7t \quad (7)$$

The diesel fuel equation is used to see the linkage of diesel fuel with the production of olein (QOLt)-stearin (QSTt) as a biodiesel feedstock from palm oil and a decrease in the import of diesel fuel. The equation for diesel fuel blocks consists of the equation of diesel oil production (QDSLt), diesel oil consumption (CDSLt), diesel oil prices (PDSLt), and imports of diesel oil (MDSLt). Using some variables such as population (POPt), the production value of the industrial sector (GDPIt), subsidies for diesel oil (SBDLt), demand of diesel oil for transportation (TRDLt), diesel oil demand for industry (INDLt), diesel oil demand for electricity (ELDLt), inflation rate (INFt-1), international crude oil price (WOILt). Of course, the previous of diesel production (QDSLt-1), diesel oil consumption (CDSLt-1), import of diesel oil (MDSLt-1), and price of diesel oil (PDSLt-1) are also taken account. The equations are also using the expected return:

$n1,n2<0;n3,n4,n5>0;0<n6<1 \; o1,o2,o3,o4,o5,o6>0;0<o7<1$

$p1,p3,p4>0;p2<0 \; q1>0;q2<0;0<q3<1$

Thus the equations are:

$$QDSLt = n0+n1WOILt+n2MDSLt+n3SBDLt+n4QOLt+n5QSTt+n6QDSLt\text{-}1+U14t \quad (8)$$

$$CDSLt = o0+o1TRDLt+o2INDLt+o3ELDLt+o4QDSLt+o5GDPIt+o6SBDLt+o7CDSLt\text{-}1+U15t \quad (9)$$

$$PDSLt = p0+p1WOILt+p2SBDLt+p3INFt\text{-}1+p4POPt+U16t \quad (10)$$

$$MDSLt = q0+q1CDSLt+q2QDSLt+q3MDSLt\text{-}1+U17t \quad (11)$$

3.2. Block of Production and Demand

The equations for the national production block consist of the production equation of the agricultural sector (GDPAt), the production of the industrial sector (GDPIt), the production of other sectors (GDPOt) and the total national production (ASt). Using the economic variables such as Investment, Government Expenditure, labor demand, and interest rate, so that he equation for national production blocks refers to the results of research by Arndt et al. (2008) and Lisna (2007) research results with some necessary adjustments.

Using the expected parameters:

$r1,r2,r3,r4>0 \; s1,s2,s3,s4,s5,s6>0 \; t1,t2,t3>0; t4<0$

Thus the equations that can be formulated are as follows:

$$GDPAt = r0+r1DEMAt+r2INVAt+r3GEAt+r4QTBSt+U18t \quad (12)$$

$$GDPIt = s0+s1DEMIt+s2INVIt+s3GEIt+s4QMGRt+s5QOLt+s6QSTt+U19t \quad (13)$$

$$GDPOt = t0+t1DEMLt+t2INVOt+t3GEISt+t4SBt+U20t \quad (14)$$

$$ASt = GDPAt+GDPIt+GDPOt \quad (15)$$

The equation for demand block consists of consumption (Ct) equation, investment of agriculture sector (INVAt), industrial sector investment (INVOt), total investment (TINVt), export value (Xt) and import value (Mt). The equation for this request block refers to the equation of Lisna’s (2007) research results with some necessary adjustments.

Where the expected parameters:

$u1>0;u2<0;0<u3<1 \; v1,v3<0;v2>0;0<v4<1$

$w1,w3<0;w2>0;0<w4<1 \; x1,x2,x3,x4>0;0<x5<1$

$y1,y2>0;0<y3<1$

The equations that can be formulated are as follows:

$$Ct = u0+u1(ASt/POPt)+u2INFt+u3Ct-1+U21t \quad (16)$$

$$INVAt = v0+v1(SBt–SBt-1)+v2GDPAt+v3WPt+v4INVAt-1+U22t \quad (17)$$

$$INVIt = w0+w1(SBt–SBt-1)+w2GDPIt+w3WIt+w4INVIt-1+U23t \quad (18)$$

$$TINVt = INVAt+INVIt+INVOt \quad (19)$$

$$Xt = x0+x1ERt+x2XCPOt+x3GDPAt+x4SEMt+x5Xt-1+U24t \quad (20)$$

$$Mt = y0+y1ASt+y2MDSLt+y3Mt-1+U25t \quad (21)$$

3.3. Block of Economic Indicator

The equations for the macroeconomic indicators block consist of the equation of consumer price index (CPIt), economic growth (ECROt) and national inflation (INFt). Using variables of interest rate (SBt), Aggregate Supply (ASt), the price of petroleum (WOILt), and cooking oil price (PMGRt), then the equation for the consumer price index refers to the equation of Lisna's (2007) research results with some necessary adjustments whereas the equations for economic growth and inflation are identity equations.

The equation use the expected paramaters:
$ag2<0;ag1,ag3>0;0<ag4<1$
The equations that can be formulated are as follows:

$$CPIt = ag0+ag1PMGRt+ag2SBt-1+ag3WOILt+ag4CPIt-1+U33t \quad (22)$$

$$EGROt = ((ASt–ASt-1)/ASt-1)*100\% \quad (23)$$

$$INFt = ((CPIt–CPIt-1)/CPIt-1)*100\% \quad (24)$$

The equation for poverty block consists of urban poverty (UPOVt), rural poverty (RPOVt) and total poverty (TPOVt). The equation for this poverty block refers to the equation of Yudhoyono (2004) research results with some necessary adjustments.

Equations that can be formulated are as follows:

$$UPOVt = ah0+ah1EGROt+ah2GDPIt+ah3GEIt+ah4CPIt+ah5WOILt+ah6WIt-1+ah7UPOVt-1+U34t \quad (25)$$

$$RPOVt = ai0+ai1WPt+ai2EGROt+ai3GEAt+ai4UNMt+ai5RPOVt-1+U3 \quad (26)$$

$$TPOVt = UPOVt+RPOVt \quad (27)$$

With expected parameters:
$ah1, ah2, ah3,ah6<0;ah4,ah5>0;0<ah7<1$
$ai1, ai2, ai3<0;ai4>0;0<ai5<1$

In this research also use policy simulation, where: (1) Increase production of olein and stearin as raw materials of biodiesel from palm oil by 20% as an indicator of the development of biodiesel from palm oil, (2) combination of olein and olein production increase stearin as a biodiesel raw material from palm oil by 20% and tax increases exports by 10%; and (3) combination of olein and stearin production increase as biodiesel feedstock from palm oil by 20% and rupiah appreciation by 10% (over the last 5 years from 2009 to 2014 the rupiah weakened by 14.10%).

