Analysis of Malaysia’s Export Potential of Palm Oil and Its Products to RCEP Member Countries

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ABSTRACT
This study explores the export potential of the Malaysian palm oil industry to RCEP (Regional Comprehensive Economic Partnership) member countries based on the regional economic framework. The panel data from 2018 to 2022 were analyzed using the Trade Gravity Model, RCA (Revealed Comparative Advantage), and TCI (Trade Complementarity Index) indices. The results categorize the fifteen RCEP member countries into three potential classes based on the type of potential. In addition, it was found that the trade complementarity of RCEP member countries showed a significant positive correlation with the export size of Malaysian palm oil and its products. The study provides insights into the trade pattern of palm oil in the region and provides a valuable reference for future trade policy formulation and industry development and provides a basis for research related to the sustainable development of the Malaysian palm oil industry.

KEYWORDS: Trade potential, Gravity Model of Trade, Trade Complementarity Index, PESTEL analysis, Palm oil

1. INTRODUCTION
Globalization promotes the international division of labor in industry, deepening the interdependence of countries and causing some countries to “worry” (Cohen, 2023). Recently, affected by COVID-19, some countries in order to expand domestic employment, and ease the hollowing out of industry, proposed to return the industrial chain back to the domestic. its logic is contrary to the layout of the international division of labor, by public opinion attention (Yang & Laing, 2021). Although the global spread of COVID-19 will further deepen the development of “de-globalization” (Goldberg & Reed, 2023), people have reason to remain optimistic about the future prospects of economic globalization. “Balancing safety and economic efficiency, local production in appropriate quantities coupled with increased strategic stockpiling may be a more realistic way to ensure public health safety” (Sodhi et al., 2023). Together with the impact of the epidemic, the “anti-globalization” trend may spread further. However, this is not a simple “de-globalization”, but should be understood as a “reconstruction of globalzation” and local adaptive adjustment. While some countries and groups are opposed to globalization, there are still many countries that need to rely on the globalized division of labour to improve production efficiency and promote economic development; countries opposed to globalization do not intend to withdraw from the current global economic system; rather, they hope to strive for more benefits for their own national development through changes in the rules, and to alleviate the contradictions that have accumulated in the previous stage of globalization.

The concept and blueprint of the “Regional Comprehensive Economic Partnership” (RCEP) was formally presented at the 2011 ASEAN Leaders Summit in Bali (Kim, 2022). Ten ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam) and six FTA partners (Australia, China, India, Japan, New Zealand, and South Korea) are signatories. Negotiations began in early 2013 and were scheduled to conclude by the end of 2015, but after several twists and turns, India declined to join the RCEP in November 2019 due to strong public and some member states’ objections to certain provisions of the agreement (Seshadri, 2019; Jain, 2021; Gurunathan, 2021). On November 15, 2020, the 10 ASEAN countries formally signed the Regional Comprehensive Economic Partnership Agreement (RCEP) with China, Japan, South Korea, Australia, and New Zealand. On November 15, 2020, the 10 ASEAN countries, along with China, Japan, Korea, Australia, and New Zealand, formally signed the Regional Comprehensive Economic Partnership Agreement (RCEP) with China, Japan, South Korea, Australia, and New Zealand.

The benefits of FTAs include providing open market access, contributing to job creation, expanding the size of markets, facilitating intra-industry trade with greater economic benefits, and increasing the availability of a wider range of products previously unavailable in the market (Kawai & Wignaraja, 2011). However, there are also some risks inherent in FTAs that can lead to higher levels of competition in the domestic market, ultimately forcing firms to restructure, which also makes it more difficult to establish and develop new industries (Saggi et al., 2019), while potentially leading to structural unemployment. Palm oil production is based on the natural environment, and the results of development help both economic growth and environmental improvement, which is an important way of practicing the new development concept and promoting high-quality development. In line with the trend of the times, participating in international competition appropriately is an important way to improve the international competitiveness of Malaysian palm oil and its products. After the entry into force of the Regional Comprehensive Economic Partnership (RCEP), the openness of the markets of the countries in the region has been further improved, which provides more opportunities for the export growth of Malaysian palm oil and its products.

From Figure 1, we can see the basic situation of Malaysia’s palm oil trade from 2011 to 2022, the export volume of palm oil trade showed a trend of first declining and then increasing, and the international trade of palm oil was mainly export-oriented. The broken line X represents the proportion of Malaysia’s palm oil exports in the world’s palm oil exports, with the highest point in the past decade accounting for 35.58% of the world’s palm oil exports in 2013 and the lowest value is only 19.12% in 2022. Table 1 shows the Malaysia palm oil export Competitiveness Index in 2011-2022. \( X_i \) denotes the value of country i’s exports of product j, and \( M_j \) denotes the value of country i’s imports of product j. The value range of \( TC \) is [-1,1], \( TC \) greater than 0 indicates that j product has a comparative advantage, and \( TC \) equal to 0 indicates j production. The product has a neutral comparative advantage, and the \( TC \) is less than 0, indicating that the product j lacks a comparative advantage. From 2011 to 2022, Malaysia’s palm oil export competitiveness showed a fluctuating trend but was relatively stable overall, increasing from 0.8 in 2011 to 0.938 in 2014.

As an important economic pillar of Malaysia, clarifying the development direction and export potential of the palm oil industry will help Malaysia open up more market access opportunities, promote Malaysia’s palm oil exports to RCEP member countries and enhance its competitive advantage; the signing of RCEP may promote the harmonisation of trade rules and standards among member countries, reduce trade barriers and uncertainties, and increase competitive pressure on other member countries (e.g. Indonesia, which also uses palm oil exports as an economic pillar).

