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Original Article

Factors affecting export competitiveness of fisheries industry in Malaysia

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Abstract
Fisheries constitute the most highly traded food commodity internationally owing to its fundamental contribution to global food security and nutrition. Malaysia has been amongst the world's leading fish producers; however, it has faced a serious fish trade deficit, implicating an absence of export competitiveness in the industry. This study aims to measure the export competitiveness (i.e. Comparative Export Performance index, CEP) of the industry and examine factors affecting CEP by adopting the Autoregressive Distributed Lag (ARDL) approach on the time series data for 2001 – 2022. The major findings revealed that Malaysia recorded an absence of export competitiveness (i.e. CEP < 0) in the international fisheries market, and this issue was significantly affected by fish consumption, followed by foreign income and fisheries production. Fisheries production and foreign income positively affected the CEP in the short-run while fish consumption negatively affected it. In the long-run, fish consumption and foreign income exerted a negative effect on the CEP. The findings of this study are significant for understanding the short- and long-run effects on export competitiveness in Malaysia and can be used for fisheries development strategies.

Keywords: comparative advantage theory; comparative export performance index; export competitiveness; fisheries industry; Malaysia

1 | INTRODUCTION

Fisheries have long been traded internationally but trade has increased dramatically in recent decades such that fisheries now constitute the most highly traded food commodity internationally owing to its fundamental contribution to global food security and nutrition (Ministry of Agriculture and Food Security 2025; Soh *et al.* 2024). Statistically, around 75% of the total world's fish imports are concentrated in developed countries such as the United States (US) while over half of the international fish trade now originates in developing countries (Erokhin *et al.* 2021; ITC 2024a, 2024b). According to Food and Agriculture Organization of the United Nations (FAO), the international fish trade expansion is generally attributable to broadened exports from developing countries (i.e., generally rely on growing fisheries production for export revenue and income generation) and will influence the patterns of comparative advantage (FAO 2022, 2024).

Given a strategic location and long coastlines, Malaysia is an attractive fisheries nation with high international fish trade value among the developing economies. In 2022, Malaysia has been identified as among the leading fish producers, ranking 15th (7th) and 4th (3rd) in captured fisheries (aquatic algae) with 1.31 million tonnes (308 thousand tonnes) in the world and ASEAN, respectively (FAO 2024). Malaysian fish trade was nearly USD 2 billion, where fish exports and fish imports worth USD 663.66 million and USD 1329.29 million, respectively (ITC 2024a, 2024b). These figures also mean that Malaysia faces a stiff international competition in the fisheries industry while having high fish trade with the rest of the world based on the global demand and requirement for

fish.

Since 2009, Malaysia has experienced a fish trade deficit due to increasing fish imports and relatively lower and fluctuating fish exports (FishStat 2024; ITC 2024a, 2024b; World Bank 2024a, 2024b). In this situation, Malaysia is likely to suffer from deterioration of export competitiveness in the international fisheries market. Export competitiveness indicates the relative success or failure of the efforts of a nation to sell more domestically produced goods and services in other nations (Khai *et al.* 2016; Liew *et al.* 2021; Soh 2020). Coronavirus Disease 2019 (COVID-19) pandemic along with the Japan's discharge (Liang *et al.* 2024) of radioactive water into the sea are likely to make this issue more daunting. As mentioned earlier, Malaysia is among the major fish producers, however, there has been an overall decline in total fisheries production since 2012 (FAO 2024; World Bank 2024b). At the same time, Malaysia is also a significant high fish consumption country (i.e. more than 50 kg since 1992), where its per capita fish consumption has been above the world level and other developed countries, with the US being the top since 1961 (FishStat 2024). These situations may worsen Malaysian fish trade balance. However, US has been the world biggest fish importing country and one of the Malaysian main fish export markets (ITC 2024a, 2024b). The relatively higher income of the US may induce its demand for Malaysian fisheries, allowing Malaysia to broaden the exports and ultimately strengthen the trade balance, and vice versa. Interestingly, this trend may reverse in the long-run when the US has a preference and higher willingness to pay for relatively higher-priced and better-quality fish such as salmon (Asche *et al.* 2015; Das *et al.* 2020; Love *et al.* 2022; Nguyen *et al.* 2023; Errickson *et al.* 2024).