4. RESULTS

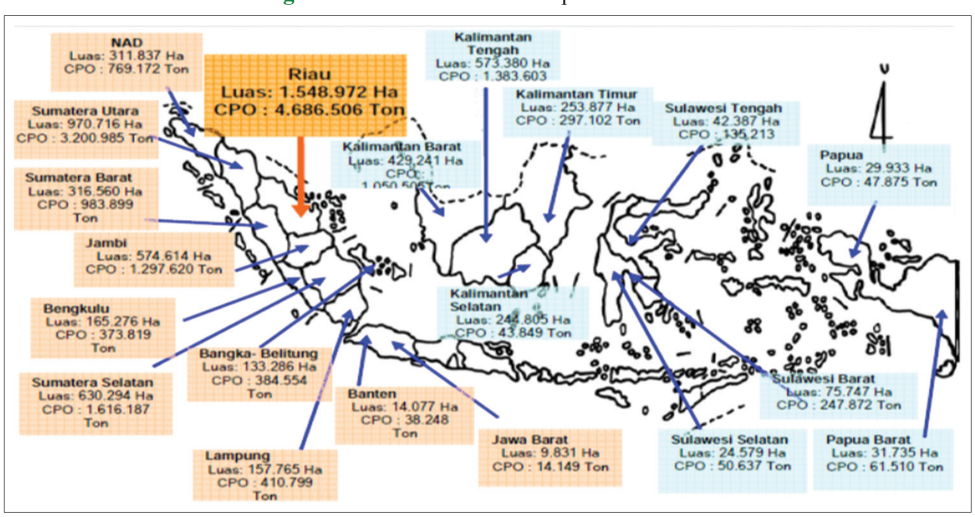
4.1. The Contribution of CPO to Economy

CPO plantations are already scattered throughout Indonesia as shown in Figure 1. where the total area of 7.32 million hectares of oil palm plantations, most are in Sumatra Province as about 21.14% of plantation area oil palm with palm oil production reaching 4.68 million tons (Central Bureau of Statistics Republic of Indonesia, 2015).

The region of Kalimantan is also growing rapidly with the largest concentration of oil palm plantations in Central Kalimantan with an area of oil palm plantations of 573.38 thousand hectares and 1.38 million tons of palm oil production. It is estimated that in the next few years, the Kalimantan region will be able to take over the development of oil palm plantations in Indonesia.

In addition, palm oil is able to contribute significantly to job creation. With a total area of 7.3 million hectares of oil palm

Figure 1: Distribution of CPO production in Indonesia



Source: Republic of Indonesia Ministry of Agriculture, 2013. Luas: Ha area plantations, the number of workers absorbed in the upstream sector reached 1.95 million people in state and private plantations and 1.7 million farmers in smallholder plantations. The 470-unit palm plantation is capable of absorbing 70000 workers, making palm oil plantations and palm oil mill as a whole capable of creating 3.72 million jobs (TAMSI-DMSI, 2010).

In the middle and downstream industries, the number of workers absorbed reached 31664 people. This shows that from upstream to downstream the palm oil industry is able to create jobs for 3.75 million people (TAMSI-DMSI, 2010). Because the planting and harvesting of palm oil is labor intensive so that the industry plays a significant role in the provision of employment in many areas. TAMSI-DMSI (2010) even estimates the palm oil industry in Indonesia may provide employment for more than 6 million people and alleviate them from poverty.

As an earlier explanation, the palm oil industry can also contribute to poverty reduction. Riau Province for example, as the largest palm oil producer in Indonesia has a PDRB per capita of Rp. 47.19 million per year This means that every resident of Riau Province on average earns 47.19 million IDR per year or Rp. 3.9 million per month. Meanwhile, Southeast Sulawesi province as the smallest producer of palm oil has GRDP per capita of 8.07 IDR million per year. Meaning that every resident of Southeast Sulawesi Province has average income 8.07 million IDR per year or 672.645 IDR per month This figure shows that the population of Riau Province as the largest producer of oil palm is much more prosperous than the people of Southeast Sulawesi province which produces only a few palm oil.

The contribution to poverty reduction is further underscored in the percentage of the poor. For the five largest palm oil producing provinces, the percentage of the poor is below the national poor except South Sumatra. For five provinces the smallest producer of palm oil the percentage of the poor is well above the percentage of the nation's poor. This shows that the palm oil industry is able to increase the income of the population and decrease the number of poor people where the industry is located.

4.2. The CPO and Fuel Production

The result of the estimation of the parameters of the Indonesian palm oil production equation gives the coefficient of determination (R^2) is 91.63%. This means that variations in explanatory variables in the equation may account for 91.63% of the variable fluctuations in Indonesian palm oil production. Endogenous variables in the Indonesian palm oil production equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with a value of 62.11.

Table 1 (on appendix) shows the estimates of the Indonesian palm oil production equation. Indonesia's palm oil production is significantly affected by the domestic price of palm oil, domestic demand for palm oil and palm oil production last year. Each parameter's expected value is 0.006, −0.015, 0.801 and 0.544.

The domestic price of palm oil is a significant factor in the production of Indonesian palm oil with the estimated parameter value of 0.006. That is, if the domestic price of palm oil increased by 1 IDR per kg then Indonesia's palm oil production will increase amounting to 0.006 million tons per year. Fluctuations in the domestic price of palm oil will affect the fluctuation of Indonesian palm oil production.

The domestic demand for palm oil also has a significant effect on Indonesia's palm oil production with the estimated of value parameters 0.801. If domestic demand for palm oil increases by 1 million tons per year then Indonesia's palm oil production will increase by 0.801 million tons per year. The development of downstream palm oil industry could increase domestic demand for palm oil to encourage increased palm oil production in Indonesia (Susila and Munadi, 2008). This is another factor affecting Indonesia's palm oil production is the production of Indonesian palm oil last year. This is due to the large production of palm oil last year is usually used as a reference in the determination of production targets in the next year.

4.3. The Demand of Domestic CPO

The result of estimation of the parameters of domestic demand of oil palm oil gives the value of determination coefficient (R^2) is 57.11%. This means that variations in explanatory variables in the equation may account for 57.11% of the variable fluctuations in domestic demand for palm oil. Endogenous variables in the domestic demand for palm oil are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 shown by F statistic with a value of 3.99.

