Demand Evaluating the Nexus: Factors Propelling Malaysia's Export Competitiveness in Natural Rubber Downstream Products

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ABSTRACT

Malaysia, although being a significant player in the international rubber market, faces difficulties in properly capitalising on rubber exports to strengthen its national accounts. This can be attributed to the challenges posed by limited land availability and uneven productivity distribution. Hence, the aims of this study were: (i) to evaluate Malaysia's comparative advantage in the production of natural rubber downstream products compared with Thailand, the primary natural rubber producer and (ii) to examine the influence of trade openness (TO), foreign direct investment (FDI), gross domestic product (GDP), and inflation (INF) on Malaysia's export competitiveness in the natural rubber industry. This study utilised secondary data from the United Nations Commodity Trade Statistics Database (COMTRADE) and World Bank data spanning 32 years, from 1990 to 2021. The study used regression analysis and the autoregressive distributed lag (ARDL) technique to uncover the index of relative export advantage (RXA). The RXA index revealed that Thailand was more competitive in natural rubber exports than Malaysia. Furthermore, the ARDL technique findings indicated that trade openness (TO) and inflation (INF) had a considerable statistical impact on Malaysia's export competitiveness in the natural rubber industry. Meanwhile, foreign direct investment (FDI) significantly affected export competitiveness in the long term.

Keywords: Relative Export Advantage, Rubber Downstream, National Accounts Autoregressive Distributed Lag

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INTRODUCTION

The natural rubber industry plays a pivotal role in global economic development. As a versatile material derived from the latex of rubber trees, it serves as a fundamental component in the manufacturing of tires, footwear, medical gloves, and countless industrial products. Its widespread applications across diverse industries underscore its economic importance, making the natural rubber industry a cornerstone for growth, innovation, and job creation worldwide (Lebdioui, 2022). Thailand, Indonesia, Vietnam, India, and Malaysia are among the main global natural rubber producers. These nations leverage favourable climates and strategic cultivation to maintain their prominence, though rankings may shift based on evolving market dynamics. Thailand leads with extensive rubber plantations, a significant contributor to global production and exports (Tanielian, 2018).

Despite Malaysia's prominent position in the global rubber market, the country encounters challenges in fully leveraging rubber exports to bolster its national accounts. The current structure for rubber export does not effectively optimise the economic advantages that might substantially enhance Malaysia's national income. An important problem arises from the dependence on conventional export models, mostly focused on raw rubber supplies. This approach limits the potential for higher returns achievable through value-added processes and the production of innovative rubber-based products. The lack of a strategic emphasis on research and development hampers Malaysia's ability to capitalize on emerging market trends and secure a competitive edge in the rapidly evolving rubber industry.

Moreover, the susceptibility of Malaysia's national accounts to swings in global rubber prices and reliance on a limited number of key export destinations present economic vulnerabilities. To enhance resilience and sustainability, there is a pressing need for diversification strategies that tap into new markets and industries. Additionally, addressing environmental concerns related to rubber cultivation and processing is vital to align Malaysia's rubber sector with international sustainability standards.

In light of these challenges, the development of a comprehensive strategy is imperative. This strategy should encompass value addition, innovation, market diversification, and sustainable practices to optimize the contribution of rubber exports to the Malaysian national accounts. Addressing these challenges will not only ensure a consistent and reliable source of income but also establish Malaysia as a proactive and adaptable participant in the international rubber industry.

Malaysia is a key contributor to the global production of natural rubber. While it has decreased from the extremely high vulnerability of the 1980s, when mining and agriculture accounted for more than a quarter of Malaysia's GDP, Malaysia's exposure to global primary commodity prices is still uncomfortably high. (Umezaki, 2019). The COVID-19 pandemic has brought Malaysia's rubber industry into focus, especially among downstream latex manufacturers, such as glove manufacturers, whose products have surged in demand especially during the pandemic (Sodhi et al., 2023). On the other hand, the rubber industry custodians of the upstream sector in Malaysia, which are mainly small rubber tappers, have different profit margins from the downstream sector. Small farmers dominate the rubber industry, and the price of rubber must be sufficient to motivate small farmers to start tapping their trees. Notably, there is a disparity between the upstream and downstream sectors of the Malaysian rubber industry.

In January 1988, the Malaysian government established the first Malaysia Natural Rubber Board (MRB) to manage the development of the natural rubber sector. MRB's primary goal is to aid in the development and modernization of Malaysia's natural rubber sector. This covers natural rubber tree cultivation, latex extraction and processing, natural rubber product manufacture, and natural rubber product marketing (Ali et al., 2021).

However, due to numerous problems such as land scarcity and uneven production patterns, the production of this export commodity has decreased in recent years. According to the Department of Statistics Malaysia (DOSM) statistics (Figure 1), the production of natural rubber decreased by 19.7% in November 2020 to 42,554 tons, compared with 53,019 tons in November 2019 (TheStar, 2022). A substantial percentage of rubber plants remains untapped due to the prevailing low rubber pricing. In addition, given that synthetic rubber can replace natural rubber, manufacturers are more inclined to use cheaper materials in order to maintain their competitiveness.

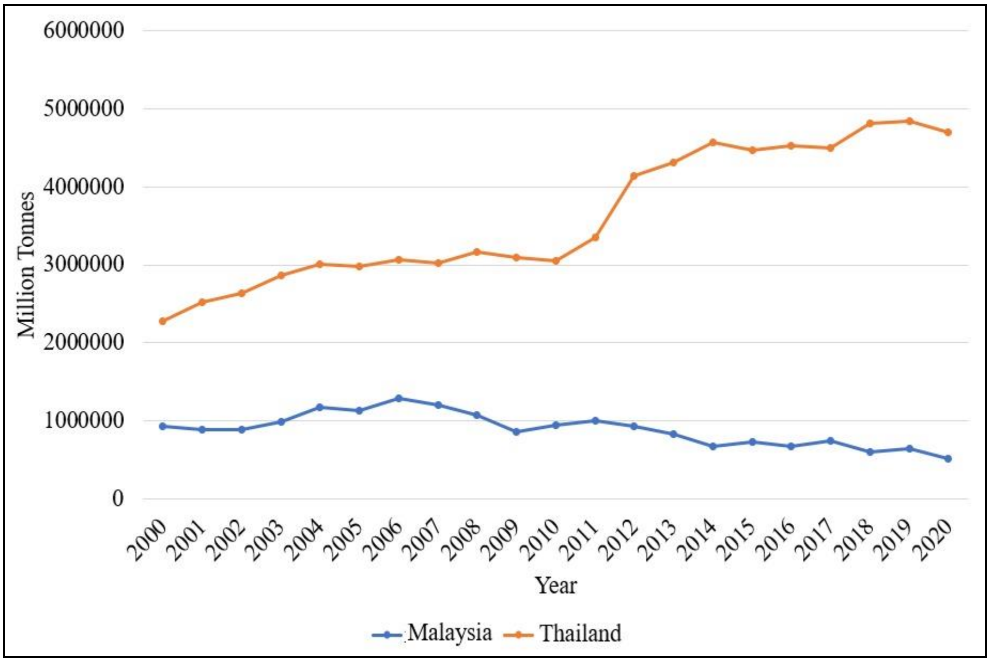

Figure 1: Total Rubber Production of Malaysia and Thailand (2000-2020)

