https://doi.org/10.17221/332/2023-AGRICECON

Palm oil trade restrictiveness index and its impact on world palm oil exports

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Citation: Hamidi H.N.A., Khalid N., Karim Z.A. (2024): Palm oil trade restrictiveness index and its impact on world palm oil exports. Agric. Econ. – Czech, 70: 101–111.

Abstract: Despite numerous attempts to remove tariff and non-tariff barriers, the average number of barriers in the agricultural sector, particularly in the palm oil sector, is rising. Non-tariff effects are subjective, which makes them challenging to quantify. A new palm oil trade restrictiveness index that considers each trade barrier imposed on palm oil exports, such as tariff and non-tariff measures, is necessary to facilitate the sector's exports. Hence, this study aims to calculate the trade restrictiveness index (*TRI*) of palm oil and analyse its impact on Malaysia's and Indonesia's palm oil exports. This study uses a gravity model with Poisson pseudo-maximum likelihood (PPML) estimation to analyse the impact of trade barriers on world palm oil export for a sample of 59 major palm oil importing countries from 2009 to 2019. The study revealed that each importing country imposes different restrictions on Malaysia and Indonesia. The TRI showed a negative and significant relationship influencing palm oil exports in the case of Malaysia, while a positive and significant relationship for Indonesia. The policy implications of this study suggest that policymakers in both Malaysia and Indonesia should take proactive steps to comply with every criterion demanded by the importing country.

Keywords: non-tariff measures; tariff; trade; trade barrier; vegetable oil

Over the past hundred years, Indonesia and Malaysia have grown to be the world's largest palm oil-producing nations, with both countries producing approximately 85% of the total global crude palm oil trade. Due to trade liberalisation and lower tariff levels, both countries have been able to increase their trading activities all over the world. In 2022, Malaysia imposed an 8% export duty and lowered its reference price, while Indonesia lifted export restrictions until the end of that year (Tan and Lim 2022). Despite the difference in export duty, palm oil exports for both countries remain firm as global palm oil demand has been rising recently. Key importing countries for 2022 were India, the European Union countries, and China (USDA 2022). The higher imports from these countries were attributed to several factors, such as replenishing stocks to ensure food security and much greater palm oil discounts offered relative to those for rival vegetable oils, which were attractive to price-sensitive buyers.

Despite the fact that trade liberalisation has successfully decreased or eliminated tariffs, every country nowadays turns to other forms of protectionist measures known as non-tariff measures (NTM). This policy was introduced in order to protect their domestic market from increased import competition. According to UNCTAD (2010), the imposition of NTMs was

Supported by the National University of Malaysia, Grant No. GUP-2023–080.

https://doi.org/10.17221/332/2023-AGRICECON

widely reported, especially in agricultural products. Doanh and Heo (2007) and Vakulchuk and Knobel (2018) similarly found that NTMs were more sensitive towards the agricultural sector, compared to other sectors. Palm oil is no exception to this new trade policy. Figure 1 shows a significant increase in the number of NTMs implemented on palm oil products throughout the year. This clearly indicates that the implementation of NTMs has exerted an impact on the world palm oil trade.

NTMs are divided into two types: the technical (NTM-T) and non-technical measures (NTM-NT). Sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT), and pre-shipment inspection measures (INSP) were classified as NTM-T, while the remainder was classified as NTM-NT. Based on Figure 1, palm oil exports are more exposed to technical measures, namely SPS and TBT, compared to other measures. The finding is consistent with past studies which similarly indicated that the agricultural sector is more vulnerable to technical measures than non-technical ones (Devadason and Chennayah 2014; El-Enbaby et al. 2016). However, the NTMs exert different effects on trade, either increasing or restraining it (Beghin et al. 2015; Zainuddin et al. 2019). It is thus crucial to differentiate between the two types of NTM when assessing their impacts on world palm oil exports.

Since the NTMs are presented in the form of qualitative data, their implications for export are difficult to explain. However, in agricultural or palm oil exports, existing studies use only simple measurements, such as average tariffs, in assessing the impact of trade restrictiveness (Sithamaparam and Devadason 2016; Devadson and Mubarik 2021). Rodriguez and Rodrik (2001) and Kee et al. (2009) stated that most studies use simple indicators that are not well grounded in the trade theory, thus computing inaccurate economic outcomes and consequently proferring misinformed policy recommendations. With this cognisance, the main objective of this study is to compute the trade restrictiveness index (TRI) of palm oil and subsequently to determine its impact on Indonesian and Malaysian palm oil exports.