Table 1 (on appendix) shows the result of estimation of demand of domestic palm oil. Domestic demand for palm oil is significantly

Table 1: Production of palm oil and poverty in some province in Indonesia 2014

Province	GDP regional	Population	Poverty	CPO production			
				Private	Small farmers	Government	Total
Riau	522,241.43	5,538,367	159.53	434	709	133	1277
Sumatera Utara	403,933.05	12,982,204	667.47	1,664	1,022	1,025	3,712
Sumatera Selatan	231,683.04	7,450,394	370.86	15	25	32	73
Jambi	85,558.31	3,092,265	109.07	548	326	40	915
Sumatera Barat	127,099.95	4,846,909	108.53	855	759	140	1,754
Sulawesi Tenggara	40,773.20	2,232,586	45.79	0	0	10	10
Sulawesi Tengah	58,641.18	2,635,009	71.65	97	8	9	114
Lampung	164,393.43	7,608,405	224.21	149	162	36	348
Bengkulu	27,388.25	1,715,518	99.59	208	217	8	434
Indonesia	7,578,118.87	237,641,326	10 ,356.69	9,263	6,358	2,174	17,796

Source: Republic of Indonesia Central Bureau of Statistics, 2015 affected by last year's export prices of palm oil, export prices. The result of estimation of domestic demand parameter of palm oil gives determination coefficient value (R^2) is 57.11%. This means that variations in the explanatory variables in the equation may include 57.11% fluctuations in domestic demand variables for palm oil. Endogenous variables in domestic demand for palm oil were significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with a value of 3.99.

Table 1 (on appendix) shows the estimated results of domestic palm oil demand. Domestic demand for palm oil was significantly affected by last year's export price of palm oil, export prices palm oil, olein production, production stearin and domestic palm oil demand in previous year. Each of these is the parameter −0.003, −0.003, 0.004, 0.001, 0.001 and 0.295.

The domestic price of palm oil last year was a significant factor affecting domestic demand for palm oil with an estimated parameter value of −0,003. If the domestic price of palm oil last year rose by 1 IDR per ton, the demand for domestic palm oil will decrease by 0.003 million tons per year. The rise in domestic prices of palm oil can affect domestic demand for palm oil so that the development of downstream industries is hampered.

The export price of palm oil is also a factor significantly affect domestic demand for palm oil with the estimated parameter value of −0.003. If the price of palm oil exports last year increased by 1 IDR per ton, the demand for domestic palm oil will decrease by 0.0001 million tons per year. The rise in the price of palm oil exports helped boost the domestic price of palm oil so that domestic demand for palm oil declined due to the hampered development of downstream palm oil industry.

The price of palm oil is also a factor significantly affect domestic demand for palm oil as reflected by the value of the estimation parameter of 0.005, if the price of palm-oil cooking oil increased by 1 IDR per kg, the demand for domestic palm oil will increase by 0.005 million tons per year. The rise in the price of palm oil frost causes palm oil cooking producers to increase production so that domestic demand for oil palm is increasing.

Production of olein and stearin production as biodiesel feedstock also significantly influenced domestic demand for palm oil with estimation of parameter values 0.0001 and 0.0001. If the production of olein and stearin production increases by 1,000 tons per year then the demand for domestic palm oil will rise by 0.001 million tons per annum and 0.001 million tons per year. The expansion of biodiesel from palm oil will encourage increased production of olein and stearin so that domestic demand for oil palm is increasing.

Another factor related to domestic demand for palm oil is the demand for domestic palm oilin in previous year with an estimated parameter value of 0.295. This is related to data on domestic demand for palm oil in the previous year is often used as a reference to domestic demand for palm oil the following year (Raswant et al., 2008).

The result of estimation parameter of price equation of Indonesian palm oil gives the coefficient of determination (R^2) is 87.79%. This means that variations in explanatory variables in the equation may account for the 87.79% fluctuations in domestic variables of palm oil palm Indonesia. Endogenous variables in the domestic price equation of Indonesian palm oil are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with the value of 21.58.

The Table 1 (on appendix) shows the estimation of the domestic price equation of. The domestic price of Indonesian palm oil is significantly influenced by the export prices of palm oil and palm oil production. Each parameter value is 0.0005 and −8.38.

The export price of palm oil is a significant factor in the domestic price of palm oil with the estimation of parameter value 0.000471. If the price of palm oil exports increases by 1 IDR per ton then the domestic price of palm oil will also go up by 0.005 per kg. Fluctuations in the price of palm oil exports influenced by international prices in Rotterdam, the Netherlands will affect the ups and downs of the domestic price of palm oil (Siregar and Sugino 2008). The production of palm oil also has a significant effect on the price of palm oil with the estimation of parameter value −8.384. If palm oil production rises by 1 million tons then the price of palm oil will decrease by 8.384 IDR per kg increase in palm oil production can be excess supply in the domestic market so that the price of palm oil decreases to adjust to domestic demand of palm oil (Johnson and Matsika, 2006).

Meanwhile, the result of estimation of the parameter of palm oil export price equation Indonesia gives the coefficient of determination (R^2) of 89.95%. It means the variations of the explanatory variables within the equation can explain 89.95% fluctuations in palm oil export price variables Indonesia. Endogenous variable in the CPO export price equation Indonesian palm oil is significantly influenced by explanatory variables together at the real level (α) 0.01 shown by the F statistic 26.86.

The Table 1 (on appendix) shows the estimates of oil export price equations palm oil Indonesia. The price of Indonesian palm oil exports is really influenced by the export tax on palm oil, palm oil exports and the domestic price of palm oil. Each of the parameter estimations are 2961.161, −21482.6 and 1721.817.

The export tax of palm oil is a real factor that has an effect on increasing export prices of Indonesian palm oil. This problem reflected from the parameter estimation value 2961,161, which means the tax increase 1% export will raise Indonesian palm oil export price 2961.161 IDR per ton. Increased export tax with export prices in accordance with the magnitude of export prices that will occur increased. Palm oil exports also have a significant effect on export prices Indonesian palm oil with estimated parameter value −21482.6. It is every increase in palm oil exports by 1 million tons then export prices palm oil fell by 21,482.6 IDR per ton. Increase in oil exports Indonesia's palm oil is the largest producer of palm oil causing the supply of palm oil in the world market will be abundant so that oil export price tends to weaken.

Another factor that significantly affects the export price of coconut oil Palm oil is the price of domestic palm oil with the parameter value found 1721.817. That is, every increase of domestic palm oil price is Rp. 1/kg then the export price of crude palm oil will increase by 123 IDR 1721.817 per ton. The rise in domestic palm oil prices, which is influenced by various factors driving the rise in export prices of palm oil (Elbersen et al., 2008; and Hartoyo et al., 2009).

The result of the parameter estimation of the Indonesian palm oil export equation gives the coefficient of determination (R^2) of 63.02%. This means that variations in explanatory variables in the equation may account for 63.02% of the variable fluctuations in Indonesian palm oil exports. Endogenous variables in the Indonesian palm oil export equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with the value of 9.66.

