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ENVIRONMENTAL POLICIES AND TRADE COMPETITIVENESS: THE MALAYSIAN PALM OIL DOWNSTREAM INDUSTRY

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ABSTRACT

This paper explore how export competitiveness in the Malaysian palm oil downstream industry is affected by European Union (EU) environmental regulation. Porter (1990) suggests that environmental policies may foster international competitiveness. To investigate the impact of EU environmental policies on trade competitiveness in the Malaysian palm oil downstream industry, the dynamic generalized method of moments (DGMM) is employed. The final results reveal that EU environmental regulations have a positive impact on palm oil industry competitiveness. This result is consistent with the Porter Hypothesis, which argues that a more stringent environmental regulation can trigger innovation to non-compliance cost. Palm oil downstream innovation is crucial to improve the overall competitiveness of the industry, including the smallholders' sector. This implies that the Malaysian government may want to introduce certain measures, such as energy taxes to promote the use of renewable energy. This may lead to more sustainable palm oil production which may improve the overall competitiveness of the palm oil downstream industry.

Keywords: Palm oil, trade competitiveness, environmental policies, Dynamic Generalized Method of Moments (DGMM), porter hypothesis.

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1. THE DEVELOPMENT OF THE PALM OIL DOWNSTREAM INDUSTRY IN MALAYSIA

Malaysia is the world's second-largest supplier of palm oil, after Indonesia, and has supplied approximately 30% of the global export market. Consequently, palm oil has been a major export contributor of the Malaysian economy over the last ten decades. In the 1950s, Malaysia exported low value-added crude palm oil. After independence in 1957, the Malaysian government aggressively doubled its efforts to move up the value chain and produce refined palm oil, fuelling export-led growth in the 1960s (Basiron, 2007). As a result, Malaysian palm oil products are currently exported to more than 150 countries worldwide.

Palm oil downstream products are products produced from oil palm extracted palm oil. Mahat (2012) states that the palm oil supply chain is one of the most highly organized sectors in the agricultural system. This system can be separated into three primary segments (Table 1): upstream production, midstream activities, and downstream processing products

Table 1 shows the first, the plantation. The plantations segment includes seed production, nursery, cultivation, harvesting and milling. The products that come from the upstream segment are comprised of fresh fruit bunches (FFB), crude palm oil (CPO), palm kernel oil (PKO) and palm oil mill effluent (POME). The second segment includes refining, fractionation, refined product storage and trading activities. Finally, the downstream segment includes oleochemicals, biodiesel and consumer products. The downstream industry includes all activities for palm oil into semi-finished materials or finished products for local and global consumers.

The Malaysian government aims to improve value added through downstream activities to ensure the competitiveness and sustainability of the industries. This is because the downstream palm oil sector provides a more profitable per unit revenue, which is roughly 40% higher than the output from the upstream sector (Malaysian Palm Oil Board [MPOB], 2015; Economic Transformation Programme (ETP) Annual Report 2013). Furthermore, due to limited land availability, Malaysian palm oil production may soon reach its peak. It is expected that Malaysia's role as a leading crude palm oil exporter will decrease in the future due to land constraints, dependence on foreign workers, comparatively higher input costs and increasing rivalry from palm oil substitutes and other palm oil producing countries (e.g., Indonesia) (Alam et al., 2015).