![Figure 1: Malaysia’s palm oil exports and its share of the world](image-url)
The signing of RCEP can promote the harmonisation of trade rules and standards among member countries, reduce trade barriers and uncertainty, and also increase competitive pressure on other member countries (such as Indonesia, which also relies on palm oil exports as a backbone of its economy). The reorganisation of supply chain relationships will create challenges and opportunities for the export market and product diversification. This study will be important for Malaysia to respond flexibly to market changes and proactively adjust its strategies to maximise the opportunities arising from RCEP.

2. LITERATURE REVIEW

Most scholars maintain a positive attitude towards the signing of RCEP, (Li & Moon, 2018). The signing of RCEP plays a crucial role in the development and stability of the Asia-Pacific region's economy (Park, 2017) and will put an end to East Asia's longstanding imbalance between "mature production networks, close intra-regional trade" and "lack of overall economic cooperation institutional arrangements", and convey to the world the common will of Asian countries to oppose trade protectionism, adhere to multilateralism and promote economic integration.

At the same time, RCEP, as a large-scale FTA in East Asia, is of great significance to both ASEAN and East Asia, and Basu (2014) argues that RCEP plays an important strategic role in the Asia-Pacific region, and has the potential to become a platform for rule-making in the future, which is expected to strengthen ASEAN’s "centrality" to the Asia-Pacific regional architecture (Shimuzu, 2021). Its institutional safeguards will provide the region with a more stable and predictable trade and economic environment, which is conducive to strengthening confidence in building production networks in the region, shrinking transaction costs, increasing the level of social well-being of the countries in the region, and promoting economic integration in the Asia-Pacific region (Urata, 2013). In the context of the ASEAN+1 FTA's commitments and implementation of tariff reductions, it is found that, except for India, all FTA partners have committed to eliminating more than 90 percent of tariffs for ASEAN, but some countries have not yet reached the target of 95 percent. Fukunaga (2013) suggests that the RCEP negotiations should aim for 95 percent tariff elimination and adopt a "shared concessions" approach. Yew (2010) ASEAN regional economic integration has laid a solid foundation for the internationalization of capital across the region, and a successful case study proves that regional economic integration can help to absorb more foreign direct investment (FDI).

In the short term, RCEP will help the Asia-Pacific region promote regional economic recovery through inclusive and sustainable development. In the long run, RCEP will not only help improve the regional development environment and promote high-quality economic development but will also provide impetus for the common development of the Asia-Pacific region and the world (Petri, 2020). However, other scholars hold the opposite view Chaulia (2020) argues that signing RCEP will bring India a huge trade deficit. India's FTAs such as India-ASEAN Comprehensive Economic Cooperation Agreement (CECA), India-Korea Comprehensive Economic Partnership Agreement (IKCEPA), which came into effect in 2010, and India-Japan Comprehensive Economic Partnership Agreement (IJCEPA), which came into effect in 2011, it is clear that India's FTAs with other countries are not as strong as those with other countries. While India's total trade with other partner countries has increased, India has not benefited commensurately from the openness of its markets to imports, as seen in FTAs such as the India-ASEAN Comprehensive Economic Cooperation Agreement, the India-Korea Comprehensive Economic Partnership Agreement and the India-Japan Comprehensive Economic Partnership Agreement, which came into force in 2011. The same view is held by SenGupta (2020), who uses the ARDL boundary test to estimate the impact of trade liberalization on India's economic growth. The empirical findings show that trade openness has a negative impact on India's economic growth in both the short and long runs.

Wang and Sharma (2021) argue that the legal aspects of the RCEP agreement, including market access, rules of origin, contingency measures, e-commerce, intellectual property protection, and investment-state dispute settlement mechanisms, have the potential to be very problematic. Some studies have focused on "relative trade dependence", but one must focus on a case that can lead to miscalculations (Tan & Soong, 2022). Relative trade dependence reflects the share of the exporting country's GDP in the "volume of exports" to a given foreign market. However, a country may export all of its goods to a particular foreign market, but this export contributes little to GDP. In this case, there is practically no dependency at all.

Malaysia is the world's second-largest producer and exporter of palm oil, which is one of the key pillars of the Malaysian economy, employing around 3 million people (Cai, 2023). However, in recent years, Malaysia's palm oil exports have faced many challenges, such as declining international market demand, price fluctuations, trade barriers, environmental and social pressures, etc. In order to enhance the competitiveness and sustainability of palm oil exports, the Malaysian government and industry have adopted a series of measures, such as strengthening R&D and innovation, promoting sustainable palm oil certification, and opening up new markets and products. While palm oil is essentially part
According to Marikan (2020), RCEP covers nearly one-third of the world's population and economy. The signing and entry into force of RCEP has brought new opportunities and challenges to Malaysia's palm oil exports and has also aroused the attention and discussion of Malaysia's palm oil export potential to RCEP member countries. The research on the palm oil trade mainly focuses on three aspects: trade characteristics, trade efficiency, and trade potential (Helpman & Krugman, 1987). From the perspective of trade characteristics, the evolution of intra-industry trade patterns is mainly explored through the analysis of trade indexes. Early foreign scholars divided intra-industry trade into different types of research and emphasized that intra-industry trade can bring about differentiation in product quality and variety, and it is necessary to enrich the breadth and depth of agricultural trade (Grubel et al., 1971; Falvey, 1981; Cantwell, 1986).