The calculated TRI in this study includes both the tariff rates and the technical and non-technical NTMs, thus representing a more holistic index than the average tariff measure generally used in past studies. The computed TRI was thus used to analyse the overall protection level implemented on palm oil exports and therefore identify the countries subjected to the most protection. This study further estimates the impact of broad trade restrictions and specific non-tariff measures (NTM-T and NTM-NT) on world palm oil exports. The results are expected to provide some insight into how new policy measures affect these exports. This information is pivotal for exporting countries to understand the level of restrictions they have to face when exporting their palm oil.

The following provided important motivation for this study: First, given the role of palm oil as a major agricultural industry in both Malaysia and Indonesia, evaluating the level of trade restrictions imposed

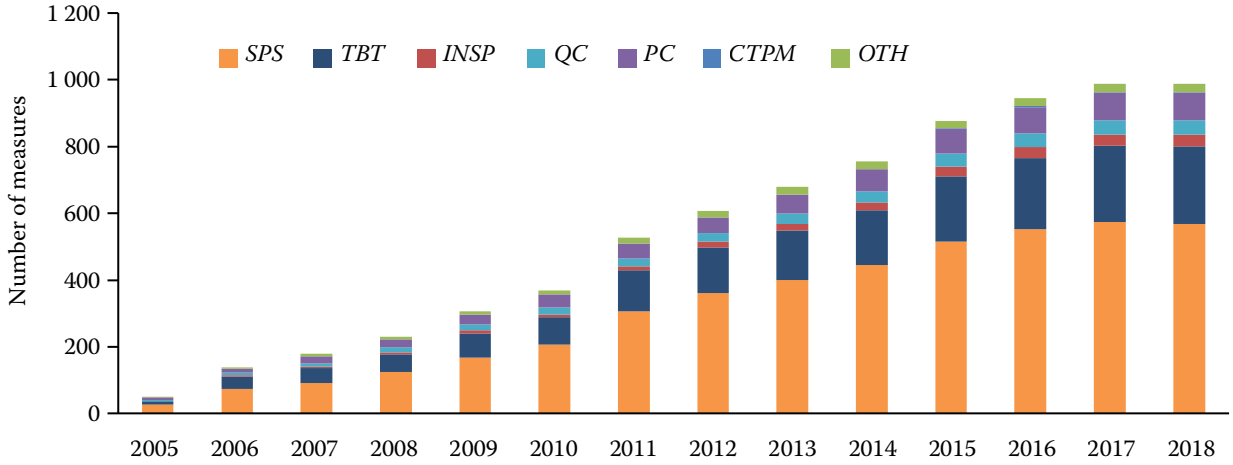

Figure 1. Numbers of non-tariff measures (NTMs) on palm oil products

SPS – sanitary and phytosanitary measures; *TBT* – technical barrier to trade; *INSP* – pre-shipment inspection and other formalities; *QC* – quantity control measures; *PC* – price control measures; *CTPM* – contingent trade-protective measures; *OTH* – other measures

Source: TRAINS (2022)

https://doi.org/10.17221/332/2023-AGRICECON

by importing countries is indeed crucial. For instance, high trade barriers may distort bilateral trade flows, hence preventing the exporting countries from realising their full potential. Second, TRI can also provide a useful approach to assess the openness of a country towards importing palm oil products. This may motivate the exporting countries to mitigate their main concerns, such as the specifications of the imported products, which could consequently lead to increased palm oil exports to these countries.

Given the crucial role of palm oil in Malaysia and Indonesia, this study may contribute to the industry in two dimensions. First, the findings of this study may assist policymakers in both countries. Knowledge of the trade restrictions of palm oil exports should motivate both countries to implement extensive policy reforms to ensure that palm oil exports meet al. the criteria demanded by the importing countries. The proactive actions may include the promotion of palm oil's nutritional benefits that can contribute to a stable political relationship and greater demand in the importing countries. Second, this study further expands the literature on the palm oil industry, specifically on the trade restrictiveness index and its impact on palm oil exports. Although the subject was examined in numerous earlier studies (Abdulla et al. 2014; Sithamaparam and Devadason 2016; Devadson and Mubarik 2021) they were basically focused on simple measurements such as export duty and average tariff rate. By comparison, the new measure called the palm oil trade restrictiveness index introduced in this study, is more holistic and includes the overall level of trade barriers imposed on palm oil exports, such as tariff and non-tariff measures.

