

# INTERNATIONAL MARKET SELECTION FOR FROZEN SHRIMP EXPORTS FROM THAILAND: AN INTEGRATION OF CAGE DISTANCE FRAMEWORK AND DATA ENVELOPMENT ANALYSIS

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## ABSTRACT

*Purpose* – This research aims to assess and rank the efficiency of countries where Thailand exported frozen shrimp to, and to provide actionable insights for policymakers and stakeholders in the frozen shrimp export industry based on the efficiency scores.

*Methodology* – This study employed the integration of the CAGE Distance Framework and Data Envelopment Analysis (DEA) to investigate the dynamics of international market selection for frozen shrimp exports from Thailand. The study evaluated and ranked the effectiveness of 20 nations that were chosen based on 2022 export values exceeding 1,000,000 US Dollars. The DEA BCC model, utilizing linear programming techniques, categorized these countries as Decision Making Units (DMUs), assessing their efficiency to determine how efficiently a DMU produced outputs given a set level of inputs.

*Results* – Results from the DEA analysis highlighted efficiency leaders with an efficiency score of 1, such as China, the United States, Japan, Taiwan, Hong Kong SAR, Australia, Myanmar, Vietnam, Singapore, Cambodia, and Laos. Additionally, it identified intermediate performers with room for improvement and countries with opportunities for optimization.

*Implications* – This integrated methodology served as a valuable guide for future students and professionals navigating the complexities of the global frozen shrimp trade.

*Originality/Value* – The integration of the CAGE framework with DEA offered a unique approach that had not been explored in previous applications. It established a pioneering approach for policymakers, practitioners, and entrepreneurs.

**Keywords:** International market selection, Frozen shrimp exports, CAGE Distance framework, Data envelopment analysis, DEA

**Paper Type:** Research Article

## INTRODUCTION

Frozen shrimp trade expanded significantly worldwide, establishing Thailand as a major exporter in this market. In the process of international expansion, businesses were required to meticulously evaluate a range of factors encompassing market attractiveness, political stability, economic conditions, cultural disparities, and the long-term potential of the target market (Sakarya et al., 2007). However, the decline in Thai shrimp exports to significant markets like the United States and Japan was attributed to heightened competition from major rivals, particularly India and Ecuador. These competitors provided greater volumes at more competitive prices than Thai shrimp (Thai Frozen Foods Association, 2023). As a result, finding efficient importers

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became essential for making strategic decisions. This raised the question of how efficiently countries that Thailand exported frozen shrimp to were performing. Therefore, this research aimed to 1) assess and rank the efficiency of countries that Thailand exported frozen shrimp to and 2) provide actionable insights for policymakers and stakeholders in the frozen shrimp export industry based on the efficiency scores. The utilization of Data Envelopment Analysis (DEA) in international market selection, as demonstrated by Cano et al. (2017), Elkefi and Layeb (2022), and Wang and Le (2018), facilitated the ranking of the efficiency of exported countries across various goods, providing a comprehensive and nuanced approach to decision-making.

To ensure a more systematic approach in this research, the study incorporated the CAGE distance framework introduced by Ghemawat (2001). This framework encompassed key dimensions such as Cultural, Administrative, Geographic, and Economic distances, playing a pivotal role in international market selection. This framework had been extensively applied in various studies. These applications had highlighted its significance in understanding complexities, guiding strategic decisions, and offering valuable insights into multinational enterprises' decision-making processes (Doanh et al., 2020; Ferreira & Falcão, 2019; Long et al., 2023; Tokas & Deb, 2020; Maciel et al., 2020; Wohlgemuth et al., 2020; Malhotra et al., 2009; Dow, 2000; Miloloža, 2015). Using the attributes of the CAGE distance framework, this research employed the Data Envelopment Analysis (DEA) model in recognition of the complex decision-making process involved in choosing an international market. CAGE distance framework integration with DEA offered a unique approach that had not been explored in previous applications.

## LITERATURE REVIEW

### *International Market Selection*

To select an international market for expansion, companies have considered various factors such as market attractiveness, political stability, economic conditions, cultural distance, and long-term market potential. Sakarya et al., (2007) also emphasized the importance of market selection for international expansion, highlighting the need to consider internationalization, dynamism, and emerging markets. Additionally, Douglas and Craig (2011) stressed the significance of contextual factors in assessing international marketing opportunities, suggesting that these factors provided crucial insights for market assessment. Furthermore, Zhang and Li (2022) discussed the importance of market competition intensity in accurately selecting overseas target markets, especially in the increasingly active and complex international market. Moreover, the choice of entry strategy was crucial for internationalization, as it significantly impacted export performance (Sadaghiani et al., 2011). Sadaghiani et al. (2011) also highlighted the critical role of entry strategy in the internationalization process and its influence on export performance. Similarly, Hasani-Nasab and Shirazian (2019) emphasized the importance of the selection of the entry method as a critical strategic decision for companies seeking global expansion and market selection. Furthermore, the institutional environment and market characteristics of emerging economies played a significant role in market selection. Hitt et al. (2004) found that China's stable and supportive institutional environment influenced alliance partner selection, indicating the importance of considering institutional effects in market selection, particularly in emerging markets. Additionally, Guesmi and Nguyen (2011) demonstrated the varying correlations of international stock markets over time, highlighting the need to assess the global integration of emerging market regions for market selection. Therefore, when selecting an international market for expansion, companies should carefully consider market attractiveness, political stability, economic conditions, cultural distance, as well as contextual factors in long-term market potential.

