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**Article**

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Commodity exports and macroeconomic performance: The case of palm oil in Malaysia

Sayyed Mahdi Ziaei<sup>1\*</sup> and Issa Ali<sup>2</sup>

**Abstract:** The objective of this paper is to contribute towards understanding the effects of palm oil production upon key macroeconomic variables in Malaysian economy. A dynamic general equilibrium model was employed in order to analyze the dynamic macroeconomic adjustment processes arising from palm oil production increase for Malaysian economy (the second biggest palm oil producer in world), operating under a managed float exchange rate regime. The model utilized in this paper is likely to be of interest to other palm oil-exporting economies with similar features such as that of Indonesia. Findings from this paper show that an increase in palm oil production would potentially result in an increase in private capital stock, private sector wealth, real income, public capital stock, human capital stock and non-palm oil output supply and demand. However, the revenue arising from the palm oil sector also has the potential to deteriorate the non-palm-oil trade balance through a slight loss of competitiveness from a real exchange rate appreciation.

### ABOUT THE AUTHORS

Sayyed Mahdi Ziaei, Associate Professor of Financial Economics at School of Economics and Management, Xiamen University of Malaysia. He received his Ph.D. in Economics from Universiti Putra Malaysia. Much of his research over the years has focused on three main fields, monetary and fiscal studies, Financial Economics as well as energy Economics. He has published More than 30 papers in SSCI, ABS, and/or ABDC listed Journals. He is accumulating a wide range of experience in international research institutes and universities in Asia and particularly in Malaysia.

Issa Ali, Associate Professor at the University of Benghazi (Libya), holds a Ph.D. in economics from University of Wollongong, Australia, and master's and bachelor's degrees in economics from the University of Benghazi. The author's areas of academic expertise are economic growth and development, economic modeling, natural resources and macroeconomic development, and international monetary economics. The author's most recent article has been published in *Economic Modelling*, *Applied Econometrics* and *The Journal of Energy and Development*.

### PUBLIC INTEREST STATEMENT

Malaysia is under huge pressure from European countries to reduce the production of palm oil due to environmental issues. However, palm oil plays an important role in the domestic and global economy, where Malaysia is the second biggest producer of palm oil and the leading producer of biodiesel in the world. Moreover, the Malaysian agricultural sector depends on palm oil significantly, where the palm oil industry is the fourth largest contributor to the Malaysian economy, and a large share of foreign exchange stems from palm oil exports. The results of this study confirm that this sector income has paramount impacts on Malaysia's private capital stock, private sector wealth, real income, public capital stock, human capital stock, and non-palm oil output supply and demand. Therefore, the Malaysian government should promote the intensification policy rather than expansion policy to maintain and increase the advantages of this sector and reduce the environmental concern simultaneously.

**Subjects: Agricultural Economics; Economics; Macroeconomics; Environmental Economics**

**Keywords: Palm oil production; dynamic macroeconomic model; simulation scenario; policy analysis**

**JEL colassification: E27; E60; Q33; Q43; Q48**

## 1. Introduction

Heavy reliance on a commodity export can expose a country to macroeconomic impacts from domestic production and/or global price movements. Malaysia's reliance on palm oil is a case in point. The country is the world's number one exporter of palm oil with a 44 percent share in global trade, and its second largest producer (after Indonesia) with a 39 percent share in global output (Malaysian Palm Oil board, 2017). Although Malaysia and Indonesia have 85% of the total production of crude Palm oil, they have different production strategies. Malaysia has employed an intensification policy in which focused on improving the productivity of current land, but Indonesia follows the expansion policy that has concentrated on increase the area of land used for palm oil (Varkkey et al., 2018). Based on such sound strategy Malaysia can increase palm oil production even by reducing the area of land employed for palm trees.

Moreover, Malaysia is further the world's leading producer of biodiesel, using palm oil as the biological input. The government of Malaysia took serious steps to increase biodiesel production from different sources. The government planned its strategy under the national biofuel policy in 2006 and this policy reinforce by the parliament Biofuel industry act in 2007. Eventually, the government supporting policy initiate in June 2011. The palm oil is considered as the main source of biodiesel production in Malaysia, where Biodiesel share was 952 340 out 24,876,781 tons of total Exports of all types of palm oil products in 2018 ("Malaysian Palm Oil board," 2019).

Global demand for palm oil has burgeoned in recent decades providing a major stimulus to Malaysia's economic development. Malaysia thus presents an opportune case study of the effects of commodity export on macroeconomic performance.

This study utilizes a dynamic general equilibrium macroeconomic model to assess both short and long run impacts of increasing palm oil production on the Malaysian economy. A boom in palm oil prices drives accumulation of both physical and human capital in the economy broadly following Cox and Harvie (2010) and Issa and Harvie (2013) in their applications to other commodity export economies. The effects are transmitted through a number of channels, specifically, fiscal revenue increases due to taxation of oil production (revenue effect), associated government spending increases (spending effect), and foreign asset accumulation driven by surpluses in the current account (current account effect).

This is the first study to examine the impact of palm oil production on macroeconomic performance for Malaysia. Previous studies of the palm oil sector in Malaysia have had a narrower focus. These can be classified into three main types. The first type evaluates the effect of palm oil price fluctuations on the sector itself and downstream activities. For instance, Wahid et al. (2007) investigated the relationship between palm oil prices and investment, consumption, and trade in the palm oil industry and on the production of biodiesel from palm oil. Abdullah (2011) found that the main cause of instability in Malaysia's export earnings from palm oil is palm oil price fluctuations. The second type of study analyses the effect of palm oil prices on products of a related nature. Abdullah et al. (2007) and Applanaidu et al. (2011) found a strong positive correlation between the prices of palm oil and soya beans due to their high degree of substitutability. The third type of study focuses on the effect of

exogenous variables on the price of palm oil. Hameed and Arshad (2009) and Hadi et al. (2011) evaluated the effects of crude oil prices on palm oil prices and vice versa. The results confirm both long and short run relationships in these prices.