Source: (DOSM, 2022)

Besides, natural rubber is a raw material that is primarily exported from countries in Southeast Asia, such as Thailand and Malaysia. These countries have a competitive advantage in the global market due to their favourable climate for rubber tree cultivation, as well as their established infrastructure for rubber production and export. As a result, efforts should be made to increase output while maintaining competitiveness (Daulika et al., 2020). Additionally, these countries have a long history of rubber cultivation and a well-developed rubber industry. However, the export competitiveness of natural rubber can be affected by factors such as trade openness (TO), gross domestic product (GDP), foreign direct investment (FDI), and inflation (INF). This is difficult because the natural rubber export of Malaysia showed a decreasing trend from 2000 to 2020 while Thailand showed an increasing trend over the years (Figure 2) (DOSM, 2022).

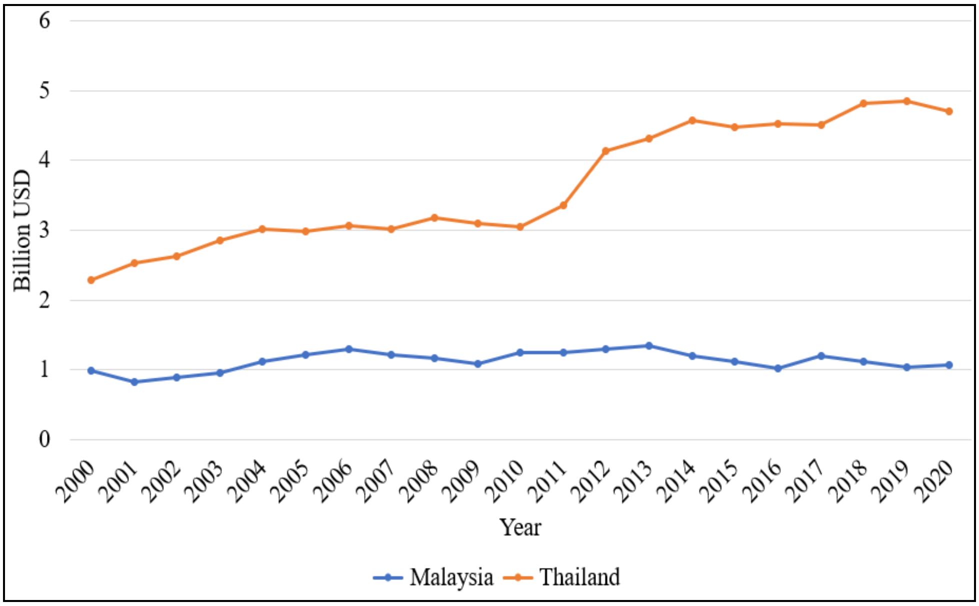

Figure 2: Malaysia and Thailand Export Value of Natural Rubber (2000-2020)

Source: (UNCOMTRADE, 2023)

In addition, it was reported that the Republic of China remained the top importer of natural rubber, accounting for 41.5 percent of total exports, followed by Finland (10.7 percent), Pakistan (4.2 percent), Turkey (3.2 percent), and Germany (2.5 percent). Natural rubber-based products such as gloves, tires, tubes, natural rubber thread, and condoms contributed to the export performance (Khin et al., 2019). The statistics trend shows that the production of natural rubber has decreased by quite huge tonnes over the years compared to Thailand (DOSM, 2022). Hence, this study intended to explore the impact of TO, FDI, GDP and INF on the export competitiveness of natural rubber in Malaysia.

The subsequent sections of the paper are organised as follows: The following section provides a concise overview of prior literature examining the export performance of natural rubber. Section 3 provides a detailed explanation of the data and the procedure used for estimation. Section 4 provides the primary empirical findings, while Section 5 summarises and concludes the study's findings.

LITERATURE REVIEW

Competitiveness is a complex notion that encompasses various research fields, such as economics, business strategy, operations management, and engineering. In economics, it is often studied in terms of a country's capability to produce goods and services at a minor cost and higher quality than its competitors. In business strategy, competitiveness can refer to a company's ability to gain market share and generate profits. In operations strategy, it refers to the ability to produce and deliver products or services efficiently and effectively. In engineering, competitiveness may refer to the design and development of advanced technologies or the ability to improve production processes. Overall, competitiveness is a key aspect of organizational and national success (Joltreau & Sommerfeld, 2019; Kawano, 2019).

Trade Openness and Export Competitiveness

The Heckscher-Ohlin (H-O) theorem (1919-1933) provides a basis for how trade openness enables countries to gain export competitiveness in goods that utilize their relatively abundant factors. The degree to which a nation permits imports and exports of goods and services is referred to as its TO (Huchet-Bourdon et al., 2018). A nation with a high level of trade openness is more likely to have a more competitive export market. On the other hand, a nation with limited TO may encounter difficulties entering global markets and may have less access to cutting-edge goods and technologies. A study conducted by Khan et al. (2023) found that economic globalisation, institutional quality, trade openness, the number of trade agreements, and trade freedom positively affected Bangladesh's long-term competitiveness in prawn exports. However, the international or exporting price of prawns negatively impacted both the short and lon-run.

Moreover, prior research examined the ASEAN trade openness indicator from 2013 to 2017, revealing that Singapore, Vietnam, Malaysia, and Cambodia had the highest levels of trade openness. Their Trade Openness Index (TOI) score exceeded 1, indicating a significant level of international trade connectedness and interdependence with the global community (Galovic, 2021). According to Marčeta and Bojnec (2021), the EU-28 countries need to focus on enhancing the coherence of their economies, promoting trade openness, and striving for greater competitiveness and economic growth. This is particularly important because a highly interconnected country with global markets is more vulnerable to external shocks.