Table 1: Palm Oil Industry Activities

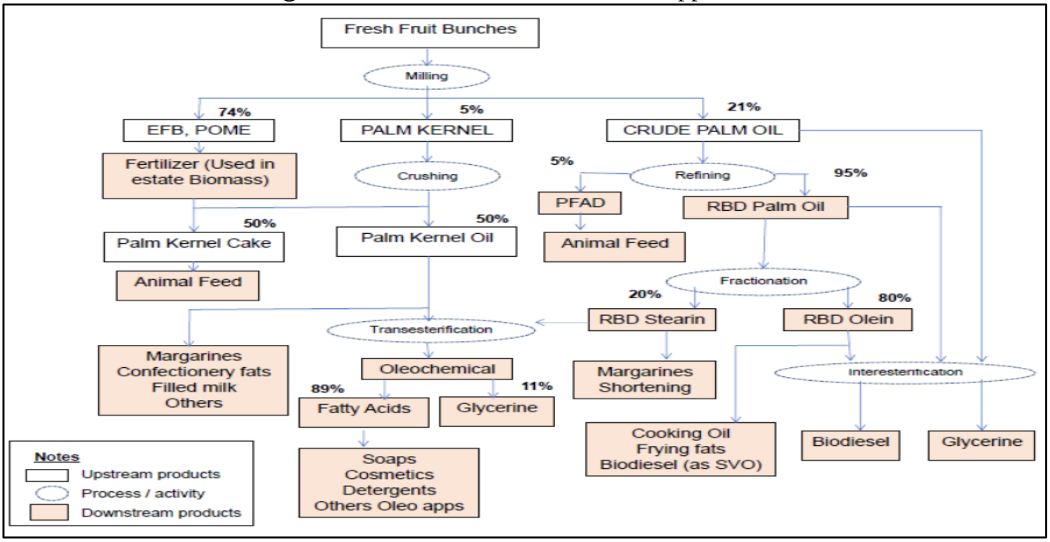
Level	Groups	Products	
UPSTREAM	• Seed Production • Nursery • Cultivation • Harvesting • Milling	➢ Fresh Fruit Bunches (FFB) ➢ Crude Palm Oil (CPO) ➢ Palm Kernel Oil (PKO) ➢ Palm Oil Mill Effluent (POME)	
MIDSTREAM	• Refining • Fractionation • Refined Product Storage	➢ RBD Palm Olein ➢ RBD Palm Stearin ➢ Palm Fatty Acid Distillate ➢ RBD Palm Kernel Olein ➢ RBD Palm Kernel Stearin ➢ Palm Kernel Fatty Acid Distillate ➢ Palm Kernel Cake	
DOWNSTREAM	• Oleochemicals • Consumer Products • Biodiesel	➢ Fatty Acids ➢ Fatty Alcohol ➢ Methyl Ester ➢ Glycerine ➢ Soap Noodles ➢ Biodiesel ➢ Shortening	➢ Vegetable / Dough Fats ➢ Cocoa-Butter Substitute ➢ Vegetable Ghee/ Vanaspati ➢ Soap ➢ Margarine

Source: MPOB, (2020).

Figure 1 shows the palm oil value chain and the application from the upstream segment throughout the various activities to produce the downstream palm oil products. More specifically, palm oil mill extract CPO and palm kernel from the FFB, represent 21% and 5% of the production process, respectively. The rest of the 74% goes to empty fruit bunches (EFB) and palm oil mill effluent (POME) to produce fertilizer. Palm kernels generates palm kernel cakes and palm kernel oils trough crushing activity. The refined, bleached and deodorized (RBD) palm oil is derived from crude palm oil through the refining activity. It can either be used directly or further refined. The RBD palm oil products that have gone through fractionation are generally classified into either a liquid form (Olein) or a solid form (Stearin). The final consumer products derived from RBD stearin include margarine and shortening, while RBD olein includes cooking oil and frying fats.

In terms of the export market, the demand for palm oil is higher, due to it having a cheaper price when compared with other vegetable oils (Othman et al., 2020Qiu, 2014). India, with a total population of 1.324 billion people, was the major importer of Malaysian palm oil products in 2017. India was followed by the European Union (EU) and China. The high demand in the EU market is due to the use of palm oil as the main feedstock for the manufacturing of industrial frying fats, high-value food, oleochemical products and the expanding biodiesel industry.

Figure 1: Palm Oil Value Chain and Application



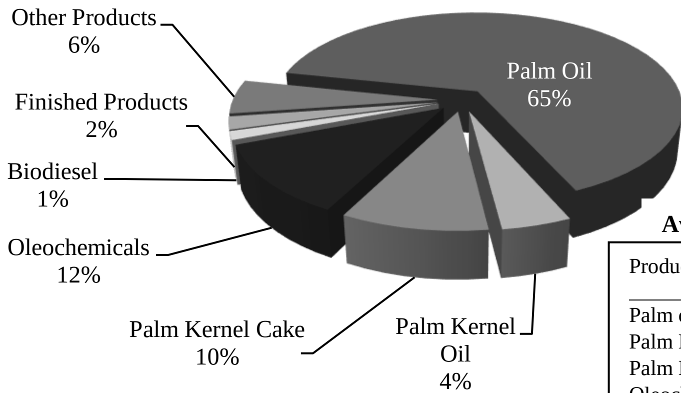
Source: Sime Darby Plantation (2014).
Note: EFB = Empty fruit bunches; POME = Palm oil mill effluent; RBD = Refined, bleached, deodorized; PFAD = Palm fatty acid distillate; and SVO = Straight vegetable oil.

Figure 2 illustrates the Malaysian palm oil export volume by product type. The export of palm oil increased to 65%, or 17.39 million tonnes of the total export of 26.7 million tonnes. This was followed by oleochemicals (12%), palm kernel cake (10%) and palm kernel oil (4%). The rest of the products recorded less than 4%. In terms of the average price per tonne for each product, the value of palm-based finished products is the highest (MYR 4650.91). This is followed by oleochemicals (MYR 4078.50) and palm kernel oil (MYR 3641.98). In the meanwhile, palm oil recorded the highest value in export volume with an average price of MYR 2815.84 per tonne.