4.4. Diesel Oil Production

Results of the estimation of the parameters of the equation of Indonesian diesel oil production gives coefficient of determination value (R^2) is 86.38%. It means the variations of the explanatory variables within the equation can explain 86.38% fluctuation of Indonesian diesel oil production variables. Variables endogenous products in the Indonesian diesel oil production equation are affected significantly by explanatory variables simultaneously on the real level (α) 0.01 shown by F statistic with value 19.03.

The Table 1 (on appendix) shows the predicted equation of diesel oil production Indonesia. Indonesia's diesel oil production is significantly affected by prices petroleum, fuel oil subsidies, olein and stearin production and Indonesia's diesel oil production last year. Each with parameters of estimations is −0.007, 0.002, 0.001 and 0.638.

The price of petroleum is a significant factor in the production of Indonesian diesel oil with an estimated parameter value of −0.008. If the price of petroleum increases by USD 1 per barrel then diesel oil production will decrease by 0.008 kl. The amount of fuel oil subsidy is also a significant factor in the production of Indonesian diesel oil with the parameter value of 0.003 estimators. If fuel subsidy increases by 1 billion IDR per year then Indonesia diesel oil production will increase by 0.003 million kilolitres per year. According to (Siregar, 2008), increasing the amount of fuel subsidies causes producers to gain greater profits, and thus providing incentives to increase production. Production of olein and stearin are factors that also significantly affect the production of Indonesian diesel oil with the value of alleged parameters of 0.099 and 0.002 respectively. If the production of olein and stearin increases by 1000 tons per year then Indonesia's diesel oil production will rise in a row 0.099 million kilolitres and 0.002 million kilolitres.

Another factor that affects Indonesia's diesel oil production is the production of diesel oil of Indonesia the previous year. This relates to the use of Indonesia's diesel oil production data for the previous year as a reference in the determination of next year's diesel oil production (Hartoyo et al., 2009).

4.5. Diesel Oil Consumption

Consumption of Diesel Oil The result of parameter estimation of diesel oil consumption equation gives the coefficient of determination (R^2) value is 99.50%. This means that variations in explanatory variables in the equation can explain 99.50% of diesel oil consumption variables fluctuations. The endogenous variable in the diesel oil consumption equation is significantly influenced by the explanatory variables simultaneously at the real level (α) 0.01 shown by F statistic with the value of 464.37.

The Table 1 (on appendix) shows the estimation results of diesel oil consumption equation. Diesel fuel consumption is significantly affected by oil demand diesel transportation sector, diesel oil demand industry sector, demand diesel oil electricity sector, industrial production value and consumption diesel oil in previous year (Boyd, 2004). Each parameter's expected value is 0.696, 0.684, 1.229, 0.005 and 0.129 respectively.

Demand for diesel oil for the transport sector is a factor has a significant effect on increasing diesel oil consumption by parameter of estimation 0.696. If diesel oil demand for the transportation sector rises by 1 million kilolitres then diesel oil consumption will be increased by 0.696 million kilolitres.

Demand for diesel oil for the industrial sector also significantly affected the consumption of diesel oil with an estimated parameter value of 0.684. If the demand for diesel oil for the industrial sector increases by 1 million kilolitres then diesel oil consumption will increase by 0.684 million kilolitres. Demand for diesel oil for the electricity sector is also significant of diesel oil consumption with an estimated parameter value of 1.229. If diesel oil demands for electricity sector increases by 1 million kilolitres then diesel oil consumption will increase by 1.229 million kilolitres. The production value of the industrial sector also has a significant effect on consumption diesel oil with the value of estimated parameter 0.005. If the value of production sector industry increases by 1 trillion IDR then diesel oil consumption will be increased by 0.005 kilolitres.

Another factor that significantly affects the consumption of diesel oil was last year's diesel oil consumption (Hartoyo et al., 2009). This is linked to last year's diesel oil consumption data which is often referred to as a reference for diesel oil consumption estimates.

4.6. Price of Diesel Oil

The result of parameter equation estimation of diesel oil price gives the coefficient of determination value (R^2) is 79.01%. This means variation he explanatory variables in the equation may account for 79.01% of the diesel oil price variables fluctuations. The endogenous variables in the diesel oil price equation are significantly influenced by the variables explanation together at the real level (α) 0.01 indicated by F statistic with value 15.06.

The Table 1 (on appendix) shows the estimates of the diesel oil price equation. The price of diesel oil is significantly affected by petroleum prices, subsidies fuel oil and population of Indonesia.

Each of the predicted values the parameters are 0.011, −0.03 and 5.638.

The price of petroleum is a significant factor in increasing the price of diesel oil. This is reflected in the estimated parameter value of 0.011, which means that an increase in oil price of 1 IDR per barrel will raise the price of diesel oil by 0.01089 IDR per litre. The amount of fuel subsidy also has a significant effect on the price of diesel oil. This is reflected in the estimated parameter value of −0.031, which means that an increase in fuel subsidy of 1 billion IDR will reduce the price of diesel oil by 0.031 IDR per litre. Conversely, if the fuel subsidy minus 1 billion IDR raising diesel prices by 0.031 IDR per litre.

Another factor that affects the price of diesel oil is the amount resident of Indonesia (Yudhoyono, 2004). If the population of Indonesia increases 1 million diesel prices will increase by 5.64 IDR per litre. If there was an increase in population with the price of diesel oil unchanged then the fuel subsidies to be provided by the government will increase (Siregar and Sugino, 2008).

4.7. Imports of Diesel Oils

The estimation of the parameters of the diesel oil import equation gives the coefficient of determination (R^2) is 91.66%. This means variation the explanatory variables in the equation may account for 91.66% of the variable fluctuation of diesel oil imports. Endogenous variables inside the diesel oil import equation is significantly influenced by the variables explanation together at the real level (α) 0.01 indicated by F statistics with a value of 62.31.

The Table 1 (on appendix) shows the estimates of the equation of diesel oil imports. Imports of diesel oil were significantly affected by diesel oil consumption, diesel oil production and the amount of diesel oil imports last year. Each parameter value of the estimation is 0.806, −0.580 and 0.206.

The consumption of diesel fuel is a significant factor in increasing the import of diesel oil. This is reflected by the estimated parameter value of 0.806, which means the increase in diesel consumption of 1 million kilolitres will increase the import of diesel by 0.806 million kiloliters. The production of diesel oil is also valued against the import of diesel oil with an estimated parameter value of −0.580. That is, if oil production diesel fuel increased by 1 million kilolitres then diesel oil imports decreased amounting to 0.580 million kiloliters.

