Journal of Business Technology and Economics
Volume 1, Number 3, July 2024, pp 131-153
E-ISSN: 3046-6822
Open Access: https://journal.pipuswina.com/index.php/jbte/about

An Econometric & Systematic Analysis of Thailand's Economic Output, Exports and Imports; Utilizing Vector Error Correction Methodology

Ali Hamza[1]*, Ferdaous Nechchad[2]
[1,2] Faculty of Economics and Business, Indonesian International Islamic University
* Corresponding Author. E-mail: ali.hamza@uiii.ac.id

Submitted: 29-05-2024 Accepted: 06-06-2024 Published: 06-06-2024

Abstract

Thailand, after Indonesia is Southeast Asia's second-largest economy. Exports made up 65.78% of Thailand's GDP in 2022. The present study, using VECM, measures the long-run effect of import & export on the economic growth of Thailand. For this aim, time series data is obtained for the period of 63 years (1960-2022) from WDI website. Based on literature review, we used logarithmic transformation of variables. The data is analyzed in two sections, descriptive statistics including basic measurement, graphics & correlation while inferential statistics includes unit root testing (ADF & PP), Johansen's Cointegration test, VECM, Impulse response and model error diagnostics. Interestingly Import & Export are found equally contributing to GDP with equal average. The correlation matrix explains significant relation among all variables at α=1%. Stationary of whole series is recorded at 1st difference, I(1). Cointegration test confirms the presence of one co-integrated equation. The VECM incorporates the co-integration model representing negative and statistically C(1) as coefficient of error correction, suggesting the presence of a long-term causal relationship among imports, exports and GDP. Impulse response of LN_GDP & LN_EXP indicates upward impact in them while LN_IMP depict downward trends. The residuals obtained from the Vector Error Correction Model exhibit independent variables (without autocorrelation), follow a normal distribution, and are devoid of heteroskedasticity.

Keywords: *Economic Growth, Imports, Exports, VECM, Thailand Context*

Abstrak

Thailand, setelah Indonesia merupakan negara dengan perekonomian terbesar kedua di Asia Tenggara. Ekspor mencakup 65,78% PDB Thailand pada tahun 2022. Penelitian ini, dengan menggunakan VECM, mengukur dampak jangka panjang impor & ekspor terhadap pertumbuhan ekonomi Thailand. Untuk tujuan ini, data time series diperoleh untuk periode 63 tahun (1960-2022) dari website WDI. Berdasarkan tinjauan literatur, kami menggunakan transformasi variabel logaritmik. Data dianalisis dalam dua bagian, statistik deskriptif meliputi pengukuran dasar, grafik & korelasi sedangkan statistik inferensial meliputi pengujian unit root (ADF & PP), uji Kointegrasi Johansen, VECM, Respon impuls dan diagnostik kesalahan model. mengingat Impor & Ekspor diketahui memberikan kontribusi yang sama terhadap PDB dengan rata-rata yang sama. Matriks korelasi menjelaskan hubungan yang signifikan antar seluruh variabel pada α=1%. Stasioner seluruh rangkaian dicatat pada selisih pertama, I(1). Uji kointegrasi menegaskan adanya satu persamaan yang terkointegrasi. VECM menggabungkan model kointegrasi yang mewakili C(1)

negatif dan statistik sebagai koefisien koreksi kesalahan, yang menunjukkan adanya hubungan sebab akibat jangka panjang antara impor, ekspor, dan PDB. Respons impuls dari LN_GDP & LN_EXP menunjukkan dampak peningkatan sementara LN_IMP menggambarkan tren penurunan. Residual yang diperoleh dari Model Koreksi Kesalahan Vektor menunjukkan variabel bebas (tanpa autokorelasi), berdistribusi normal, dan tidak terjadi heteroskedastisitas.

Kata Kunci: Pertumbuhan Ekonomi, Impor, Ekspor, VECM, Konteks Thailand

1. INTRODUCTION

In the globe stage competition, nations have been compelled to develop effective strategies to heighten their export performance, promote favorable trade balances and ultimately, foster economic growth. The impact of Thailand's dependence on international commerce on the country's economic growth is significant, which is why the study of imports and exports is so important. The influence of global economic swings like as trade wars and interruptions in supply chains, regional rivalry from neighboring ASEAN nations, and the requirement to adapt to technology improvements and green economy norms are some of the key issues that have led to this focus. To add insult to injury, the need of understanding trade dynamics is further highlighted by societal shifts such as an ageing population, increased urbanization, and the requirement for workforce development. These considerations underscore the necessity of intelligent trade policy, economic diversification, and sustainable development plans in order to guarantee long-term resilience and growth that is inclusive. While the earlier studies provided evidence on the ELG hypothesis in the context of Thailand, additional research is warranted to deepen the understanding of the dynamic linkages between the nation's economic performance, export patterns and import trends. Thailand in the SEA region serves as an intriguing case-study, given its multifaceted economic profile and significant global trade presence.

Over recent years, Thailand has navigated dynamic shifts in its economy, largely driven by its robust trade activities. Thailand's economy, as of 2022, is deeply intertwined with its export sector, which plays a pivotal role in the nation's financial dynamics. The exports from Thailand not only contribute significantly to its gross domestic product (GDP) but also underscore its status as a formidable player in the universal market. In focus, the nation's GDP for 2022 was reported at 17.367 trillion baht, approximately $495 billion USD, ranking it as the ninth-largest economy in Asia. This linkage between Thailand’s economic stature and its trade practices forms a crucial area of interest for economic analyses, especially in understanding how trade dynamics facilitate economic growth and stability (Salman et al., 2019). This environment is ripe for exploring various hypotheses concerning the causal relationships between economic growth and trade, thereby updating and expanding upon discussions traditionally found in trade and development literature.