More recently, Butt et al. (2020) emphasized the impact of the business cycle on palm oil price and the nominal exchange rate. The results of Engle-Granger and threshold cointegration indicated that there is bidirectional causality between the nominal exchange rate and palm oil price in the short and long run. Go and Lau (2020) evaluated the impact of the global financial crisis on relationship price-volume relation in the crude palm oil futures market in Malaysia. They found there is no volatility spill over between volatilities of past trading volume and current return during the crisis period. However, the relationship between the past trading volume and current return is significant before and after the financial crisis.

Since the palm oil price fluctuating movements show no apparent upward trend over time, the short and long run impacts of increasing palm oil production on the Malaysian economy are investigated in this paper.

The paper proceeds as follows. Section 2 provides a brief overview of palm oil development in the Malaysian economy. Section 3 discusses the theoretical framework of the analytical model. Section 4 presents parameter values and the results of our simulation exercise. And finally, section 5 offers conclusions and policy implications.

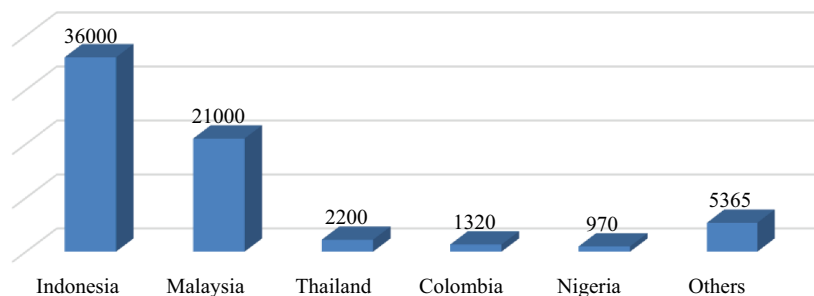
## 2. The domestic and global importance of the Malaysian palm oil sector

Palm oil is one of the most important trade commodities with edible and non-edible applications. Higher productivity and lower price in comparison with similar types of agricultural products, such as soya bean, sunflower and grape bean makes palm oil a strategic industry model for South East Asia, particularly in Malaysia and Indonesia (Stichnothe & Schuchardt, 2011). A change of Malaysian government policy in the late 1950s from the rubber industry toward the palm industry, resulting in an increased the palm oil output, and therefore the industry has become burgeon in Malaysia (Foo & Hameed, 2010). Accordingly, Malaysia has become the second biggest producer of palm oil, with 34% of world total production during 2017, as indicated in Figure 1, and the leading producer of biodiesel in the world (Lam et al., 2009).

The steady increase of palm oil production from 1392 thousand metric tons (1000 MT) in 1975 to 19,140 (1000 MT) in 2020, as indicated in Figure 2, highlights the remarkable economic growth and profitability of this industry. The palm oil industry is the fourth largest contributor to the economy, accounting for approximately 10% of gross national income and has played a significant role in the economy of this country especially during critical times such as the 1997 Asian financial crisis (Yoshizaki et al., 2013) and 2020-2021 COVID-19 pandemic. Moreover, the palm oil is the main

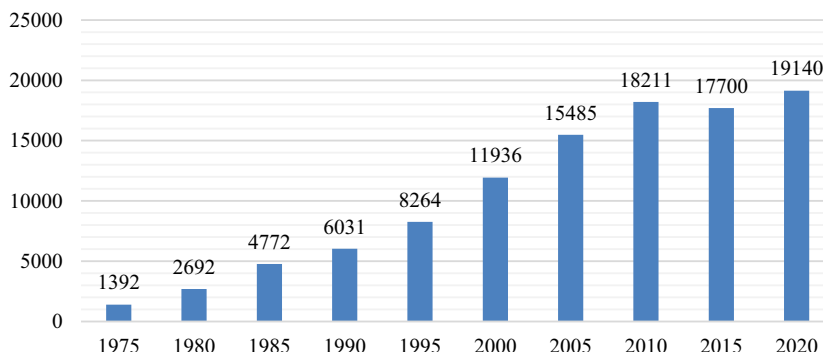
**Figure 1. World major producer of palm oli during 2017 (1000MT).**

Source; derived from Index Mundi, 2017



**Figure 2. Crude palm oil production/million MT(1875–2020).**

Source; Malaysian Palm Oil board and The Ministry of Plantation Industries and Commodities



source of foreign exchange earnings as 90% of palm oil production is exported (Abdullah, 2011; Lane, 2012; Ziaei, 2012). Figure 3 shows that the palm oil export volume increased from 406 (1000MT) in 1975 to around 26,655 (1000 MT) in 2020. It would seem likely that the export volume and value would increase since 2006 with accelerated demand for biofuel combined with government biofuel policies that have been ruled and implemented in Ninth, Tenth and Eleventh Malaysia Plans. Statistics show that around 900 hundred thousand people work directly or indirectly in this industry.

It is worth mentioning that the palm oil price fluctuating movements shows no obvious upward trend over time, as indicated by Figure 4, however; the palm oil production shows apparent upward movements over time, as indicated by Figure 2, thus, the short and long run impacts of increasing palm oil production on the Malaysian economy are investigated in this paper.

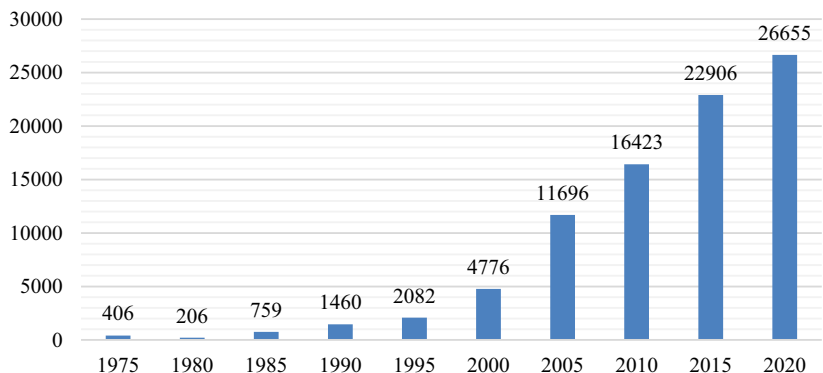
### 3. Theoretical part and model parameterization

The theoretical model utilized in this paper to analyze the effect of palm oil production on key Malaysian macroeconomic variables is based on the seminal work of Cox and Harvie (2010) for the case of a flexible exchange rate in the context of advanced resource-abundant economies, and Issa and Harvie (2013) for the case of a fixed exchange rate in the context of a developing resource-abundant country.<sup>1</sup> The model consists of four main parts: Aggregate demand and its components, asset market, aggregate supply and prices, and the external sector.