Although the EU has offered incentives to promote the uses of biodiesel, palm-based biodiesel will only be eligible for the incentives if the default value of greenhouse gas emission savings for palm oil specified in the instructions is below the set threshold. This can only be realized if palm oil biodiesel meets the right conditions (e.g avoiding methane emissions). The criteria further require the producers of palm oil products to submit additional proof of validation that the requirements are being adhered to or else the production patterns need to be changed. Despite these circumstances, the potential for palm oil to be used as a source of biodiesel raises questions, since both the EU and the US view palm oil biodiesel as an environmental threat (Naidu & Moorthy, 2021; Kumaran, 2019; Butler, 2014; Ramdani & Hino, 2013).

People from environmental NGOs in the EU have been vocal about the issues of quality, food safety and sustainability in relation to the palm oil industry (e.g., Malaysia, Indonesia) They claim that the industry has caused an increase in deforestation and unsustainable practices (e.g., poor labour conditions, negative environmental impacts) (Balu et al., 2018; Naidu & Moorthy, 2021). Due to these circumstances, the government had to deploy financial and human resources to vehemently deny these allegations with specific references to Orangutan's habitat loss and greenhouse gas emissions to improve the image of the world palm oil market. However, this still remains a major issue for local palm oil producers.

Figure 2: Malaysia's Export Volume of Palm Oil Products in 2020



Average price/tonne, 2020

Products	Average price per tonne (MYR)
Palm oil	2815.84
Palm Kernel Oil	3641.98
Palm Kernel Cake	530.25
Oleochemicals	4078.50
Finished Products	4650.91
Biodiesel	3577.93

Total: 26,725,134 Tonnes

Source: MPOB, Review of the Malaysian Oil Palm Industry (2020).

To overcome such issues, the local palm oil industry has relied on third party independent certification systems to demonstrate the implementation of good practices in the production supply chain. In 2004, the Roundtable on Sustainable Palm Oil (RSPO) was established to promote the sustainable growth of the palm oil industry throughout the world. These voluntary certification schemes currently cover approximately 30% of the palm oil cultivated area. The goal of the RSPO was to develop a set of environmental and social criteria with which companies must comply to produce Certified Sustainable Palm Oil (CSPO) (Laurance et al., 2010; Foong et al., 2019).

RSPO certification is quite costly and only large-scale producers can afford it. For this reason, the Malaysian Sustainable Palm Oil (MSPO) standard was announced in 2013 to help small and mid-size cultivators who cannot afford RSPO certification (Foong et al., 2019; Oil, 2016). Since then, numerous initiatives have been reported to promote sustainable development, meeting environmental commitments through credible global standards and stakeholder engagement. In December of 2019, the Malaysian government implemented a mandatory national certification system to ensure compliance for the entire palm oil planted area (e.g., smallholders, large plantation owners, millers) (Naidu, & Moorthy, 2021).

The EU proponent of palm oil deforestation is the second-largest buyer of Malaysia's palm oil products after India. Approximately 46% of the total palm oil imports into the 28-nation economic bloc are used for biofuels. However, palm oil exports to the EU have gradually declined. The Renewable Energy Directive proposed a total ban on palm oil usage in biofuel mixes; however, this would not be realized until 2030. Palm oil exports to the EU had already decreased by 3.3 %

to 2 million tonnes within a span of one year, from 2016 to 2017 (Malaysian Oil Palm Statistics, 2018).

This raises the question of whether any of the international environmental policies will affect the trade competitiveness of the local palm oil producers negatively or not. The traditional theories are known as the pollution haven hypothesis (PHH) in the Heckscher–Ohlin theoretical framework. These theories considered the environmental policy as a constraint to factor endowment. Thus, more stringent environmental regulations are potentially harmful to trade competitiveness since the firms are facing higher production costs (Copeland & Taylor, 2004; Letchumanan & Kodama, 2000; Levinson, 2010; Muradian et al., 2002). On the contrary, the Porter hypothesis (PH) assumes a more comprehensive and dynamic point of view, as the combination of environmental policies may lead to increasing environmental efficiency combined with productivity gains if public policies are well-designed to stimulate proper techno-organizational innovation patterns.

Consequently, it is crucial to investigate the role of environmental regulatory requirements in the EU on the export competitiveness of the Malaysian palm oil downstream industry. For this purpose, our main research question is whether environmental policies in the EU enhance the trade competitiveness of the Malaysian palm oil downstream industry. The rest of the paper is structured as follows: Section 2 provides a literature review of environmental policy and trade competitiveness. Section 3 presents the model and estimation, while Section 4 discusses details on the empirical results. Section 5 offers conclusions and provides recommendations for future research.