According to Sadiku et al. (2019), investigates how Western Balkan countries' competitiveness is affected by trade openness. Regression modeling was done as part of the study using panel data from 2005 to 2017. Their result from ordinary least squares (OLS) showed that for every 1% increase in trade openness, competitiveness rose by about 0.172% over time. Pilinkiene (2016) examined this by applying correlation analysis based on the panel data for 11 Central and Eastern European (CEE) countries over the period 2000 to 2014. The correlation analysis showed a positive and significant link between trade openness and GDP per capita. Trade openness is also favourably correlated with other competitiveness indicators such as research and development (R&D) expenditure, industry-added value, and labour productivity. The Granger-Causality test and the vector autoregression (VAR) model have demonstrated that economic growth exerts a persistent influence on trade openness.

Foreign Direct Investment (FDI) and Export Competitiveness

The investment of foreign assets into domestic structures, machinery, and organizations is known as a foreign direct investment (FDI). Due to the capital and management skills, it delivers, FDI is seen as a major contributor to economic growth (Okegbe et al., 2019). The relationship between FDI and export competitiveness is that FDI can aid a nation in enhancing its export competitiveness. Foreign investment can boost the economy of a country by creating jobs and increasing productivity, as well as boosting the competitiveness of the nation's export industry (Gamariel & Hove, 2019). Hence, the previous study has proved the relationship between FDI and export competitiveness.

A study by Sadiku et al. (2019) analyzed that countries with a higher level of FDI and higher physical capital benefit more from international trade, and in turn, increase competitiveness. Additionally, a study employing time series analysis for the years 2002 to 2017 examined the relationship between macroeconomic variables and FDI as a factor driving growth and competitiveness. The results showed that FDI can boost Croatia's economy's competitiveness levels, even though the overall impact relies on the FDI structure or greenfield vs brownfield investments (Skare & Cvek, 2020).

Moreover, there is a significant place for research on the connection between exports and economic expansion (Manzoor et al., 2019). The assumption underlying the export-driven growth hypothesis is that export-driven policies promote economic growth. The role of FDI, on the other hand, is bigger since it provides potential beneficial impacts on the improvement of competitiveness and economic growth of the recipient country. FDI is one of the most stable kinds of foreign capital inflow. The increase in employment as well as the development and accumulation of human capital can both benefit from FDI inflows (Kottaridi et al., 2019). Besides, a study examined the correlation between FDI inflow and export using regression analysis and the Granger causality test from 2009 to 2016. The findings revealed that with the increased FDI inflow in the automotive industry, the sector had significantly increased its share in the total Macedonian exports (Sekuloska & others, 2018).

Gross Domestic Product (GDP) and Export Competitiveness

The Gross Domestic Product (GDP) is defined as a measure of all finished goods and services produced and offered by a country over a specific period, such as a year. GDP considers variables such as total government spending, business spending, private consumption, and national exports. Past studies show a link between export competitiveness and GDP (Arapova, 2018; Dima et al., 2018). The basic gravity model and panel regression were used by Rosyadi et al. (2021) to examine how various factors affect Indonesia's crude palm oil (CPO) export competitiveness and intensity. The 20-year time series panel data used in this study included cross-sections from five significant importers from 1999 to 2018. The findings indicated that the GDP and export volume of the importer have a large and favourable impact on Indonesia's CPO export intensity, whereas the GDP and economic distance of the exporter had a significant and unfavourable impact.

Islam et al., (2021) used the Revealed Symmetric Comparative Advantage (RSCA) index to examine the competitiveness of tea exports for Sri Lanka, Bangladesh and India from 1980 to 2018. Their results indicated that Sri Lanka had maintained its dominant position, India achieved a respectable performance, while Bangladesh had lost competitiveness in its export of tea. Their finding also showed that Sri Lanka's export of tea and economic expansion were closely related. On the other hand, no correlation between tea exports and long-term economic growth was observed in Bangladesh and India. A similar study by Tombolotutu et al. (2019) examined the government of Indonesia's initiatives to raise the export competitiveness of Indonesian seaweed products. From 2006 to 2016, the value of Indonesian seaweed's features varied according to several factors, including export competitiveness, productivity, raw material price, trade liberalization rate, inflation rate, exchange rate, and product differentiation. The seaweed revealed comparative advantage (RCA) in Indonesia which will benefit from more economic expansion. Infrastructure that will increase productivity and efficiency in the manufacture of goods to be sold or exported on a worldwide market is impacted by economic growth (Agbo et al., 2018).

Inflation (INF) and Export Competitiveness

The Mundell-Fleming model, developed by Mundell (1963) and Fleming (1962), examined macroeconomics in the presence of capital mobility. It demonstrated how inflation (INF) led to currency appreciation, hence reducing export competitiveness, in an economy with floating exchange rates. Conversely, low INF can keep the cost of production for exports low. This makes them more affordable for foreign buyers. Additionally, as it may affect competitiveness, INF is a crucial macroeconomic element (Chugunov et al., 2019). There are two ways to look at the impact of INF on competitiveness. A higher level of prices for goods and services can result in increased expectations of the earnings of entrepreneurs, business growth, and maintaining competitiveness, therefore it can be noted as a rise in business opportunities (Sayed & Slimane, 2014).

Rusu and Roman (2018) analyzed the main economic factors that influenced the competitiveness of CEE countries. The study used econometric analysis on panel data from 2004 to 2016 by considering the dependent variable of the competitiveness of a country and independent variables consisting of seven macroeconomic and business environment indicators. The result indicated that the factors that determined competitiveness for the efficiency-driven CEE countries included inflation rate, trade, labour productivity, and the cost of company start-up procedures. The only factors that significantly affected competitiveness for nations in the transition between efficiency and innovation were growth rate, inflation rate, and labour productivity. The study also found that for the nations included in the innovation-driven stage, the growth rate, inflation rate, total tax rate, and trade were the main variables with statistically significant effects on competitiveness.

In the meantime, INF can also be detrimental because it raises market prices overall as well as startup expenses for new businesses. Tombolotutu et al. (2019) analyzed the Indonesian seaweed export competitiveness model in the global market using regression analysis for the period 2006 to 2016. The results showed that INF had a negative coefficient sign, meaning that higher INF results in lower RCA seaweed. Aghion et al. (2019) analyzed industrial exports in 83 countries from 1990 to 2015. A study revealed that high inflation harms exports of more intricately manufactured goods. INF also influenced rising prices for goods and services, as well as the value of a currency and its purchasing power. Hence, the relationship between INF and competitiveness can be either negative or positive (Khan & Hanif, 2020; Sayed & Slimane, 2014).