Historically, many quantitative studies, for instance by Kaliappan et al., (2017), Jatuporn et al., (2011) and Panta et al.,(2022)have lent support to the Exports Led Growth (ELG) hypothesis. This hypothesis argues that there is a formative flow from exports to overall economic development, suggesting that countries with substantial export volumes often experience faster economic expansion than those with lesser export activities. In Thailand, the emphasis on bolstering export markets has been a key component of its economic strategy, aligning closely with the ELG hypothesis. As reported by Thailand Export Statistics the country's exports include a diverse array of goods such as Chemicals (1.83%), Preparations of Meat and Seafood (2.03%), Cashew Nuts (2.07%), Mineral Oils and Fuels (3.22%), Precious Stones & Metals (3.29%), Plastics (5.09%), Rubber (6.55%), Vehicles & Parts (10.86%), Electrical Machinery & Equipment

(12.90%) and lastly, Electronics (14.59%). There were identified as the top 10 export commodities from Thailand in 2021.

The concept that trade acts as a catalyst for economic expansion is well-supported in economic literature, but the intrinsic nature of trade as an endogenous variable complicates empirical analysis. This complexity arises because trade activities are both influenced by and are influential to economic growth, creating a cyclic relationship that is challenging to dissect cleanly in statistical models. High-income nations often exhibit increased trade activity; however, this relationship does not strictly imply causality, as other factors might contribute to high incomes which, in turn, boost trade.

In Thailand's context, a nation thriving in the Asia-Pacific region, it becomes imperative to assess both the long & short term effects of trade on economic growth. This includes dissecting the components of trade: imports and exports. Historically, the ELG model has been a cornerstone of economic strategies in many Asian countries. By focusing on enhancing export capabilities, these nations have been able to leverage global markets to fuel domestic economic expansion.

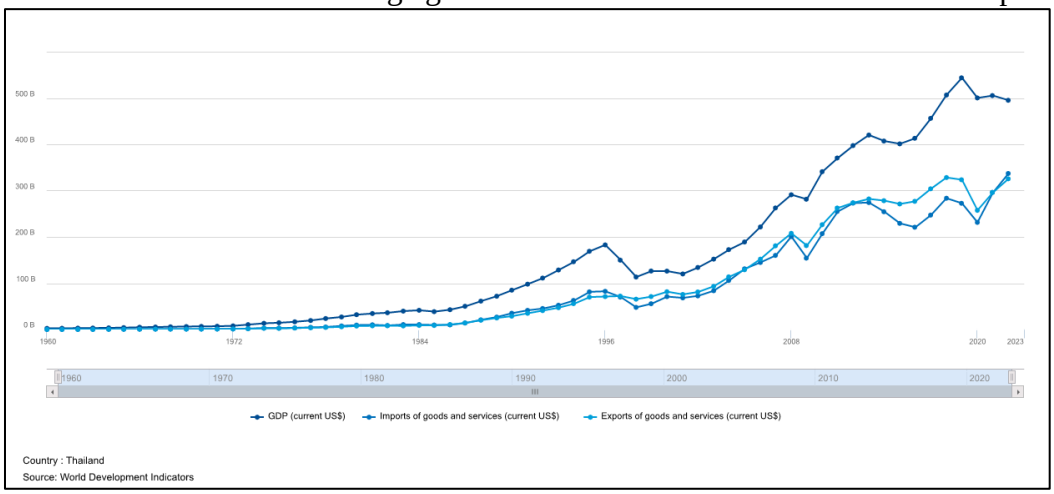

Figure 1: *Volume of Imports & Exports of Thailand w.r.t GDP*

Since 1970 to till time an upward trend has been observed in volume of imports and exports, consequently making an increment in the value of GDP. As outlined in the figure 1, a mixture of trends is reflected from 2019 to 2021. This may be due to the fact the economy was heavily disturbed during COVID-19 time. Economists have noted the various benefits stemming from a robust export sector. An efficient and profitable export sector not only enhances a nation's competitiveness on the global stage but also stimulates economic advancements at home. As the economy grows, its capacity to produce goods and services more efficiently also increases (Saaed et al., 2015; Thangavelu et al., 2004). This improved productivity allows for competitive pricing in international markets, potentially leading to an increased market share abroad.

The theory of "unbalanced growth" offers additional explanations into the relationship among trade and economic growth (Sultanuzzaman et al., 2018). According to this theory, increased production capacity typically leads to heightened export levels. Concurrently, as the GDP of a country increases, so does the purchasing power of its citizens, which can result in increased imports. Thus, economic growth could potentially alter the balance between exports and imports, impacting the trade surplus or deficit (Srinivasan et al., 2010; Kuo et al., 2014).

In sum, understanding the dynamics between economic phenomenal having the impact on trade in Thailand requires a nuanced analytical approach that considers various economic theories and empirical data. By exploring these relationships, policymakers can better devise strategies that leverage trade for economic growth while ensuring sustainable development and stability in the

broader economy. This comprehensive approach not only aids in predicting future economic conditions but also in crafting policies that enhance the welfare of Thailand's populace and its position in the global economy.