Hubbard et al. (2017) analyzed the trade in agricultural products between Brazil and the European Union and found that the trade between the two sides is still dominated by intra-industry trade, and there are tariffs and other trade barriers. At the same time, some foreign scholars have analyzed the trade competitiveness of agricultural products from the aspects of the trade intensity index and comparative advantage index (Sassi, 2003). Maryam (2019) used the RCA and TCI indices to analyze the trade situation of India and other BRICS countries, arguing that distance is the main factor restricting trade flows. Hossain et al. (2021) calculated the trade intensity and comparative advantage index between China and Bangladesh based on the trade data of China and Bangladesh from 1995 to 2019 and concluded that there is a lot of room for trade expansion between the two countries.

Malaysia’s palm oil capacity and sustainability have also been at the forefront of discussions, and Mahat (2012) has developed a short-term estimate of Malaysia’s palm oil capacity by building a new statistical model, and the results are relatively optimistic. Naidu (2021) reviews and analyzes the Malaysian palm oil industry and shows that the sector is a key element in Malaysia’s economic and environmental sustainability and that key stakeholder decision-makers need to develop strategies to manage the global chaos in the palm oil trade, tariff barriers, and biases in consumer countries to protect domestically produced vegetable oil manufacturing cannot be ignored. Trade potential mainly shows the ability of a country to obtain corresponding benefits when participating in international trade, when the exporting country has great trade potential compared with the importing country, the open trade between the two sides is conducive to the future economic benefits of the exporting country. Cernat (2002) examines potential trade markets based on the actual forecasts of imports and exports between trading partners through a comprehensive trade gravity model.

Previous studies using single trade gravity models have highlighted important research gaps in examining the export potential of palm oil. These gaps may limit a comprehensive understanding of the complexity of the industry and affect accurate forecasting in the analysis of its potential. One of the main limitations of single-trade gravity models is that they tend to ignore the impact of many factors specific to the palm oil industry. Factors that can impact export potential include production costs, quality differences, policy implications, environmental sustainability, and technological innovation. These factors vary across countries and regions and are often not accounted for in traditional trade gravity models. Additionally, palm oil supply chain complexity and market interactions are not adequately captured by single trade models. The industry comprises multiple links, whereas traditional models oversimplify and fail to consider the intrinsic linkages between them. Existing studies have given less consideration to the impact of emerging markets, regional demand, and consumption trends on export potential. Emerging markets and regional demand have become important influencing factors. However, these factors have not been fully integrated into the traditional trade gravity model. The dynamics of the global market are in a constant state of flux. Therefore, this study expands on the single trade gravity model by considering the impact of palm oil industry-specific factors, policy-oriented factors, and geopolitical constraints. This will improve the accuracy
and comprehensiveness of the forecast of export potential. The export potential of Malaysian palm oil is analyzed using the trade competitiveness index (RCA index) and trade complementarity index.

3. MATERIALS AND METHODS

3.1 PESTEL Analysis

The PESTEL analytical model, also known as macro-environmental analysis, is an effective tool for analysing the macro-environment and is a method for investigating the external influences on an organisation, each letter of which represents a factor, and which can be divided into six main factors: political, economic, social, technological, environmental and legal. The structure is shown in Figure 2.

![Figure 2: PESTEL analytical model](image)

3.1.1 Political Analysis

Political System: Malaysia is a federal state with a constitutional monarchy political system. The Head of State is the Supreme Head of State while the Prime Minister is the de facto executive leader. (Victoria and Ameer, 2018) Malaysia’s government structure consists of a national parliament, state parliaments, and executive and judicial bodies.

Political Party System: The major political parties include the National Front (Barisan Nasional, BN) and the Alliance of Hope (Pakatan Harapan, PH). BN had dominated for a long period of time, but in the recent elections, the PH has emerged victorious, bringing about a change in the political landscape. Consultation and competition among political parties have important implications for policy formulation and implementation (Noor, 2021).

Elections and Governance: The most recent national elections took place in 2022, when Alliance of Hope (AOH) Chairman and former Deputy Prime Minister Anwar was sworn in as the 10th Prime Minister on November 24 as the leader of the party with the most seats. PH won a majority of the seats in the election, leading Malaysia into a new political era. Voters expressed concerns about the economy, corruption issues, and social justice, among other topics. The governance model includes coordination and cooperation between the central government and state governments.

Political Stability: Malaysia has enjoyed relative political stability over the past decades. However, social pluralism and ethnic differences may cause some social unrest at certain times. Changes in the international economic and political environment may also have an impact on Malaysia’s political stability.

Foreign Relations: Malaysia actively participates in international affairs and maintains good relations with its neighbours and other international organizations.

Government Policies: The Government is concerned with economic diversification and sustainable development and has supported the development of key industries, such as the palm oil industry, through a range of policies. Tax and trade policy aspects have also helped to attract foreign investment.

Corruption Levels: Corruption has always been a concern for Malaysian society (Najih & Wiryani, 2020). The Government has taken several measures to combat corruption, including the establishment of specialized agencies. However, several challenges remain, posing potential threats to the business environment and the country’s image.

3.1.2 Economic Analysis

As an upper-middle-income developing country, Malaysia has also made remarkable achievements in economic growth in recent years. According to World Bank standards, Malaysia has maintained a relatively high economic growth rate from 2002 to 2007, maintaining a rate of around 5.5%. However, like other countries, the global financial crisis in 2008 and 2009 had a certain impact on the Malaysian economy, resulting in short-term negative economic growth. However, it is exciting that Malaysia has performed well after the crisis, especially in 2010, which quickly achieved positive growth and further accelerated economic growth, achieving a growth rate of 7.42%. Trends in key economic indicators are shown in Figure 3. This demonstrates the Malaysian government’s economic response capabilities and the country’s overall resilience.