All variables in the model are in log form except that of the domestic and world interest rates, and the parameter in front of each variable indicates its elasticity. The definitions of endogenous and exogenous variables are presented in Table 1.

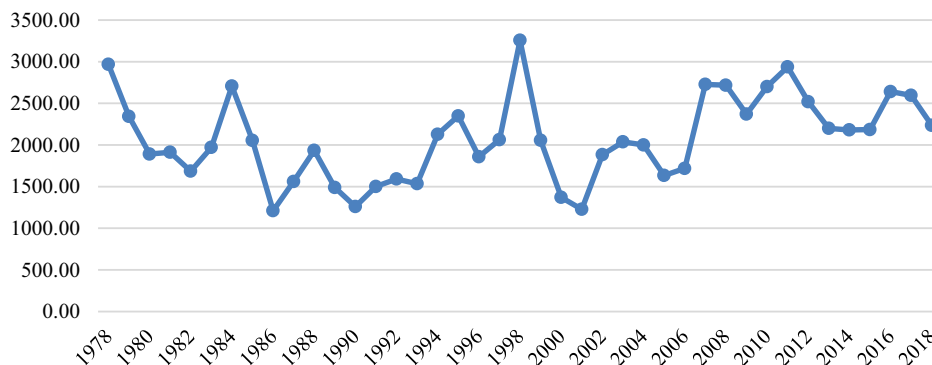
**Figure 3. Palm oil exports(1000 MT).**

Source; Malaysian Palm Oil board and The Ministry of Plantation Industries and Commodities



**Figure 4. Palm oil local delivered average price in RM/tonne, deflated by producer price index, base year 2010.**

Source; Department of statistic, Malaysia.



### 3.1. Aggregate demand and its components

The first category is related to the demand side of economy, and involves 16 equations.

#### Aggregate Demand

$No^d = \beta_1 c^p + \beta_2 i^p + \beta_3 g + \beta_4 x^n - \beta_5 m^n$	1
$c^p = \beta_6 No^s + \beta_7 w^p$	2
$i^p = k^p = \gamma(k^{p*} - k^p)$	3
$k^{p*} = \delta No^s$	4
$g = \beta_8 c^g + \beta_9 i^g + \beta_{10} h^h$	5
$c^g = (1 - \theta_1 - \theta_2)(o^g + po + e - p)$	6
$i^g = k^g = \varphi(k^{g*} - k^g)$	7
$h^h = k^h = \sigma(k^{h*} - k^h)$	8
$k^{g*} = \theta_1(o^g + po + e - p)$	9
$k^{h*} = \theta_2(o^g + po + e - p)$	10
$bd = g - t^x = \theta_{11}(-p)$	11
$t^x = \beta_{12}(o^g + po + e - p) + (1 - \beta_{12})No^s$	12
$x^n = \beta_{13}(e + p^* - p) + \beta_{14}y^*$	13
$m^n = \beta_{15}y - \beta_{16}(e + p^* - p)$	14
$y = vNo^s + (1 - v)o^g + (1 - v - \mu_2)po + (\mu_1 - v)(e - w) - (1 - \mu_1 - \mu_2)p^*$	15
$y_p = vNo^{sp} + (1 - v)o^p + (1 - v - \mu_2)po + (\mu_1 - v)(e - w) - (1 - \mu_1 - \mu_2)p^*$	16

As shown in the first equation, non-palm oil aggregate demand ( $No^d$ ) has a linear relationship with important components such as private consumption expenditure ( $c^p$ ), private investment expenditure ( $i^p$ ), government expenditure ( $g$ ) and non-palm oil trade balance (non palm oil exports minus non palm oil imports ( $x^n - m^n$ )). The  $\beta$  coefficient in the first equation and all demand side equations explain the relationship between the dependent and independent variables in this model. Equation 2 indicates the positive relationship between private sector consumption and the aggregate supply of non-palm oil output ( $No^s$ ) and private sector wealth ( $w^p$ ). Aggregate supply of non-palm oil output is the type of income that is generated by the government and private sectors. The third equation explains the relationship between private sector investment and deviation in private sector capital stock.  $\gamma$  shows the differences between private capital stock ( $k^p$ ) and desired private capital stock ( $k^{p*}$ ). According to equation 4, desired private capital depends on the aggregate supply of non-

**Table 1. Explanation of symbols used in the model**

Endogenous variables	<i>bd</i> budget deficit
<i>No<sup>d</sup></i> Aggregate demand for non-palm oil output	<i>p</i> Consumer price level
<i>c<sup>p</sup></i> Private consumption	<i>w</i> Domestic nominal wage
<i>i<sup>p</sup></i> Private investment	<i>y</i> Total real income <sup>3</sup>
<i>k<sup>p*</sup></i> Desired private capital stock	<i>y<sup>p</sup></i> Permanent real income
<i>g</i> Total government spending	<i>f</i> Foreign asset stocks
<i>c<sup>g</sup></i> Government consumption expenditure	<i>o<sup>x</sup></i> Palm oil exports
<i>x<sup>n</sup></i> Non-palm oil exports	<i>c</i> Real exchange rate
<i>m<sup>n</sup></i> Non-palm oil imports	<i>l</i> Real money balance
<i>T</i> Non-palm oil trade balance	<b>Exogenous variables</b>
<i>No<sup>s</sup></i> Aggregate supply of non-palm oil output	<i>e</i> Nominal exchange rate
<i>w<sup>p</sup></i> Real private sector wealth	<i>o<sup>a</sup></i> Palm oil production
<i>k<sup>p</sup></i> Private capital stock	<i>po</i> World palm oil price (in foreign currency)
<i>k<sup>g</sup></i> Actual public capital stock	<i>p *</i> Price of non-palm oil imported goods
<i>k<sup>h</sup></i> Human capital stock <sup>#</sup>	<i>y *</i> World real income
<i>k<sup>g*</sup></i> Desired government physical capital stock	<i>No<sup>sp</sup></i> Permanent non-palm oil income
<i>k<sup>h*</sup></i> Desired human capital stock	<i>o<sup>p</sup></i> Permanent palm oil-income
<i>i<sup>g</sup></i> Government investment spending on physical capital	<i>r *</i> World nominal interest rate
<i>i<sup>h</sup></i> Government investment spending on human capital <sup>#</sup>	<i>r</i> Domestic nominal interest rate
<i>t<sup>x</sup></i> Total tax revenue	<i>em</i> Employment
<i>m</i> Nominal money supply	
$\pi$ Inflation rate	