Literature review. With the existence of trade liberalisation, such as regional or bilateral free trade agreements, world tariffs have been successfully lowered and partially eliminated to encourage further trade exchanges in the countries involved. Along with the success of tariff reduction, non-tariff measures (NTM) have conversely emerged as a significant obstacle to international trade today. For example, an early study by Lee and Swagel (1997) and Winkelmann and Winkelmann (1998) showed that non-tariff barriers have inflicted greater trade losses and impairments than tariffs. A study by the OECD (2015) established that implementing non-tariff barriers greatly affects trade in developing countries. Mohan et al. (2013) concluded earlier that developing countries are the worst affected by the implementation of non-tariff barriers, especially as imposed by developed countries.

More interestingly, trade protection implemented today is considered to be more sensitive to agriculture, relative to other sectors. UNCTAD (2010) reported that agricultural food products are heavily affected by NTM, and have attracted the greatest number of complaints on the imposed measures. Doanh and Heo (2007) exposed that Vietnam and Thailand are the two countries that have imposed higher trade barriers in the agricultural sector than in the non-agricultural sectors. This measure is also consistent with the trade policy of Iran, where a high level of protection was imposed on some agricultural products such as rice, bananas, and sugar (Norouzi et al. 2012). Vakulchuk and Knobel (2018), examining the European Union (EU) countries, similarly concluded that the agricultural sector is more vulnerable to the imposition of high non-tariff barriers. Recent studies by Kodua et al. (2022) for West Africa, Nga et al. (2023) for Vietnam, and He (2023) for China also concurred that agricultural products are most affected by the NTM.

The majority of past researchers considered the technical barriers to trade and sanitary and phytosanitary measures to be mostly of non-tariff types imposed on agricultural trade. According to the World Trade Organization (WTO), these are imposed to ensure that each commercial product is safe for consumers while simultaneously protecting the sustainability of the environment. Nevertheless, their imposition causes trade activities to be more restrictive in the Eurasian Economic Union (EAEU) countries than in other countries (Tarr 2015). In the case of Association of Southeast Asian Nations (ASEAN), increased implementation of SPS and TBT proved to be harmful to the export of agricultural products in member countries (Devadason and Chennayah 2014). Hoda et al. (2016) have also established that the implementation of SPS produces a negative impact on exports in Egypt from the perspective of business firms.

Conversely, some past studies have proven the positive effects of non-tariffs on trade flows that were able to increase a country's trade competitiveness. For example, Masakure et al. (2009) showed that the certification regulations imposed on Pakistani national merchandise, such as agricultural products and textiles, have benefited the country's exporters. Jayasekhar and Kumar (2010), who studied Indian seafood exports, similarly revealed the positive effects of multiple non-tariff implementations in OECD countries. Nguyen et al. (2022) reported that SPS and TBT produced a positive and significant effects on Vietnam's export of agricultural products.

https://doi.org/10.17221/332/2023-AGRICECON

There are studies, however, that found no significant effect of non-tariff enforcement on trade flows (Choi et al. 2016). Decreux et al. (2010) reported that the non-tariff barrier implemented in the free trade area between the EU and South Korea showed different implications according to the type of industry. Such conflicting effects of non-tariff implementation on world trade flow are quite apparent in the preceding discussion. There is no clear indication of whether the effect is beneficial or harmful to global trade, especially in agricultural products (Schlueter et al. 2009; Li and Beghin 2012). Further research is undoubtedly necessary to elucidate this trade barrier.

Research into the impact of trade barriers, especially of non-tariff measures, on palm oil exports is still rather limited. A notable study by Pratama and Widodo (2020) used an ex-ante analysis to investigate the impact of the European Union non-tariff trade policies on Indonesian and Malaysian palm oil products, showed that the policy harmed palm oil exports of both countries and consequently affected the overall economies of the two countries. A recent study by Hamidi et al. (2022) adopted non-tariff measures as one of the indicators to identify the technical efficiency of palm oil exports. The export potential of two leading producers and exporters of palm oil, Malaysia and Indonesia, was subsequently analysed.

MATERIAL AND METHODS

Source of data. Annual time series data from Malaysia and Indonesia, spanning from 2009 to 2019, were used in the study. The two countries represent the world-leading palm oil exporters. Data were also sourced for the 59 major importers of palm oil, as shown in Appendix A [see the Electronic Supplementary Material (ESM)]. The selection of an importing country is based on the percentage of total palm oil it imported, and also on the availability of data. The 59 countries selected in this study accounted for 89% of the world's total palm oil imports. Data gathered for the study were obtained from various sources. Table S2 in the ESM provides detailed description of the data used, including their sources. This study notably includes the trade agreement (TA) variables, as related to the agriculture or palm oil sector, that are still in force to date (see Appendix A in the ESM).