Another most important factor for oil imports is the amount of diesel oil imports the previous year. This is done by using a policy that uses the value of imported diesel oil previously as a goal to import diesel oil from petroleum-producing countries for domestic consumption needs (Domac et al., 2005; Hartoyo et al., 2009).

4.8. GDP in Agriculture Sector

The result of parameter estimation equation of agricultural production value gives coefficient of determination (R^2) is 47.52%. This means that the GD from agriculture sector of explanatory variables in the equation can account for 47.52% of the variable fluctuation in agricultural production value. Endogenous variables in the equation of agricultural production value are significantly influenced by explanatory variables simultaneously on the real level (α) 0.01 as indicated by F statistic with the value of 5.13.

The Table 1 (on appendix) shows the estimation result of agricultural production value equation. The value of agricultural production is significantly influenced by the demand for agricultural labour and the production of fresh fruit bunches of oil palm. Each of the expected parameter values is 1.185 and 0.308. Agricultural labour demand is a significant factor in agricultural production value with the parameter value of 1.185, if the demand for agricultural labour increases by 1 million people then the value of agricultural production will increase by 1.185 trillion IDR.

Another factor that significantly affects the value of agricultural production is the production of fresh fruit bunches of palm oil (Siregar and Sugino, 2008) with a parameter value of 0.308 estimates. This means an increase in the production of the fresh coconut fruit bunches palm oil of 1 million tons can increase the production value of agricultural sector amounted to 0.308 trillion IDR.

4.9. GDP in Industrial Sector

The result of estimation of equation parameter of GDP in industrial sector gives coefficient value of determination (R^2) is 97.18%. This means that variations of explanatory variables in the equation may account for the 97.18 per cent fluctuation in the variable GDP in industrial production. Endogenous variables in the GDP in industrial sector equation are significantly influenced by explanatory variables simultaneously on the real (α) 0.01 level indicated by the F statistic with a value of 103.62.

The Table 1 (on appendix) shows the estimation result of equation of GDP sector industry. The industrial production value is significantly affected by demand industrial sector workforce, palm oil cooking production olein and stearin production. Each with the estimated parameter values are 9.016, 5.039, and 0.012.

The demand for labour from the industrial sector is a factor that has a real effect in increasing the production value of the industrial sector (Nkomo, 2017; Peskett et al., 2007). This is reflected in the parameter estimation value of 9.016011, which means an increase in demand for industrial jobs of 1 million people will raise the value of industrial sector production is 9.016 trillion IDR. The production of palm kernel oil is also a significant factor in increasing the production value of the industrial sector. This is reflected in the estimated value of the 5.039 parameter, which means an increase of palm oil cooking oil production of 1 million tons will increase the production value of the industrial sector of 5.039 trillion.

Another factor that significantly affects the value of industrial production is the production of olein and stearin with the value of each of the alleged parameters 0.009 and 0.002. If the production of olein and stearin increases respectively amounting to 1 million tons then the production value of the industrial sector will increase in a row 0.009 trillion IDR and 0.002 trillion IDR.

4.10. GDP in Other Sector

The result of estimation of equation parameter of production value of other sector gives coefficient value of determination (R^2) is 88.36%. This means that the variation of explanatory variables in the equation can explain the 88.36% fluctuation in the variable value of industrial production. Endogenous variables in the production value equation of industrial sector are significantly influenced by explanatory variables simultaneously on the real level (α) 0.01 which is indicated by F statistic with the value of 30.38.

The Table 1 (on appendix) table shows the result of equation estimation of sector production value others. Other sector production values are significantly influenced by other sector labor demand and government infrastructure expenditure. Each with the estimated parameter values is 12.063 and 12.140.

Demand for labor of other sectors is a significant factor in increasing the production value of other sectors (Arndt et al., 2008; Blackwood, 1994; Lisna, 2007). This is reflected from the value of the alleged parameter of 12.063, which means an increase demand for other sector workforce of 1 million people will raise the value production of other sectors amounted to 12.063 trillion IDR. Government infrastructure spending is also a significant factor in increasing the value of other sectors' production (Lisna, 2007). This is reflected by the estimated parameter value of 12,140, meaning that the increase of government spending on the infrastructure sector is 1 trillion IDR will raise the production value of other sectors by 12.140 trillion IDR.

4.11. Consumption

The result of parameter estimation of consumption equation gives the coefficient value of determination (R^2) is 99.41%. This means that the variation of explanatory variables in the equation can account for 99.41% of the variable fluctuations of consumption. Endogenous variables in the consumption equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by the F statistic with a value of 959.10.

The Table 1 (on appendix) table shows the estimation result of the consumption equation. Consumption is significantly influenced by total national production per capita and consumption last year, where the estimation each parameter value is 96.179 and 0.528. Total national production per capita is an influential factor in increasing consumption. This is reflected from the estimation of parameter value 96,179 which means an increase in total per capita national production of 1 trillion IDR per capita will increase consumption by 96.179 trillion IDR.

Another factor affecting consumption is the amount of consumption last year with an estimated parameter value of 0.528. This is related to the policy of using in previous year's consumption value as the reference value for next year's consumption (Arndt et al., 2008).

4.12. Investment in the Industrial Sector

The result of estimation of equation parameter of investment of industrial sector gives a coefficient value of determination (R^2) 48.06%. This means that variations in explanatory variables in the equation may account for 48.06% of the industry sector variable investment fluctuations. Endogenous variables in industrial sector investment equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with a value of 3.70.

The Table 1 (on appendix) table shows the estimation result of the industrial sector investment. Industrial sector investment is significantly influenced by GDP in industry sector, industry average wage, and industrial sector investment value in last year. Each of the expected parameter values is 0.217, −0.002 and 0.375.

The production value of the industrial sector is a significant factor in the investment value of the industrial sector. This is reflected by the value of estimation parameter of 0.217, meaning that any increase of industrial production value of 1 trillion IDR can increase the investment value of industrial sector amounted to 0.217 trillion IDR. The industry average wage is a factor that also significantly influences investment in the industrial sector. This is reflected by the estimated parameter value of −0.002, meaning that every average industrial sector wage increase of 1 IDR per month will decrease industrial sector investment of 0.002 trillion IDR.

Another factor affecting industrial sector investment is the investment value of industrial sector in previous year with the estimation parameter value 0.375. This is related to the investment value of the industry sector in previous year as a reference for the achievement of the investment value target of the next industrial sector (Gonsalves, 2006: Hartoyo et al., 2009).

4.13. Export

The result of prediction parameter of export value equation gives coefficient value of determination (R^2) 96.11%. It means that variations in explanatory variables in the equation may account for 96.11% of fluctuations in the variable of export value. Endogenous variables in the export value equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with 99.07.