Research Questions

1. What kind of link exists between Thailand's economy and its imports & exports?
2. Is there a causal long-term link between Thailand's GDP, imports, and exports?
3. How much does Thailand's GDP fluctuate depending on imports and exports?

Research Objective

1. To examine the short & long-term relationships between trade and economic development in Thailand.
2. To determine the export and import contributions to Thailand's GDP over a last 63-year.
3. To use co-integration and error correction models to ascertain the existence and kind of any long-term equilibrium between GDP, exports, and imports.

Research Contribution

Completion of this study would play a vital role in the academia, in the sense that it will be able to add contributions to the existing literature, whereby those in academia like students & lecturers can be able to benefit from my knowledge. Furthermore, the findings of this study would help policymaker and other stakeholders to make informed decisions.

2. SYSTEMATIC LITERATURE REVIEW

In the past there have been many studies to investigate the impact or relationship of GDP as an indicator of economic growth with other macroeconomic variables especially imports & exports. David Ricardo's theory of comparative advantage, which was first presented in 1817, as well as the Export-Led Growth (ELG) hypothesis, which was stated earlier, both provide evidence that refutes these findings. Ricardo believes that nations that produce goods with a lower level of efficiency may nevertheless engage in trade that is mutually advantageous by concentrating on items that have the lowest absolute loss and comparative disadvantages. On the other hand, research lends credence to the ELG theory, which proposes that nations that have high export volumes see a more rapid development of their economies..

The investigation done by Juliansyah et al., (2022) used a number of tests, such as the unit root, the lag length criteria, the co-integration test, the Granger's causality and VAR model. They measure that trade (i-e, exports & imports) have a favorable impact on the expansion of Indonesia's economy. Pashtoon et al., (2022) using ARDL bounds testing, looks at how tourism affected Thailand's economic development between 1995 and 2018, explain long-run cointegration, but there is no discernible positive connection among FDI and growth of economy. In Nepal, no solid-evidence is found supporting the ELG & GLE hypotheses in both long & short run during 1965 to 2020 (Panta et al., 2022). Raksong & Sombatthira (2021) explain true effective exchange rate of developing ASEAN nations (Indonesia, Malaysia, the Philippines, Thailand, and Vietnam) on quarterly data from 1980Q1 to 2020Q3. The findings indicate that government expenditure and FDI have a favorable effect on the exchange rate.

Oad et al., (2021) confirmed a strong correlation but short-term association between GDP and fisheries exports in Pakistan's economy. A study conducted by Raza et al., (2020) explains long-term cointegration of internal investment, exports-imports with GDP of Thailand, but found no short run relationship. Using a novel technique, Phrakhruopatnontakitti et al. (2020) examines consumption and investment in energy sector in MMVT nations from 1971 to 2005. Results imply that energy supply investment, efficiency, and conservation measures may decrease CO2 emissions and economic development in MMVT (Malaysia, Myanmar, Vietnam and Thailand).

Unique approach of financial metrics like size and efficiency is used by Fukuda (2020) to assess the connection between financial development and economic develop in Turkey, Brazil, India, the Philippines, and Thailand. Results show a positive reciprocal link, with Turkey more prone to crediting financial size for economic progress. Rahman et al., (2020) findout that the price of oil, inflation, trade-related fiscal development, and FDI all contribute to growth in both unidirectional and bidirectional ways. Thus, they suggest that in order to improve. However, in Indian's economy, imports show a unidirectional causal link with economic growth while rising incomes drive rising import expenditures (Devkota 2019) while by the research of Manikandan and Rajarathinam (2019) a negative and substantial co-integration model is shown by the VECM, suggesting a long run causal connection among import and export and GDP. According to the research of Romyen et al., (2019), in Thailand's economy, export-output growth is associated with GDP relative to import and export, but not with export relative to import.

In the Lao PDR (1990 to 2015) both long & short run relationships were examined applying VECM method and the ARDL Cointegration approach (Khamphengvong et al., 2017). Based on data from 2001 to 2014 in Thailand, (Keorite & Moubarak, 2016) find that although exports reduce employment, government spending raises it. In Malaysia, Philippines, and Thailand, there is a bidirectional Granger-causality in short-run dynamics (Lam, 2016). The findings of a research conducted by (Malhotra & Kumari, 2016) imply that all factors i-e, exports & GDP are cointegrated for East Asian economies, with growth-led exports (GLE) occurring in Japan during short-run periods and export-led growth (ELG) is occurring over the long term in China and South Korea. Interestingly, GDP shocks account for around 50% of FDI volatility, while exports have little bearing in Romania from 2005 to 2014 (Popovici & Călin 2016).

Butts et al., (2012) find out a positive & strong relationship in GDP and short-term external debt (STED) in Thailand. Islam et al., (2010) uses ARDL to assess the connection in imports and economic development for 62 nations including USA, UK, Japan, Iceland, Canada, Italy, Algeria etc. They found long-term correlation between import and economic growth. A strong short-term connection between the oil price, employment, economic growth is observed in Malaysia from 1980 to 2005 (Bekhet & Yusoff 2009). The impact of exports & FDI on development of economy at various phases of growth in Chile, India, Mexico, Malaysia, Pakistan, and Thailand is examined by using VECM. The findings indicate that export-led development is visible across South Asia but FDI and production growth in Latin American nations are impacted by exports (Miankhel et al., 2009).