Methodology. This study adopted the framework from Kee et al. (2009) that was based originally on the concept of a trade barrier index by Anderson and Neary (1992). This study, however, improved the measurement of *TRI* by including two types of non-tariff measures, technical and non-technical, as mentioned earlier. The method of *TRI* calculations was based on the procedure from Kee et al. (2009) and the details are provided in Appendix B in the ESM. Once the *TRI* for palm oil was computed, the gravity model was estimated, and the trade barrier effects on palm oil exports for Malaysia and Indonesia were gauged. Until today, the gravity model is still utilised in studies of international trade. Tinbergen (1966) first applied this model to elucidate the factors influencing trade. It can generally be expressed in log-linear form as follows:

$$\ln X_{ijt} = \beta_0 + \beta_2 \ln GDP_{jt} + \beta_3 \ln POP_{jt} + \\ + \beta_4 \ln DIST_{ij} + \varepsilon_{ijt} \quad (1)$$

where: X_{ijt} – palm oil exports from Malaysia or Indonesia to importing country j in time period t; GDP_{jt} – income of the importing country; POP_{jt} – population of the importing country; $DIST_{ij}$ – distance between world palm oil exporting countries i with palm oil importing countries j (this distance variable is a proxy for transportation costs that are expected to have a negative relationship with trade flows); ε_{ijt} – error term.

Past studies have also highlighted the importance of the multilateral resistance (MR) factor (Anderson and Wincoop 2003; Nguyen 2010; Atif et al. 2017), which is the average trade resistance by a trading country with all other trading partner countries. Based on suggestions from the earlier studies, our gravity model also takes into consideration the trade restrictiveness index (*TRI*) and the trade agreement dummy (*TA*) as MR factors.

The pseudo-Poisson maximum likelihood (PPML) estimation method, first presented by Silva and Tenreyro (2006), was used in this study to address the bias and consistency issues that arise when the gravity model is estimated using the ordinary least squares (OLS) approach. Silva and Tenreyo (2011) conducted additional research that further demonstrated the effectiveness of the PPML technique as an estimator, even in the presence of several zero trade flows and the heteroskedasticity issue. In order to determine how trade obstacles affect exports of palm oil from Malaysia and Indonesia, this study adopted the PPML methodology. The PPML model used is shown below:

$$X_{ijt} = \exp\{\beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln POP_{it} + \beta_3 \ln DIST_{ij} + \\ + \beta_4 \ln TRI_j + \beta_5 \ln ER_{ij} + \beta_6 TA_{ij}\} \times \varepsilon_{ijt} \quad (2)$$

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where: TRI_j – level of trade barriers in the importing country; TA_{ij} – trade policy which is the dummy variable of the trade agreement; ER_{ij} – control variable which is the real exchange rate.

Equation (2) is able to analyse the effect of the overall level of protection represented by the trade restrictiveness index variable, TRI_j on Malaysian and Indonesian palm oil exports. For the analysis of the effect of technical and non-technical NTM, the PPML model used in this study were as follows:

$$X_{ijt} = \exp\{\beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln POP_{it} + \\ + \beta_3 \ln DIST_{ij} + \beta_4 \ln Tariff_j + \beta_5 \ln AVE\_T_j + \\ + \beta_6 \ln AVE\_NT_j + \beta_7 \ln ER_{ij} + \beta_8 TA_{ij}\} \times \varepsilon_{ijt} \quad (3)$$

where: $Tariff_j$ – average tariff rate imposed by country j; $\ln AVE\_T_j$, $\ln AVE\_NT_j$, – average *ad valorem* equivalents of technical and non-technical NTM by country j for palm oil exports, respectively.

From the estimation results of Equations (2) and (3), we expected to have either positive or negative relationships between the trade barriers, i.e. TRI_j, AVE_T_j, AVE_NT_j, and Malaysian and Indonesian palm oil exports.

RESULTS AND DISCUSSION

There were two phases to this investigation. For the first stage, the TRI values imposed on palm oil exports from Malaysia and Indonesia by 59 major palm oil importing countries were calculated for the period from 2009 to 2019. The average R^2 value for the entire sample of this study was 0.9371, which thus demonstrated that the study's estimation was sufficient. The calculated *TRI* values are presented in Tables S5 and S6 (see the ESM) and are summarised according to the region of the country. In general, it was apparent that each importing country imposed different levels of restrictions on Malaysia and Indonesia.