According to FAO (2022, 2024) and Soh *et al.* (2024), international fish trade expansion has been driven primarily by fisheries production, technological and/or cultural advancement associated with globalization. In Malaysia, the main fisheries policies are driven by mere consideration of the total fish trade which is the summation of exports and imports, often ignoring the underlying factors (Soh 2023; Ministry of Agriculture and Food Security 2025). Hence, important factors such as total fisheries production, fish consumption and foreign income should be explored to improve export competitiveness. As aforementioned, Malaysia is among the leading fish producers and fish consumer has high fisheries trade with the US but it still confronts a serious trade deficit in its fisheries industry that is relatively labour-intensive (FAO 2024; FishStat 2024; ITC 2024a, 2024b). Given the shortcomings of the widely adopted Revealed Comparative Advantage index (RCA), Comparative Export Performance index (CEP) has been developed to measure the ability of a country to survive and gain large market shares relative to other countries in logarithm terms (Serin and Civan 2008; Torayeh 2013; Soh 2023). The latter provides relatively more precise outcomes of export competitiveness of the country globally although these two indicators cover export side based on the theory of comparative advantage (Khai *et al.* 2016; Soh 2023). The key variables underpinning the domestic demand and supply drivers are total fisheries production, fish consumption and foreign income where their effects may differ in the short- and long-runs (Huo 2014; Lee 2020; Soh and Lim 2020). In this context, it is significant to study the export competitiveness of fisheries industry and its factors affecting in Malaysia, where improving export competitiveness should be regarded as an important part of ensuring national food security, boosting national development and ultimately obtaining a higher position globally.

The theory of comparative advantage, which was introduced by Ricardo (1817) is perhaps the most foundational concept in international trade theory based on economic conditions, production ability of specific goods at the lowest costs, export and imports patterns (Soh *et al.* 2022a). Supported by the theory, there have been many studies that measure the export competitiveness of a country, sector and/or industry with the application of RCA. In fact, only minuscule research focuses on the Malaysian fisheries industry. For instance, Tao *et al.* (2023) concluded that Malaysia had no export competitiveness in the category of fish, crustaceans, molluscs and other aquatic invertebrates relative to China in 2017-2019. By analyzing a longer period, Erokhin *et al.* (2021) also proclaimed that Malaysia had no export competitiveness in fisheries with dominant fish traders in 2000 – 2019. This is consistent with other studies of fisheries industry during 2009 – 2018 (Soh *et al.* 2022b), agricultural products for 1988 to 2014 (Liew *et al.* 2021), crustacean exports to Japan in 2010 – 2016 (Lee 2020) and seaweed products compared to other leading producers (e.g. Indonesia, the Philippines and Thailand) during 2008 – 2011 (Mohamad *et al.* 2013). On the other hand, Malaysia enjoyed export competitiveness in non-frozen shrimp products and live fish in 1999 – 2009 (Khai *et al.* 2016) and 1995 – 2015 (Tirumalaisamy *et al.* 2023). Interestingly, Malaysia had export competitiveness in regional fish markets but lost its position in the world market from 2010 to 2018 (Mizik *et al.* 2020). Moreover, even no one has investigated factors affecting the export competitiveness of the industry, especially in terms of the short- and long-runs of those important variables such as production, consumption and foreign income. The salient studies on the factors affecting are as follows:

Backed by comparative advantage theory, more domestic production that is driven by specialization encourages export competitiveness. With the application of Vector Error Correction Model (VECM), Hapsari and Yuniasih (2020) found a positive long-run effect of cocoa bean production on the RCA of Indonesian cocoa industry dur-

ing 1992 – 2017. Similar findings were also reported in the EU's ham and cheese during 1999 – 2013 (Torok and Jambor 2016) and 1990 – 2013 (Balogh and Jámbor 2017). The former adopted the Revealed Symmetric Comparative Advantage (RSCA) and Panel-Corrected Standard Errors (PCSE) method whilst the latter used additional RCA and Normalized Revealed Comparative Advantage (NRCA) to strengthen the results in the Feasible Generalized Least Squares (FGLS) estimation. In fact, Khaldun *et al.* (2018) found the negative effect of production growth in the case of Indonesian seaweed throughout 2006 – 2016 with the application of Ordinary Least Squares (OLS) method. Over-productivity reduced the RCA because the seaweed that cannot be absorbed by the Indonesian industry is then exported to various countries in the form of raw material which has very little added value and the low quality. Unexpectedly, Lee (2020) observed insignificant and negative effect of local (i.e. Japan) shrimp production and the RCA of crustacean during 2010 – 2016 with the implementation of Random Effect (RE) method.

Based on Keynesian theory (Keynes 1936; Soh *et al.* 2022a), the switch to domestically produced goods due to higher income will reduce the availability of local goods for exports. As proof, increased local consumers' demand for brackish water fish reduced the competitiveness of the industry with the adoption of the Porter's Diamond Model approach (Tirumalaisamy *et al.* 2023). Huo (2014) also concluded the adverse effect of consumption of agricultural products, which was measured by the consumption expenditure on food, on the RCA of 24 selected emerging economies' (e.g. Malaysia) agriculture sector during 1997 – 2006. From another point of view, Bojnec and Fertő (2017) argued that higher household consumption would enhance the RCA of global agrofood sector during 2000 – 2011 when there were relatively more different varieties of agrofood products. The importance of innovation and development of fisheries in meeting consumers' preferences was also highlighted elsewhere (e.g. Cavenaghi-Altemio *et al.* 2022).

Theoretically, when the foreign country has higher income, the foreign demand for its imports rises, likely increasing competitiveness for exporting countries (Keynes 1936, Soh and Lim 2020). The RE and Fixed Effect (FE) outcomes of Chang *et al.* (2019) concluded that the RCA of the shrimp exporting countries to the US was positively affected by the US (i.e. foreign) income per capita from January 2003 to December 2014. However, Apridar (2014) revealed that ASEAN (i.e. foreign) GDP worsened the RCA of Indonesian tuna based on the FE method. Lee (2020) observed insignificant negative effect of foreign income (i.e. per capita income of Japan) on the RCA of crustacean during 2010 – 2016 based on the RE method.

In short, research on CEP and its determinants in Malaysia is scarce. Furthermore, the existing literature, primarily focused on foreign countries and using RCA to analyze export performance, lacks an assessment of short- and long-run effects. At this end, the present study aims to (1) calculate the Comparative Export Performance index (CEP) for Malaysian fisheries; and (2) test and quantify the role of selected determinants through an econometric technique on time series data, with particular interest in the short-run relationships. The fisheries industry of Malaysia is likely to benefit due to the nature of production, consumption and trade policies. The findings of this study will contribute to fisheries literature and policies by extending the scope of existing studies on export competitiveness by examining short- and long-run relationships.

2 | METHODOLOGY

2.1 Study area and data collection

This study utilized time-series data from 2001 – 2022 to evaluate factors affecting export competitiveness of the Malaysian fisheries industry using the ARDL approach. The ARDL approach is chosen due to its ability to handle variables with mixed integration orders, estimate both short- and long-run relationships, and produce reliable results even with relatively small sample sizes. It considers the entire fisheries aggregate, in which the annual data for fish exports and fish imports were collected from the Trade Map's website (ITC 2024a, 2024b). Total fisheries production and constant GDP per capita of the US (GDP_US) in 2015 USD were collected from the World Bank's official website (World Bank 2024a, 2024b) while fish consumption per capita was from FAO Fishery Statistics database (FishStat 2024).

The distributions of CEP, FPROD, FCONSUM and GDP_US are almost symmetrical because their values of the mean and median are close, also implying a normal distribution.

TABLE 1 The descriptive statistics of the variables.