palm oil output. Government expenditure in equation 5 explains the relationship with government consumption expenditure ( $c^g$ ), government investment spending on physical capital ( $i^g$ ) and government investment spending on human capital ( $i^h$ ). It should be noted that current government consumption is a huge economic burden for the government. A 50 year perspective of Malaysian expenditure confirms that government expenditure on physical capital, like certain types of infrastructure investment, increased significantly and expenses on education and healthcare (government expenditure on human capital) have been highly subsidized. Equation 6 indicates the relationship between government consumption expenditure with palm oil production ( $o^a$ ), palm oil price ( $po$ ) and real exchange rate ( $e-p$ ). Equations 7, 8, 9 and 10 explain the relationship between government investment spending with physical capital stock and human capital stock. The equations show how government expenditures have gradually adjusted toward desired capital stock levels. Parameters  $\theta_1$  and  $\theta_2$  are the proportion of government expenditure allocated towards desired physical capital stock and desired human capital stock. Equation 11 shows government budget ( $bd$ ) and the difference between government expenditure and tax income ( $t^x$ ). In the last 28 years, the government deficit has shown an increasing upward trend in Malaysia. From 1990 to 2018 government debt to GDP has specifically fluctuated. According to the National Bank of Malaysia (Bank Negara Malaysia) the average rate was 47 percent during these years, reaching a high of 79 percent in 1992 and a low of 32 percent in 1997. In 2017 the rate was 50.9.

As shown in equation 12, two sources of income such as palm oil production and non-palm oil production are defined for government income tax purposes. Moreover, equations 13 and 14 indicate the trade balance status of non-palm oil exports and non-palm oil imports. The non-palm oil export equation indicates the positive relation between this variable, real exchange rates and world real income ( $y^*$ ). On the other side, consumption of non-palm oil imports has a negative relationship with real exchange rates and a positive correlation with total real income ( $y$ ). The last two equations on the aggregate demand side of the economy are total real income (15) and (16) total permanent income ( $y^p$ ). Total real income depends on non-palm oil output, palm oil production, palm oil price, real exchange rates and the price of non-palm oil imported goods in foreign



currency ( $p^*$ ). The 16 equation explains the permanent real income relationship. Permanent real income variable has a positive relationship with permanent real non-palm oil income, permanent palm oil production, palm oil price, real exchange rates and non-palm oil imported goods.  $v$  parameter is the share of non-palm oil in total output,  $(1-v)$  is the share of oil production in real income and  $\mu_2$  is the share of palm oil consumed domestically.

### 3.2. Asset Market

Asset market	
$m - p = \varepsilon_1 No^s - \varepsilon_2 \pi - \varepsilon_3 r$	17
$w^p = \varepsilon_4 k^p + \varepsilon_5 (m - p) + \varepsilon_6 y^p$	18
$= dce + \tau(r - r^* f)$	19

The second part of model explains the asset market. The asset market is divided into three important categories. Equation 17 focuses on money market equilibrium, equation 18 explains the real wealth of the private sector and 19 deals with the growth of money.

Money market equilibrium assumes that the market is cleared. In this model nominal money is deflated by price levels and has a direct and positive relationship with non-palm oil real income and a negative relationship with inflation ( $\pi$ ) and interest rate ( $r$ ). In developing countries, interest rates are not good criteria for price deviation, especially in the case of Malaysia, where after the financial crisis of 1997–98 the government employed capital controls and a reflationary policy. Thus, in this study, both interest rates and inflation are employed as indexes of holding money. In addition, the real wealth ( $w^p$ ) of the private sector in this model depends positively on private sector capital levels, real money balances and permanent real income.

The last component of the asset market is money growth (equation 19). This equation is divided into two categories. The first is called domestic credit expansion (DCE), which is the fraction of the increase in the amount of money attributable to bank loans and the money the government borrows to finance its activities, so it is determined exogenously. For simplicity, we consider it as zero in this model. The second part is related to aggregate foreign exchange reserves related to balance of payment channels. Deviation in the level of foreign exchange reserves depends on growth in the current account ( $f$ ) and capital inflow. The level of capital inflow depends on the difference between domestic and foreign interest rates ( $r - r^*$ ), and  $\tau$  is the coefficient of interest rate sensitivity to international capital flow.

Malaysia has experienced several surges in capital flow levels in the last 23 years. The first era was when the 1990s policy of capital linearization encountered the financial crisis in 1997–1998. This led to a government policy of restricted capital control (such as prohibition of direct investment abroad by Malaysian companies). However, from September 1998 the government tried to gradually remove restrictions on capital inflow and outflow. In 2005 and 2006 many restrictions were removed, and a new linearization policy was begun at that time. It was anticipated that the removal of these restrictions would enhance trade balance surpluses and lead to the resumption of capital inflow. In addition, the new policy encouraged Malaysians to invest abroad.

### 3.3. Aggregate supply and prices

The third part of the model focused on aggregate supply and prices.

<b>Aggregate supply and prices</b>	
$p = \mu_1 w + \mu_2(e + po) + (1 - \mu_1 - \mu_2)(e + p^*)$	<b>20</b>
$\dot{w} = \psi_1(No^d - No^s) + \psi_2$	<b>21</b>
$No^s = {}_1k^p + {}_2k^g + {}_3k^h + {}_4e^m$	<b>22</b>

Equation 20 shows the relationship between consumer price levels and nominal wages ( $w$ ) (parameter  $\mu_1$  is coefficient of this relationship), the domestic cost of palm oil production and the domestic cost of non-palm oil imported goods in foreign currency. The nominal wage equation is based on an augmented Philips curve and shows the relationship between nominal wages with different rates of non-palm oil demand over the supply of non-palm oil output and, money growth rate. Moreover, according to equation 22, the aggregate supply of non-oil output is positively related to private sector capital stock, government capital stock, human capital stock and employment( $e^m$ ).