### *Global Shrimp Export Dynamics*

The global shrimp export market has been influenced by various factors such as trade policies, sanitary and phytosanitary (SPS) measures, and technical barriers to trade (TBT) (Debaere, 2010; Khalili et al., 2018). The export of Thai shrimp in major markets such as the United States and Japan has trended downward due to increased imports from key competitors, particularly India and Ecuador, which have offered larger volumes at lower prices than Thai shrimp. As a result, there has been a shift in shrimp exports towards China and the ASEAN region as an alternative to

the declining primary markets (Thai Frozen Foods Association, 2023). The loss of Thailand's preferential trade status in Europe and differences in food-safety standards during the antibiotics crisis shifted Thai shrimp exports away from Europe towards the United States (Debaere, 2010). Additionally, the impact of SPS and TBT policies on Indonesian shrimp exports has been found to be inconclusive, indicating the complexity of trade regulations affecting shrimp exports (Khaliqi et al., 2018). The determinants of shrimp importation into the USA have been studied, with findings indicating substantial damage or threat to the US shrimp industry from exports of shrimp from Thailand, China, Vietnam, India, Ecuador, and Brazil (He et al., 2013). This highlights the competitive dynamics and trade disputes within the global shrimp market, particularly concerning the USA as a major importing country. Moreover, the competitiveness of shrimp exports from Indonesia and Vietnam has been a focus of research, with studies analyzing the level of competitiveness and export dynamics position among competing countries in the international market (Yolandika et al., 2022; Mashari et al., 2019). These studies provide insights into the competitive landscape and export performance of these key shrimp-exporting countries. In addition to trade dynamics, the sustainability and ecological challenges of market-oriented shrimp farming have been examined, particularly in Vietnam, one of the largest shrimp exporters in the world (Lan, 2013; Nguyen et al., 2019). These studies shed light on the social, ecological, and economic dimensions of shrimp farming, emphasizing the need for sustainable practices in the industry. The economic factors affecting Thailand's frozen shrimp export volume to the United States and Japan have also been investigated, with findings indicating that wholesale prices in Thailand play a key role in determining export demand (Shuquan & Bu-iad, 2020). This underscores the significance of pricing strategies and economic factors in shaping export volumes to key markets. The literature has provided a comprehensive understanding of the complexities and challenges within the global shrimp export market, encompassing trade policies, competitiveness, sustainability, and economic factors influencing key exporting countries such as Thailand, Indonesia, and Vietnam.

### ***International Market Selection Using DEA***

To select international markets using Data Envelopment Analysis (DEA), companies can leverage DEA as a strategic tool to identify their competitive capabilities and recognize market export opportunities Wang and Le (2018). DEA has proven instrumental in international market selection, offering a robust approach to rank the efficiency of exported countries. Cano et al. (2017) and Elkefi and Layeb (2022) applied BCC models of Banker, Charnes, and Cooper in diverse contexts, including the selection of foreign markets for frozen bovine and pharmaceutical products. In addition, DEA was employed as a strategy for stock selection and portfolio construction, utilizing both CCR and BCC models to identify firms with high efficiency. Furthermore, Wang and Le (2018) showcased the application of DEA in international market selection for the export of goods, presenting a case study in Vietnam. Their study aimed to develop an integrated DEA model, combining the Super Slack-Based Measure (Super SBM) and Malmquist Productivity Index (MPI) analysis, to explore the most productive manner in which Vietnam exports goods.

DEA has been widely applied in various fields for different purposes, such as supplier selection and evaluation of the influence of e-marketing on performance (Liu et al., 2020). Besides, in the context of stock selection, DEA models have been widely utilized to construct portfolios and evaluate stock market efficiency (Chen, 2008). Furthermore, DEA models are becoming popular in stock portfolio selection due to their flexibility in selecting inputs and outputs as criteria for portfolio selection (Kedžo & Škrinjarić, 2015). The application of DEA in international market selection aligns with the need for efficient decision-making processes. DEA can be used to assess the efficiency and performance of various entities, providing valuable insights for market selection and entry mode choice processes, particularly for small and medium-sized enterprises (SMEs) (Musso & Francioni, 2014). Additionally, DEA can aid in the evaluation of the efficiency of general insurance companies, contributing to informed decision-making in the insurance sector (Mahyideen et al., 2021). Moreover, DEA has been utilized in the context of portfolio optimization, providing a valuable methodology for investors and researchers

(Huang et al., 2014). The integrated DEA-MODM approach has been proposed as a useful tool for portfolio optimization, offering practical benefits to investors and researchers (Huang et al., 2014). The literature demonstrated the diverse applications of DEA in market selection, portfolio optimization, efficiency assessment, and decision-making processes, highlighting its relevance and effectiveness in supporting strategic choices in international markets.

### ***CAGE Distance Framework***

The literature also addressed the influence of variables such as expropriation risk, psychic distance, and internalization theory on market entry decisions, underscoring the multifaceted nature of the variables influencing international market selection (Hearn et al., 2017; Elia et al., 2019; Sinha et al., 2015). Beugelsdijk et al. (2017) provided a comprehensive review and meta-analysis of literature about cultural distance and firm internationalization. Rothaermel et al. (2006) conducted their empirical analysis focusing on country risk, national culture, and market size concerning international market entry. Malhotra et al. (2009) explored the role of distance factors and target market selection, considering the moderating effect of market potential. Furthermore, Tokas and Deb (2020) applied the CAGE distance framework in their study titled "CAGE distance framework and bilateral trade flows: case of India." The authors utilized the framework to study the role of "distance" in cross-border acquisitions, providing insightful perspectives on its application in international business interactions. Interestingly, the variables used in various studies were relevant to the CAGE distance framework in international market selection.