(Sulaiman & Saad, 2009; Liu et al., 2009) discover appreciative correlation in export & economic advancement but negative correlation with import, in the Malaysian economy between 1960 and 2005 using a five-variable model. The export-led growth theory is validated in Asian countries like Singapore, South Korea, Taiwan, and Thailand using VECM (Tan, 2007). It is important to note that, in contrast to emerging nations, which only promote development in the short term, industrialized nations exhibit a bidirectional causal relationship between economic growth and energy consumption over the long term (Mahadevan & Adjaye, 2006).

Baharumshah & Rashid (1999) used the Johansen process and VECM to investigate the correlation between income growth and export growth in Malaysia. They discover a fixed long-run connection between GDP, imports, and exports, with exports driving economic expansion. The research also demonstrates that there is a feedback causal link between exports and economic growth for both types of exports, with manufacturing exports growing as a result of economic growth.

Table 1: *Systematic Summary of Literature*

Contributor	Periods	Methods	Countries	Studied Variable	Core Results
Juliansyah et al., (2022)	1967 2020	Cointegration & VAR Stability	Indonesia	GDP, Imports, Exports	Exports & imports have a favorable impact on Indonesia's economic development.
Panta et al.,(2022)	1965 2020	Cointegration & VECM	Nepal	Economic Growth, Exports, Imports	No evidence supports the ELG & GLE hypotheses in both the short & long run.
Pashtoon et al., (2022)	1995 2018	ARDL Bounds Testing	Thailand	Tourism, FDI,GDP	Long-run cointegration, but no discernible positive relationship among FDI and economic growth.
Raksong & Sombatthira (2021)	Q1:1980 Q3:2020	Cointegration & ECM	ASEAN Nation	FDI, Exchange Rate, GDP	Government expenditure and FDI have a favorable effect on the exchange rate.
Oad et al., (2021)	1960 2017	VECM & OLS	Pakistan	GDP, Exports	Strong correlation but short term association between GDP & Exports.
Raza et al., (2020)	1975 2018	Cointegration & VECM	Thailand	Domestic Investment, Imports, Exports, GDP	Long term cointegration but no short term relationship was found among defined variables.
Phrakhruopatnontakitti et al. (2020)	1971 2005	Error Correction Models	MMVT Nations	Energy Consumption, Economic Growth	Energy supply investment may decrease CO2 emissions and economic development.
Fukuda (2020)	1974 2017	Financial Metrics like size and efficiency	Turkey, Brazil, India, Thai, Philippines	FDI, Trade Openness, GDP	Reciprocal link found between financial scale and economic development in all countries expect in Turkey
Rahman et al., (2020)	1974 2018	Granger Causality & Johansen's Cointegration	Thailand	Oil price, Trade openness, FDI, GDP	Defined variables contribute to economic growth in both unidirectional and bidirectional ways.
Devkota (2019)	Q2:1996 Q2:2019	Cointegration & VECM	India	Exports, Import, Economic Growth	GDP and imports have a unidirectional causal relationship, but growing earnings cause increased import expenditures.
Jermsittiparsert et al., (2019)	1990 2014		ASEAN 5	Public Spending, Economic Growth	Govt. expenditure has significant and positive impact on economic development.
Romyen et al., (2019)	1990 2017	VAR & Threshold VEC Models	Thailand	Export, Import, Production, GDP	Export output growth is linked with GDP relative to import and export, but not with export relative to import.

Manikandan and Rajarathinam (2019)	1950 2014	Co-integration, VECM & Granger Causality test	India	GDP, Export, Imports	A negative and substantial cointegration found, suggesting a long term causal relationship between variables.
Khamphengvong et al., (2017)	1990 2015	VECM & ARDL	Lao PDR	Trade Openness, FDI, GDP	Both short and long term relationships were examined among defined variables.
Keorite & Moubarak 2016	2001 2014	Cointegration & VECM	Thailand	Manufacturing, Jobs, Exports, FDI	Exports have a greater immediate impact on employment declines than FDI
Lam (2016)	1980 2014	ECM & Cointegration	ASEAN	GDP and Exports	Bidirectional Granger causality is observed in short-run dynamics.
Malhotra & Kumari (2016)	1980 2012	Cointegration & VECM	China, South Korea, Japan	Export Performance, Economic Growth	Factors are cointegrated in short run for Japan, and long run for China & SK.
Popovici & Călin (2016	2005 2014	VECM	Romania	GDP, FDI, Goods Exports	GDP shocks account for around 50% of FDI
Butts et al., (2012)	1970 2003	ARDL Bounds Testing	Thailand	Economic Growth & STED	Strong and positive relationship between GDP & short-term-external debt (STED).
Jatuporn et al., (2011)	1961 2009	Granger Causality	Thailand	Agricultural Output, Economic Growth	Long term causal link and influence transmission among defined factors.
Islam et al., (2010)	1971 2009	ARDL	62 Nations	Imports, Economic Development	Long run correlation among imports & GDP is observed.
Jiranyakul, (2010)	1993 2008	Cointegration	Thailand	Real Exports, Real GDP	There is a confirmation of the validity of the ELG hypothesis.
Bekhet & Yusoff (2009)	1980 2005	Granger Causality	Malaysia	Energy Usage, Oil Price, Jobs, GDP	Strong short term connection is seen between macroeconomic variable and GDP.
Miankhel et al., 2009	1960 2005	VECM	6 countries	Export, FDI, GDP	Stationarity effects are seen overall in GDP.
Sulaiman & Saad (2009)	1960 2005	Cointegration & 5 Variable Model	Malaysia	Imports, Exports, Economic Growth	Economic Growth is positively correlated with exports and negatively with imports.
Tan 2007	1960 2000	VECM	4 Asian Countries	GDP, Exports, Investment	Export led growth theory is validated.
Mahadevan & Adjaye (2006)	1971 2002	VECM	20 Countries	Energy Consumption (import-export), GDP	Industrialized nations show a bidirectional causal relationship.
Baharumshah & Rashid (1999)	1970 1988	VECM	Malaysia	Income Growth, Export Growth	A fixed long run connection between GDP, imports & exports is seen.