### 3.4. The external sector

The external sector of this model consists of two categories, trade balance and palm oil trade balance as indicated in equations 23 and 24.

The first equation shows that current account balance is positively related with non-palm oil trade balance, foreign interest income, net palm oil exports ( $\sigma^x$  represents of palm oil export) and is negatively related to real exchange rates. In addition, the second equation indicates that palm oil exports are exogenously dependent on palm oil production ( $\sigma^a$ ).

It is possible to use a more sophisticated model in the case of Malaysia but we encountered two main obstacles. First, due to lack of data, we skipped some model variables such as imported capital as employed by Issa and Harvie (2013). Second, because of financial constraints imposed on the Malaysian financial system after the financial crisis of 1997 (Ang, 2008), we simplified our asset market in the model, limiting it to the money market, and we do not follow the pattern of Cox and Harvie (2010) model.

### 4. Parameters values and simulation results from palm oil production increase scenario

In order to analyze the full response path of key macroeconomic variables in response to shocks in palm oil production, we log linearize a system of 25 equilibrium conditions around a uniquely deterministic steady state. We calibrate (to some extent) and mostly estimate the parameters. Table 2 presents the parameter values with the corresponding steady-state values in Table 3. We employed vector error correction models (VECM) using Malaysia’s quarterly data from 1990Q1 to 2017Q1 to obtain the main parameter values in each model. However, some calibrated parameters are mainly steady state ratios which can be found in the data and parameters that are easily found in the Malaysian literature such as:  $\gamma, \sigma, \varphi, \phi_1, \phi_2, \phi_3$  (Ang, 2007A, 2007B; Law & Azman Saini, 2008; Musa Ahmed, 2008; Anwar & Sun, 2011; Ziaei, 2012; Ibrahim & Eskandar Shah, 2012; Bhatti et al., 2015;; Ziaei & Bhatti, 2017).

The simulation analysis conducted in this section emphasizes the dynamic adjustment process and long-run steady state properties of a number of key macroeconomic variables arising from palm oil-related shocks. The variables emphasized are real income, real government revenue, non-palm oil output, private capital stock, public capital stock, human capital stock, non-palm oil trade balance, real exchange rate, domestic price level and private sector real wealth.<sup>2</sup> These variables were chosen

since changes in them, arising from an increase in palm oil production, exert an essential influence upon the development of other key variables and for the domestic economy as a whole. The simulation outcomes were generated by a program called “Dynare”, which is designed for solving and simulating deterministic and stochastic dynamic general equilibrium models (see Adjemian et al., 2011), and it is also suitable for a small open palm oil-exporting economy such as that of Malaysia. Since the palm oil price fluctuating movements show no apparent upward trend over time, we conducted one simulation scenario in this paper, representing 15% increase in palm oil production, which indicates extraordinary upward movement in palm oil production and exports (see Figures 2 and 3). This also can be justified by increased global demand for palm oil in recent years which providing a major stimulus to Malaysia’s economic development.

A summary of the long run steady state properties of the Malaysian macroeconomic model focusing upon the key macroeconomic variables mentioned previously, for increase in palm oil production scenario, is summarized in Table 3. This table shows the long run deviations in the steady state values of the aforementioned macroeconomic variables, in percentage terms, from their presumed initial base values. In addition, the impact of palm oil production increase upon the adjustment path of each key macroeconomic variable of interest is contained in Figure 5. The horizontal axis measures time periods while the vertical axis for each diagram measures the percentage deviation of each variable from its initial or base value. These graphs indicate that the adjustment period arising from palm oil production increase lasts 60 periods, by which time all variables have reached their long-run steady state equilibrium. Each graph contains one scenario, which represents the impact of palm oil production increase upon the variables of interest. A detailed analysis of the simulation results arising from palm oil production increase is discussed in detail below.

$\beta_1 = 1$	$\beta_2=0.27$	$\beta_3=0.52$	$\beta_4=0.56$
$\beta_5 = 0.23$	$\beta_6=0.98$	$\beta_7=0.27$	$\beta_8=1$
$\beta_9=0.40$	$\beta_{10}=0.04$	$\beta_{11}=0.03$	$\beta_{12}=0.55$
$\beta_{13}=0.53$	$\beta_{14}=4$	$\beta_{15}=1$	$\beta_{16}=0.30$
$\gamma = 0.50$	$\delta=0.60$	$\varphi=0.50$	$\sigma=0.50$
$\theta_1 = 0.48$	$\theta_2 = 0.41$	$\nu=0.48$	$\mu_1 = 0.7$
$\mu_2 = 0.58$	$\varepsilon_1=1$	$\varepsilon_2 =0.03$	$\varepsilon_3=0.02$
$\varepsilon_4=1$	$\varepsilon_5=0.78$	$\varepsilon_6=0.62$	$\tau = 0.48$
$\psi_1 = 0.39$	$\psi_2=0.09$	$\lambda_1=0.23$	$\lambda_2=0.60$
$\lambda_3=0.02$	$\lambda_4=1$	$a_1=0.21$	$a_1=0.02$
$a_1=0.36$	$\zeta=0.60$		

Variable	$t$	$xn$	$mntx$	$c$	$w^p$ $y$ $No^s$ $k^g$ $k^h$ $k^p$
15% $oa_1^*$	-7	0.01	12	0.0	15.2 9.5 5.3 2.6 2.1 3.3 8

\*Palm Oil production increase

It is assumed that an increase in palm oil production by 15% initially leads to an accumulation of foreign asset stocks, arising from current account surpluses (*current account effect*) during the earlier part of the adjustment path (not shown in [Figure 5](#)). This arises from an immediate increase in palm oil exports and surplus in the palm oil trade balance and higher foreign interest income (see Equations 23 and 24). An initial accumulation of foreign exchange reserves leads to a temporary increase in the money stock so as to maintain the management of nominal exchange rate policy, leading to an increase in the domestic price level in the short term.