The CAGE distance framework (Ghemawat, 2001), developed by Ghemawat, encompasses four dimensions: Cultural, Administrative, Geographic, and Economic distances, which are crucial in international market selection and expansion. This framework has been widely utilized in various studies to analyze its impact on different aspects of international business (Yang et al., 2022; Xi & Katsumata, 2019). They highlighted the application of the CAGE distance framework in the context of inbound tourism, emphasizing its role in understanding the comprehensive distance and its impact on tourist satisfaction and consumption of specialty products by inbound tourists. These studies demonstrated the framework's relevance in the tourism industry and its influence on consumer behavior and satisfaction. Furthermore, the CAGE distance framework has been applied in the context of trade efficiency, foreign direct investment outflows, and international trade. Studies by Doanh et al. (2020), Ferreira and Falcão (2019), and Long et al. (2023) explored the impact of institutional and cultural distances on trade efficiency, foreign direct investment decisions, and international trade, highlighting the framework's significance in understanding the complexities of international business interactions. In addition, the CAGE distance framework has been utilized to analyze the challenges of international market selection, subsidiary strategy, and expatriate destination matching. Studies by Tokas and Deb (2020); Maciel et al. (2020); and Wohlgemuth et al. (2020) demonstrated the framework's application in understanding market selection, subsidiary strategy, and expatriate destination matching, providing valuable insights into the decision-making processes of multinational enterprises. Moreover, the framework has been employed in the context of target market selection, psychological distance, and export market obstacles. In addition, Malhotra et al. (2009); Dow (2000); and Miloloža (2015) focused on the role of the CAGE distance framework in target market selection, psychological distance impact on export market selection, and identifying export obstacles, shedding light on its relevance in strategic decision-making. The CAGE distance framework has been widely applied across various domains, including tourism, trade, foreign direct investment, market selection, and strategic decision-making, highlighting its significance in understanding the complexities of international business interactions and expansion.

### ***Cultural Distance***

Cultural differences must be observed on national level. The reason for that is the fact that culture leaves the formative impression on international collaboration (Malhotra et al., 2009). The Hofstede cultural dimensions theory has been widely used in international marketing research to understand cultural values and their impact on market selection (Furrer et al., 2000; Lam et al., 2009; Soares et al., 2007). It provides a framework for comparing cross-cultural

receptivity and understanding the impact of cultural values on marketing ethical norms (Paul et al., 2006). The cultural gap, as measured by Hofstede's dimensions, influences word-of-mouth communication, service quality perceptions, and the development of suitable commercials for culturally different target groups (Lam et al., 2009; Calabrese et al., 2015; Rinuastuti et al., 2014). Cultural distance, as measured by Hofstede's dimensions, influences market entry decisions, with higher cultural distance reducing the likelihood of international market entry (Rothaermel et al., 2006). It also affects the choice of entry modes in emerging markets and influences the success of market entry in small emerging markets (Ha et al., 2020; Gollnhofer & Turkina, 2015; Alexander et al., 2007). Additionally, cultural congruence can strengthen the internal marketing and employee satisfaction relationship, impacting market selection decisions (Huang & Rundle-Thiele, 2014). The cultural gap can also influence the timing of foreign market entry, with near-market knowledge impacting entry timing decisions (Mitra & Golder, 2002). Furthermore, cultural distance significantly affects the entry mode selection of multinational enterprises, particularly in emerging markets (Lv et al., 2021). In conclusion, the cultural gap plays a crucial role in international market selection, influencing market entry decisions, consumer behavior, marketing strategies, and the success of market entry in culturally diverse environments which can be measured by Hofstede's dimensions.

### ***Administrative Distance***

Countries also create administrative and political distance through unilateral measures. These measures can include trade policies, regulatory changes, and sanctions. Therefore administrative distance can be measured through import tariffs and index of Economic Freedom. Import tariffs affect market access and trade efficiency, influencing the volume of imports and welfare (Soderbery, 2021; Anderson & Neary, 2007; Hwang et al., 2011). They can act as a barrier to market entry and impact the welfare of a country, affecting the level of foreign direct investments and trade flows (Soderbery, 2021; Burnie, 2019; Taran et al., 2016). Meanwhile, the Index of Economic Freedom is a significant determinant of economic performance, market integration, and foreign direct investments. It influences the integration of developing countries into global value chains and has a positive impact on employment growth and economic resilience (Burnie, 2019; Siregar et al., 2020).

In the study by Soon et al. (2019), the researchers investigated how adjusting quotas or reducing over-quota tariffs could increase Korean rice imports, revealing important insights into how import tariffs influence decisions related to market selection. Hwang et al. (2011) explored the equivalence of tariffs and quotas within a tariff-rate quota system, offering valuable perspectives on how import tariffs impact market access and trade. Hossain et al. (2018) took a broader approach, examining how globalization, including trade policies like import tariffs, affects economic growth and shapes market selection. In the work by Hranaiova and Gorter (2006), simulations demonstrated that increasing imports is achievable through a moderate expansion of quotas or a reduction in out-of-quota tariffs, providing valuable insights into the influence of import tariffs on market access. Additionally, Chen et al. (2011) examined the equivalence of domestic prices when considering tariff reduction and quota expansion, contributing important insights into how import tariffs shape decisions regarding market selection.

Sambharya and Rasheed (2015) explored how economic freedom affects foreign direct investment and its role in market selection decisions. Apergis and Cooray (2015) analyzed panel data from 138 countries to understand the relationship between economic freedom and income inequality, offering insights into its impact on market selection. Stocker (2016) examined the effects of crises on policy change and liberalization, revealing the dynamic nature of economic freedom and its influence on market selection. These studies collectively highlight the significance of economic freedom in the complex landscape of international business, shaping not only investment decisions but also broader economic indicators.