The Table 1 (on appendix) shows that the predicted equation of the export value. The value of exports is significantly influenced by the rupiah exchange rate against the USD (Dornbusch and Startz, 2004; Yudhoyono, 2004), the export of palm oil, the value of agricultural production and the supply of labour. Each with the estimated parameter value is 0.005; 1.779; 0.451; and 0.549.

The exchange rate of rupiah against US Dollar is an influential factor real in increasing export value. This is reflected from the value of estimation parameter of 0.005122, meaning that the increase of rupiah exchange rate against USD amounting to 1 IDR per USD will raise the export value of 0.005 trillion IDR. The export of palm oil is a factor which also significantly influence export with the parameter value of estimation 1.779. If export palm oil increased by 1 million tons per year then exports will increase by 1.779 trillion IDR. GDP in agricultural sector is also a significant factor to export (Islam and von Braun, 2007) with the parameter value of alleged 0.451. If the value of agricultural production increased by 1 trillion IDR then the value of exports will also increase by 0.451 trillion IDR.

Another factor which also has a significant effect on exports is labour supply with a parameter value of 0.549 estimates. If labour supply increases by 1 million people then the value of exports will increase by 0.549 trillion IDR.

4.14. Import Value

The result of prediction parameter of import value equation gives the value of a coefficient of determination (R^2) 87.27%. It means variations of variables the explanation in the equation can explain 87.27% of the fluctuation of the variable of the value of imports. Endogenous variables in the equation of import value are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with the value of 38.87.

The Table 1 (on appendix) also shows the result of predicting the value equation of import. Value imports were significantly affected by diesel oil imports and imports in last year. Each of the estimated parameter values is 2.218 and 0.466.

The import of diesel oil is a significant factor in increasing import value. This is reflected in the value of the estimation of the parameter 2,218, which means that any increase in diesel oil imports of 1 million kiloliters will raise the import value of 2,218 trillion IDR. The import of diesel oil is an important factor in increasing import value. This is reflected in the estimated parameter value of 2,218, which means that any increase in import of 1 million kiloliters of diesel will increase the import value of 2,218 trillion IDR. Previous year's import value was a factor that also greatly influenced to import value with parameter value 0.469 estimations. This is related to previous year's import value data used as a reference for determining the imports in next year (Kennedy et al., 2002).

4.15. Consumer Price Index

The result of estimation of equation parameter of consumer price index gives coefficient value of determination (R^2) 98.75%, where the variation in the explanatory variables in the equation can explain the 98.75% fluctuation in the consumer price index variable. Endogenous variables in the consumer price index equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as shown by F statistic with a value of 317.79.

The Table 1 (on appendix) shows estimates from consumers of price index equations. The consumer price index was significantly affected by the price of cooking oil, petroleum prices and consumer price index previous year (Kojima et al., 2007; Peskett et al., 2007; Hartoyo et al., 2009). Each parameter value obtained is 0.118; 0.001; and 0.949

The price of palm kernel oil is a significant factor in increasing the consumer price index. This is reflected in the value the estimation of the parameter 0.118; it means the increase of cooking oil price palm oil of 1 IDR per kg will raise the consumer price index by 0118 points. The price of petroleum is also a significant factor in consumer price index with the parameter value of 0.001 predictions. If the price of petroleum increases by USD 1 per barrel then the consumer price index will increase by 0.001 points.

Another factor that also affects the consumer price index is the consumer price index last year with a parameter value of 0.949 estimates. This relates to the value of the consumer price index previous year that affected the price level in the next year (Hartoyo et al., 2009).

4.16. Urban Poverty

The result of estimation of the parameter of poverty equation in urban gives coefficient determination value (R^2) 80.62%. Therefore the variations in explanatory variables in the equation may account for 80.62% of fluctuations in urban poverty variables. Endogenous variables in urban poverty equation are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by F statistic with a value of 9.71.

The estimation shows the results of the poverty in urban areas. Urban poverty is significantly affected by growth economy, government spending on the industrial sector, petroleum prices and the number of poor people in urban areas in previous year (Yudhoyono, 2004). Each of the predicted parameter values is −0.206; −0.05; 0.001; and 0.4112.

Economic growth is a significant factor in reducing urban poverty (Dornbush, 2004; Shaffer et al., 2007; Selim, 2006; Suryahadi et al., 2006). This is reflected from the estimated parameter value of −0.206. That is, an increase in economic growth of 1% will reduce urban poverty by as much as 0.206 million people. Government expenditures in the industrial sector also have a significant effect on reducing urban poverty. This is reflected from the estimation of the parameter values −0.057. That is, an increase in government spending of the industrial sector of 1 trillion IDR will reduce urban poverty by as many as 0.057 million people. Petroleum prices also have a significant effect on urban poverty. This is seen from the value of the alleged parameter of 0.001. That is, if the price of oil increased by 1 IDR per barrel then the poverty in urban areas will increase by 0.001 million people or if the price of oil increased by 10,000 IDR per barrel then poverty at urban areas will increase by 0.11 million people. Other factors that have a significant effect on urban poverty were poverty in urban areas last year. The expected parameter value is 0.4112.

4.17. Poverty in Rural Areas

The result of parameter estimation of poverty equation in the rural area gives a coefficient value of determination (R^2) 92.56%. This means that the variations in explanatory variables in the equation can explain 92.56% of the variable fluctuations in rural poverty. Endogenous variables in the poverty equation in rural areas are significantly influenced by explanatory variables simultaneously at the real level (α) 0.01 as indicated by the F statistic with a value of 37.35.

The result showed the poverty equation estimate in rural areas. Rural poverty is significantly influenced by growth economy, unemployment and poverty in rural areas last year. With each result obtained −0.321, 0.01 and 0.742. Economic growth is a significant factor in reducing rural poverty (Selim, 2006; Suryahadi et al., 2006). This is reflected from estimation parameter value −0.322, meaning that an increase in economic growth of 1% will reduce poverty in rural areas as many as 0.321 million people. The number of unemployed is also a significant factor in increasing rural poverty. This is reflected from the estimated parameter value of 0.013, where an increase in unemployment by 1 million will increase rural poverty by as many as 0.013 million people.

Another factor affecting rural poverty is the number of rural poverty in the previous year (Selim, 2006). This is related to the number of rural poverty in the previous year, and often used as a reference in calculating the number of rural poverty in the next year (Agrawal, 2007).