Total real government revenue increases immediately during the early stage of adjustment process, as can be observed from [Figure 5](#). This is, in turn, facilitating larger government capital spending upon public capital (infrastructure) and human capital formation and larger potential benefits for the private sector. Accordingly, this enhances development in the non-palm oil sector.<sup>3</sup> Real government revenue increases thereafter to the long run steady state level where it is higher than its base value by 9.5 percent. This result is perfectly consistent with Malaysian government goals of bringing about, and benefitting more from, an increase in palm oil production in the economy.

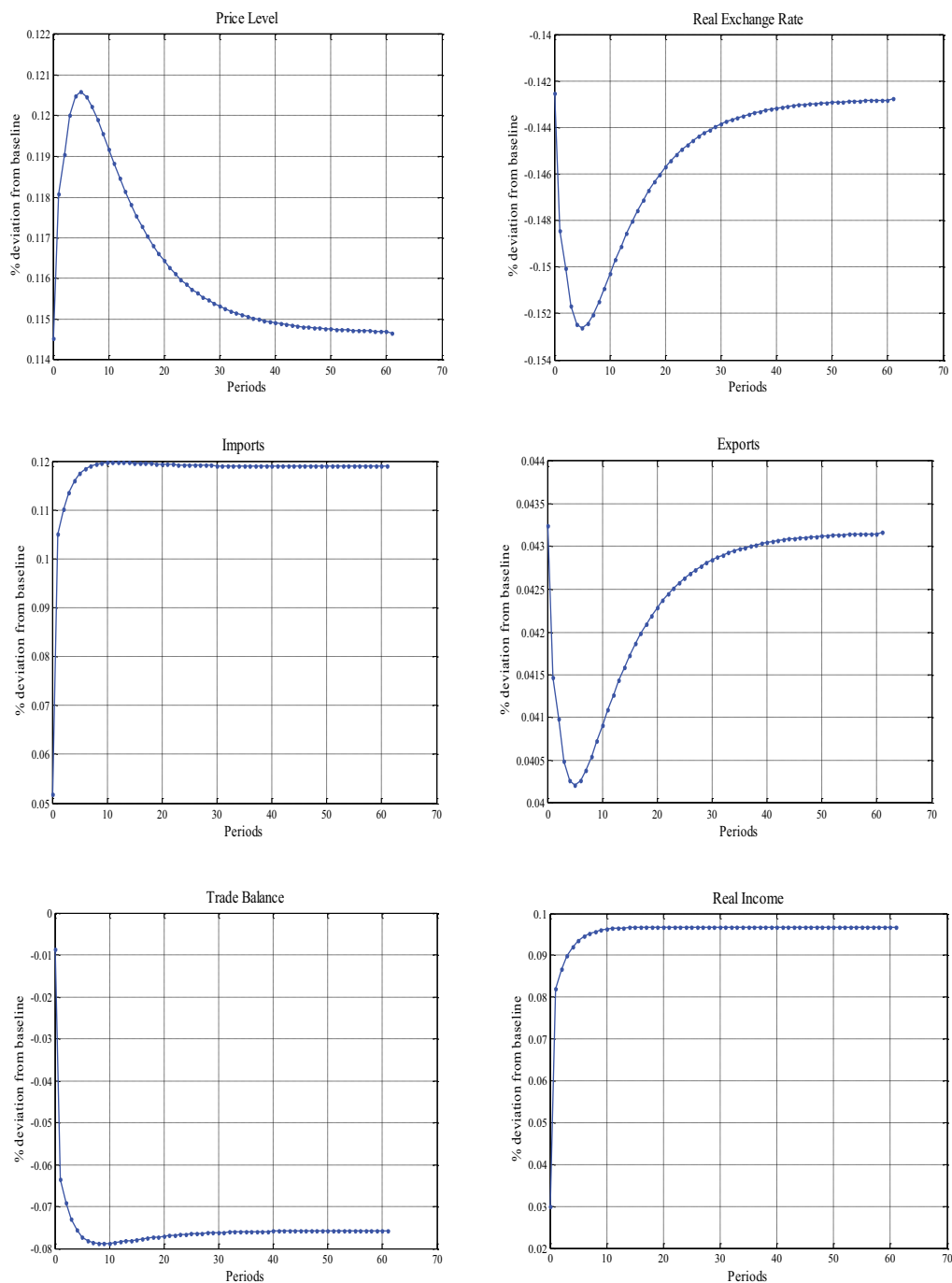
Developments in government revenue (*revenue effect*) influence total real income directly since government expenditure increases, and indirectly through development in non-oil output supply as can be observed from Equation 22. The indirect effect is stimulated, as mentioned above, by public capital stock and human capital stock accumulation, which also promotes the private capital stock and non-palm oil output supply. Also, increased government real income arising from palm oil production increase will have an impact upon the real exchange rate. During palm oil increase periods the government increases its expenditure to retain its balanced budget policy, resulting in increased demand for both non-palm oil and imported goods (see Equation 1). Consequently, the increased demand for non-oil output (*spending effect*) will cause a higher domestic price level during the short run and an appreciation of the real exchange rate. As can be seen from [Figure 5](#) the exchange rate will appreciate slightly by 1.5 percent during the early stage of adjustment path, before depreciated to the long run steady state level where, due to an increase in the price level in the earlier adjustment process. An appreciation of the real exchange rate during the short run (*exchange rate effect*) will have an influence upon the adjustment of a number of key macroeconomic variables, particularly non-palm oil exports, non-palm oil imports, and therefore, non-palm oil trade balance, and consequently upon the domestic economy as whole.

The non-palm oil trade balance initially deteriorates during the adjustment process by almost 7.5 percent, as can be seen from [Figure 5](#). The main reason for the deterioration in the non-palm oil trade balance is a combination of increasing non-palm oil imports and declining non-palm oil exports throughout the adjustment path. Increased non-oil imports are stimulated by an appreciation of the real exchange and an increase in real domestic income. However, the adjustment of non-palm oil exports is strongly influenced by the initial appreciation of the real exchange rate. As the real exchange rate appreciates this may result in a loss of competitiveness for non-palm oil exports (*exchange rate effect*), and higher domestic demand stimulated by an increase in real income increases the demand for non-palm oil imports.