### ***Geographic Distance***

Geographic distance can affect the cost of transportation. Costs are significantly reduced between companies that are geographically close to each other (Sousa & Bradly, 2006). To assess the impact of geographical factors, transportation and communication infrastructure indices can be considered.

The distance between countries, the physical size of the country, the lack of common border and sea access, and differences in climate, transportation and communication due to time difference can increase costs. Therefore, geographic distance can be measured by distance between countries, temperature difference, time difference and logistics performance index ranking. The logistics performance index ranking influences market access, trade efficiency, and the integration of countries into global value chains (Kawahara, 2013).

The impact of distance on international market selection has been a subject of extensive research in the field of international business. Various dimensions of distance, including psychological, cultural, and geographic distance, have been studied to understand their influence on market selection decisions. The literature provides valuable insights into the complexities of international market selection and the role of distance in shaping firms' strategies and performance. Psychological distance has been identified as a significant predictor of market selection, with its impact decreasing after the first market entry decision but remaining a relevant factor in subsequent decisions Dow (2000). Similarly, the role of psychic distance, or its constituent elements, in determining foreign market selection has been a topic of debate, with no clear consensus in the current literature (Evans et al., 2008). However, it is evident that psychic distance is considered to be a significant predictor of international market selection (Sousa & Lages, 2011). Cultural and geographic distance have also been studied extensively in the context of market selection. The findings suggest that entry priority of small and medium-sized enterprises (SMEs) shifts from countries within a short geographical distance to countries with high purchasing power and within a greater geographical distance (Ojala & Tyrväinen, 2007). Additionally, as geographical distance decreases, export markets are more likely to be chosen, as companies tend to perform best in the foreign markets nearest their respective domestic markets (Lii et al., 2011). The impact of distance factors on firms' internationalization processes has been highlighted, emphasizing several boundary conditions of the impact of distance factors on market selection decisions (Malhotra et al., 2009). Furthermore, it appears that distance remains an important factor in explaining trade flows in commodity markets, including maize (Szerb et al., 2022). Additionally, during the process of market expansion, firms encounter the psychic distance paradox, which poses challenges in market selection and entry strategies (Sinha et al., 2015). The literature also suggests that distance from the home market has a negative impact on international trade levels, highlighting the significance of distance in market selection decisions (Alexander et al., 2007).

The Logistics Performance Index (LPI) has been a subject of extensive research in the field of international trade and logistics. The LPI is a composite index developed by the World Bank to assess the efficiency of logistics and trade facilitation processes in different countries. The literature provides valuable insights into the impact of LPI on international market selection and trade performance. Several studies have investigated the relationship between LPI and international trade, highlighting its significant impact on trade volume, trade probability, and trade efficiency. For example, Wang et al. (2018) found that the LPI of exporting and importing countries is positively correlated with trade volume, indicating that higher logistics performance is associated with increased trade activity. Similarly, Martí et al. (2014) used the LPI as an explanatory variable of trade and confirmed the marked impact that logistics performance has on trade, particularly in terms of infrastructure improvements.

### ***Economic Distance***

Economic distance pertains to factors such as income, wealth distribution, and the comparative purchasing power within a given context. Consumer income, in particular, emerges as a key economic attribute capable of distinguishing between countries. Furthermore, it plays a crucial role in influencing the feasibility of establishing business collaborations and the extent of trade engagement. Therefore GDP per Capita can be used to measure the economic distance. GDP per capita is a significant macroeconomic factor that influences foreign direct investments and economic performance (Taran et al., 2016). The Gross Domestic Product (GDP) per capita has been the subject of extensive research in the field of economics and international business. The GDP per capita is a key indicator of a country's economic performance and standard of living, and it plays a significant role in shaping international market selection decisions. Several studies have

investigated the relationship between GDP per capita and international market selection, highlighting its significant impact on trade, investment, and market attractiveness. For example, Wang and Le (2018) found that GDP per capita is positively correlated with trade volume, indicating that higher GDP per capita is associated with increased trade activity. The impact of GDP per capita on market selection has also been studied in the context of business cycles and economic growth. Osei et al. (2016) found that higher GDP per capita is associated with increased profit and market share for small and medium-sized enterprises (SMEs), influencing their marketing strategies and growth prospects. Additionally, the level of GDP per capita is an important factor in identifying international market competition intensity, reflecting its influence on market dynamics and competitive landscapes (Zhang & Li, 2022). Moreover, the literature suggests that GDP per capita impacts food consumption patterns, housing rent prices, and export performance, indicating its broad influence on market selection decisions (Chen & Chai, 2022; Laurinavičius & Laurinavičius, 2021; Trintini et al., 2021). Furthermore, the GDP per capita of source and destination countries has been found to be significant in shaping coal exports, highlighting its role in international trade and market selection (Az-zakiyah, 2023). In conclusion, the literature provides valuable insights into the significant impact of GDP per capita on international market selection, trade activity, investment decisions, and market dynamics.

Apart from the GDP per capita, inflation rate can also be used to measure purchasing power. The inflation rate affects economic performance and the attractiveness of markets for investment and trade (Hassan & Othman, 2015). The impact of inflation rate on market selection has also been studied in the context of trade and economic performance. For instance, Iqbal et al. (2020) found that high rates of inflation in trading partners have a positive and significant impact on the demand for Pakistani basmati rice, indicating its influence on market selection decisions (Iqbal et al., 2020). Additionally, Singh and Saxena (2022) observed that low inflation rates are associated with increased production efficiency, better allocation of resources, and increased foreign investments, influencing market selection decisions. Moreover, the literature suggests that the inflation rate impacts stock market returns, securities market behavior, and business cycle dynamics, indicating its broad influence on market selection decisions. Shubiri (2010) noted that inflation is inversely correlated to stock market price behavior. Additionally, Kapchanga et al. (2018) found that the inflation rate had a negative effect on securities market returns. In conclusion, the literature provides valuable insights into the significant impact of inflation rate on international market selection, trade activity, investment decisions, and market dynamics.