The average *TRI* annual values for Malaysia and Indonesia are shown in Figure 2. The *TRI* values of Malaysian palm oil in 2009 and 2019 were 0.1723 and 0.2654, respectively. In comparison, the average values for Indonesia were 0.2268 and 0.1743, respectively. This clearly shows that the palm oil importing countries imposed lighter trade restrictions on Indonesia relative to Malaysia, thus giving the former a competitive advantage in palm oil export trade in the international market. Further, the level of trade restrictions varied each year, hence presenting a great challenge for both countries to export at the maximum level.

The average values for *AVE NTM-T* and *AVE NTM-NT* are summarised in Figure 3, together with the average tariff and *TRI* values, compared between Malaysia and Indonesia. The average tariff value showed a declining trend during the course of the year in both countries. The average NTM-T and NTM-NT values for Malaysia and Indonesia however exhibit divergent tendencies. Both *AVE* values were initially lower than the normal tariff value in Malaysia but the *AVE NTM-T* value has increased (with fluctuations over time) from 0.0919 in 2015 to 0.2108 in 2019. In comparison, the average value of *AVE* for NTM-NT in Indonesia decreased annually, whereas NTM-T values began to increase in 2014. The dif-

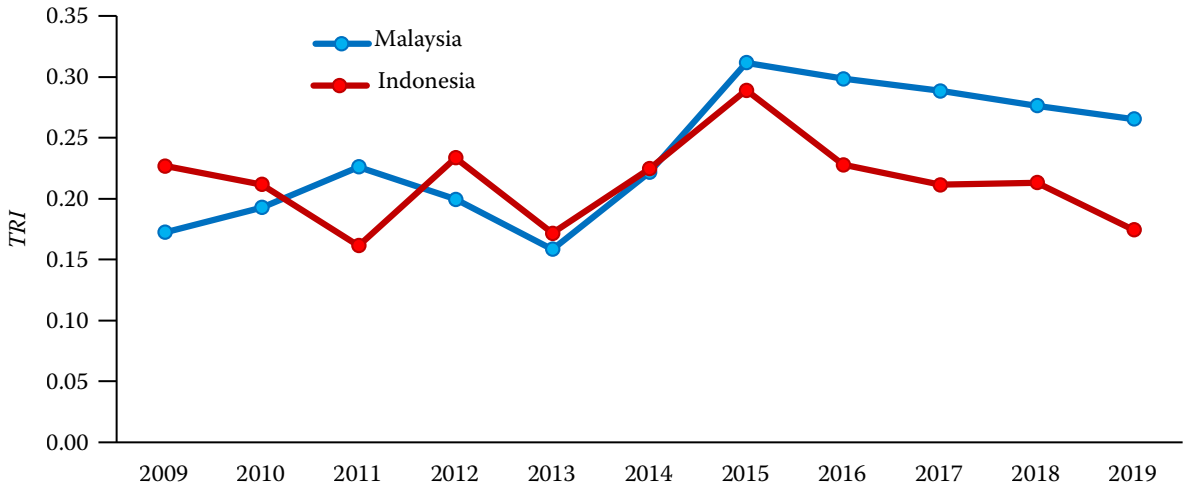

Figure 2. Average values of trade restrictiveness index (*TRI*) for Malaysia and Indonesia

Source: Authors' own calculation

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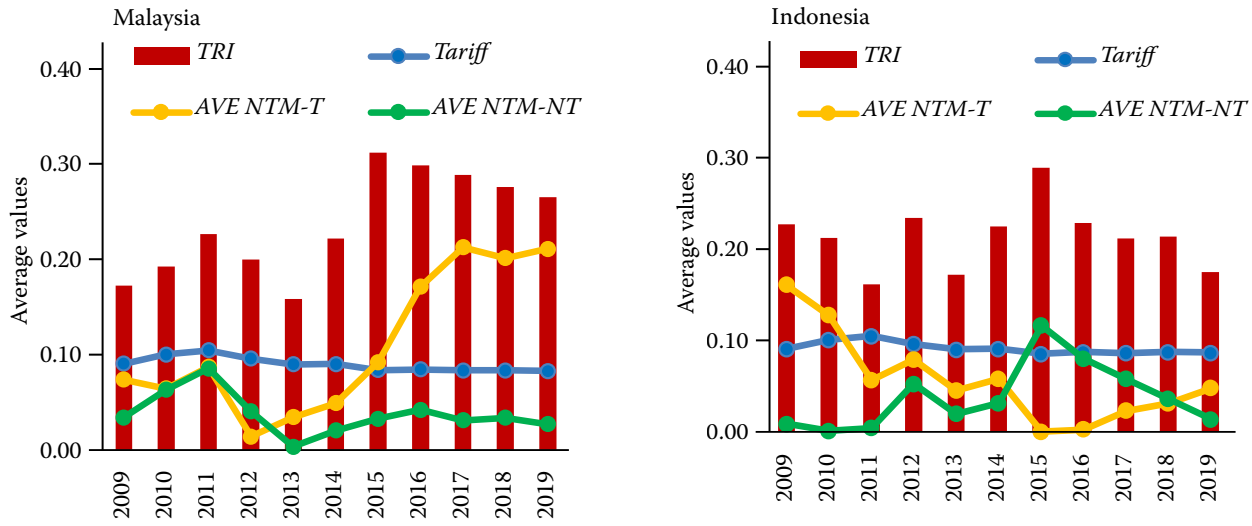