2. LITERATURE REVIEW

In the economic literature, Smith (1776) proposed a mutually beneficial free trade model through the concepts of absolute advantage and labour specialization. In general, the absolute advantage theory states that a competitive nation holds at least one absolute advantage in one productive sector. However, this does not explain trade between countries with no absolute advantage in any of the production sectors. Due to the vacuum in the absolute advantage theory, the theory of comparative advantage in international trade gained more importance (Brue & Grant, 2012). The concept of comparative advantage within international trade theory was initially developed by Ricardo (1817). It revolves around the fact that even if the country is not an efficient producer of the good, it can benefit from the trade activity as long as it specializes and exports the goods in which it possesses a relatively lower opportunity cost of production or higher comparative advantage (Davis & Weinstein, 2003).

The international trade theories discussed previously emphasize production based or supply-side economics. As economies produce and export the products in which they have a comparative advantage, they gain competitiveness in that production sector. In contrast, Porter (1990) stated that competitiveness is not only a supply-side phenomenon. The "diamond model" (Porter, 1990) reveals the four micro factors that affect the competitiveness of a nation and its industries relative to its international counterparts. Porter (1990) argued that competitive advantage in a specific industry in the country was obtained from the combined effects of the following four main attributes: (i) factor conditions, (ii) demand conditions, (iii) related and supporting industries structure, and (iv) firm strategy, structure and rivalry.

One of the external factors that can affect competitiveness is the presence of environmental regulations (ER) (e.g., technology standards, environmental taxes, certificate permits). These force firms to allocate expenditures and buy inputs to reduce pollution, which is considered a non-productive expenditure from a business perspective. The traditional view held by businesses had been that environmental protection comes at an additional cost imposed on firms, which may erode their global competitiveness (Muradian et al., 2002; Levinson, 2010).

This traditional paradigm was challenged by Porter (1990). He argued that environmental regulation on business could enhance competitiveness. He stated that "strict environmental regulations do not inevitably hinder competitive advantage against rivals; indeed, they often enhance it" (Porter, 1991). This argument was also supported by Porter and Linde (1995). They argued that a more stringent and properly designed ER (e.g., taxes or cap-and-trade emissions allowances) can trigger innovation that may offset the costs of complying with them. This phenomenon is generally known as the Porter Hypothesis - PH (Dai et al.,2016; Costantini & Mazzanti, 2012; Ambec et al., 2013; Rubashkina et al., 2015; Ketels, 2006; Jin, & Moon, 2006).

A more recent study by Qiang et al. (2021) validates the Porter hypothesis using panel data from 30 provinces in China from 2008 to 2017 to investigate the impact of China's environmental regulations towards export trade. Their results verify the conclusion that the Porter hypothesis is confirmed in China. This is because the existence of innovation efficiency in environmental regulations will change from having a restraining effect in the short run to a promoting effect on export trade in the long run. Strict environmental regulations will reduce the production cost of Chinese products, further improve the export competitiveness of Chinese enterprises and promote export trade.

Gonseth, et al. (2015) also adopted the porter hypothesis model to estimate the effect of energy tax changes on total factor productivity (TFP) and net trade at the industry level using the generalized method of moments (GMM). Their study covers a panel of industries from European countries spanning from 1990 through 2003. They analyse the data to investigate the hypothesis where industries with a high adaptive capacity are able to mitigate the adverse effects of energy tax increases by identifying the interaction of human capital (proxied by wage levels) with energy taxes. Their results showed a negative and significant marginal effect of higher energy taxes on TFP and net trade for industries with stronger human capital. This result recommends that human capital becomes the key if a nation wants to adopt higher energy costs.

Zhang and London (2013) argued that sustainable development should be included as an internal determinant of competitiveness in PDM. They named the new model the internationalized sustainable industrial competitiveness (ISIC) model, which merged the concepts of internationalization, sustainable development and industry competitiveness to determine the competitiveness of the nation. Balkyte and Tvaronaviciene (2010) also highlighted the new concept of "Sustainable competitiveness" and recommended that it be incorporated in the most frequently used models for competitiveness (e.g., PDM). Rubashkina et al. (2015) used the porter hypothesis (PH) model introduced by Porter (1991) and Porter and Linde (1995) to incorporate environmental regulations under competitiveness equations for the manufacturing sectors in 17 European countries between 1997 and 2009.

Costantini and Mazzanti (2012) based their theory on Porter's view. They used a theory-based gravity model for the export dynamics of five manufacturing sectors classified by technology or environmental content to reveal a mechanism similar to Porter's. The results show that the overall effect of the environmental policies appear to be harmless to the export competitiveness of the manufacturing sector, while specific energy tax policies and innovation efforts have a positive impact on the export flow dynamics.