## **METHODOLOGY**

The DEA (Data Envelopment Analysis) BCC (Banker, Charnes, Cooper) model (Banker et al., 1984) model is typically solved using linear programming techniques. To establish a methodology for international market selection using Data Envelopment Analysis (DEA), countries with the potential to import shrimp from Thailand are represented as Decision Making Units (DMUs). DEA is employed to categorize these countries, aiding the decision-making process for International Market Selection (IMS). The DEA model adopts the notation outlined in Table 1, where N DMU which will be evaluated consumes M inputs to generate S outputs.

**Table 1.** Index and parameter for DEA Model

<b>Index and Parameter</b>	
$j = 1 \dots N$	DMU index
$i = 1 \dots M$	Inputs index
$r = 1 \dots S$	Outputs index
$X(i,j)$	Amount of input i required by DMU j
$Y(r,j)$	Amount of output r used by DMU j
$\lambda(j)$	Weighing of DMU j to build a virtual DMU
$\Phi$	Efficiency of performance of the evaluated DMU

Source: Cano et al. (2017)

In the context of Data Envelopment Analysis (DEA) for international market selection, an output-oriented model is employed to assess the efficiency of decision-making units (DMUs), such as countries. an output-oriented model allows for the DMU to become an efficient entity by increasing outputs while outputs remain unchanged (Cooper et al., 2007). In this framework, the outputs represent the desirable outcomes or benefits that a destination country offers to a business engaging in international trade. These outputs, when assigned higher values, indicate more favorable conditions for business performance within the selected country. The choice of an output-oriented model is driven by the decision-maker's interest in finding a country where the benefits of exporting specific goods or services are maximized relative to the associated costs and efforts. Thus, the mathematical approach of the BCC output-oriented model is described in eq. (1)-(5).

$$\text{Max } \Phi \quad (1)$$

Subject to:

$$\sum_{j=1}^N \lambda_{(j)} y_{(r,j)} \geq \Phi y_{(r,j)} \quad \text{for } r = 1, \dots, S \quad (2)$$

$$\sum_{j=1}^N \lambda_{(j)} x_{(i,j)} \leq x_{(i,o)} \quad \text{for } i = 1, \dots, M \quad (3)$$

$$\sum_{j=1}^N \lambda_{(j)} = 1 \quad (4)$$

$$\lambda_{(j)} \geq 0, \text{ for } j = 1, \dots, N \quad (5)$$

The DEA BCC model (Banker et al., 1984) is a variant of the DEA approach, a non-parametric method used to measure the relative efficiency of decision-making units (DMUs), such as countries, companies, organizations, or other entities. The primary goal of the DEA BCC model is to evaluate the efficiency of each DMU relative to others. Efficiency is assessed by comparing the output produced to the inputs used, and the model identifies the best-performing DMUs. Efficiency scores obtained from the DEA BCC model range from 0 to 1. A score of 1 indicates a fully efficient DMU, while scores below 1 indicate varying degrees of inefficiency.

The selected countries (DMUs) include China (CHN), the United States (USA), Japan (JPN), Taiwan (TWN), Canada (CAN), Hong Kong (HKG), South Korea (KOR), Australia (AUS), Malaysia (MYS), Myanmar (MMR), Vietnam (VNM), Singapore (SGP), the United Kingdom (GBR), Germany (DEU), New Zealand (NZL), Cambodia (KHM), Russia (RUS), Laos (LAO), France (FRA), and Israel (ISR). These 20 countries were chosen based on the exported value exceeding 1,000,000 US Dollars in the year 2022.

This research collected secondary data from online sources available for download on the internet. The Harmonized System code (HS code) 0306, employed to identify frozen shrimp exports from Thailand to various countries, was used to search for import tariffs on the World Trade Organization website, exported amounts on the Ministry of Commerce website, and market share on the Trade Map website. Subsequently, inputs and outputs in the DEA model were calculated using MAXDEA Lite Software. The sources for each input and output are presented in Tables 2 and 3.

**Table 2.** Inputs collected according to CAGE distance framework during August to December 2023

<b>CAGE Distance Framework</b>	<b>Input</b>	<b>Description</b>	<b>Measurement</b>	<b>Online Source</b>
Cultural Distance	Cultural distance (CD)	<p>Measures differences in cultural values between countries across six dimensions: power distance, individualism vs. collectivism, masculinity vs. femininity (Currently changed to Motivation towards Achievement and Success), uncertainty avoidance, long-term orientation vs. short-term orientation, and indulgence vs. restraint. Higher scores indicate greater cultural differences.</p> <p>Represents how disparate one nation is from another, as can be calculated using this formula (Babin &amp; Harris, 2016, pp. 180-201):</p> $CD = \sqrt{\sum_{i=1}^6 (TCSV_i - BCSV_i)^2}$ <p>Where:</p> <p>CD = Cultural Distance</p> <p>TCSV = Target Country Value Score on Dimension <i>i</i></p> <p>BCSV = Baseline Country Value Score on Dimension <i>i</i></p>	1-100	Hofstede Insights (Data as of Aug 2023)
Import tariff (IT)		<p>A tax imposed on imported goods, affecting the cost of doing business across borders. Higher tariffs can make it more expensive to export to a particular country.</p>	%	World Trade Organization (HS Code: 0306; Data as of Aug 2023)
Administrative Distance	Index of Economic Freedom ranking (IEFR)	<p>Measures the degree of economic freedom in a country based on 12 quantitative and qualitative factors, grouped into four broad categories:</p> <p>Rule of Law (property rights, government integrity, judicial effectiveness)</p> <p>Government Size (government spending, tax burden, fiscal health)</p> <p>Regulatory Efficiency (business freedom, labor freedom, monetary freedom)</p> <p>Open Markets (trade freedom, investment freedom, financial freedom)</p>	1-184	The Heritage Foundation (Data as of Aug 2023)
	Logistics Performance ranking (LPIR)	<p>A measure of a country's logistics infrastructure, including factors like customs efficiency, infrastructure quality, and timeliness of shipments. Higher rankings indicate better logistical capabilities and potentially smoother trade processes.</p>	1-139	World Bank (Data as of Aug 2023)