3. METHOD

This study employs a combination of descriptive and inferential statistical approaches. In order to give a thorough and objective assessment of the most recent data on related researches, a systematic literature review is used to critically examine many studies or publications. This is a methodical approach that is used in many domains such as healthcare, social sciences, and education now a day. During the descriptive analysis, we used rudimentary graphs to delineate the patterns and numerical values of the data. The data is given with fundamental properties such as the averages, St. deviation, and other relevant measurements. Finally, the data is subjected to correlation analysis in order to know the association among all variables. Various tests are performed in the inferential phase of analysis, such as the Augmented Dickey-Fuller and Phillips-Perron unit root tests (which are used to test for stationarity). Methodologically, this study advances beyond the commonly used ADF test, which has faced criticism for its limited efficacy. Instead, it incorporates the PP unit root test, known for its robustness against various forms of heteroscedasticity in error terms and not requiring the specification of serial correlation levels. The Optimal Lang-Length measurement is applied to find the suitable lag-length. Subsequently, the Cointegration test of Johansen is utilized to assess the presence of cointegrating relationships between the under study variables. The model of Vector Error Correction is employed to assess the long term relationship among the variables. Additionally, Impulse response is also considered to identify the short run link among the variables. This methodological approach enables a more precise determination of the direction and strength of these relationships, offering valuable insights for refining Thailand's economic policies to optimize trade and economic outcomes.

3.1 Data & Variables

The time based series pertaining to GDP and Thailand's trade's annual prices (current USD) from 1960 to 2022 has been gathered from the official website of the World Development Indicators (WDI) and presented in table 1 with descriptions.

***Table 1**: Description of Variables*

Name	Abbr.	Description	Source
Gross Domestic Product	GDP	It is amount measured in current US$	WDI
Import	IMP	The total of goods & services imported to Thailand as % of GDP	WDI
Export	EXP	The sum of goods & services exported from Thailand as % of GDP	WDI

3.2 Unit Root Test

The study employed two different tests but used for same purpose i-e, to assess the stationary characteristic of all the variables. First unit root test is ADF or Augmented Dickey-Fuller. This test was introduced in 1979. The second unit root test is PP or Phillips-Perron, introduced in 1988. These tests were conducted using both trend and trend & intercept.

3.3 Johansen Co-integration Test

Understanding cointegration is crucial in econometrics as it determines the existence of a long run relationship among variables with unit-roots and as well as integration of order one. According to this technique, it is determined that multiple random variables become cointegrated when every series is non-stationary and there exists an equilibrium connection in the long-term across the variables. The cointegration technique helps in determining either a set of non stationary data is co-integrated or not. Implementing Johansen requires a certain precondition. When conducting a cointegration test, it is worth to consider that the variables should initially be non-stationary at the level. However, after applying differencing technique, variable will exhibit stationarity. The integration of every variable should be at the identical order. The Johansen procedure, specifically the works of Johansen and Juselius (1990) and Johansen (1991), is used to test the existence and quantity of co-integrating relationships among the foundational variables. In order to determine the total quantity of co-integrating vectors, two tests are commonly employed: the trace test and the test of maximum-eigenvalue. The maximum eigenvalue statistic examines the null-hypothesis of a certain number of cointegrating relations against a different number of cointegrating relations. The test statistics are calculated as follows:

$$LR_{max}\left(\frac{r}{(n+1)}\right) = -T*\log(1-\emptyset)$$

Trace statistic examine the null hypothesis of r co-integrating links compared to the alternative of n co-integrating relations. This analysis is conducted for different values of r, ranging from 0 to n-1, where the total count of variables in the system is denoted by n. The equation is calculated using the following formula:

$$LR_{tr}\left(\frac{r}{(n+1)}\right) = -T*\sum_{i=r+1}^{n} \log(1-\emptyset)$$

The formula calculates the rate of return using the maximum eigenvalue (∅) and the sample size (T). There may be instances where the Trace and Maximum Eigen value statistics produce different outcomes. According to Alexander (2001), in such situations, it is advisable to give preference to the results of the trace test.