Figure 3. Average tariff value, *AVE NTM-T*, *AVE NTM-NT* and *TRI* for Malaysia and Indonesia

AVE NTM-T – *ad valorem* equivalent for technical non-tariff measures; *AVE NTM-NT* – *ad valorem* equivalent for non-technical non-tariff measures; *TRI* – trade restrictiveness index; *Tariff* – tariff rate

Source: Authors' own calculation

fering trends in *AVE* values thus exert varying impacts on *TRI* values in the two countries.

The study clearly indicates that the value of tariffs was no longer the main trade protection tool. Both countries should now focus on the implementation of NTMs in palm oil exports as a new policy for protecting their trade. The results concur with those of Kee et al. (2009), who maintained that NTM currently outweighs tariff measures in trade protection value. The results were also in line with other earlier studies, establishing that non-tariff policies have a greater negative impact on the agricultural sector relative to tariffs (UNCTAD 2010; Vakulchuk and Knobel 2018).

In the second stage of investigation, the relationships were analysed using gravity models. Descriptive analysis was used to determine the state of the data and the total number of observations used before making estimates. The findings of the study for both Malaysia and Indonesia are shown in Table 1, which shows the impact of trade barriers on world palm oil exports. These observations represent bilateral exports from Malaysia and Indonesia to 59 major palm oil importing countries worldwide.

The mean columns indicate the average values for the variables across years and countries. The means for the GDP, population, *TRI*, and distance were higher than their respective standard deviations, suggesting less variability in the data as they were closer to the mean. Conversely, the opposite was true for all other variables, as their standard deviations were higher compared to their means. The median and maximum values also showed low dispersion for all variables except for exports, which were not in natural logarithm form. The mean *TRI* for Malaysia was slightly higher compared to that of Indonesia, consistent with Figure 3, which shows higher trade restrictions imposed on Malaysia compared to Indonesia. A correlation matrix analysis was also conducted to determine whether a correlation problem existed between the variables used in this study (see Appendix C in the ESM). The value of the correlation test coefficient for both Malaysia and Indonesia was less than 0.8, confirming that the variables were not correlated with each other, and further estimation was thus free from the multicollinearity problem.

Tables 2 and 3 present the empirical results for Malaysia and Indonesia, respectively, obtained using the gravity model and the PPML method. There were two models tested for the two country samples, where models (1) and (3) used the trade restrictiveness index (*TRI*) values, while models (2) and (4) used the tariff and the *AVE* for NTM-T and NTM-NT.

For Malaysia, the results showed that each gravity model variable significantly explained its impact on palm oil exports. Further, the signs for population and distance were consistent with the existing theory for both models. However, the variable *GDPj* contradicted the theory by showing a negative relationship with palm oil exports. This can be attributed to the

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Table 1. Descriptive statistics for Malaysia and Indonesia

Variable	Observations	Mean	SD	Minimum	Maximum
Malaysia					
X_{ij}	590	165 000 000	396 000 000	0.0000	3 570 000 000
lnGDP_j	590	26.2469	1.8338	21.9369	30.6007
ln*POPj*	590	17.0663	1.4759	13.9853	21.0499
lnTRI_j	590	0.1935	0.1594	0.0000	0.8834
ln$Tariff_j$	590	0.0827	0.0934	0.0000	0.6553
ln$AVE_NTM_T_j$	590	0.0771	0.1175	0.0000	0.9532
ln$AVE_NTM_NT_j$	590	0.0361	0.0651	0.0000	0.3875
ln$Dist_{ij}$	590	8.8705	0.7263	5.7543	9.8573
lnER_{ij}	590	1.2679	2.8127	–2.6516	8.8163
TA_{ij}	590	0.2222	0.4161	0.0000	1.0000
Indonesia					
X_{ij}	590	203 000 000	617 000 000	0.0000	5 260 000 000
lnGDP_j	590	26.2469	1.8338	21.9369	30.6007
ln*POPj*	590	17.0663	1.4759	13.9853	21.0499
lnTRI_j	590	0.1824	0.1643	0.0000	0.8649
ln$Tariff_j$	590	0.0833	0.0934	0.0000	0.6553
ln$AVE_NTM_T_j$	590	0.0518	0.1131	0.0000	1.1789
ln$AVE_NTM_NT_j$	590	0.0380	0.0637	0.0000	0.2576
ln$Dist_{ij}$	590	9.0099	0.5805	6.7869	9.8920
lnER_{ij}	590	–6.7847	2.8126	–10.7034	0.8495
TA_{ij}	590	0.1789	0.3836	0.0000	1.0000