**Table 2.** (Cont.)

CAGE Distance Framework	Input	Description	Measurement	Online Source
Geographic Distance	Distance between Thailand and exported country (DIST)	The physical distance between two countries' capital, measured in kilometers. Greater distances can increase transportation costs and time, as well as logistical challenges.	Kilometer	Google map (Data as of Dec 2023)
	Temperature Difference (TempDiff)	Measures the average temperature disparity between Thailand and the exported country. Higher differences may impact exported countries by influencing product suitability, storage requirements, and overall market adaptability, thereby affecting trade efficiency	Degree Celcius	Trading economics (Data as of Dec 2023)
	Time Difference (TimeDiff)	Measures the time disparity between Thailand and the exported country's capital. Higher differences affect exported countries by influencing communication and coordination challenges, potentially impacting the efficiency of trade processes	Hour	Countries-of-the-word.com (Data as of Dec 2023)
Economic Distance	GDP per capita difference (GDPCap Diff)	The average income per person in a country, serving as an indicator of overall economic development. Significant differences in GDP per capita between Thailand and exported country can signal differences in consumer preferences and purchasing power.	US Dollar per capita	International Monetary Fund – IMF (Data as of Aug 2023)
	Inflation rate (IR)	The rate at which prices increase over time, affecting the cost of goods and services. High inflation rates can make it more challenging to predict costs and manage business operations.	%	International Monetary Fund – IMF (Data as of Aug 2023)

**Table 3.** Outputs collected based on HS Code 0306

Exported Amount (EA)	The exported amount of frozen shrimp to the destination country.	USD	Thailand's Ministry of Commerce (Data as of Aug 2023)
Average exported amt over the past 5 years (AvgEA5Y)	The average exported amount of frozen shrimp to the destination country over the past 5 years	USD	Thailand's Ministry of Commerce (Data as of Aug 2023)
Market Share (MS)	a proportion of the total market for frozen shrimp in that destination.	%	Trade Map (Data as of Aug 2023)

## RESULTS

When collecting data, the cultural scores for Cambodia, Myanmar, and Laos from Hofstede Insights were not available. Therefore, we decided to use the same score difference as Vietnam to be able to continue running the analysis since they belonged to the CLMV group, and their cultural characteristics were assumed to be more or less similar.

Regarding the Index of Economic Freedom ranking, data for Myanmar was not available. In this case, it was recommended to use the data for Laos, as the GDP per capita of Laos and Myanmar was closer compared to Vietnam.

Similarly, for the LPI (Logistics Performance Index) ranking of Myanmar, no data was available. Therefore, the rankings of Cambodia and Laos, both at 115, were used. It's worth noting that Vietnam had a better logistics infrastructure, as reflected in its higher ranking.

Table 4 shows the secondary data collected from online sources based on the Harmonized System code (HS code) 0306, gathered during August to December 2023, as presented below.

**Table 4.** DMUs (Country), Input, and Output Data Collected from Websites during August to October 2023.

DMU	Input								Output			
	CD	IT	IE FR	DIST	LP IR	Temp Diff	Time Diff	GDP Cap Diff	IR	EA	AvgEA5Y	MS
CHN	76.8	6.11	154	4,248	19	18.7	1	5,243.4	0.7	285,275,498	266,215,495.2	3
USA	85.4	0.87	25	14,145	17	16.9	12	73,114.4	4.1	160,819,577	206,625,447.0	1.7
JPN	91.8	0.98	31	4,596	13	14.6	2	26,651.7	3.2	129,595,050	132,386,244.2	4.1
TWN	62.7	18.39	4	2,533	13	5.9	1	25,041.7	2.1	63,494,524	54,406,417.6	10.6
CAN	73.1	2.96	16	13,415	7	30.6	12	45,949.0	3.6	34,426,297	34,390,986.0	4.1
HKG	58.5	0	154	1,728	7	2.7	1	43,870.1	2.2	29,783,417	39,428,914.2	4.7
KOR	73.3	20.26	15	3,666	17	13.9	2	25,849.2	3.4	28,223,440	30,519,360.0	2.1
AUS	85.3	0	13	7,473	19	4.9	3	56,189.1	5.8	24,585,090	35,642,637.2	7.9
MYS	51	0.68	42	1,472.4	26	0.4	1	5,736.1	2.9	15,515,435	20,811,152.8	7.6
MMR	44.2	0	147	611	115	2.8	0.5	5,916.9	14.2	11,862,028	16,587,978.4	96.2
VNM	44.2	0	72	1,003.4	43	1.9	0	2,981.6	3.4	10,882,852	24,908,272.4	1.9
SGP	70.9	0	1	1,829.7	1	0.8	1	80,586.2	5.5	10,145,571	9,600,277.8	4.5
GBR	91.7	11.22	28	9,526	19	17.5	7	41,614.8	7.7	9,942,266	17,652,875.0	1.9
DEU	81.9	10.66	14	8,598	3	17.4	6	45,525.6	6.3	3,139,361	5,434,247.4	0.6
NZL	83.3	0	5	9,734	26	15.7	5	40,773.8	4.9	2,369,411	2,364,505.8	4.7
KHM	44.2	16.06	110	651.6	115	0.5	0	5,382.4	2	2,188,126	4,567,162.4	96
RUS	72.1	4.5	125	7,060	88	30.6	4	5,707.7	5.3	1,671,778	2,208,357.0	0.4
LAO	44.2	0	147	644.3	115	2.6	0	5,419.3	28.1	1,392,802	902,210.0	96.1
FRA	64.4	10.66	57	9,437	13	15.3	6	39,017.2	5.6	1,234,584	1,900,030.6	0.1
ISR	79.8	10.14	34	6,883	26	6	5	45,897.9	4.3	1,231,620	1,049,040.8	5.4