Statistics	CEP	FPROD	FCONSUM	GDP_US
Mean	–0.706	1779949.0	56.714	55127.980
Median	–0.717	1855009.0	56.265	54256.540
Maximum	–0.320	2116237.0	63.102	62866.710
Minimum	–1.160	1415881.0	52.730	48726.580
Std. Dev.	0.261	224175.2	2.773	3,956.774

CEP = Comparative Export Performance index; FPROD = total fisheries production; FCONSUM = fish consumption; GDP_US = foreign income.

2.2 Model

Firstly, CEP, which is a logarithmic transformation of RCA, has been applied to measure export specialization and competitiveness of Malaysian fisheries relative to the world (Serin and Civan 2008; Torayeh 2013; Soh 2023). As elucidated by Liew *et al.* (2021) and Soh (2023), CEP measures the changes in market share and growth, thus offering a more dynamic picture of export competitive-

ness. The formula is expressed as follows:

$$CEP = \ln(\frac{X_{Mf}/X_M}{X_{wf}/X_w})$$

where X_{Mf} represents the export value of Malaysian fisheries; X_M is the total export value of Malaysia; X_{wf} is the export value of the world's fisheries; and X_w is the total export value of the world. If the index CEP > 0, it indicates that the country exerts comparative superiority or export competitiveness. However, if CEP < 0 it means a lack of export competitiveness.

In order to evaluate factors affecting CEP of the Malaysian fisheries, the export competitiveness model in this study closely follows Rose and Yellen (1989); Soh and Lim 2020), Apridar (2014), Huo (2014), Natale *et al.* (2015) and Hapsari and Yuniasih (2020).

$$CEP_t = a + b\ ln\ FPROD_t + c\ ln\ FCONSUM_t + d\ ln\ GDP\_US_t + \varepsilon_t$$

where CEP_t is the Comparative Export Performance index of Malaysian fisheries, *ln* $FPROD_t$ is the total fisheries production, *ln* $FCONSUM_t$ denotes fish consumption, *ln* GDP_US_t represents foreign income, and ε_t refers to error term. The coefficients for *ln*$FPROD_t$, ln $FCONSUM_t$ and *ln* GDP_US_t are b, c and d, respectively.

Coefficients *b* (for fisheries production) and *d* (for foreign income) are expected to be positive. Increased fisheries production should lead to broader exports, and higher foreign income is likely to encourage demand for Malaysian fish exports. Yet, the coefficient of *c* is expected to be negative because higher fish consumption should decrease the availability of fish exports in Malaysia. As Malaysia is experiencing a lack of export competitiveness in fisheries, higher fisheries production and foreign income as well as lower fish consumption are expected to enhance the export competitiveness.

To gauge the short-run effect, the task is now reduced to converting (1) into an Auto-regressive Distributed Lag (ARDL) model such as the one outlined by equation (2) below. Following Pesaran *et al.* (2001), an error-correction term (ECT) is employed to estimate the linear relationship:

$$\Delta CEP_t = \alpha + \sum_{k=0}^{n1} \delta_k \Delta\ lnFPROD_{t-k} + \sum_{k=0}^{n2} \phi_k \Delta lnFCONSUM_{t-k} + \sum_{k=0}^{n3} \gamma_k \Delta\ lnGDP\_US_{t-k} + \mu_t + ECT_{t-1}$$

ECT is based on Pesaran *et al.* (2001), who proposed employing the standard *F*-test to detect the joint significance of lagged level variables. The short-run effects of each variable are deduced by the coefficients' estimate attached to the first-differenced variable. For example, the short-run effect of fisheries production is reflected by the estimates of δ_k's. The F-test would be carried out to test the null hypothesis of no co-integration against the alternative of the presence of a long-run relation between the studied variables. The Bound F-statistic would be compared to the two critical values- the upper and lower bounds (Pesaran *et al.* 2001). If the computed F-statistics are above the upper bound critical value, then the null hypothesis is rejected.

Eventually, diagnostic tests were also conducted to check the goodness of fit in the model. This includes the Ramsey Regression Specification Error Test (RESET), to check if non-linear combinations of the fitted values can explain the dependent variable whilst the cumulative sum (CUSUM) of the recursive residuals and the cumulative sum of squared (CUSUMSQ) recursive residuals tests to analyze the stability of the short- and long-run coefficients (Brown *et al.* 1975; Soh *et al.* 2024).