X – palm oil export; *GDP* – gross domestic product; *POP* – population; *TRI* – trade restrictiveness index; *Tariff* – tariff rate; *AVE_NTM_T* – *ad valorem* equivalent for technical non-tariff measures; *AVE_NTM_NT* – *ad valorem* equivalent for non-technical non-tariff measures; *Dist* – bilateral distances; *ER* – exchange rates; *TA* – trade agreements

Source: Authors' own calculation

assumption that as disposable income increases, consumers have more choices and are not subjected to lower price factors alone. Under this condition, the demand for palm oil will fall because consumers have the option to choose other products according to their tastes and preferences.

From the perspective of trade barriers, TRI_j showed a negative and significant relationship with Malaysian palm oil exports. This finding was in line with the expectations and the initial hypothesis of the study. With a high level of trade barriers imposed by importing countries, Malaysia's palm oil exports will decrease by 0.966%. However, model (2) proved that the tariff variable did not significantly influence the export value of palm oil. Hence, tariffs were no longer the main instrument used by importing countries to control import trade in their countries.

On the other hand, the non-tariff variable showed that $AVE\_NTM\_T_j$ was significant and had a negative relationship with Malaysia's palm oil exports. An increase in the value of $AVE\_NTM\_T_j$ by 1% will reduce the value of Malaysian palm oil exports by 0.413%. The result was also consistent with the initial expectations of the study, where a high level of NTM-T was imposed on Malaysian palm oil exports. The real exchange rate had a positive impact on Malaysian palm oil exports. The finding was supported by the J-curve hypothesis which states that when a depreciation of exchange rate occurs, the price of imports will increase and this in turn will incur a higher cost of producing a product. The study also proved that trade liberalisation helps increase palm oil exports. Through this avenue, Malaysia benefited from its involvement in trade agreements.

The population, distance and real exchange rates in Indonesia were significant (Table 3) and in line with the findings for Malaysia, except for trade barriers. The TRI_j showed a positive and significant relationship in influencing Indonesian palm oil exports. A 1% increase

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Table 2. Impact of trade barriers towards Malaysia palm oil export

Variable	(1)		(2)	
	coefficient	SE	coefficient	SE
lnGDP_j	–0.730***	0.169	–0.818***	0.204
ln*POPj*	2.939***	1.136	3.455***	1.159
lnTRI_j	–0.966***	0.291	–	–
ln$Tariff_j$	–	–	–0.119	0.611
ln$AVE_NTM_T_j$	–	–	–0.413***	0.150
ln$AVE_NTM_NT_j$	–	–	–0.092	0.183
ln$Dist_{ij}$	–2.026*	1.179	–2.408**	1.177
lnER_{ij}	0.134**	0.056	0.157**	0.068
TA_{ij}	0.901***	0.220	0.963***	0.245
Constant	4.113	10.446	0.840	10.935
Observations	581		581	
R^2	0.944		0.938	

*, **, *** significant at 1%, 5%, and 10%, respectively; country fixed effect and time fixed effect are included in both models; *GDP* – gross domestic product; *POP* – population; *TRI* – trade restrictiveness index; *Tariff* – tariff rate; *AVE_NTM_T* – *ad valorem* equivalent for technical non-tariff measures; *AVE_NTM_NT* – *ad valorem* equivalent for non-technical non-tariff measures; *Dist* – bilateral distances; *ER* – exchange rates; *TA* – trade agreements