Only a few recent Malaysian-specific time series research looked at the rubber export industry. Most of the research that has been done on export competitiveness has been cross-country. In addition, most of the research employed different modeling techniques on broad multi-country datasets rather than using recent advanced econometric approaches tailored to examine industry-specific developments over time in Malaysia. Hence, there is scope for further time-series analysis concentrated solely on the Malaysian rubber export sector to evaluate the determinants of competitiveness better as the industry and external environment have evolved. This can provide more targeted, data-driven, and robust evidence to inform policies to improve rubber export performance.

METHODOLOGY

Comparative Advantage

Although the Ballasa index, often known as the B index, has some significant limitations, such as the asymmetric value problem and logarithmic transformation, it continues to be widely used in trade analysis (Balassa, 1965, Othman et al., 2022). The RXA index is calculated by dividing a country's export of a certain product in the global market by that country's proportion of the world's export of all other goods. The formula for RXA is given by Equation (1) as follows:

$$RXA_{ij} = \left({X_{ij}} \middle/ {\sum_{n,n \neq i} X_{nj}} \right) \middle/ \left({\sum_{t,t \neq j} X_{it}} \middle/ {\sum_{n,n \neq i} \sum_{t,t \neq j} X_{nt}} \right) \tag{1}$$

In Equation (1), X indicates the export value. The subscripts i and n indicate the specific country and all countries worldwide, respectively. The subscripts j and t reflect the rubber downstream product and a group of product categories, respectively. The global export value of a certain product group, X_{nj}, is utilised as a benchmark point. The RXA index has a unique characteristic where the problem of double counting is resolved by excluding the export of product group by the ith nation, X_{it}, and the export of world rubber downstream products, X_{nj}, from the calculation of X_{nt}. In addition, the country in question is not included in the calculation of global product group exports (X_{ij} is excluded from X_{it}). Hence, in Equation (1), n ≠ i and t ≠ j. If the RXA value exceeds one, it signifies a higher comparable RXA in palm oil downstream products in the global market.

The 'Balassa index' methodological approach demonstrates that comparative advantage is indicated by a relatively high share of export markets, while a low share of export markets reflects comparative disadvantage. The RCA measure can determine the sector where a certain country has a comparative advantage and disadvantage (Othman et al, 2020; Pitts et al., 1997). For a particular country, RCA in a product is calculated as the ratio of the export share of that product in the country divided by the export share in world trade (Vozárová, 2013). The country is said to have RCA in the product if the RCA is greater than one. Table 1 summarises the subscripts in Equation (1).

Table 1: Explanation of the Subscripts in Equation (1)

Subscript	Countries and Products
Subject country (i)	• Malaysia • Thailand
World (n)	294 countries defined in UN COMTRADE
Rubber downstream products (j) (HS 6 digit)	The description of the HS code • **HSC400110:** Natural rubber; natural rubber latex, whether pre-vulcanized, in primary forms or plates, sheets or strip • **HSC400121:** Natural rubber; natural (including latex), in smoked sheets • **HSC 400122:** Natural rubber; technically specified natural rubber (TSNR), in primary forms or plates, sheets or strips (excluding latex and smoked sheets) • **HSC 400129:** Natural rubber; natural (excluding latex, technically specified natural rubber and smoked sheets), in primary forms or in plates, sheets or strip • **HSC 400130:** Balata, gutta-percha, guayule, chicle and similar natural gums; in primary forms or plates, sheets or strip
Set of product groups respectively (t)	HSC 40 Rubber and articles thereof.

Regression analysis is a statistical method employed to examine and understand the correlation between two or more variables of interest (Wahab et al., 2021). The regression analysis methodology facilitates the identification of significant elements, the exclusion of irrelevant ones, and the examination of their interactions. RXA is based on the Ricardian trade theory, which asserts that the differences in their production capabilities govern the trade patterns between nations (Nower, 2019). The metric can be used to give an overview and initial approximation of a nation's export competitiveness. It centres on the idea that more exports do not require a country to have a monopoly in each industry.

The data used in this study was an annual time series data spanning from 1990 to 2021 (32 years). The data was gathered from United Nations Commodity Trade Statistics Database (COMTRADE), and World Bank Data. The analysis took into account 5 products listed under the HS 6-digit codes as these specifically represent natural rubber downstream products. Besides, the objective of this study was to determine the impacts of TO, FDI, GDP, and INF on the export competitiveness of natural rubber in Malaysia, using multiple regression analysis tools. The data was estimated using E-views software version 12.

Autoregressive Distributed Lag (ARDL) Cointegration Technique

This study employed the ARDL bounds testing technique to investigate the long-term relationship among variables due to the dataset's integration with a mix of I(0) and I(1) elements within a limited sample size. The ARDL model, introduced by Pasaran et al. (2001) is a widely used and adaptable approach for testing cointegration in a multivariate context. The ARDL method offers several advantages. Firstly, it necessitates a considerable number of delays to capture the data-generating process comprehensively, ranging from a broad to a specialized framework. Secondly, it produces reliable results even when analyzing a small sample size.

In order to assess the determinants of competitiveness in downstream products of natural rubber, the RXA index was utilized as a proxy. Drawing from existing literature, the model framework, formulated based on the chosen variables, was articulated as follows:

$$lnREC_t = \chi_0 + \chi_1\, ln\mathrm{TO}_t + \chi_2\, ln\mathrm{FDI}_t + \chi_3\, ln\mathrm{Y}_t + \chi_4\, ln\mathrm{INF}_t + \varepsilon_t \qquad (2)$$

Where REC indicated natural rubber downstream export competitiveness used as a dependent variable proxied by RXA index, TO, FDI, net inflows (BoP, current US$), Y was Malaysia's GDP (constant 2015 US$), INF and e_t was the error term. This study transformed all variables into natural logarithms as this provided a more comprehensive estimation than a simple linear form (Shahbaz et al., 2017). The data for the analysis were obtained from the World Development Index (WDI), and the analysis covered annual data from 1990 to 2022. The expected signs of the coefficients of the variables were: χ_1, χ_2, χ_3> 0 and χ_4< 0.