4.18. Policy Simulation

Simulations were conducted to analyze the impact of changes in various biodiesel development policy scenarios from oil palm and other factors on Indonesia's macroeconomic indicators (Hartoyo et al., 2009; Yudhoyono, 2004), especially in terms of agricultural and industrial production, economic growth, labor demand, unemployment and poverty. The simulation is designed in two main scenarios first, the scenario of the rise in the price of petroleum and secondly, the combined scenario of the increase in the price of petroleum by increasing the production of olein-stearin and government spending (Hartoyo et al., 2009).

As shown in Table 2, from 42 equations in the model there are 12 equations that have RMSPE above 35% and the rest having RMSPE <35%. While the U-Theil stats in the model are only one that has values above 0.5, which indicates most of the value of U-Theil is near zero (Intriligator et al., 1996). The results of this validation indicate that the model may or may be used to simulate these various policy scenarios above.

The research will also find the impact of policy especially macro-economic policy, where 4 simulations will conduct to this research.

4.19. Simulation 1: Development of Biodiesel from Palm Oil

In the first scenario (Table 3), simulation increased production of olein and stearin by 20% as an indicator of biodiesel development from CPO. The simulation results show that the development of biodiesel from palm oil has an impact on the decline the urban poverty of 2.71% and poverty reduction in rural areas of 0.89% so that the total poverty is reduced by 1.50%. This is in accordance with the results of research Susila and Munadi (2008) and Arndt et al. (2008).

Urban poverty decreased by 2.71% due to an increase in economic growth by 2.13%. The simulation also defined, the urban poverty was reduced by 2.71% due to an increase in economic growth of 2.13% and an increase in industrial production by 4.41% due to the development of biodiesel from palm oil. Similarly, poverty in rural areas decreased by 0.89% as well as an increase in economic growth by 2.13%.

Likewise, economic growth increased by 2.13% due to the development of biodiesel from crude palm oil due to increased production of industrial sector by 4.41%. This increase in production and economic growth has resulted in an increase in labour demand by 0.17% so that it can reduce unemployment by 5.28%. This is also in accordance with the results of research by Arndt et al. (2008).

Development of biodiesel from palm oil itself also has an impact on the national palm oil industry (Susila and Munadi, 2008; Wakeford, 2006) where consumption or demand domestic palm oil increased by 4.02% so production palm oil increased by 2.08%. Increase in consumption or the domestic demand for palm oil has caused the domestic price of palm oil to rise by 0.59%, which has contributed to an increase in the price of palm oil exports, which increased by 0.90%. The rise in the price of palm oil exports and increased

Table 2: The validation result of economic model

Endogenous variable	Variables	RMSPE (%)	U-Theil
CCPO	CPO consumption	52.921	0.203
DCPO	CPO domestic price	33.232	0.159
PXPO	CPO export price	58.785	0.273
XCPO	CPO export	126.1	0.242
QDSL	Diesel oil production	19.533	0.058
CDSL	Diesel oil consumption	2.311	0.001
PDSL	Price of diesel oil	29.72	0.133
MDSL	Import of diesel oil	18.06	0.081
DEMI	Demand on industry labor	11.937	0.046
UPOV	Urban poverty	30.936	0.131
RPOV	Rural poverty	24.884	0.109
TPOV	Total poverty	25.866	0.111
GDPA	GDP agriculture sector	13.589	0.066
GDPI	GDP industry sector	29.655	0.079
GDPO	GDP other sector	26.655	0.079
C	Consumption	3.583	0.014
INVI	Investment on industry sector	61.129	0.127
X	Export	11.087	0.049
M	Import	16.621	0.066
AS	Agregate supply	22.489	0.074
CPI	Consumer price index	36.121	0.068
EGRO	Economy growth	156.7	0.45
INF	Inflation	299.3	0.516

Source: Intriligator et al., 1996; author, 2017

Table 3: Simulation policy result

No	Endogenous variable	SIM-1	SIM-2	SIM-3	SIM-4
1	Crude palm oil				
	a. Production	2.08	2.06	−0.37	2.33
	b. Consumtion	4.02	4.25	5.16	3.99
	c. Dometic price	0.59	1.44	0.358	0.7
	Export price	0.9	2.59	7.09	1.08
	CPO export	−0.28	−1.69	−14.63	−0.33
2	Industry sector production	4.41	5.22	6.54	4.41
3	Economy growth	2.13	2.18	2.39	3.65
4	Labour demand	0.17	0.2	0.24	0.79
5	Unemployment	−5.28	−6.27	−7.52	24.39
6	Poverty				
	a. Urban	−2.71	−2.86	−3.18	−2.71
	b. Rural	−0.89	−0.94	−1.03	−1.74
	c. Total	−1.5	−1.58	−1.75	−2.07

Source: Intriligator et al., 1996; Pyndick, 1991; author, 2017 consumption or domestic demand for palm oil also caused the export of palm oil to decline by 0.28%.

Simulation 2: Development of biodiesel from palm oil and increase of 10% export tax.

In the second scenario (Table 3), a combined 20% olein and stearin production simulation was used as an indicator of biodiesel development from palm oil and a 10% tax increase. Results were compared that the development of biodiesel from palm oil combined with a very large tax of 2.86% and weight loss of 0.94% the total amount of reduction was 1.58%.

Urban poverty decreased by 2.86% due to an increase in economic growth of 2.18% and an increase in industrial production by 5.22%, and an increase in export taxes. In addition, rural poverty was reduced by 0.94% as well an increase in economic growth of 2.18%. Economic growth increased by 2.18% due to the development of biodiesel from palm oil and the increase in export taxes due to industrial production by 5.22%. Increased production and the economic growth have an impact on the increase in labour demand (Lisna, 2007; Saunders, 2002) by 0.20% so it can reduce unemployment by 6.27%. Development of biodiesel from palm oil and tax increases exports had a significant impact on the palm oil industry national consumption or domestic demand for palm oil increased by 4.25% so that the production of palm oil increase of 2.06%.

Increase in consumption or domestic demand for palm oil is influenced by an increase in export taxes which causes the price of palm oil exports to increase by 2.59% and beyond affecting the domestic price of palm oil increased by 1.44%. An increase in the price of palm oil exports leads to oil palm exports has decreased by 1.69% domestic processed into biodiesel and other downstream products that have an impact on increasing consumption or domestic demand for palm oil (Johnson and Matsika, 2006).

An increase in palm oil export tax will encourage the development of downstream palm oil industry in Indonesia due to the low cost of raw materials of palm oil (Amatucci, 2010; Elbersen et al., 2008; Susila and Munadi, 2008; Johnson and Matsika, 2006). Development of downstream coconut oil industry palm oil produces many added values to be received in the country (Elbersen et al., 2008).\

Simulation 3: Development of biodiesel from palm oil and 10% strengthening exchange rate of Rupiah (IDR).