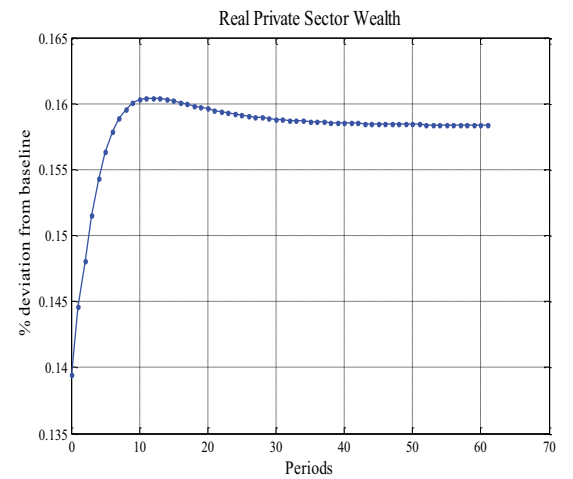
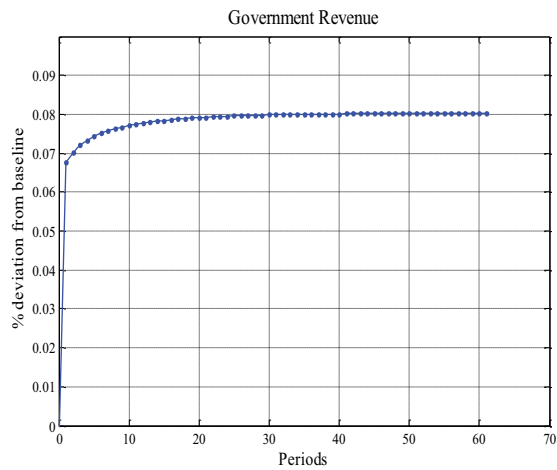
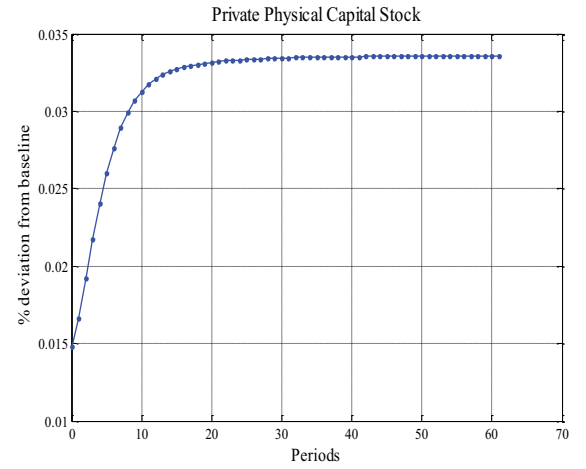
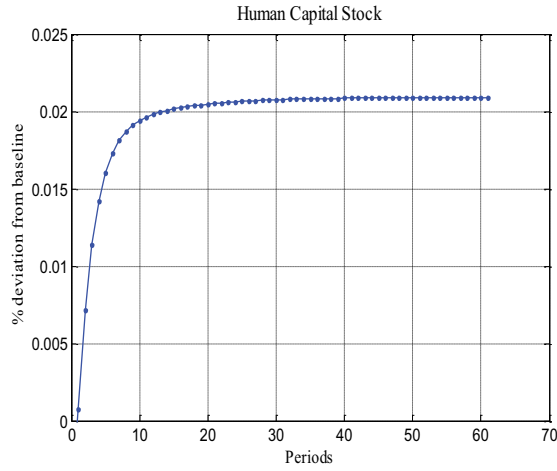
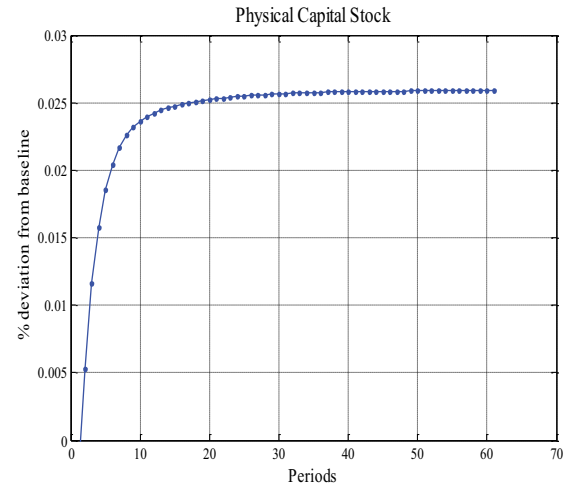
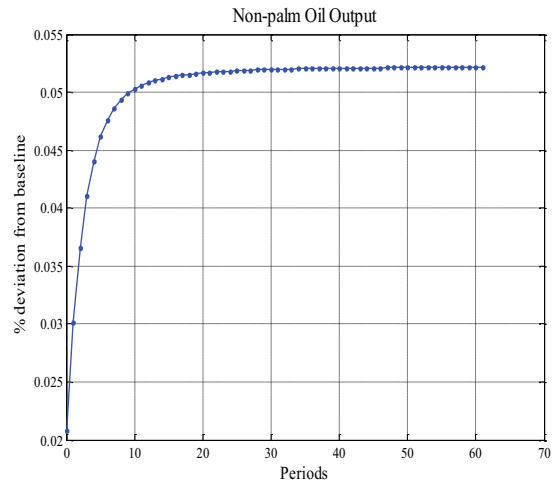
During the medium to long run steady state, the non-palm oil trade balance experiences a slight improvement as a result of an improvement in non-palm oil exports. This arises from a subsequent depreciation of the real exchange rate, as can be observed from [Figure 5](#). The non-palm oil trade balance declines by almost 7 percent in long run steady state.