The concept of stationarity is of utmost significance in regression analysis, as any results obtained from a nonstationary series would be deemed illegitimate (Gamal & Dahalan, 2016). Determining the stationarity of a variable will thus involve the application of the Phillip–Perron (PP) and Augmented Dickey–Fuller (ADF) tests. In the form of an unrestricted error correction model, the following general specification describes the ARDL bound test approach utilised in this study to examine for cointegration:

$$\Delta lnREC_t = \alpha_0 + \sum_{i=1}^{f} \alpha_i \Delta lnREC_{t-i} + \sum_{j=0}^{g} \gamma_j \Delta lnTO_{t-j} + \sum_{i=k}^{h} \tau_k \Delta lnFDI_{t-k} + \sum_{m=0}^{i} \partial_m \Delta lnY_{t-m} + \sum_{n=0}^{j} \beta_n \Delta lnINF_{t-n} + \theta_1 lnREC_{t-1} + \theta_2 lnTO_{t-1} + \theta_3 lnFDI_{t-1} + \theta_4 lnY_{t-1} + \theta_5 lnINF_{t-1} + \varepsilon_t \quad (3)$$

Using Δ to denote the first difference operator and n as the lag order, the expression $\Delta lnREC_t = \alpha_0$ signifies changes in the lagged dependent variable, where α_0 represents the drift term, and ε_t denotes the residuals. Subsequently, this study identifies the optimal lag length for variables f, g, h, i, and j in Equation (3). The determination of maximum lags is followed by the Akaike information criteria (AIC), following the approach of Pesaran et al. (1995), who employed a uniform lag length. To assess the results, the calculated F-statistics are compared to critical values tabulated by Narayan (2005) due to the small sample size (ranging from 30 to 80 observations).

Once the models in Equation (4) are serially independent, we conducted a bounds test to identify if there is a long-run statistical relationship between the variables. The bounds F-test procedure was performed on Equation (3), allowing a joint significance test of the null hypothesis of no cointegration (H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$) against its alternative (H_1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$) that cointegration exists. If the computed F-statistic falls below the lower bound, the null hypothesis of no cointegration cannot be rejected. Conversely, if the computed F-statistic exceeds the upper threshold, the null hypothesis of no cointegration can be rejected, indicating the presence of a cointegrating long-run relationship. However, when the calculated F-statistic falls between the two critical value limits, the test outcome is inconclusive. Lag selection based on AIC is then employed for optimization.

The ARDL cointegration method is more suitable for variables integrated in a specific order, such as I(0), I(1), or a combination of both. Additionally, it is robust when a small sample size reveals a singular long-run relationship among the underlying variables. In order to identify the long-term relationship between the fundamental variables, the F-statistic (Wald test) was utilised. The long-run relationship of the series is considered to be established in this methodology when the F-statistic surpasses the critical value band (Nkoro et al., 2016). Following this, diagnostic and stability tests were performed to assess the ARDL model's goodness of fit.

To evaluate the adequacy of the ARDL model's goodness of fit, diagnostic and stability tests were executed. The diagnostic test scrutinizes serial correlation, the shape of the function, the normality of the data, and heteroscedasticity concerning the model. Meanwhile, the structural stability test employs two statistical measures: the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

The CUSUM test involves calculating the cumulative sum of recursive residuals from the initial observation to the n^{th} observation in a series. This sum is iteratively updated and compared to predefined breakpoints. If the plot of the CUSUM statistic remains within the critical boundaries of a 5% significance level, it indicates that the null hypothesis, assuming stability in all model coefficients, cannot be rejected. A crossing point between either of the lines may lead to rejecting the null hypothesis of constant coefficients at a 5% significance level. The CUSUMSQ test employs a similar methodology, relying on the squared recursive residual. The summary of the determinants of rubber is presented in Table 2 which indicates the lists of all causal and proxy variables used to determine the competitive advantage of Malaysian rubber downstream industry in the world market.

Table 2: Summary of All Causal and Proxy Variables

Variables	Measurement	Sources
Export Competitiveness (RXA)	The export-to-market-share ratio of a country for a certain product, according to its share in the global market, compared to the country's share in the global export of all other goods.	(COMTRADE, 2022)
Trade Openness (TO)	The aggregate value of goods and services exported and imported is calculated as a proportion of Malaysia’s Gross Domestic Product (a significant nation in terms of imports).	(WorldBank, 2022)
Foreign Direct Investment (FDI)	Foreign direct investment refers to the net inflows of capital used to acquire a significant ownership stake (10 per cent or more of voting stock) in a company for long-term management control. The phrase refers to the aggregate value of equity capital, reinvestment of earnings, and other forms of long-term and short-term capital, as indicated in the balance of payments.	(WorldBank, 2022)
Growth Domestic Product (GDP)	The annual percentage growth rate of GDP per capita is calculated using constant local currency. GDP per capita is calculated by dividing the GDP by the population at the year's midpoint. Gross Domestic Product (GDP) at purchaser's prices is calculated by adding the total value of goods and services produced by all resident producers in the economy, including any product taxes, and subtracting any subsidies that are not included in the value of the products.	(WorldBank, 2022)
Inflation (INF)	The consumer price index measures inflation by indicating the yearly percentage change in the cost for an average consumer to get a collection of goods and services, which can either remain constant or be adjusted at predetermined intervals, such as annually. The Laspeyres formula is commonly employed.	(WorldBank, 2022)

RESULTS AND DISCUSSION

Malaysia's Competitiveness in Natural Rubber Downstream Products

Figure 3 compares the RXA index for five (5) downstream natural rubber products from 1990 to 2021 in Malaysia. The product with the highest RXA index, which is frequently utilized by the natural rubber and tyre industries, was 400122. Besides, the RXA for product 400122 showed an increasing trend until 2005 but later showed a diminishing return until 2021. The item with the lowest RXA index among the items was 400130, which is a solid natural rubber seal used on shafts to keep lubricants within while keeping dirt, moisture, and other undesirable material out of an oil seal, housing, or any other desired location. The RXA for product 400130 showed a decreasing trend to the end but at 2021, it slightly increased with the value of RXA is 0.6347. Thus, it becomes clear that Malaysia places a great value on export competitiveness of tyres.

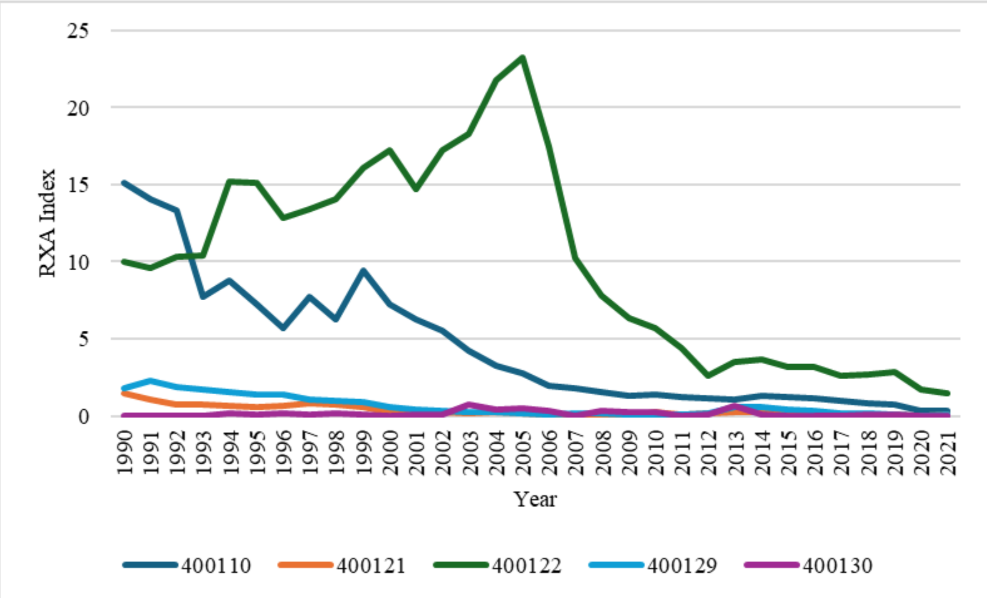

Figure 3: The RXA for Natural Rubber Products in Malaysia (1990-2021)