Source: Authors' own calculation

Table 3. Impact of trade barriers towards Indonesia palm oil export

Variable	(3)		(4)	
	coefficient	SE	coefficient	SE
lnGDP_j	0.008	0.170	0.260	0.184
ln*POPj*	4.090***	1.121	4.895***	1.203
lnTRI_j	0.763***	0.203	–	–
ln$Tariff_j$	–	–	0.097	0.366
ln$AVE_NTM_T_j$	–	–	1.472***	0.466
ln$AVE_NTM_NT_j$	–	–	–0.858	0.710
ln$Dist_{ij}$	–5.895***	1.571	–7.373***	1.774
lnER_{ij}	0.091***	0.034	0.063	0.046
TA_{ij}	0.317*	0.175	0.306	0.219
Constant	–3.237	7.077	–12.620	8.700
Observation	581		581	
R^2	0.966		0.965	

*, *** significant at 1% and 10%, respectively; country fixed effect and time fixed effect are included in both models; *GDP* – gross domestic product; *POP* – population; *TRI* – trade restrictiveness index; *Tariff* – tariff rate; *AVE_NTM_T* – *ad valorem* equivalent for technical non-tariff measures; *AVE_NTM_NT* – *ad valorem* equivalent for non-technical non-tariff measures; *Dist* – bilateral distances; *ER* – exchange rates; *TA* – trade agreements

Source: Authors' own calculation

in TRI_j, will increase the value of palm oil exports in the country by 0.763%. The technical NTM likewise had a positive and significant effect on Indonesian palm oil exports. An increase of 1% of $AVE\_NTM\_T_j$ will increase the export value of Indonesian palm oil by 1.472%.

The findings of this study were consistent with the initial assumptions made, namely that the impact of NTM on exports can be positive, negative or neutral (having no relationship). If an exporting country can meet every condition and regulation requested

https://doi.org/10.17221/332/2023-AGRICECON

by the importing country, its product is assumed to be highly trusted by domestic consumers. In comparison, tariff variables do not significantly influence Indonesian palm oil exports. For the dummy variable, representing the trade agreement, the study confirmed that trade liberalisation helps boost Indonesian palm oil exports. Despite its lower value compared to that of Malaysia, the trade agreement does benefit palm oil export in Indonesia.

CONCLUSION

The objective of this study is to determine the trade restrictiveness index (*TRI*) for palm oil and examine its effect (technical NTM and non-technical NTM) on trade barriers in world palm oil exports. The main findings of the study can be summarised as follows: First, the *TRI* value of Malaysian palm oil was higher than that of Indonesian, which indicates that importing countries impose lighter trade restrictions on Indonesia compared to Malaysia. Second, the average values of *AVE NTM-T* and *AVE NTM-NT* for Malaysia and Indonesia had different trends. Third, in keeping with the findings of the PPML estimation, both the *TRI* variable and non-tariff technical type (*NTM-T*) significantly and negatively affected Malaysia's exports of palm oil. Further, *TRI* and *NTM-T* demonstrated a positive and significant link in influencing Indonesia's exports of palm oil. In addition, the study confirmed that Malaysia and Indonesia benefit through their involvement in the trade agreement.

In policy recommendations, this study provided information on the level of trade restrictions implemented by importing countries. The high average value of *AVE* in comparison to the tariff rate indicates that the sole use of the tariff rate as an indicator of a country's openness to palm oil products is insufficient. As such, policymakers should resort to more holistic and inclusive variables, such as *TRI*, in formulating policies related to the palm oil trade. Second, the *TRI* indicator considered both tariff and non-tariff measures in providing clearer information to policymakers. This is important since in the process of negotiating trade agreements, high levels of trade barriers can disrupt the process of trade liberalisation and economic integration. In addition, the negative impact on Malaysian palm oil exports, in contrast to the positive impact on Indonesian exports, should motivate Malaysian policymakers to take proactive steps to ensure that their exporters fully comply with every criterion demanded by the importing country. As for Indonesia, policymakers need to be aware of current developments so that their palm oil industry is not affected by the increase in NTM imposed by importing countries.

There are three limitations in this study which can be addressed in subsequent research. Firstly, NTM was not divided into the relevant categories in computing *TRI* due to the constraint on the degree of freedom in the model used in the study. Future studies need to address this and produce nuanced results that may be more accurate and refined, and thus more beneficial to policymakers in understanding the holistic implications and implementation of NTM in the palm oil trade. Secondly, further research should also conduct analysis at the level of a firm so that it can provide clearer information for policymakers on how the variation in trade barriers may affect individual firms, including medium to small ones. Third, this study did not take into account the major events that happened in Indonesia, which include the rejection of Indonesian crude palm oil commodity exports by the European Union from 2017 to 2020 and the imposition of the Roundtable on Sustainable Palm Oil (RSPO) certificate following the burning activities in the oil palm plantation industry in 2019.

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Received: October 2, 2023
Accepted: February 6, 2024
Published online: March 18, 2024