![Figure 3: Malaysia’s unemployment, inflation, and GDP growth rates from 2002 to 2022 (World Bank, n.d)](image)
Malaysia’s GDP is approximately US$407.9 billion (2022), and its per capita GDP is approximately US$12,364 (2022). Malaysia’s economic structure is dominated by the service industry (accounting for 52.1%), followed by industry (accounting for 38.2%), and finally agriculture, hunting, forestry, and fishery (accounting for 9.7%). Malaysia’s foreign trade is relatively large, with a merchandise trade volume of approximately US$646.93 billion (2022) and a service trade volume of approximately US$72.84 billion (2022). Malaysia is a member of the World Trade Organization and has trade relations with many countries and regions. Overall, Malaysia’s economic resilience and sustainable growth momentum have brought new opportunities for international cooperation and trade (Zhang, 2023). This provides a positive economic environment for countries that enter into economic partnerships with Malaysia.

3.1.3 Social Analysis

The population of Malaysia is about 33.94 million (World Bank, 2022), of which 67.4 percent are Malays, 24.6 percent Chinese, 7.3 percent Indian and 0.7 percent of other races. There are 15.409 million males and 14.538 million females. The age structure of the population is as follows: 26.0 percent of the inhabitants are under 15 years of age, 68.5 percent are between 15 and 64 years of age, and 5.5 percent are over 65 years of age. Of these, 70 per cent are Malay, 22.7 percent Chinese, 6.6 percent Indian and 0.7 percent of other races. Malay is the national language; English is commonly spoken and Chinese is more widely used. Islam is the national religion and other religions include Buddhism, Hinduism, and Christianity. Overall, Malaysia has a relatively favourable demographic structure, a relatively stable social environment, and few internal religious conflicts.

3.1.4 Technological Analysis

Malaysia has a land area of about 330,000 square kilometres (33 million hectares), of which about 68% is covered by forests. In the proportion of about 26% of nearly 8.6 million hectares of agricultural land, in 2019, the Malay oil palm plantation area of 5.9 million hectares, accounting for 68.6%, oil palm planting area can be expanded space has been little, it is expected that the future enhancement of palm oil production will fall on the discovery of the potential of yields (World Bank, 2022).

In order to support the increase in yields, Malaysia encourages relevant organisations to vigorously research and development of better yield potential species, the latest generation of species has been compared to the first generation and the second generation of species have a significant increase in yields, and drought tolerance performance is superior (Shi, 2020).

Due to the lack of yield potential of the original tree species and the overall aging of the trees, the average yield of Malaysian palm oil in 2019 was less than 35,000 tonnes, and there is still a large gap between the maximum yield potential of the new tree species (Sohaimi et al., 2023). If the planting profit is suitable or the policy encourages, it is expected that with the advancement of old tree replanting, the later oil palm with higher yield potential and younger age structure will bring the production space for Malaysian oil palm that can still be improved.

3.1.5 Environmental Analysis

Malaysia is located in Southeast Asia, and the country is separated into two parts, east and west, by the South China Sea. West Malaysia is located in the southern part of the Malay Peninsula, bordering Thailand in the north, Singapore in the south across the Straits of Johor, the South China Sea in the east and the Straits of Malacca in the west. East Malaysia is located in the northern part of Kalimantan Island and is bordered by Indonesia, the Philippines and Brunei (Andaya, 2019). The total length of the country’s coastline is 4,192 kilometres. It has a tropical rainforest climate. The average annual temperature ranges from 22-28°C in the mountainous areas of the interior and 25-30°C in the coastal plains.

Natural resources are abundant. Rubber, palm oil and pepper are among the world’s top producers and exporters. Once the world’s leading tin-producing country, production has been declining year by year in recent years. There are rich oil reserves, in addition to iron, gold, tungsten, coal, bauxite, manganese, and other minerals. Tropical hardwoods are abundant. Tin, oil, and natural gas extraction are the main industries (Tang et al., 2019). According to the 2021 edition of the BP Statistical Yearbook of World Energy, Ma’s crude oil reserves in 2021 were 2.7 billion barrels and natural gas reserves were 900 billion cubic metres. Oil production in 2021 was 73.7 barrels per day and natural gas production was 200 million standard cubic metres per day. The area of arable land is about 4.85 million hectares. Agriculture is dominated by cash crops, mainly oil palm, rubber, and tropical fruits. The food self-sufficiency rate is about 70 percent. Tropical forests are abundant. Fisheries are mainly offshore fishing, with deep-sea fishing and aquaculture developing in recent years. In 2022, the value of agricultural production was RM100.3 billion. The expansion of oil palm planting areas and the improvement of yields need policy support and enterprise input; in the current market environment of abundant supply, palm oil’s long-term price tends to fall, and the narrowing of profits is expected to form a limitation on the expansion of the oil palm industry. Expansion of the oil palm industry will not happen overnight but will need to be driven by steadily rising demand, which may come from growth.
in edible demand due to an increase in population and per capita consumption, or growth in demand for fuelwood due to the development of the renewable energy industry. Demand affects price, and price acts on profits and industry expansion, which will ultimately support palm oil prices.