Export Competitiveness between Malaysia and Thailand

The RXA index results for Malaysia and Thailand for downstream natural rubber goods are shown in Figure 5. Given that the market for natural rubber products has been growing since 2000, Thailand had the best competitive edge. However, as the crises that started in Thailand in early 1998 with a series of speculative attacks on the baht unfolded following several decades of Asia's best economic performance, the competitive advantage gradually diminished. However, the results showed that Malaysia had lost ground to Thailand in the market for natural rubber goods. Malaysia's production and export competitiveness of natural rubber products was extremely poor, and there had not been any particularly impressive performance because the trend had been one of minor increase and drop over time.

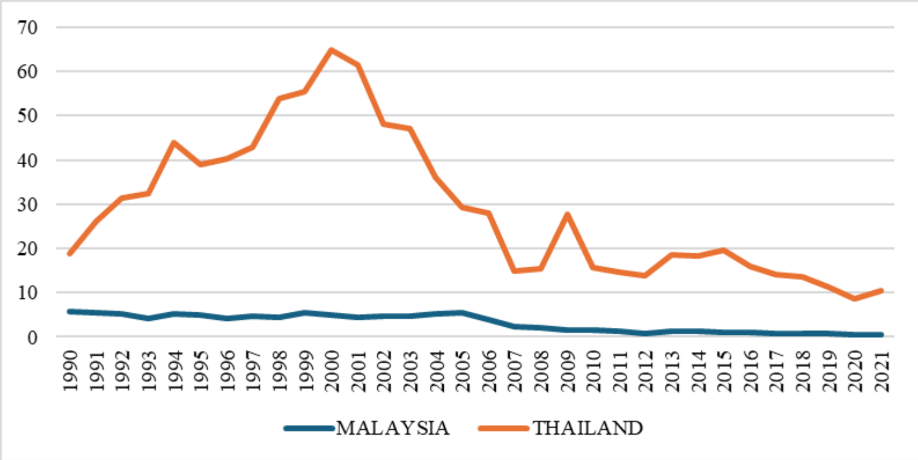

Figure 5: RXA Index for NR Products between Malaysia and Thailand (1990-2021)

Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit Root Test

The finding of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests demonstrated that the p-values for all variables exhibited statistical significance, leading to the rejection of the null hypothesis of stationarity at both the level and first difference. Therefore, the study's conclusion indicated a combination of stationary and non-stationary results for the unit root test. Table 3 below shows the results for the unit root test of all variables in this study which comprised export competitiveness (lnREC), trade openness (lnTO), foreign direct investment (lnFDI), growth domestic product (lnY), and inflation (lnINF). The ADF test and the PP test show that variables lnREC and lnTO are non-stationary at level and stationary at first difference. Meanwhile, variables lnFDI, lnGDP and lnINF were stationary at level for both the ADF test and PP test.

Table 3: ADF and Phillip–Perron Unit Root Test

	ADF		PP	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
Variables	**Level**			
LnREC	0.638474	-1.558957	0.700108	-1.553441
lnTO	-0.555718	-2.294701	-0.720597	-2.714736
lnFDI	-2.745327	-4.284669**	-2.875287*	-7.546610***
lnY	-4.355662***	-4.297619**	-4.300453***	-4.243055**
lnINF	-4.221126***	-5.444901***	-4.236631**	-5.445945***
Variables	**First Difference**			
LnREC	-5.364923***	-5.657580***	-5.363999***	-5.657580***
lnTO	-4.066552***	-4.069827**	-4.148777***	-3.874212**
lnFDI	-5.442092**	-5.936084**	-7.290079***	-13.39111***
lnY	-5.587165***	-4.224870**	-13.93173***	-13.49140***
lnINF	-6.479669***	-8.727359***	-11.34762***	-10.98923***

Note: *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Reported are the results of the intercept and trend. The null hypothesis of the ADF and PP tests investigates the presence of nonstationary panels. The default lag chosen is the Schwarz information criterion (SIC).

Cointegration Bound Test

The first step in the bound test approach of co-integration involves estimating the autoregressive distributed lag (ARDL) model using an appropriate criterion to determine the lag length. The current work utilised the Schwartz Information Criterion (SIC) to ascertain the optimal lag order for the conditional Autoregressive Distributed Lag (ARDL) model, selecting a maximum lag order of 2. The ensuing analysis evaluated the coefficients' combined significance using the Wald test. This statistical process involves imposing limitations on the estimated long-run coefficients of the variables. The findings of the bounded test are presented in Table 4.

Table 4: Bounds Test for the presence of a relationship level

Test Statistic	Value	Sig	I(0)	I(1)
F-Statistic	4.848327*		K=4 N=29	
		1%	4.28	5.84
		5%	3.05	4.22
		10%	2.52	3.56

** Represents the null hypothesis that no cointegration is being rejected at a 10% significance level. The crucial values are derived from Narayan (2005)*

As shown in Table 4 show when lnREC was used as the dependent variable, the null hypothesis of no cointegration was not true because the F-statistic value of 4.8483 was higher than the upper bound critical value at a 5% significance level. The obtained result indicated the rejection of the null hypothesis, which implied the absence of cointegration and gave evidence in favour of a long-term link between the variables. Hence, the long-run co-integration relationship existed between the variables in the model for export competitiveness and its independent variables which were lnTO, lnFDI, lnY, and lnINF in Malaysia.

The long-term coefficients of the ARDL model for each variable are presented in Table 5. The results suggested that the natural logarithm of TO (lnTO) positively affected the natural logarithm of REC (lnREC) and was statistically significant at the 5% significance levels. This result was inline with the Heckscher-Ohlin theorem that indicated that openness allows countries to export goods utilizing their abundant factors of production. The results were also inline with the studies conducted by Galovic (2021) and Sadiku et al. (2019) that indicated increasing openness led to average export growth.