Given the past empirical evidence, it can be deduced that environmental regulations will significantly improve the trade competitiveness of the industry. Therefore, this study follows the suggestions in the aforementioned literature and includes sustainability as an additional and central factor of competitiveness and identifies the impact of environmental policies on the export competitiveness of the Malaysian palm oil downstream industry. On this basis, the following hypothesis was proposed:

H1: Environmental policies have significantly lead to positive impacts on the trade competitiveness of Malaysia's downstream palm oil products.

A recent study by Othman et al. (2022) investigates the trade competitiveness of Malaysia's oleochemical products as by using the Revealed Trade Advantage (RTA). The results indicate that Malaysia has higher and more stable trade advantages relative to other main producers of oleochemical products – namely Indonesia, China, the European Union (EU) member states, the United States and Argentina.. Nesti et al. (2020) investigated the competitiveness of the CPO exports of five provinces on Sumatra Island in a domestic market and compared these values with that of the West Sumatera Province using the Revealed Comparative Advantage (RCA) Index. The results show that most of the province shows fluctuating RCA values that lend to show a declined. One of the reasons for the declining RCA values is that the province started to focus on the development of downstream palm oil, which led to increasing demand for the domestic market as feedstock for downstream products.

Sharma et al. (2014) evaluated the competitiveness of Indian soymeal when compared to major competitors using a revealed comparative advantage (RCA) and a revealed symmetry comparative advantage (RSCA). The results indicated that the values of RCA and RSCA for Argentina, Brazil, Paraguay and India were highly competitive in soy meal exports, while the USA and the Netherlands were marginally competitive. However, the trend of RCAs showed that Argentina and India did not have a competitive advantage during the early 1980s and became competitive in subsequent years.

Bahta and Willemse (2016) utilized the revealed comparative advantage (RCA), Hirschman index, major export category (MEC), the effective rate of protection (ERP) and nominal rate of protection (NRP) method to analyse the effect of trade policy on the South African soybean industry. They used the 4 digits of the Standard International Trade Classification (SITC) of soybean (1201) data spanning from 1996–2011. The results obtained from the RCA index revealed that the soybean industry in South Africa had a comparative disadvantage from 1996 to 2011. Moreover, the Hirschman index illustrated that the soybean industry had a lower concentration throughout the 16 years. A lower concentration reduces the impact of the international trade risk due to the possibility of soybean price fluctuations. The MEC measurement also indicates that South Africa does not rely on the soybean industry for its international trade income.

3. ESTIMATING PALM OIL DOWNSTREAM TRADE COMPETITIVENESS

3.1. Revealed Symmetric Comparative Advantage (RSCA)

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In this study, competitiveness is reflected by the level of trade. Despite several critical caveats in the Balassa index, which are introduced by Balassa (1965) (e.g., asymmetric value problem, logarithmic transformation (De Benedictis & Tamberi, 2004), the index remains a popular tool in trade analysis. The index of revealed comparative advantage (B-index) is shown in Equation 1 as:

$$B_{ij} = RCA_{ij} = \left(\frac{X_{ij}}{X_{it}}\right) / \left(\frac{X_{nj}}{X_{nt}}\right) \tag{1}$$

where: X indicates exports, i and j denote the country and the product respectively, t stands for product group and n represents a group of countries. Dalum, Laursen and Villumsen (1998) tackle the problems of the B-index with a Revealed Symmetric Comparative Advantage (RSCA) by transforming the B-index as shown in Equation 2.

$$RSCA_{ij}^{t} = \frac{RCA_{ij}^{t} - 1}{RCA_{ij}^{t} + 1} \tag{2}$$

The RSCA index takes on values between -1 and 1. Values between 0 and 1 indicate a comparative export advantage and values between −1 and 0 reflect a comparative export disadvantage. Since the RSCA distribution is symmetric around zero, a potential bias in the regression coefficients is avoided (Dalum et al., 1998; Jambor, 2013). Subject country (i) is limited to Malaysia, and n are limited to the EU, which is made up of 27 countries . The EU-27 selection was due to their strong environmental policies and the data availability of the proxy for the Environmental Regulation (ER) variable, which is the energy tax and government expenditures on environmental protection. Therefore, this study was limited to these countries.

The data for the exports and imports of palm oil downstream products was based on the HS six-digit codes retrieved from the UN Comtrade database annually spanning the 8 years from 2009 through 2016. The detail for the selected palm oil downstream products was based on the HS six-digit codes. The definition of the products were obtained from the Malaysia Revision of customs tariff codes for palm oil products published by the MPOB (2013). All 32 products listed under the HS six-digit codes includes oleochemical products, palm-based finished products and biodiesel (refer to Table A1 in the Appendix).