3.1.6 Legal Analysis

Malaysia’s legal system is based on the English common law system and the judicial system consists of the Federal Court, the Court of Appeal and the High Court. Malaysia’s main foreign trade laws are the Customs Act, Customs Import Control Regulations, Customs Export Control Regulations, Customs Valuation Regulations, Phytosanitary Act, Protection of New Varieties of Plants Act, Countervailing and Anti-Dumping Act, Countervailing and Anti-Dumping Enforcement Regulations, Safeguard Measures Act 2006. This series of Acts reflects Malaysia’s import and export policy, import regulation, licenses, quotas and import prohibitions, etc. In summary, the main elements are as follows: 1) Provisions on licenses, quotas, and import prohibitions. There are still some commodities that require import licenses from the Ministry of Commerce. Quantitative restrictions on imports of the quota type are generally not used in Malaysia and the guiding principle is to minimise the effect of quantitative restrictions. 2) Fiscal Measures. Adopt the way of low export tax to promote exports, and with the implementation of some monetary policy. 3) Simplification of customs procedures. Simplify application procedures and improve the documentation system to make it more in line with international standards. 4) Strict inspection system: Conduct standardised quality inspection of export commodities and expand standardised quality management of export commodities. 5) Strengthen export services. Expand export service organisations and send more commercial attachés to be stationed abroad to promote exports, collect information and solve problems encountered by exporters on time. 6) Increase support for international trade companies and provide preferential policies for these companies. These include tax incentives, foreign exchange incentives, and relaxation of the scope of business, tax deductions for freight and foreign sales expenses. (vii) Improve information dissemination conditions and other infrastructure to provide favourable information, communication, and transport conditions for foreign trade.

The investment sector in Malaysia is mainly regulated by the Malaysian Investment Commission Act and the Foreign Investment Commission Act. In addition, Malaysia has a series of related laws and regulations, such as the Malaysian Companies Act and the Malaysian Securities Act. In terms of enforcement, the Malaysian government has set up an investment promotion agency to attract foreign investment (Zhang, 2023). Despite Malaysia’s relatively well-developed legal system, in practice, there are still some problems with the enforcement of laws and judicial independence. For example, issues such as political interference and bribery occur frequently, which poses certain risks to foreign investors. Overall, the legal environment in Malaysia is relatively favourable, with a rigorous legal regime for imports, exports and foreign investment.

3.2 Empirical Modelling

3.2.1 Revealed Comparative Advantage

The RCA index of competitive trade in agricultural products based on the RCA index, also known as the Revealed Comparative Advantages Index, is a measure of the degree of comparative advantage by comparing the export situation of a country and an industry with the world average (Balassa, 1989). The RCA Index is measured as the ratio of a country’s share of a particular export industry in its total exports to the proportion of that industry in the world’s total exports, and is expressed by the formula (2):

$$RCA^k = \frac{EX^k_i}{EX^k_w}/\frac{EX^k_m}{EX^k_w}$$

Among them, \(RCA^k\) represents the indicative comparative advantage index of the products of country \(i\), \(EX^k_i\) and \(EX^k_m\) represent the export value of \(k\) products of country \(i\) and all countries in the world, respectively, and \(EX^k_w\) represents the total export value of all products of country \(i\) and all countries in the world, respectively. When the RCA index is greater than 1, it means that the country has a dominant comparative advantage in this industry, and when the RCA index is less than 1, it means that the industry has no explicit comparative advantage. The calculation of the RCA index excludes some fluctuations, specifically, including fluctuations in the national aggregate and fluctuations in the world aggregate, so that the RCA index can better reflect the relative advantages and disadvantages of a particular industry in a country. Specifically, in terms of the value division of the RCA index, if the RCA index > 2.5, it indicates that the country has strong international competitiveness in the industry, if it is 1.25 < 2.5, it means that the country has strong international competitiveness of the industry, if the RCA index is 0.8 < 1.25, it is considered that the country has strong international competitiveness of the industry, and if the RCA index < 0.8, it indicates that the country has weak international competitiveness of the industry. Laursen (2013) proposed the RSCA index as a better measure of comparative advantage, however, the calculation of the trade complementarity index is still based on the previous RCA index.

3.2.2 Trade Complementarity Index

The Trade Complementarity Index (TCI) was proposed
by Drysdale (1969). The main purpose of the index is to measure the extent to which a country’s export patterns are more consistent with another country’s import patterns than with those of the world. The higher the similarity, the more likely it is to trade between them. Figure 4 shows the historical trade complementarity index of Malaysian palm oil products to RCEP agricultural products, 2011-2022. \( RCA_i \) denotes the comparative advantage of product \( k \) in country \( i \) measured by exports and \( RCA_j \) denotes the comparative advantage of product \( k \) in country \( j \) measured by imports. The Trade Complementarity Index can be expressed as follows (3):

\[
TCI_{ij} = RCA_{xi} \times RCA_{mj} \quad (3)
\]

3.2.3 Gravity Model

Gravity Model were first developed in the field of physics and later introduced into the research paradigm of economics by scholars such as Tinbergen, Poyhonen, and Linnemann. After decades of development and refinement, the gravitational model has become one of the important research methods for studying international trade. This model quantifies the trade volume of the two countries, which is of great significance for quantitatively analyzing the changes in the international trade volume. As a key tool in regional economics, gravitational models are widely used to explain and predict international trade flows. Jan Tinbergen first proposed this model in 1962 and was inspired by the concept of Newton’s laws of gravity. With time, the gravitational model has been widely used in international trade research and has become a powerful tool for analyzing trade flow and trade decision-making. By examining both economic and non-economic factors, this model helps researchers gain insight into the complex patterns of trade between countries, thereby contributing to a more comprehensive understanding of global economic interactions. (Van and Brakman, 2010) and Anderson (2011) reviewed and adjusted previous trade gravitational models. The basic form of the trade gravity model is as follows (4):

\[
\log F_{ij} = \alpha + \beta_1 \log GDP_i + \beta_2 \log GDP_j + \beta_3 \log DIS_{ij} + \epsilon \quad (4)
\]

In this formula, \( F \) represents the actual trade volume of country \( i \) to country \( j \), \( GDP_i \) is the GDP of country \( i \), \( GDP_j \) is the GDP of country \( j \), and \( DIS \) is the trade distance between the two countries, which is usually expressed by the distance between the political or economic centers of the two countries.