3 | RESULTS AND DISCUSSION

3.1 Comparative Export Performance index (CEP)

The CEP index of Malaysia showed an overall increment from –0.827 in 2001 to the highest –0.320 in 2008, then decreased significantly to the lowest value –1.160 in 2022. Throughout the years, Malaysian fisheries industry has recorded a negative value, indicating an absence of export competitiveness in the global market. This is likely to be caused by lack of local production (Soh 2020; Soh *et al.* 2022b; World Bank, 2024b). The outcomes are aligned with other studies (e.g. Mohamad *et al.* 2013; Soh *et al.* 2021, 2022b, 2024).

Unit root tests were carried out to confirm that all variables are between the order of zero and one (i.e. I(0) to I(1))) given the application of ARDL approach. Table 2 presents the Augmented Dickey-Fuller (ADF) and Phillip and Perron (PP) results. CEP was integrated of order one in levels, I(1) at the 5% significance level while other three variables were I(1) at the 1% significance level.

3.2 Long-run effect on CEP

Based on the ARDL bounds testing approach, the calculated value of the *F*-statistic (4.4477) was above the upper critical values at the 5% significance level, implying that the null hypothesis of no co-integration was rejected. It confirmed the long-run relationship among the variables.

Since ARDL approach is sensitive toward lag length, ARDL (1, 3, 1, 2) specification was employed in this study. Based on the Schwarz Bayesian Criteria which is a consistent model-selector, this study chose one (three) as the maximum order of lag for the dependent (independent) variable in generating the best-fit and stable ARDL model (Pesaran *et al.* 2001; Eviews 2017; Soh *et al.* 2022a, 2024). Based on Table 3, all the variables registered a statistically significant effect on export competitiveness except for fisheries production. The insignificant effect of fisheries production on the export competitiveness is aligned with

Lee (2020). This might be due to the fish import restriction (i.e., quality certificate requirement for exporting countries), which is imposed by some importing countries such as the European Union (EU) in the long term for quality control and food safety purposes. Since July 2008, the EU has banned the import of coldwater ornamental fish, such as koi (*Cyprinus carpio*) and goldfish (*Carassius auratus*), from Malaysia (Department of Fisheries Malaysia 2023). Such a decrease in fish exports itself will undoubtedly harm export competitiveness without any influence from fisheries production. Domestic fish consumption exerted a negative sign and significant estimate at the 5% level, which meant that 1% decrement in consumption leads to an enhancement of the export competitiveness by 6.990 units. This inverse relationship which follows the Keynesian theory is consistent with Huo (2014) and Tirumalaisamy *et al.* (2023). When domestic residents have higher consumption of fish, the availability of domestic fish for export decreases which then lower the export competitiveness given the formula. Also, foreign income recorded an unexpected negative effect on the export competitiveness, at the 5% significance level. The results are supported by Apridar (2014) as well as Gong and Kinnucan (2015), which deduced that the expanding foreign economy (i.e. driven by rising production of substitute goods) worsened the export competitiveness. Interestingly, higher foreign income encourages the US people to consume more luxury fisheries products such as salmon, lobster and oyster compared with that of Malaysian fisheries products (Asche *et al.* 2015; Love *et al.* 2022; Nguyen *et al.* 2023; Errickson *et al.* 2024).