Before running the input and output data, correlations were tested. Table 5 shows Correlation analysis of inputs and Table 6 Correlation analysis of outputs. Correlation values closer to 1 or -1 indicate stronger relationships between variables, while values closer to 0 suggest weaker or no correlation. Highly correlated variables, with correlation coefficients between 0.7 and 1.0 (positive) or -0.7 and -1.0 (negative) (Ratner, 2009), may be removed from the model to avoid redundancy and prevent the inclusion of duplicate or highly similar information. In input model, since "Temperature Difference" and "Time Difference" are highly correlated with distance, it is advisable to consider excluding them. Additionally, since distance is highly correlated with cultural distance, it can be inferred that the further apart countries are, the greater the difference in culture. Therefore, distance can be omitted from the analysis. In output model, "Export Amount" and "Average Export Amount over the Past 5 Years" are highly correlated; therefore, choose to keep "Average Export Amount over the Past 5 Years" as it provides a more stable representation of the country's export performance over time.

**Table 5.** Correlation Analysis of Inputs

Input	CD	IT	IEF	DIST	LPIR	TempDiff	TimeDiff	GDP/Cap	IR
CD	1	0.061	-.568**	.712**	-.635**	.575**	.579**	.607**	-0.334
IT		1	-0.214	-0.008	-0.065	0.105	-0.012	-0.118	-0.271
IEF			1	-.480*	.652**	-0.141	-.448*	-.620**	0.344
DIST				1	-.445*	.747**	.958**	.568**	-0.204
LPIR					1	-0.231	-0.393	-.646**	.583**
TempDiff						1	.693**	0.108	-0.197
TimeDiff							1	.570**	-0.155
GDP/Cap								1	-0.195
IR									1

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

**Table 6.** Correlation Analysis of Outputs

Output	EA	AvgEA5Y	MS
EA	1	.986**	-0.217
AvgEA(5Y)	.986**	1	-0.229
MS	-0.217	-0.229	1

\*\* Correlation is significant at the 0.01 level (2-tailed).

Twenty DMUs were selected. After removing highly correlated coefficients, the existing number of DMUs is deemed sufficient, in accordance with the guidelines proposed by Golany and Roll (1989), which suggest that the number of units should be at least double the number of inputs and outputs considered, resulting in a total of 14 units (5 inputs + 2 outputs = 7; 7 x 2 = 14). Boussofiane et al. (1991) emphasized the importance of achieving good discriminatory power in BCC models by setting a lower bound on the number of Decision Making Units (DMUs) as the multiple of the number of inputs and outputs, recommending a minimum of 20 DMUs (5 inputs x 2 outputs = 10; 10 x 2 = 20).

**Table 7.** DEA Results

DMU	Score	Rank
CHN	1	1
USA	1	1
JPN	1	1
TWN	1	1
CAN	0.72	13
HKG	1	1
KOR	0.35	15
AUS	1	1
MYS	0.45	14
MMR	1	1
VNM	1	1
SGP	1	1
GBR	0.16	18
DEU	0.18	17
NZL	0.9	12
KHM	1	1
RUS	0.01	20
LAO	1	1
FRA	0.02	19
ISR	0.23	16

In Table 7, the DEA analysis of frozen shrimp exports from Thailand to 20 selected countries revealed valuable insights into the relative efficiency of these markets. Notably, several key observations emerged from the data. The DEA analysis sheds light on the relative efficiency of 20 countries importing frozen shrimp from Thailand. It revealed insights into resource utilization and potential for optimization within this dynamic trade sector, which can be concluded below:

*Top Performers: Utilizing Resources Optimally*

China, the United States, Japan, Taiwan, Hong Kong SAR, Australia, Myanmar, Vietnam, Singapore, Cambodia, and Laos stand out with perfect DEA scores of 1 and rank first. These "efficiency leaders" efficiently convert their inputs – likely resources, capital, and infrastructure – into maximum frozen shrimp import volumes. Their adept resource allocation positions them as model importers within the Thai frozen shrimp market.

*Intermediate Performers: Room for Improvement*

Canada, Malaysia, and New Zealand occupy the middle tier with scores between 0.45 and 0.90. While performing well, they possess potential for efficiency gains. Benchmarking against the leaders and identifying areas for streamlining processes could propel them closer to the efficiency frontier.

*Opportunities for Optimization: Addressing Inefficiencies*

The United Kingdom, Germany, Korea Rep., and Israel exhibit scores below 1, indicating opportunities for substantial improvement. The UK, with a score of 0.16, presents the most pressing case for efficiency enhancement. Analyzing underlying constraints and implementing targeted interventions in these countries could unlock significant increases in their frozen shrimp import performance.

*France and Russia: Potential for Transformation*

France and Russia Federation bring up the rear with scores of 0.02 and 0.01, respectively. Their efficiency lags significantly behind the pack. Comprehensive restructuring, strategic investments in infrastructure or trade agreements, and a focus on streamlining import processes could be crucial for them to tap into the full potential of Thai frozen shrimp imports.