3.2. The Generalized Method of Moments (GMM)

The Generalized Method of Moments (GMM) estimator was introduced by Arellano and Bond (1991). It is employed to estimate the model. This estimator was selected because the panel data covers a small time period (T = 8 years, from 2009 to 2016) and a large sample (N = 27 countries). The model for trade competitiveness is based on the Porter Diamond Model, which consists of factor conditions, demand conditions, related and supporting industries and the firm strategy, structure and rivalry (Porter, 1991).

Labour productivity is crucial as a factor condition. The assumption is that an increase in labour productivity results in a cost decrease, which leads to a potential competitive advantage (Stone & Ranchhod, 2006; Uzík & Vokorokosova, 2007; Wijnands et al., 2015). The larger the value in factor conditions, the higher would be the competitive advantage of the Malaysian palm oil downstream industry. This study focuses on farmers and others employed in the palm oil industry to factor in labour productivity.

The attributes of the world oil prices represent the international demand for the Malaysian palm oil downstream industry. It is relevant, because the export demand responds significantly to a change in world oil prices, especially considering exports related to the vegetable oils complex (Songsiengchai et al. 2018). Petroleum is a part of the aggregate production function of the agricultural commodities, due to the high usage of various energy-intensive inputs (e.g., fertilizers and fuels for agricultural commodities) and transportation. The high price of petroleum boosted the demand for biofuels (e.g., biodiesel) which utilizes vegetable oils as feedstock, reflecting the competitiveness of the palm oil. It is, therefore, important to incorporate the petroleum price as a major determinant of the competitiveness of the palm oil industries (Hunegnaw, 2017; Indahsari & Wibowo, 2013; Sobrino et al., 2010; Hameed & Arshad, 2009).

The strength in innovation is considered to be within and across the sectors in the value chain (e.g. technology development, suppliers, distribution channels, marketing, quick information flow enhanced downstream industries competitiveness) (Filippini & Molini, 2003; Archibugi & Coco, 2005; Chobanyan & Leigh, 2006; Setyawan, 2011; Kharub & Sharma, 2016). Following Filippini and Molini (2003) and Setyawan (2011), the innovation related variable is taken into account for incorporating this factor in the diamond model.
The concept of technological capabilities proposed by Costantini and Mazzanti (2012) has been considered. The formulation of the Malaysian innovation (innit) index at time t represents the diffusion of technological infrastructures and the creation of human capital. This is presented in Equation 3.

$$inn_{it} = \frac{1}{2}\left[\frac{1}{3}\left(\frac{\ln(Tel_{it})}{ln(Tel_{maxt})} + \frac{\ln(Internet_{it})}{ln(Internet_{maxt})} + \frac{\ln(Elec_{it})}{ln(Elec_{maxt})}\right) + \frac{1}{2}\left(\frac{\ln\,(Edu_{it})}{ln(Edu_{maxt})} + \frac{\ln\,(FDI_{it})}{ln(FDI_{maxt})}\right)\right] \tag{3}$$

In Equation 3, Tel_{it} is the per capita fixed and mobile telephone lines; $Internet_{it}$ indicates internet subscribers; $Elec_{it}$ is per capita electricity consumption; Edu_{it} is the secondary gross enrolment ratio and FDI_{it} is the Foreign Direct Investment inflows as a percentage of GDP.

Firm strategy, structure and rivalry describe the conditions of a country determining how firms are organized and how they operate. This determines also reflects the way companies compete (e.g., price/costs) and how much competition they face. The international rivalry factors include the rival market share (%) of the country in the global market for the rivalry proxy, as proposed by Vu and Pham (2016). A higher rival market share implies lower competitiveness in the local industry.

Porter (1990) does not include foreign competition based on market share from other countries. If a country has a relatively high import level of a specific product, the domestic performance for that product is considered weak. Since Malaysia and Indonesia cover more than 80 percent of the world export in palm oil products, this study will only employ the Indonesian palm oil downstream market share in the EU as an indicator of international rivalry. A high number on this variable indicates weak competitiveness for Malaysian palm oil industries.

The hypothesis of environmental regulations for this study is that the importing countries with stringent environmental policies may foster Malaysia's competitiveness in producing sustainable palm oil products, since compliance with an environmental commitment may be achieved by adopting a sustainable and environmentally friendly production process. Two environmental regulation indicators are employed in the analysis: energy tax and government expenditures on environmental protection (Costantini & Mazzanti, 2012). The environmental protection description is based on the classification of the functions of the government (COFOG). This includes pollution abatement, the protection of biodiversity and landscapes, waste management, water waste management and research and development (R&D) related to environmental protection.