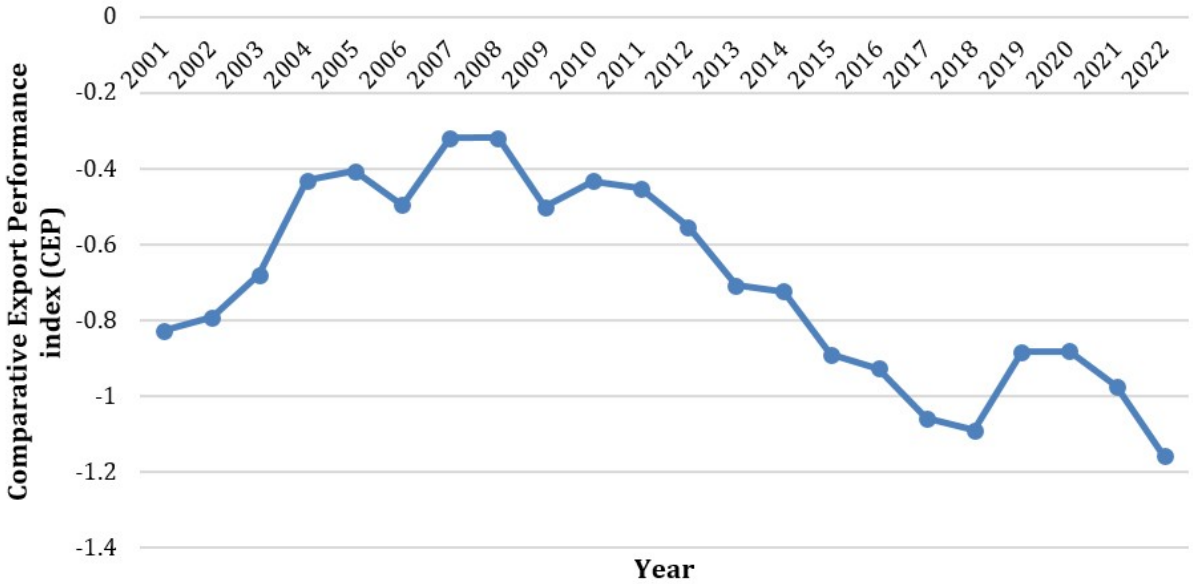

FIGURE 1 Comparative Export Performance index (CEP) of Malaysian fisheries in 2001–2022.

TABLE 2 Unit root test results (trend and intercept) of Comparative Export Performance index (CEP), total fisheries production (FPROD), fish consumption (CONSUM) and foreign income (GDP_US).

Variables	Level		First difference	
	ADF test	PP test	ADF test	PP test
CEP	-2.2588	-2.8749	-3.8788**	-3.8480**
	(0.4361)	(0.1893)	(0.0331)	(0.0351)
lnFPROD	-0.5248	-0.3484	-5.0625***	-5.0611***
	(0.9727)	(0.9823)	(0.0036)	(0.0036)
lnFCONSUM	-2.2811	-2.3245	-3.4328*	-4.5774***
	(0.4242)	(0.4034)	(0.0783)	(0.0092)
lnGDP_US	-2.1622	-2.1622	-4.7980***	-4.7994***
	(0.4845)	(0.4845)	(0.0055)	(0.0055)

3.3 Short-run effect on CEP

Based on Table 4, every variable had at least one significant coefficient, thus all variables seemed to have short-run effects. Furthermore, these significant short-run effects were positive for fisheries production and foreign income, but negative for fish consumption.

TABLE 3 ARDL long-run estimates of total fisheries production (FPROD), fish consumption (FCONSUM), foreign income (GDP_US) and constant.

Variable	Coefficient	Standard error	*t*-statistic	*p*-value
lnFPROD	0.9295	0.7050	1.3184	0.229
lnFCONSUM	–6.9904	2.6533	–2.6346	0.034**
lnGDP_US	–3.4587	1.4094	–2.4541	0.044**
Constant	51.6901	15.1752	3.4062	0.011**

It is a general phenomenon that the international trade of many interdependent production industries (e.g. fisheries) is transported by sea with time lags given its suitability for high-volume cargo that has long lead times