In the third scenario (Table 3), a combination simulation of 20% oleins and stearin production increase as an indicator of the increase of biodiesel production from palm oil and 10% strengthening of exchange rate (Orden, 2002). Simulation results show that development biodiesel from palm oil and the strengthening of Rupiah exchange rate has an impact in urban poverty reduction of 3.18% and a 1.03% reduction in rural poverty in total so that poverty decreased by 1.75%.

Urban poverty was reduced by 3.18% due to an increase in economic growth by 2.39%, an increase in industrial production by 6.54% and the strengthening of the rupiah (IDR). Poverty in rural areas was reduced by 1.03% due to an increase in economic growth by 2.39%.

Economic growth increased by 2.39% due to the development of biodiesel from palm oil and the strengthening of the rupiah exchange rate due to a significant increase in industrial production (by 6.54%. The increase in production and economic growth has resulted in an increase in labour demand by 0.24% so that it can reduce unemployment (Lopez, 2008; Nkomo, 2017) by 7.52%.

The development of biodiesel from palm oil and the strengthening of the Rupiah exchange rate itself had a significant impact on the national palm oil industry where the export of palm oil decreased by 14.63% due to rising export prices of crude palm oil by 7.09% due to the strengthening of the Rupiah exchange rate that also affects the domestic price of palm oil increased by 3.58%. A significant drop in palm oil exports caused palm oil production to decline by 0.37% while domestic consumption or domestic demand for palm oil continued to increase by 5.26% due to the development of biodiesel from palm oil and other downstream industries.

Simulation 4: Development of biodiesel from palm oil and decrease interest rate 10%

In the fourth scenario (Table 3), a combination simulation of olein and stearin production increases by 20% as an indicator of increased biodiesel production from palm oil and a 10% reduction in interest rates (Susila and Munadi, 2008; Wakeford, 2006). Simulation results show that the development of biodiesel from palm oil and lower interest rates have had an impact on the decline urban poverty of 2.71% and poverty reduction in rural areas of 1.74% so that the total poverty is reduced by 2.07%.

Meanwhile, the simulation also showed urban poverty decreased by 2.71% due to an increase in economic growth by 3.65% and an increase in industrial production by 4.41% due to the development of biodiesel from palm oil. Poverty in rural areas was reduced by 1.74% due to an increase in economic growth by 3.65%.

Economic growth increased by 3.65% due to the development of biodiesel and the decline in interest rates due to increased production of the industrial sector by 4.41%, and an impact on the increase in labour demand by 0.79% so that unemployment is reduced by 24.39%.

The decline in unemployment due to the development of biodiesel from palm oil and the decline in interest rates in a large percentage, however, the value is possible because unemployment is only reduced by 810000 people. This condition occurs because of the impact of a combination of changes at the micro level (in this case biodiesel) with changes in the macro level which in this case a decrease in interest rates that have a significant impact on the decline in unemployment (Lisna, 2007; TAMSI-DMSI, 2010). The decline in interest rates also led to an increase in investment, creating more jobs (Lisna, 2007; Schubert et al., 2007).

The development of biodiesel from palm oil and lower interest rates have an impact on the national palm oil industry where the production increased (Siregar and Sugino, 2008) by 2.06% and consumption or domestic demand increased by 4.03%. An increase in domestic consumption or demand for palm oil causes the domestic price increased by 0.59% affecting the rising export prices by 0.89%. Increase in the export price and increases consumption or domestic demand leads to exports declined by 0.27%.

5. CONCLUSION

The impact model of biodiesel development produced from oil palm on poverty, and economic growth in Indonesia can be formulated and presumed to be parameters. Each equation in the model is able to explain the diversity that occurs in important endogenous variables such as olein-stearin production, domestic production and palm oil prices, production and imports of diesel oil, national production, growth economy, labor demand, unemployment and poverty. The production of palm oil is significantly affected by the domestic price of palm oil, domestic consumption of palm oil and palm oil production the previous year. The domestic consumption of palm oil is significantly affected by the price of palm oil exports, the price of palm oil, olein production, stearin production and domestic consumption of palm oil the previous year. The domestic price of palm oil is significantly influenced by the export price of palm oil and the large amount of palm oil production. The export price of palm oil is significantly influenced by the export tax, the amount of palm oil exports and the domestic price of palm oil. The export of palm oil is significantly affected by the rupiah exchange rate against the USD. Changes in the palm oil industry, due to increased production of olein and stearin production as raw materials from biodiesel that impact on macroeconomic indicators such as national production, economic growth, labor demand, unemployment and poverty. It happens because of production national sector is influenced by the demand of labor of industrial sector, production of olein and stearin, and government expenditure of infrastructure sector, while, the economic growth is significantly influenced by the increase in total national production. The demand for labor is the sum of the demand for labor of the industrial sector. Unemployment is the total difference between labor supply and labor demand. Poverty itself is distinguished between in urban and rural areas is significantly affected economic growth, industrial government spending, oil prices earth, the number of urban poverty the previous year, the number of unemployed and the number of rural poverty in the last year. The model of biodiesel development of crude palm oil to poverty and economic growth in Indonesia has resulted in some interesting information, where the development of biodiesel from palm oil can reduce the number of poor people both in urban and rural areas so that the total number of poor people in Indonesia will decrease. Of course, the development of CPO biodiesel can increase the total national production thus creating economic growth for Indonesia. The study also found that if the Biodiesel CPO development policy can combined and supported by some macroeconomics policies such as increased export taxes, strengthening of the rupiah (IDR), lower bank interest rates, increased government spending on infrastructure, and increased the industry positive; the impact development will have positive impact to poverty reduction, and increased economic growth in Indonesia, where the best impacts are generated by a combination of increased biodiesel production from the CPO and increased government spending on infrastructure and industry. The model compiled in this study can still be developed by researchers who are also studying the impact of biodiesel development from CPO. Improvements to the model can be done in the form of improving the form of the equation by using more appropriate variables. In addition, the estimation of model parameters is likely to be even better if more data related to biodiesel from palm oil is available in Indonesia, especially in the Ministry of Agriculture, Ministry of Industry, Ministry of Trade, and Central Bureau of Statistics. For the follow up of the results of this study, it is necessary to conduct a more in-depth study in terms of the impact of biodiesel development from oil palm especially with the problems in conversion of land between food and energy in Indonesia, the impact of biodiesel development from oil palm to food prices in the future, the impact of biodiesel development from oil palm on social and social aspects in Indonesia. This follow-up study is used to sharpen the policy that will be done by the government if the development of biodiesel from oil palm really becomes one of the government's priority policies.

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