The simulation results for private sector real wealth point out that it increases continuously throughout the adjustment process toward its long run steady state. It considerably accumulates

**Figure 5. The effects of palm oil production of 15% increase upon key macroeconomic variables.**



by almost 15 percent, as can be observed in Figure 5. Increased private sector real wealth arises due to an accumulation in private capital stock (see Figure 5), an increase in permanent income and an increase in real money balances. The increased private capital stock is induced by increased non-oil output supply (see Equations 3 and 4), which in turn is induced by government investment spending on physical and human capital stock that is of further benefit to the private sector. This is



due to the fact that public capital expenditure on infrastructure and human capital formation raises the productivity of private factors of production, inducing both the aggregate supply of non-palm oil output and aggregate demand for non-palm oil output.

Figure 5 also indicates that real income increases continuously throughout the adjustment process (*income effect*), with most of the increase in real income occurring very early in the adjustment process. It is stimulated directly by an increase in palm oil production and also by subsequent changes in non-palm oil output (see Equation 15). In long run steady state real income is approximately 9.5 percent higher than its base value, as indicated in Table 3. On the demand side an increase in real income stimulates non-oil imports, which in turn contributes to a deterioration of the non-oil trade balance.

Non-palm oil output supply improves continuously throughout the adjustment process to its long run steady state in the early stage of adjustment. The major contributory factors to this development throughout the adjustment process include: a continuous increase in private capital stock, public capital stock (namely, infrastructure) and human capital stock (education and training (*a Labor productivity effect*)) (see Figure 5). An increase in overall public capital stock is stimulated directly by government development spending (*spending effect*). An increase in non-palm oil output supply stimulates demand via private consumption and private investment. Also, an increase in non-palm oil output supply increases the nation's real income and induces imports, thereby possibly leading to a trade balance deficit. Thus, the positive effects of an increase in non-palm oil output supply are offset partially by deterioration in the non-oil trade balance.

The non-oil output is not likely to deteriorate during the early stage of the adjustment process toward long run steady state from the above results. The revenue arising from the palm oil sector increase leads to increased domestic demand for non-palm oil output, while a real exchange rate appreciation reduces the demand for non-oil output (*spending effect and an exchange rate effect*). The latter may contribute to a loss of competitiveness of the non-palm oil tradeable sector. In this model, the former effect dominates the latter effect and non-palm oil output demand increases overall. The non-palm oil output supply, during the early periods of adjustment, increases due primarily to the gradual accumulation in physical and human stocks (see Figure 5 and Equation 22).

In the long run, steady state non-palm oil output supply is found to be higher than its base value by 5.3 percent. This is again due to the accumulation of public and human capital stock as well as private capital stock in long run steady state.

## 5. Conclusion and policy implications

This paper has utilized a dynamic general equilibrium macroeconomic model for Malaysia, an important palm oil producing and exporting country, aimed at evaluating the effects of additional palm oil revenue upon key macroeconomic variables. Additional palm oil revenue is assumed to have occurred as a result of palm oil production increase. Key macroeconomic variables focused upon were the real government revenue, the real exchange rate, the non-palm oil trade balance, public capital stock, human capital stock, non-palm oil output and real income.

The simulation results from the base scenario suggest that an increase in palm oil price by 15 percent would potentially result in an increase in foreign assets, real government revenue, private capital stock, private sector wealth, real income, public capital stock, human capital stock and non-palm oil output supply and demand. These results confirm how a rise in production has a pivotal role in increasing GDP and its components. However, the palm oil sector boom also has the potential to some extent to deteriorate the non-palm oil trade balance through a loss of competitiveness from a slight real exchange rate appreciation during the short run. The simulation results also has displayed the importance of a number of channels through which a palm oil

production increase will affect the macroeconomy, namely: a revenue effect, income effect, spending or wealth effect, exchange rate effect, and current account effect.

It is worth mentioning here that, as emphasized in previous empirical studies (Dislich et al., 2017; Hidayat et al., 2018; Qaim et al., 2020) expansion of oil palms leads to deforestation, declining biodiversity, and has negative impacts on the ecosystem. The issue that marked by the EU (the second-largest importer of Malaysia palm oil) and leads to palm oil sanction by these countries. However, an increase in production is also possible without expansion of the area of land used for oil palms. The Malaysian government should take the initiative and show its intention to implement the intensification policy more seriously to boost the production without further expansion of oil palm plantation.

The fiscal policy responses by government could improve productivity and increase the availability and type of capital available for the non-palm oil tradable sector, such as that for the manufacturing sector, by changing the composition of government investment in infrastructure and human capital formation in non-palm oil tradable sector. This will eventually improve their competitiveness. The benefits for the non-palm oil sector arising from public capital stock and human capital stock accumulation induced by the increasing in palm oil production sector could be of substantial importance in terms of employment and growth generation for Malaysian economy. An increase in non-palm oil output will possibly lead to an increase in the demand for

The model presented in this paper can also be modified with the aim of conducting equivalent simulations under alternative exchange rate policies, combined with different degrees of international capital mobility. A change in the nominal exchange rate from a managed float to flexible exchange rate regime could affect the development of the overseas sector; therefore, the government may further minimize the minor adverse effects of the palm oil boom upon the non-palm oil trade balance by moving to a more flexible exchange rate system. Moreover, the model can be used to evaluate the effects of the declining in palm oil production and prices upon key macroeconomic variables, arising from containment measurements due to the spread of coronavirus pandemic. The economic effects of the spread of COVID-19 were widespread and uncertain, as supply-side and demand-side of the palm oil sector were affected. Therefore, it could also be interesting to conduct a decreasing in palm oil production and prices scenario and its impact upon the Malaysian government's budget and other key macroeconomic variables in order to develop appropriate economic policies to address the negative effects. However, due to the limitations of data and the time allocated for this study on the one hand, and the complexity of the model to complete policy analysis, on the other hand, these additions have been left for future studies.

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#### Notes

1. The model of Cox and Harvie (2010), and Issa and Harvie (2013) have their foundation in the contributions of Dornbusch (1976), Buiter and Miller (1981), Eastwood and Venables (1982), and Buiter and Purvis (1982), Harvie and Thaha (1994).

2. The adjustment of a number of macroeconomic variables can be obtained from the simulation analysis. However, in order to keep the discussion tractable, focus is placed on only a few key variables as emphasised here.
3. This explains the continual increase in non-palm oil output supply in the early stage of adjustment (see Figure 5).

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