Table 5: Long-run projections derived from the chosen ARDL model (1,1,0,0,0)

Variable	Coefficient	t-Statistic	Prob.
lnTO	1.8377**	2.2753	0.0321
lnFDI	0.0078	0.702218	0.4893
lnY	0.6329	1.010544	0.3223
lnINF	-1.3108*	-1.783736	0.0871
C	0.8749**	8.667770	0.0000

*Notes: ***,**,* are significant at 1%, 5%, and 10%, respectively.*

In contrast, the natural logarithm of INF (lnINF) had a negative effect and statistically significant at the 10% significance levels. This outcome aligned with the Mundell-Fleming model, which emphasized how inflation diminished export competitiveness. Aghion et al. (2019) and Tombolotutu et al. (2019) had also discovered that an increase in inflation leads to a decrease in export growth.

Both coefficients of lnFDI and lnY were positive but not statistically significant. The limited effect of foreign direct investment (FDI) on rubber exports indicated that the influx of FDI had not significantly contributed to the growth of exports. Moreover, the insignificance of FDI in promoting exports is attributed to the fact that export-oriented FDI is mostly concentrated in the electrical and electronics sector (Lee et al., 2018; Sarmidi & Salleh, 2011).

The next phase involved performing diagnostic tests to identify possible issues. In order to guarantee the absence of bias in the chosen model and results, we performed tests for serial correlation, heteroscedasticity, and stability (specifically, CUSUM stability tests). Table 6 presents the results of the diagnostic testing.

Table 6: Diagnostic test for ECM-based ARDL model

Test Statistic	F-Statistic	Prob. Values
Serial Correlation	0.3122	0.6519
Normality	0.0117	0.9941
Heteroscedasticity	0.5647	0.8821
Ramsey RESET	0.3371	0.5671
CUSUM	Stable (refer to fig. 4.1)	
CUSUMSQR	Stable (refer to fig.4.2)	

The diagnostic tests included an analysis of serial correlation, normality, heteroscedasticity, the Ramsey RESET test, the CUSUM test, and the CUSUM square test. The crucial boundaries were established by employing a significance level of 5%. The model was considered stable if the blue line falls inside the critical boundaries, as shown in Figures 6 and 7. However, if the blue line deviated from the crucial thresholds, inconsistency or unpredictability might characterise the model's effectiveness. The findings suggested that the model exhibited both impartiality and consistency.

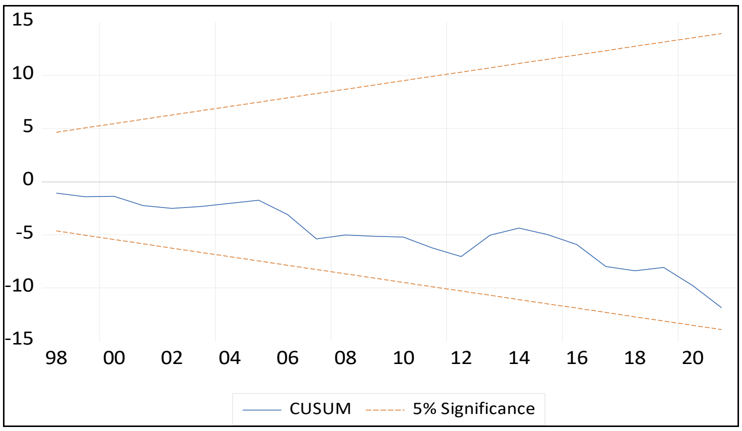

Figure 6: CUSUM Stability Tests

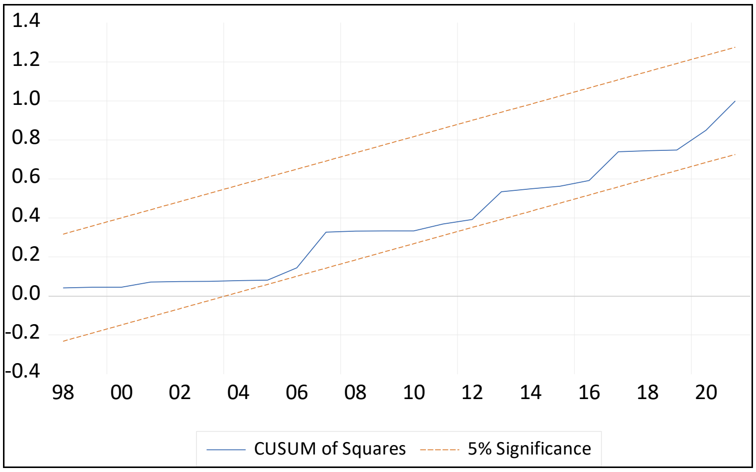

Figure 7: CUSUMSQ Stability Tests

CONCLUSION

This study examined the export competitiveness of Malaysia in the natural rubber industry and compared it to that of Thailand from 1990 to 2021. The RXA index was utilised to gauge the degree of competitiveness in the export of natural rubber for Malaysia and Thailand. According to the RXA index result, Thailand had a greater competitive advantage than Malaysia when it came to exporting natural rubber. The ARDL analysis revealed that TO and INF had a statistically significant influence on Malaysia's export competitiveness in the natural rubber industry. Nevertheless, the absence of any association between Malaysia's export competitiveness in natural rubber and FDI and GDP rendered these variables inconsequential.

Future studies should address certain limitations of this study, including the availability of data. The data gathered for the variables FDI, GDP, and INF included negative numbers. Therefore, it is necessary to convert these values to positive before doing regression analysis in E-Views. Model specification bias may arise when the model is inadequately described or when crucial variables are excluded. This can result in outcomes that are imprecise or untrustworthy. In addition, the RXA just focused on a single commodity and country, so it failed to take into consideration other factors that could influence the competitiveness of rubber exports, such as exchange rates and domestic demand. Further investigation can broaden the scope of examining the influence of TO and INF on export competitiveness, as both factors exhibit a noteworthy effect.

To obtain a more comprehensive knowledge of their influence, it is recommended to investigate additional trade-related factors, such as trade agreements and tariffs. Thailand's superiority in natural rubber export over Malaysia has been substantiated through the utilisation of the RXA index. Subsequent studies may delve into the underlying factors contributing to this disparity and examine strategies for Malaysia to enhance its competitive standing in the international market. To enhance the comprehension of the export competitiveness of Malaysian natural rubber products, researchers could employ sophisticated econometric approaches such as panel data analysis, Granger causality test, and non-parametric techniques.