for delivery. Also, robust world demand for fish and some unanticipated conditions (e.g. the COVID-19 outbreak and financial crisis) have resulted in longer delivery times (Gani 2017; Federal Agricultural Marketing Authority 2021). For instance, the signs of level until second lagged fisheries production were positive and statistically significant at the 1% and 5% levels, respectively. These outcomes follow comparative advantage theory, which is identical to the study of Torok and Jambor (2016) and Balogh and Jámbor (2017). Malaysia is rewarded with a vast range of fisheries resources and has produced a high supply of fisheries, thus making it enjoy export competitiveness, for example, on fresh oysters and frozen fillets (Soh *et al.* 2021; FishStat 2024). When the level of fish consumption grew by 1%, the export competitiveness would contract by 3.356%, at the 1% significance level. The negative relationship is aligned with Huo (2014) and Tirumalaisamy *et al.* (2023), thus consistent with the Keynesian theory (Soh and Lim 2020). Higher fish consumption is likely to boost the demand for domestic fish, especially "people's fish", reduce the available fish for export purpose and finally worsen the competitiveness in Malaysian fish exports (Huo 2014; Soh and Lim 2020; Vanar and Sokial 2024). In Malaysia, "people's fish" refers to the species which the people usually consume, such as Indian mackerel, sardine and cad (Ruban 2016). Moreover, the sign of first lagged foreign income was positive and statistically significant at 5% level. The findings obey the Keynesian theory and are also consistent with Natale *et al.* (2015) and Soh and Lim (2020), which evinced that higher foreign income encouraged the foreign demand for Malaysia fish exports, then the exports escalate. Interestingly, this also suggests that the Malaysian fish and fisheries products are considered as normal goods by the US.

TABLE 4 ARDL short-run estimates of total fisheries production (FPROD), fish consumption (CONSUM), foreign income (GDP_US) and error-correction term (ECT).

Variable	Coefficient	Standard error	*t*-statistic	*p*-value
Constant	0.0007	0.0275	0.0261	0.980
$\Delta lnFPROD_t$	2.7670	0.4134	6.6927	<0.001***
$\Delta lnFPROD_{t-1}$	2.8796	0.5953	4.8374	<0.001***
$\Delta lnFPROD_{t-2}$	1.2090	0.5046	2.3962	0.038**
$\Delta lnFCONSUM_t$	-3.3563	0.5578	-6.0169	<0.001***
$\Delta lnGDP\_US_t$	0.4673	0.8767	0.5330	0.606
$\Delta lnGDP\_US_{t-1}$	2.5599	0.9885	2.5897	0.027**
ECT_{t-1}	-0.7574	0.1484	-5.1046	<0.001***

3.4 Diagnostic tests and robustness checking

Conforming to Table 5, the residuals of the ARDL model were free from serial correlation and heteroskedasticity, and the optimum model was correctly specified. Both the LM version and *F* version test probabilities were insignificant for all tests, at the 1% significance level. Hence, it failed to reject all the null hypotheses of no misspecification, no serial correlation and no heteroscedasticity, respectively.

TABLE 5 Diagnostic tests results for misspecification, serial correlation, and heteroskedasticity based on Lagrange Multiplier (LM) and *F*-test versions.

Test statistics	LM version	Test stat.	F version	F stat.
Misspecification	NA	NA	F(1,9)	0.3078 (0.593)
Serial correlation	*CHSQ(2)*	3.7324 (0.155)	F(2,8)	1.0464 (0.395)
	CHSQ(4)	6.2842 (0.179)	F(4,6)	0.8046 (0.565)
Heteroskedasticity	*CHSQ(7)*	2.5970 (0.920)	F(7,10)	0.2409 (0.964)

Ramsey RESET tests for misspecification; Breusch-Godfrey serial correlation LM test; and Breusch-Pagan-Godfrey for heteroskedasticity test. Parentheses are the *p*-values.

Figure 2 reported that the model was stable since the plots of both tests lied within their critical bounds at the 5% significance level. Beside the US, Singapore has been also a major trading partner of Malaysia. Thus, the income of Singapore was employed as another proxy of foreign income in checking the robustness of this study. The signs of the variables in Table 6 were similar with those in the main estimation (Table 3). Yet, the estimated coefficients of all variables in Table 8 were insignificant. This situation increased the robustness of the main estimation.

TABLE 6 NARDL long-run estimates of total fisheries production (FPROD), fish consumption (FCONSUM), another proxy of foreign income (the GDP of Singapore, GDP_SG) and constant.