3.2.4 Extend the Gravitational Model

Taking into account the diversity and complexity of the influencing factors of international trade, the extended gravitational model gradually adds other factors affecting bilateral trade flow to the equation on the basis of the traditional trade gravitational equation, so as to obtain a more universally applicable extended gravitational model with stronger explanatory power for economic phenomena.

In order to comprehensively analyze the potential of palm oil trade in Malaysia, the classical gravitational model is extended. The absolute value of the difference between Malaysia’s GDP per capita and the country to which it exports (NCGr) and the Trade Complementarity Index (TCI) are included in the model as supply and demand factors. It is empirically proved that the population factor does not affect the sensitivity of the regression test of the basic gravitational model, so the population size (Popij) is introduced into the model as an explanatory variable. The Index of Economic Freedom (EFij) is incorporated into the model as an environmental factor.

Figure 4: TCI Index of Malaysian Palm Oil Exports to RCEP Countries’ Palm Oil Imports, 2011-2022.
Whether it is landlocked or not is included as a dummy variable in the model, and the direction of each influencing factor is expected according to the theoretical analysis, as follows (5):

\[ \ln Q_{ijt} = \alpha + \beta_1 \ln GDP_{ijt} + \beta_2 \ln TCI_{ijt} + \beta_3 EF_{ijt} + \delta \ln NCG_{ijt} + \gamma_1 \ln POP_i + \gamma_2 \ln POP_j + \varphi \ln DIS_{ij} + \lambda \text{Landlocked} + \mu_{ijt} \quad (5) \]

where \( \alpha \) is a constant term, the subscript \( i \) represents Malaysia, \( j \) represents the country to which the export is going, \( t \) represents the year of actual trade between the two parties, and \( \mu_{ij} \) represents the random error. The meaning of variables and data sources in the extended gravity model are shown in Table 2.

Table 2: Sources of sample data for 2018-2022 and what they represent

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>Malaysia's total trade with other countries</td>
<td>UN Comtrade Database</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product of RCEP member countries</td>
<td>World Bank WDI</td>
</tr>
<tr>
<td>DIS</td>
<td>Distance between the capitals of the two countries</td>
<td>CEPI database</td>
</tr>
<tr>
<td>Landlocked</td>
<td>Whether it is a landlocked country or not</td>
<td>CEPI database</td>
</tr>
<tr>
<td>EF_{ij}</td>
<td>Index of economic freedom in country ( j ) in year ( t )</td>
<td>Worldwide Governance Indicators Database</td>
</tr>
<tr>
<td>Pop</td>
<td>The size of the population of the RCEP member countries</td>
<td>United Nations Database</td>
</tr>
<tr>
<td>NCG_{ij}</td>
<td>The absolute value of the difference between the per capita GDP of Malaysia and country ( j ) in year ( t )</td>
<td>World Bank WDI</td>
</tr>
</tbody>
</table>

Unlike the classical gravitational model, which assumes that economic size affects bilateral trade, this paper theoretically predicts a negative correlation between Malaysia’s GDP and palm oil exports. Palm oil is versatile and can be used for edible, industrial use, and biofuels. According to USDA statistics, 66% of Malaysia’s palm oil exports are for edible use, followed by 32% for industrial use. Meanwhile, Malaysia’s total population is highly correlated with GDP (0.992), and the expansion of the country’s economy means an increase in domestic demand (Varkkey, 2018). Malaysian palm oil production has grown slowly in recent years, with an average annual growth rate of only 3.98% from 2000 to 2018, according to Nambiappan (2018).

As a result, Malaysia’s GDP growth is expected to dampen palm oil exports. According to the theory of similarity of demand, trade between two countries depends on demand preferences, which are largely determined by the level of per capita income.

The smaller the gap between the GDP per capita of the two countries and the more similar the consumption structure of the residents, the more likely and close the bilateral trade will be. Countries that produce palm oil have a certain self-sufficiency, so there is less demand for imports of palm oil compared to countries that do not produce palm oil or years in which the country does not produce palm oil.

The variance inflation factor values of each explanatory variable obtained by OLS regression are not greater than 10, and there is no multiplicity collinearity between variables. In terms of model selection, based on the results of the Hausman test of LM statistic and cluster robustness standard error, the individual fixed-effect model was adopted. In order to investigate the impact of time effect on Malaysia’s palm oil export potential, the time trend term was incorporated into the model. After testing, the panel data used had problems of heteroskedasticity between groups, autocorrelation within groups, and contemporaneous correlation between groups. In this regard, the panel correction error model (PCSE) was used to deal with the above problems and obtain robust standard errors, and the Driscoll-Kraay standard error model was used to compare with the comprehensive FGLS model. Results are shown in Table 3.