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APPENDIX

Table A1: RXA Results (Malaysia)

	400110	400121	400122	400129	400130
1990	15.12801205	1.493529486	9.984654069	1.827675287	0.000372168
1991	14.07957518	1.061495675	9.60532422	2.270627607	0.025528526
1992	13.3289536	0.76398501	10.34795986	1.849953035	0.002199802
1993	7.750897626	0.694508048	10.40265799	1.740714198	0.013486452
1994	8.750768952	0.684819759	15.16581435	1.566080798	0.183177806
1995	7.21207182	0.577702065	15.12567917	1.353089996	0.045314493
1996	5.674885333	0.66124433	12.84044336	1.345729607	0.144919228
1997	7.716686597	0.785918832	13.37689475	1.086245952	0.077976031
1998	6.274376645	0.762731068	14.09265471	0.946052179	0.136587208
1999	9.431402538	0.532019553	16.0842631	0.926609596	0.046292999
2000	7.210339612	0.217123278	17.22350569	0.587409528	0
2001	6.27407178	0.289263667	14.7453535	0.436004237	0.096013424
2002	5.504438706	0.238452561	17.23303501	0.348439393	0.045107595
2003	4.254768816	0.138384559	18.32672815	0.279893962	0.745466392
2004	3.215571649	0.241276524	21.79535693	0.238781017	0.393202803
2005	2.776049243	0.160588687	23.21587924	0.126069208	0.449671821
2006	1.958385699	0.072439539	17.51074468	0.099064842	0.287466681
2007	1.781624493	0.093840292	10.21452031	0.139133126	0.01324863
2008	1.536848187	0.087318656	7.793121625	0.154744584	0.350314515
2009	1.323457213	0.039122672	6.343094208	0.104727621	0.230563233
2010	1.350220416	0.236100952	5.675261545	0.090277026	0.223048465
2011	1.199078089	0.05365138	4.396711671	0.079453243	0.029724632
2012	1.158139532	0.163007883	2.570338721	0.143163231	0.059534756
2013	1.086883436	0.235189835	3.50546699	0.539799287	0.634795714
2014	1.262646098	0.204710738	3.636352691	0.602021895	0.103767651
2015	1.205449063	0.116824547	3.15141476	0.389474327	0
2016	1.168824359	0.045190786	3.145902408	0.285221196	0
2017	0.989182903	0.029769975	2.623011845	0.130823316	0.00282825
2018	0.778682885	0.032017567	2.717540931	0.133928659	0.052110007
2019	0.726702383	0.066845697	2.855017353	0.062667511	0.05907775
2020	0.333662911	0.006126197	1.689625608	0.039090028	0.004602698
2021	0.328956606	0.047461374	1.47325036	0.120232834	0.001539303

Table A2: RXA Results (Thailand)

	400110	400121	400122	400129	400130
1990	2.239177272	47.69656064	0	16.15393135	0.000231401
1991	2.959667282	75.26572816	0	25.53981796	0.000459827
1992	4.16092179	86.53007255	0	40.48586113	0
1993	9.982297737	94.96604177	0.002123791	36.01700213	0.282519362
1994	9.963907986	137.8725078	0.009781023	45.85008251	0.121946619
1995	11.10498095	128.0135481	0.009067892	31.4873493	0.297664672
1996	10.35598529	141.6369971	0.01299936	28.1691182	0.14050376
1997	17.15265179	128.5238358	0.017125965	44.93029791	0.183095603
1998	25.97788658	163.7725882	0.021779573	57.33307447	0.307233202
1999	23.9699961	165.1221127	0.020367888	61.45967137	0.188430851
2000	24.7611672	172.6349642	0.010454058	101.1570725	0.011160112
2001	38.03241052	156.9483557	0.000255498	89.98758763	0.001801224
2002	35.54512	124.6082951	0.108817161	56.98631984	0.000539239
2003	36.52496538	120.0222968	0.088401735	54.4440301	0.077270731
2004	30.6769788	70.76553091	0.107136266	52.18534371	0.369574754
2005	39.55435613	38.46271956	0.132052601	41.94650162	0.068280635
2006	39.40024227	35.95642645	0.105833611	45.00775334	-1.59399E-05
2007	20.78062543	31.48852487	3.178206344	6.706230521	-0.000141735
2008	21.86061614	36.72934745	3.477787469	4.654675034	-7.84268E-06
2009	44.6148299	75.76921175	4.623789461	5.392878123	-4.38356E-05
2010	26.58524508	38.02109584	2.908500058	3.331024872	-2.56294E-05
2011	20.89219206	41.3994473	2.316961028	2.483298848	0.149388037
2012	32.20292972	28.1655132	2.007472756	1.852885368	0.259964142
2013	37.37798599	41.05940941	3.976512963	4.539105975	0.223143786
2014	37.06514026	38.7503675	4.696171686	4.424639121	0.142958051
2015	49.66922771	31.74489517	5.978351217	3.732226172	1.957070312
2016	33.19528239	27.47128306	6.121298487	1.8885505	6.203382422
2017	32.26520885	25.42825023	3.710473403	3.611367236	1.890793825
2018	33.45394016	20.62908663	3.812076659	3.851127288	2.54686415
2019	26.18129622	19.97715437	4.026861929	1.888827065	0.262788281
2020	22.06049393	14.56703366	2.927921696	0.823367278	0.072882861
2021	27.15290003	17.66382492	4.735420184	1.127931811	0.036472765

Table A3: RXA Results (Malaysia vs Thailand)

	MALAYSIA	THAILAND
1990	5.686848611	13.21798013
1991	5.408510242	20.75313464
1992	5.258610263	26.23537109
1993	4.120452863	28.24999696
1994	5.270132333	38.76364519
1995	4.86277151	34.18252219
1996	4.133444371	36.06312074
1997	4.608744431	38.16140141
1998	4.442480361	49.48251241
1999	5.404117557	50.15211579
2000	5.047675621	59.71496361
2001	4.368141323	56.99408211
2002	4.673894653	43.44981826
2003	4.749048375	42.23139296
2004	5.176837785	30.82091289
2005	5.34565164	24.03278211
2006	3.985620288	24.09404795
2007	2.44847337	12.43068908
2008	1.984469513	13.34448365
2009	1.608192989	26.08013308
2010	1.514981681	14.16916804
2011	1.151723803	13.44825745
2012	0.818836824	12.89775304
2013	1.200427052	17.43523163
2014	1.161899815	17.01585532
2015	0.972632539	18.61635412
2016	0.92902775	14.97595937
2017	0.755123258	13.38121871
2018	0.74285601	12.85861898
2019	0.754062138	10.46738557
2020	0.414621488	8.090339885
2021	0.394288096	10.14330994