3.4 Vector Error Correction Model

If co-integration has been discovered in series, then we are aware that there is a connection capable of managing balance for long period of time between them. Consequently, in order to assess the short-term characteristics of the cointegrated series, we make use of the VECM formulation. The VECM is no longer necessary in the event that there is no cointegration; instead, we go straight to Granger causality tests in order to determine the existence of causal relationships between the variables. Following is an example of the form of the regression equation for the VECM:

$$\Delta X_t = \sum_{i=1}^{n} a_{1t}\,\Delta X_{t-i} + \sum_{i=1}^{n} b_{1t}\,\Delta Y_{t-1} + \sum_{i=1}^{n} c_{1t}\,\Delta Z_{t-1} + \sum_{i=1}^{n} d_{1t}\,\Delta Q_{t-1} + \alpha ECT_{t-1} + e_{1t}$$

$$\Delta Y_t = \sum_{i=1}^{n} a_{2t}\,\Delta X_{t-i} + \sum_{i=1}^{n} b_{2t}\,\Delta Y_{t-1} + \sum_{i=1}^{n} c_{2t}\,\Delta Z_{t-1} + \sum_{i=1}^{n} d_{2t}\,\Delta Q_{t-1} + \beta ECT_{t-1} + e_{2t}$$

$$\Delta Z_t = \sum_{i=1}^{n} a_{3t}\,\Delta X_{t-i} + \sum_{i=1}^{n} b_{3t}\,\Delta Y_{t-1} + \sum_{i=1}^{n} c_{3t}\,\Delta Z_{t-1} + \sum_{i=1}^{n} d_{3t}\,\Delta Q_{t-1} + \gamma\delta ECT_{t-1} + e_{3t}$$

$$\Delta Q_t = \sum_{i=1}^{n} a_{4t}\,\Delta X_{t-i} + \sum_{i=1}^{n} b_{4t}\,\Delta Y_{t-1} + \sum_{i=1}^{n} c_{4t}\,\Delta Z_{t-1} + \sum_{i=1}^{n} d_{4t}\,\Delta Q_{t-1} + \delta ECT_{t-1} + e_{4t}$$

At this point, the error correction term is denoted by ECTt-1. When considering the ECMt variable at the first lag, which controls the long-run path of the dependent variable, it is easy to conceive of it in this manner. In the equations shown above, a coefficient of the ECM that is both negative and significant suggests that any fluctuations that occur among the explained & explanatory variable over a short period of time will result in a stable connection between the variables over the long run.

4. RESULTS AND DISCUSSION

4.1 Graphical Representation of GDP, Import & Export

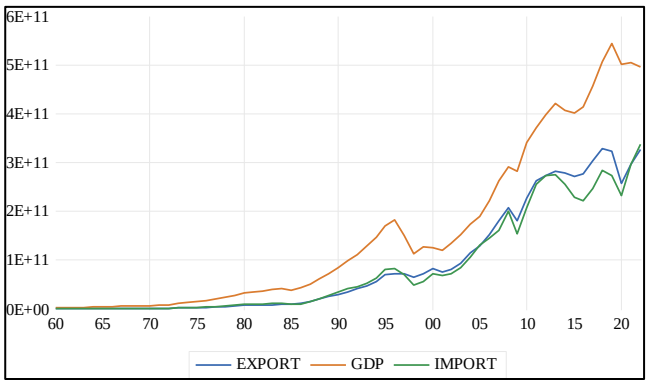

***Figure 2**: Line Graph of GDP, Exports & Import*

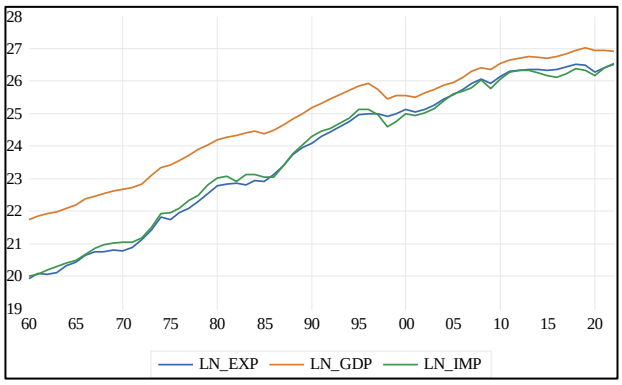

***Figure 3:** Line Graph of Natural Log of GDP, Exports & Import*

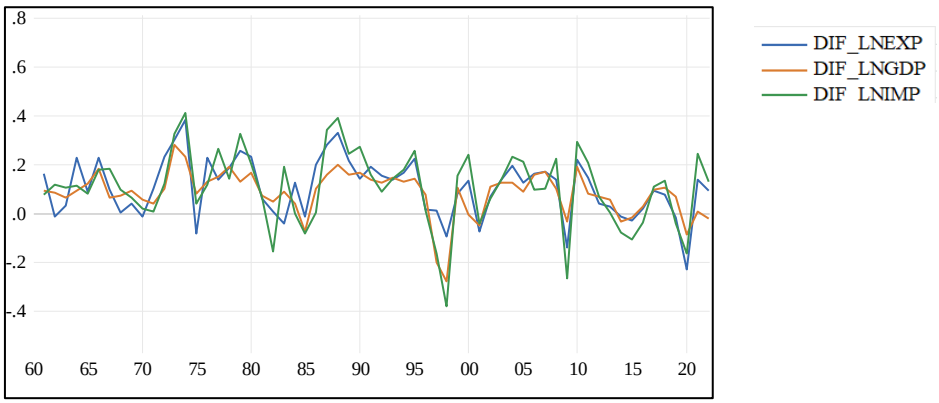

***Figure 4**: Line Graph of 1st Difference of GDP, Exports & Import*

An investigation that was carried out by Manikandan and Rajarathinam (2019) involves the use of the natural log of every macroeconomic indicator. Following the results of the existed studies, complete series pertaining to the variables under investigation have been converted into natural logarithms. The graphs are plotted depending on diffeent feature of data as stated in figure discription. A secular movement may be inferred from the fact that the plot for economy & trade (i-e, imprt-export) demonstrates a long turm move in the same direction across the course of 63 years. In addition, the graphs demonstrate that imports and exports of goods and services make for a significant share of the gross domestic product at all times. Despite the fact that the lines of import and export on the graphs were quite comparable to one another, the contribution of exports to GDP is only slightly higher than the imports.