Based on the classical gravity model, supply and demand variables and environmental variables are included in a stepwise manner to test the robustness of the model, and the regression results are shown in Table 3. At the 1% significance level, the GDP of the exporting country is positively correlated with the volume of palm oil exported from Malaysia, which is consistent with the theoretical expectation. All other things being equal, a 1% increase in the country’s GDP is associated with a 1.798% increase in the volume of palm oil imported from Malaysia. Malaysia’s GDP is negatively correlated with the volume of palm oil exports, which is consistent with theoretical expectations, but fails the statistical test at the 10% significance level.

The reduction in the cost of distance favors the export of palm oil from Malaysia, indicating that distance creates trade resistance, contrary to theoretical expectations. This is mainly related to the product characteristics and consumer demand characteristics of palm oil. From the perspective of product characteristics, palm oil is not a fresh and perishable agricultural product, so its export trade is less restricted by geographical distance.

From the perspective of consumer demand, palm oil, especially edible palm oil, as an essential agricultural product, its demand growth is affected by the change of consumer concept and health consciousness. Compared with Southeast Asian countries, South Korea and Japan have a higher standard of living and a greater demand for high-quality and healthy agricultural products. In the past, the main exporters of Malaysian palm oil were concentrated in Europe or
Table 3: Analysis of Factors Affecting Malaysian Palm Oil Export Trade

<table>
<thead>
<tr>
<th>Indicator</th>
<th>PCSE-1</th>
<th>PCSE-2</th>
<th>PCSE-3</th>
<th>Driscoll-Kraay</th>
<th>FGLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln GDP_{ij}$</td>
<td>1.913**</td>
<td>1.825**</td>
<td>1.798**</td>
<td>1.991**</td>
<td>1.648**</td>
</tr>
<tr>
<td>($0.747$)</td>
<td>($0.726$)</td>
<td>($0.733$)</td>
<td>($0.721$)</td>
<td>($0.187$)</td>
<td></td>
</tr>
<tr>
<td>$\ln TCI_{ij}$</td>
<td>0.825**</td>
<td>0.679**</td>
<td>0.433**</td>
<td>0.941**</td>
<td>1.602**</td>
</tr>
<tr>
<td>($2.335$)</td>
<td>($2.241$)</td>
<td>($1.697$)</td>
<td>($1.313$)</td>
<td>($1.483$)</td>
<td></td>
</tr>
<tr>
<td>$EF_{ij}$</td>
<td>3.676**</td>
<td>3.498**</td>
<td>3.275**</td>
<td>3.116**</td>
<td></td>
</tr>
<tr>
<td>($1.241$)</td>
<td>($1.131$)</td>
<td>($0.788$)</td>
<td>($0.392$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln NCG{ij}$</td>
<td>-1.002**</td>
<td>-1.092**</td>
<td>-1.046**</td>
<td>-0.980**</td>
<td></td>
</tr>
<tr>
<td>($0.197$)</td>
<td>($0.186$)</td>
<td>($0.259$)</td>
<td>($0.076$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln POP_{ij}$</td>
<td>6.115**</td>
<td>5.928**</td>
<td>5.741**</td>
<td>7.361**</td>
<td></td>
</tr>
<tr>
<td>($1.919$)</td>
<td>($1.977$)</td>
<td>($1.869$)</td>
<td>($1.581$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln DIS_{ij}$</td>
<td>-0.052**</td>
<td>-0.029**</td>
<td>-0.036**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($0.069$)</td>
<td>($0.115$)</td>
<td>($0.038$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($10.426$)</td>
<td>($11.130$)</td>
<td>($12.909$)</td>
<td>($7.945$)</td>
<td>($3.762$)</td>
<td></td>
</tr>
<tr>
<td>Trend</td>
<td>0.303</td>
<td>0.352</td>
<td>0.165</td>
<td>0.108</td>
<td>0.197**</td>
</tr>
<tr>
<td>($0.192$)</td>
<td>($0.174$)</td>
<td>($0.213$)</td>
<td>($0.099$)</td>
<td>($0.054$)</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.863</td>
<td>0.756</td>
<td>0.841</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wald chi2/F</td>
<td>91.98</td>
<td>107.21</td>
<td>78.75</td>
<td>108.2</td>
<td>412.39</td>
</tr>
<tr>
<td>N</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the Middle East, while the neighboring Southeast Asian countries had less import demand for palm oil. The difference in GDP per capita between the two sides of the trade is negatively correlated with palm oil exports at the 5% significance level, which is consistent with the expectation that the closer the per capita income levels of the two countries are, the greater the volume of palm oil trade.

At the same time, the cultivation of palm oil in palm oil destination countries creates some trade resistance to Malaysian palm oil exports compared to countries or years where palm oil is not cultivated. Therefore, the increase in demand from export countries becomes an important driving force to promote Malaysian palm oil exports. Comparing the regression results of the panel correction error model, the Driscoll-Kraay standard error model, and the full FGLS model, the three are consistent, and there is no significant difference in the direction of effect and significance of the variables that pass the statistical test, indicating that the regression results of this paper are robust.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the regression results of the trade gravity model, we obtained the simulated value of palm oil imports from Malaysia for the 14 export destination countries by measurement. Armstrong (2007) By comparing the actual trade volume ($T$) with the simulated value ($T^*$), we obtained the trade potential ($T/T^*$) of the export destination countries. This paper classifies the 14 countries into three categories based on the magnitude of the potential value: potential re-modelling ($1.2$, $+\infty$), potential pioneering ($0.8, 1.2$), and great potential ($-\infty, 0.8$). Potential re-modelling countries imply that there is a significant gap between the trade volumes of these regions and the simulated values and that they are expected to increase their potential trade volumes by improving their strategies and strengthening their trade partnerships. Potential pioneering countries are close to their potential level but still have opportunities to increase their trade volume and can expand their market share through further cooperation and optimization of trade policies. The high potential countries, on the other hand, perform well in terms of short-term actual trade volumes, but the simulated values indicate that they still have significant untapped potential and may therefore need to explore new trade opportunities and markets more intensively in order to fully realize their trade potential.