## DISCUSSION AND IMPLICATIONS

This study explores the effectiveness of Data Envelopment Analysis (DEA) as a strategic tool for Thai businesses to identify promising international export markets. DEA allows entrepreneurs to assess the efficiency of potential target countries, highlighting competitive advantages and export opportunities. Research by Cano et al. (2017), Wang and Le (2018), and Elkefi and Layeb (2022) reinforces the value of DEA in selecting markets for various products. Our contribution lies in combining DEA analysis with the CAGE distance framework (Ghemawat, 2001). This comprehensive approach acknowledges the significance of external environmental factors captured by the CAGE framework (Cultural, Administrative, Geographic, and Economic distances). This aligns with previous studies emphasizing the multifaceted nature of market selection (Sakarya et al., 2007; Douglas & Craig, 2011). Our findings echo prior research (Sadaghiani et al., 2011; Hasani-Nasab & Shirazian, 2019) by demonstrating the crucial role of strategic market selection in achieving international expansion goals and maximizing export performance. We expand on existing literature by applying the CAGE framework (Ghemawat, 2001) to the specific context of shrimp exports. We recognize cultural, administrative, geographic, and economic distances as key determinants of market selection. Integrating insights from the CAGE framework allows for a holistic perspective on the complexities of international trade. This, in turn, provides practical guidance for Thai businesses navigating diverse market environments, aligning with recent studies in related fields that exhibit varied influence, illustrating the dynamic nature of distance in international business dynamics. (Tokas & Deb, 2020; Yang et al., 2022).

For countries operating at peak efficiency, such as China, the United States, Japan, Taiwan, Hong Kong SAR, Australia, Myanmar, Vietnam, Singapore, Cambodia, and Laos, leveraging the insights from the CAGE framework can aid in maintaining their competitive edge. Understanding the specific dimensions where they excel or face challenges allows for targeted strategies in adapting to evolving market dynamics. Countries in the middle tier, such as Canada, Malaysia, and

New Zealand, can capitalize on the CAGE-informed findings to streamline their processes and potentially move closer to the efficiency frontier.

United Kingdom, Germany, Korea Rep., Israel, France, and Russia, exhibiting lower efficiency scores, necessitate a strategic overhaul informed by the CAGE framework. Addressing cultural, administrative, geographic, and economic distances can unlock untapped potential and facilitate a more efficient integration into the frozen shrimp market.

In essence, the CAGE distance framework, when applied in conjunction with the DEA analysis, not only refines the understanding of efficiency but also guides targeted interventions and strategic decisions in the intricate landscape of international trade. This integrated approach offers a potent tool for policymakers and stakeholders in navigating the challenges and opportunities within the global frozen shrimp trade.

## LIMITATIONS AND FUTURE RESEARCH POSSIBILITIES

### *Limitation of the study*

There are two primary limitations to the study that should be taken into account. First of all, one of the challenges is the lack of complete data from some countries, most notably Laos and Myanmar. As a result, the study chooses a practical strategy by using data from comparable nations. The economic environments of the replacement countries may differ, which creates a possible source of bias even though this substitution permits ongoing investigation. Second, the inherent dynamic of market conditions, a common challenge in international trade studies, adds another degree of complexity. The study may not fully capture the temporal aspect introduced by the dynamic nature of markets, which could hinder the findings' long-term application.

### *Future recommendation*

Future research in the domain of international market selection and trade efficiency could benefit from targeted improvements in data accessibility, methodological refinement, and the incorporation of qualitative factors. Firstly, efforts should be directed towards enhancing data accessibility and completeness, particularly for countries with limited available data. Collaborations with international organizations and initiatives promoting data transparency could contribute to a more comprehensive analysis. Secondly, the exploration of alternative or complementary methodologies, such as the Slack-Based Measure (SBM) in conjunction with Data Envelopment Analysis (DEA), would offer a more detailed perspective on efficiency assessments. Comparative analyses between different models could uncover additional insights and enhance the robustness of efficiency evaluations. Lastly, future research could enrich the analysis by incorporating qualitative factors through methods like interviews, surveys, or case studies. This qualitative dimension would provide a deeper understanding of the contextual factors influencing market selection and trade efficiency, complementing the quantitative findings and offering a more holistic view for policymakers and practitioners.

## CONCLUSION

The DEA analysis of frozen shrimp exports, augmented by the incorporation of the CAGE distance framework, revealed an efficiency landscape among the 20 selected importing countries. China, the United States, Japan, Taiwan, Hong Kong SAR, Australia, Myanmar, Vietnam, Singapore, Cambodia, and Laos emerged as high-efficiency markets with DEA scores of 1, operating at the highest level of effectiveness. Conversely, a middle tier, including Canada, Malaysia and New Zealand, exhibited moderate efficiency, signaling potential areas for improvement. While the United Kingdom, Germany, Korea Rep., and Israel exhibit scores below 1, indicating opportunities for substantial improvement. Notably, France and Russia lagged behind, showcasing substantial inefficiencies in their frozen shrimp import processes.

The DEA research provides insight into the efficiency landscape of Thailand's frozen shrimp exports, especially when combined with the inclusion of the CAGE distance framework. Thai

entrepreneurs may use the findings to boost sales and expand market share in their pursuit of improved market performance.

The CAGE-informed DEA study provides crucial information for Thai firms looking to maximize their efficiency in the global frozen shrimp industry. The differences in efficiency rankings among importing countries highlight the need for strategic steps to acquire a more significant market presence. When designing strategies for certain markets, it is essential to understand the effects of cultural, administrative, geographic, and economic distances.

## CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest found in this research.

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