4.2 Descriptive Statistics

H_0: The data is normal
H_1: The data is not normally distributed

Table 2: *Descriptive Statistics*

Variable	Minimum	Maximum	Mean	Std.	Skewness	Kurtosis	Jarque-Bera	P-value
LN(GDP)	21.73877	27.02217	24.82246	1.647481	-0.39841	1.875897	4.983613	0.08276
LN(IMP)	9.99094	27.02217	23.79659	2.105668	-0.36611	1.760561	5.439895	0.065878
LN(EXP)	19.91519	26.51802	23.76196	2.194884	-0.31897	1.692648	5.554846	0.062199

A presentation of the descriptive statistics of the variables under investigation can be found in table 2. As a consequence of the findings, it has been determined that the mean values of imports and exports are identical, and the standard deviation follows the same pattern. It is common practice to regard numbers that fall within the range of -0.5 to +0.5 to be about typical when it comes to skewness. In light of this, the measures of skewness imply that all variables are symmetric by nature. The value of coefficient of kurtosis suggests that the distribution of data is platykurtic. This mean with fewer & less severe abnormal values. Additionally, the JB test of normality also support these findings, as the p-value more than 5%, rejecting the H1 and indicating that all variables follow a normal distribution.

4.3 Correlation Analysis

H_0: There is no correlation among variables
H_1: There is correlation among variables

Table 3: *Correlation Matrix*

Variable	Ln(GDP)	Ln(IMP)	Ln(EXP)
Ln(GDP)	1		
Ln(IMP)	0.997672 0.0000	1	
Ln(EXP)	0.996041 0.0000	0.998580 0.0000	1

Correlation is significant at the 0.01 level

In order to study the relationships that exist between GDP, imports, and exports, a bivariate quantitative analysis is often used. In order to demonstrate the symmetrical character of the table and to serve as a measure of linear dependency, the diagonal of the table is composed of ones. At the threshold of 0.01, all of the variables in this table have high significant positive correlations with one another. This finding was also corroborated by the study undertaken by Safillah et al., (2024), who conducted an examination of the influence of external debt on the development of the Indonesian economy.

4.4 Unit Root Test

H_0: There is presence of unit root
H1: The data is stationarity

Table 4. *Results of ADF and PP tests*

	Variables	Augmented Dickey-Fuller (ADF) Test		Philipp-Perron (PP) Test	
		Level	1st Difference	Level	1st Difference
Intercept	Ln(GDP)	0.3530	0.0004	0.2726	0.0004
	Ln(IMP)	0.4150	0.0000	0.4559	0.0000
	Ln(EXP)	0.2488	0.0000	0.3132	0.0000
Intercept & Trends	Ln(GDP)	0.8754	0.0008	0.9446	0.0009
	Ln(IMP)	0.9443	0.0000	0.9059	0.0000
	Ln(EXP)	0.9964	0.0000	0.9964	0.0000

p-value less than alpha levels (i-e, 0.0000<0.05) *Source: Author's calculations using Eviews*

Table 4 presents the outcomes obtained from the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) techniques. It is noteworthy that there is a consistent pattern of findings obtained between the ADF and PP tests. All analyzed variables, namely GDP, import, and export, exhibit non-stationarity at levels that reject the null hypothesis of non-stationarity at a significance level of 5%. All three variables being examined exhibit a unit root at level I(0), confirming the results of (Devkota, 2019 ; Manikandan & Rajarathinam, 2019; Goh et al., 2017). In order to mitigate the issue of non-stationarity, we use the differencing approach, namely first difference, to provide stationarity for the whole series. After using first difference techniques, it was seen that the p-values for all variables are below the predetermined significance threshold of 0.05. As a result, the cumulative results suggest that all series have achieved stationarity, denoted as I(1). The integration of all three variables is of the same order. This implies that at the level, the variables exhibit non-stationarity, but when being transformed into first differences, they attain stationarity. It is possible to conduct the Johansen Cointegration test when the variables are integrated in the same order.

4.5 Optimal Lag-Length

***Table 5**: Suggested Lag-Length*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-30.29416	NA	0.000633	1.148075	1.254649	1.189587
1	197.9197	424.9500	3.30e-07	-6.411025	-5.984726*	-6.244973*
2	209.9750	21.20057*	2.98e-07*	-6.516378	-5.770355	-6.225787
3	219.8829	16.39935	2.91e-07	-6.547686*	-5.481940	-6.132556
4	228.8451	13.90682	2.95e-07	-6.546382	-5.160911	-6.006713
5	236.5203	11.11583	3.15e-07	-6.500699	-4.795505	-5.836492

Based upon LR & FPR criteria, we decided to proceed with 2 as an optimal lag-length for rest of analysis.

4.6 Johansen's Co-integration test

For the purpose of locating stationary linear combination and long-run cointegrating equilibrium among the non-stationary variables, Johansen's cointegration test is used. Remember that we only use Johansen's conintegration test on original series or log transformational series. This is a crucial point to keep in mind before proceeding. When it comes to the first or subsequent difference in series, we are unable to apply this test.