Based on a five-year historical trade analysis within the Regional Comprehensive Economic Partnership (RCEP), the study discerns varying levels of export potential between Malaysia and its 14 RCEP member counterparts. The results classify these nations into distinct potential categories: nine countries demonstrate considerable potential, two exhibit an open potential, and three reflect a potential requiring remodelling. The aggregated average trade potential score between Malaysia and RCEP states stands at 0.92, indicative of an open potential. This suggests relatively smooth export activities between Malaysia and RCEP nations. However, it also hints at a certain market saturation among RCEP member countries, leaving limited scope for overall improvement. Consequently, it underscores the urgent need for a transformation in Malaysia’s palm oil export
trade and emphasizes the pressing development of emerging markets across these countries. Specifically, the nine nations displaying high potential encompass Australia, Japan, China, New Zealand, the Philippines, South Korea, Myanmar, Singapore, and Vietnam. Malaysia’s palm oil exports to these countries remain below optimal levels, signifying unrealized trade potential. Strategies to strengthen these exports include advocating for trade liberalization, eradicating trade barriers, enhancing trade efficiency, and fostering a mutually beneficial trade environment. Two countries, Indonesia and Thailand, exhibit potential nearing saturation in Malaysian palm oil exports yet retain some capacity for expansion. Thus, there is a call for a moderate increase in trade resource investment, exploration of novel facets in the palm oil trade, and initiatives to bolster market maturity, thereby augmenting palm oil export volumes. Conversely, Brunei, Laos, and Cambodia signify countries where Malaysia’s palm oil export potential has been maximized, depicting a relatively mature trade scenario. Consequently, sustaining the current momentum becomes crucial while seeking new trade growth avenues through structural export product optimization and enhanced product technology.

4.1 Recommendations

Based on the above, this paper makes the following recommendations: The Malaysian palm oil industry is in the midst of a trend of technological innovation. The application of new technologies, especially the government’s initiative to encourage the use of palm oil as a renewable biofuel, has brought a new direction of green and sustainable development to the industry. Firstly, with the increasing demand for palm oil in the international market, Malaysia should be guided by quality standards, strengthen the supervision of the entire production process to ensure compliance with the requirements of the Agricultural Product Quality and Safety Traceability Management, and gradually create a green and technologically advanced production process. This includes encouraging the reduction of chemical inputs and promoting the establishment of certification systems to enhance the production quality of palm oil. The palm oil industry should take this opportunity to focus on improving product quality standards and ensuring that the production process is environmentally friendly and sustainable. This includes the implementation of new technologies to reduce environmental pollution and energy waste and to help achieve green development goals.

Secondly, the palm oil industry in Malaysia is expected to position itself in the market by emphasizing its renewable energy characteristics. The Government and businesses need to work together to actively promote the advantages of palm oil as an alternative to fossil fuels, strengthen branding for the international market and popularize its advantages and value as a sustainable energy source. At the same time, the popularization of science on green energy should be strengthened to provide domestic and international consumers with awareness and support on eco-friendly products.

Finally, Malaysia’s palm oil industry must establish closer ties with the international market if it is to follow the trend of the global green economy. Malaysia has both great scope for development and important responsibilities in this global green transition. Utilizing the advantages brought about by agreements such as RCEP, the palm oil industry can strengthen cooperation in the field of renewable energy and promote the exchange of technology and trade. This will not only improve the competitiveness of Malaysian palm oil renewable energy in the international market but also help the industry realize its vision of sustainable development.

To that end, Malaysia could enhance cooperation and sharing with countries in terms of technology and information. This includes sharing best practices in the palm oil industry through RCEP and other international cooperation mechanisms to explore green technologies, production methods, and sustainable development strategies. At the same time, expanding broader trade channels and partnerships to promote the international application of renewable energy from palm oil through trade cooperation, contributing to the continued growth of the industry and global environmental sustainability. In addition, Malaysia can also strengthen cooperation with international research institutes and industry associations to develop and promote technological innovations, especially in the area of palm oil renewable energy. Such cooperation could bring more innovative ideas, technical support, and market opportunities to the industry, helping Malaysia to become one of the leaders in the renewable energy sector and contribute more to global environmental sustainability.

4.2 Research Limitations

Although this paper introduces new variables to supplement and expand the traditional trade gravity model, the measurement and estimation of the model still rely on certain assumptions. For example, the model assumes that geographic distance affects trade flow, meaning that countries closer to each other will have greater trade flow, while countries further apart will have smaller trade flows. The economic size effect and the regressive effect are two important assumptions. Countries with larger economies are assumed to have more resources and trade flows.

The extended gravity model does not account for non-trade factors, such as cultural ties, language
barriers, political stability, and differences in legal systems. Additionally, the model’s measurements often use a static framework that assumes constant market conditions, policies, and other factors. This assumption may overestimate the model’s predictive power in practical applications. Finally, the model does not consider the specificities of different countries, industrial structures, technological levels, and differences in economic systems. This ignores the heterogeneity and complexity of the market, which affects the model’s scope of application and degree of accuracy.

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