Many empirical studies have modified the original PDM to achieve the objectives of the respective studies. Since environmental issues are crucial for the palm oil industry, this study will follow a suggestion in Zhang and London (2013). They recommend including sustainability as an additional and central factor of competitiveness in the PDM framework and identifying the impact of environmental policy on the competitiveness of Malaysian palm oil in the downstream sector.

This study uses a modified PDM framework for identifying the determinants of competitiveness in the Malaysian palm oil downstream industry products exported in the EU. It specifically intends to investigate the role of environmental policies in enhancing the export competitiveness of the Malaysian palm oil downstream industry in the EU. Two factors have been utilized for measuring environmental policies in the analysis: energy taxes and government expenditures on environmental protection.

Therefore, the model estimation is as follows:

$$\mathrm{RSCA}_{\mathrm{ijt}} = \beta_0 + \beta_1 Labour_{it} + \beta_2 WOP_{jt} + \beta_3 inn_{it} + \beta_4 Irival\_ms_{jt} + \beta_5 EP_{jt} + \mu_{ijt} \quad (4)$$

In Equation 4, i refers to the exporting country of Malaysia, $j = 1,\ldots, 27$ refers to the 27 importing countries from the EU (EU-27), while $t = 1,\ldots, 8$ represents the number of years spanning from 2009 to 2016. RSCA represents the competitiveness index of the palm oil downstream products. Labour is the total palm oil labourers (i.e., mandore, field worker, executive, clerk, other workers) which represents the factor condition; WOP is the world oil price, which represents the demand conditions; inn is the local innovation, which represents the supporting industry and $Irival\_ms$ is the market share of palm oil Indonesia in EU-27, which represents the rivalry factor. The proxy for Environmental Policy (EP) variables includes the total general government expenditure environment (million Euro) and energy taxes and revenues (percentage of gross domestic product (GDP)) from the EU-27. This data was obtained from the EUROSTAT database.

Rubashkina et al. (2015) incorporates environmental regulations under competitiveness equations for the manufacturing sectors in 17 European countries between 1997 and 2009. Their analysis applied two-stage least squares (2sls) and generalized method of moments (GMM) models. They state that the advantages of using GMM is to control the potential endogeneity problem which basically affects all proxies for the developed model. They also show the effect if you do not control for the endogeneity. They find that it may lead to biased estimates and may reverse the interpretation of the environmental regulation effect on economic competitiveness.

Moreover, GMM is a relevant estimator, since it takes the first differences of the variables in the model to get rid of the country specific effects or any time invariant country specific variable. This also eliminates endogeneity that may be due to the correlation of these country specific effects and the independent variables (Baltagi et al., 2008). There are several studies that have illustrated that this type of modelling strategy may lead to incorrect inferences if the explanatory variables are persistent (Arellano & Bover, 1995). However, this is particularly not relevant for this study, as the competitiveness indices of the RSCA have a weak tendency to persist. To check the serial correlation problem and the variance decomposition model, the differenced GMM method is highly recommended for a short time span to investigate the impact of external shocks to each variable in the model (Mansur et al., 2017).

4. RESULTS AND DISCUSSION

The two-step differenced GMM estimator is applied to examine the impact of environmental policy implemented in the EU on the competitiveness of the Malaysian palm oil downstream industry. Table 2 presents the empirical results using the two-step GMM estimator. In Model 1a, the environmental policy indicator is measured by using the energy tax. In Model 1b, its measurement is conducted by using the expenditures on environmental protection. The RSCA was used as the competitiveness indicators or the dependent variables.

The consistency of the GMM estimator depends on the two specification tests proposed in Arellano and Bond (1991). First is the Sargan test of over-identifying tests for the joint validity of the instruments. The null hypothesis is that the instruments are not correlated with the residuals. Second is to test for the first order and second order serial correlation. The null hypothesis of the absence of first order serial correlation should be rejected and the absence of second order serial correlation should not be rejected (Law & Azman-Saini, 2012; Baltagi et al., 2008). Two factors have been utilized for measuring environmental policies in the analysis: the energy tax and government expenditures on environmental protection.

The results indicate that both environmental policy indicators (i.e. energy tax and expenditure on environmental protection) have a positive impact on the Malaysian palm oil downstream competitiveness. In line with the strong Porter Hypothesis (PH), this shows that green policies help in increasing the entrepreneurial efforts towards the invention of green technology, which raises the competitive edge of the nation. With respect to the general conditions required for environmental regulation setting in PH, when policies are price-based (e.g., energy taxes), their pervasiveness ensures their successfulness and stimulates the overall economic competitiveness.