Variable	Coefficient	Standard error	*t*-statistic	*p*-value
lnFPROD	1.3651	1.3148	1.0382	0.334
lnFCONSUM	-6.1091	3.5626	-1.7148	0.130
lnGDP_SG	-1.3706	0.8289	-1.6535	0.142
Constant	18.9403	5.8916	3.2148	0.015**

4 | CONCLUSIONS

Since Malaysia experiences a persistent fish trade deficit, the export competitiveness of this industry should be evaluated. To the best of our knowledge, this is the first study to explore the factors affecting the export competitiveness of Malaysian fisheries industry in terms of short- and long-runs. In summary, Malaysia recorded an absence of export competitiveness (i.e. CEP < 0) in the international fisheries market, and this issue was significantly affected by fish consumption, followed by foreign income and fisheries production. In the short-run, fisher-

ies production and foreign income had a positive effect on export competitiveness, but fish consumption exerted a negative effect on it. In the long-run, fish consumption and foreign income negatively influenced export competitiveness. All variables follow the comparative advantage and Keynesian theory, respectively, in the short-run whereas only fish consumption obey the theory in the long-run.

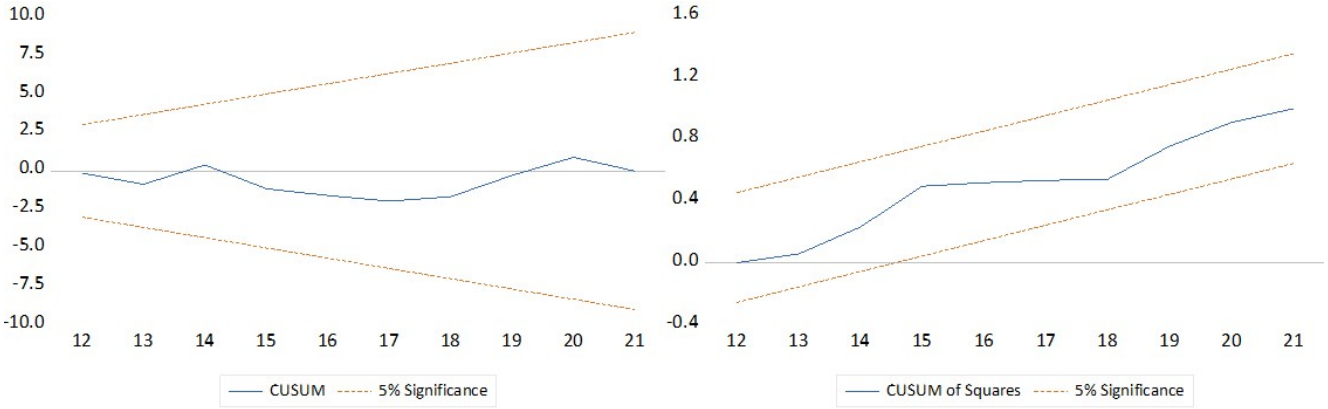

FIGURE 2 Plot of Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) of recursive residuals.

These findings have significant policy implications for emerging country like Malaysia. Firstly, more routine maintenance and upgrade of science and technology in fisheries industry are proposed in the short-run. In addition, with an improvement in fishers' knowledge and skill, these would massively help in export production of better-quality fisheries and the development of the industry. Secondly, since export competitiveness is highly reliant on fish consumption, moderate imports of lower-priced fish and fisheries products are recommended to fulfill the home consumption for fish and minimize the dependency of imported fisheries. Eventually, the relationship between the US income and export competitiveness work in an opposite way in the short- and long-runs. Hence, more cultivation and export diversification of high value-added fish and fisheries products (e.g., oyster), which have a relatively lower level of local consumption demand, to different countries are recommended for expanding the Malaysian fisheries market globally. In addition, Malaysia should also venture into luxury fisheries industry (e.g. mahseer) for sustaining its market share at the international level.

CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHORS' CONTRIBUTION

Conceptualization: GTL and SYC; methodology: BHS and GTL; validation: GTL; software: BHS; formal analysis: BHS; investigation: BHS; resources: GTL and SYC; data curation: BHS; writing- original draft: BHS; writing- review and editing: BHS, GTL and SYC; visualization: BHS and GTL; supervision and project administration: GTL and SYC. All the authors have read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data supporting this study's findings are available on request from the corresponding author.

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