The empirical outcome also states that labour productivity seems to carry more weight than the other factors in determining the Malaysian palm oil downstream competitive advantages in EU-27. This result is in line with the argument of Krugman (1994) cited in Užík and Vokorokosová (2007), who stated that national competitiveness is generated in the long run by increasing output per worker or, in other words, labour productivity. Productivity allows a nation to support high real wages, strong currency, attractive returns to capital and a high standard of living. Labour productivity also enables a high incidence of innovative technology which helps in maintaining the competitive edge of the palm oil industry.

Table 2: Results of Different GMM Estimations for Trade Competitiveness in EU-27: Dependent Variable: RSCA

Variables	**COMP: RSCA**	
	(1a)	**1(b)**
Constant	-0.906***	-0.853***
	(0.013)	(0.002)
$RSCA_{ijt-1}$	0.242***	0.247***
	(0.002)	(0.002)
$Labor_{it}$	1.422***	1.286***
	(0.030)	(0.022)
WOP_{jt}	0.278***	0.272***
	(0.002)	(0.002)
inn_{it}	0.066***	0.068***
	(0.001)	(0.001)
$Irival\_ms_{jt}$	-0.000***	-0.0002***
	(1.85e-05)	(1.81e-05)
$lener\_tax_{jt}$	0.008***	
	(0.002)	
env_protec_{jt}		0.001**
		(0.000)
Sargan Test	26.467	26.461
(*p*-value)	0.150	0.151
AR(1)	-1.999**	-2.001**
(*p*-value)	(0.045)	(0.045)
AR(2)	0.666	0.671
(*p*-value)	(0.505)	(0.502)
Number of code	27	27

Note: All models are estimated using the two-step Arellano and Bond differenced GMM estimations (Stata xtabond command). The variables are defined as follows: RSCA = competitiveness of palm oil downstream products; $Labor$ = total palm oil labour (i.e., mandore, field worker, executive, clerk, other general worker) represents the factor conditions; WOP = world crude oil price represents demand; inn = local innovation represents the supporting industry; $Irival\_ms$ = the market share of palm oil Indonesia in EU-27 represents the rivalry factor; $lener\_tax$ = energy tax; env_protec = government expenditures on environmental protection. The figures in parentheses are the t-statistics. $***$ and $**$ indicate significance at the 1% and 5% levels, respectively.

The sign of the world oil price (WOP) and innovation (inn) also indicates positive and significant results and is in line with the traditional theories. An increase in Brent crude oil prices will lead to higher demand for palm oil in the form of a biofuel mix. The results showed that an increase in world crude oil prices encouraged some countries to use alternative fuels (e.g., palm-based bio-diesel fuel) as a substitute. These conditions favour the use of biodiesel as a variety of target alternatives to fossil energy applied to several countries around the world.

The lagged dependent variable is statistically significant, which implies that the dynamic GMM is an appropriate estimator and the empirical results can be relied upon for statistical inference. The results of the diagnostic tests suggest that models are relatively well specified. The Sargan test for all models fails to reject the over-identification restriction. The absence of first-order serial correlation (AR1) is rejected and all models show the absence of second-order serial correlation (AR2). It can, therefore, be concluded that the impact of environmental protection is positive on palm oil-based exports opposing the traditional view that such policies raise the costs and reduces the competitiveness of the local firms engaged in exports.

5. CONCLUSION

This study investigated the impact of European environmental policies on the export competitiveness of the Malaysian palm oil downstream industry. The results show that environmental regulations in the EU lead to better palm oil industry competitiveness, which is consistent with the Porter Hypothesis, which states that more stringent environmental regulations trigger innovation, and thus, enhance the competitiveness of the industry. Therefore, to sustain the competitiveness of the palm oil downstream products, it is important for Malaysia to take prompt decisions to ensure that the development of palm oil in the country is within the boundaries of sustainable development that minimizes environmental degradation. In this regard, the Malaysia Sustainable Palm Oil (MSPO) Certification Scheme should be made compulsory among the major producers to ensure the sustainability of palm oil and its export competitiveness. The future research related to this study can explore the other perspectives of environmental issues. These may include the impact of a number of anti-palm oil campaigns initiated by western environmental NGOs on Malaysian competitiveness in palm oil downstream industry.

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APPENDIX

Appendix A1: List of Palm Oil Products under the HS-6 Digit Code

Product Code (HS 6 digit)	
290516	**382490**
290517	**151710**
290519	**151790**
290539	**151800**
290545	**152000**
290559	**152200**
291539	**340111**
291570	**340120**
291590	**340213**
291615	**340219**
291732	**340490**
291734	**293621**
291739	**293628**
382311	**382600**
382312	**271020**
382319	**382370**

Source: Malaysia Revision of customs tariff codes for oil palm products published by MPOB (2013).