H_0: There is no co-integration at all
H_1: The series are co-integration

Table 6: *Results of Johansen's Co-integration test*

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value at α=5%	Prob.**	Max-Eigen Statistic	Critical Value at α=5%	Prob.**
None*	0.3205	32.53148	29.79707	0.0236	23.18040	21.13162	0.0254
At most 1	0.0815	9.351083	15.48471	0.3339	5.102114	14.26460	0.7289
At most 2*	0.0584	4.248969	3.841465	0.0393	4.248969	3.841465	0.0393

Trace test & Max-Eigen Value test indicates 1 cointegrating eqn at the 0.05 level
* Denotes rejection of the null hypothesis (H0) at the 0.05 levels
** MacKinnon-Haug-Michelis (1999) p-values

Table 6 contains the findings of the maximal eigen value test statistics as well as the trace statistics that were performed. With a probability of 5%, the null hypothesis that there is no co-integration equation is strongly rejected. It is clear that the null hypothesis of at most 1 is not supported by either the trace statistics or the maximal eigen statistics. To put it another way, there are a maximum of two equations that are co-integrating among the variables. The findings indicate that there is a link that is in equilibrium over the long term between the variables that were investigated.

Table 7: *Normalized cointegrating coefficients*

1 Cointegrating Equation(s):	Log likelihood	221.7230
Normalized cointegrating coefficients (standard error in parentheses)		
LN_GDP	LN_EXP	LN_IMP
1.000000	2.137991	-2.990161
	(0.44004)	(0.45925)
Adjustment coefficients (standard error in parentheses)		
D(LN_GDP)	0.013151	
	(0.05593)	
D(LN_EXP)	-0.070286	
	(0.07566)	
D(LN_IMP)	0.171468	
	(0.08882)	

ECT=LN(GDP)+2.13799LN(exports)-2.990161LN(import)

Evident from table 7; taking all other factors into consideration, the long-term effect of LN(export) on LN(GDP) is negative, but the impact of LN(import) on LN(GDP) is positive, on average. In terms of statistical significance, the coefficients are significant at the 1% level. In contrast, there is a possibility that there will be deviations from this equilibrium in the short run. It is necessary to determine whether or not such disequilibrium will eventually converge on the equilibrium in the long run. As a result, the Vector Error Correction Model is used in order to effectively construct short-run dynamics.

4.7 Vector Error Correction Model

This is so because the three variables of interest in this study are co-integrated and this will allow for the execution of the Vector Error Correction Model. It is important to hold the perspective that GDP as the dependent variable, this case, whereas import and export are considered to be independent variables. Table 8 presents the independent variable and the properties of the target model, followed by the VECM model:

D(LN_GDP)=C(1)*(LN_GDP(-1) + 2.04081860423*LN_EXP(-1) - 2.89973934714*LN_IMP(-1) - 4.31490627877) + C(2)*D(LN_GDP(-1)) + C(3)*D(LN_EXP(-1)) + C(4)*D(LN_IMP(-1)) + C(5)

Table 8: *Results of Fitted VECM*

	Coefficient	**St. Error**	**t-Statistic**	**Prob.**
C(1)	-0.46706	0.048598	-2.961069	0.03406
C(2)	0.571248	0.206023	2.772736	0.0075
C(3)	0.108327	0.165058	0.656294	0.5143
C(4)	-0.132939	0.150946	-0.880703	0.3822
C(5)	0.037197	0.015607	2.383329	0.0206

R-Squared	0.34395	Mean dependent vra	0.083533
Adj. R^2	0.289947	S.D dependent var	0.094034
S.E of Regression	0.084633	AIC	-2.022561
SSE	0.401118	Schwarz Criterion	-1.849539
Log Likelihood	66.68812	Hannan-Quinn Crit.	-1.954752
F-Statistic	4.517302	D-W stat	1.981781
Prob(F-Statistic)	0.003113		

Here C(1) is the co-efficient of co-integration which is negative and significant this implies the exists a long run causality from import and export to the GDP. Furthermore, it also says that there is long run effect with both the independent variable Import and Export. All the coefficients C(2), …, C(4) are termed as Short Run Coefficients. The next result from the model focuses on the overall fitness of the model which is indicated by R Squared value, which asserts that it is highly significant; it means that export and imports which are the independent variables can account for not less than 34% of changes in the dependent variable, which is GDP. This is because other variables will be affecting the GDP, implying that analyzing and comparing the real GDP will be easier and more effective. It is evident from the above results that the D-W statistics value is almost close to two; therefore, the residuals due to the VECM are independently distributed. For better and consistent estimates, diagnostic checks on VECM model will be performed including; Normality, Serial correlation and Heteroskedasticity tests.

In-sum, one of the most important aspects of Thailand's economic strategy has been the country's efforts to strengthen its connection to export markets. Commodities such as chemicals, meat and seafood preparations, cashew nuts, minerals, precious stones, metals, plastics, rubber, cars, electrical machinery, and electronics were among the top ten most exported goods from the nation in the year 202.

4.8 Impulse Response

Impulse response measurement is a statistical technique used to examine the impact of a shock on many variables. Modifications in the value of a single variable will have an impact on both the variable itself and additional variables. The impulse response analysis reveals the direction of the link between the size of the effect between variables and the expected time necessary to establish a balance of values on a variable.

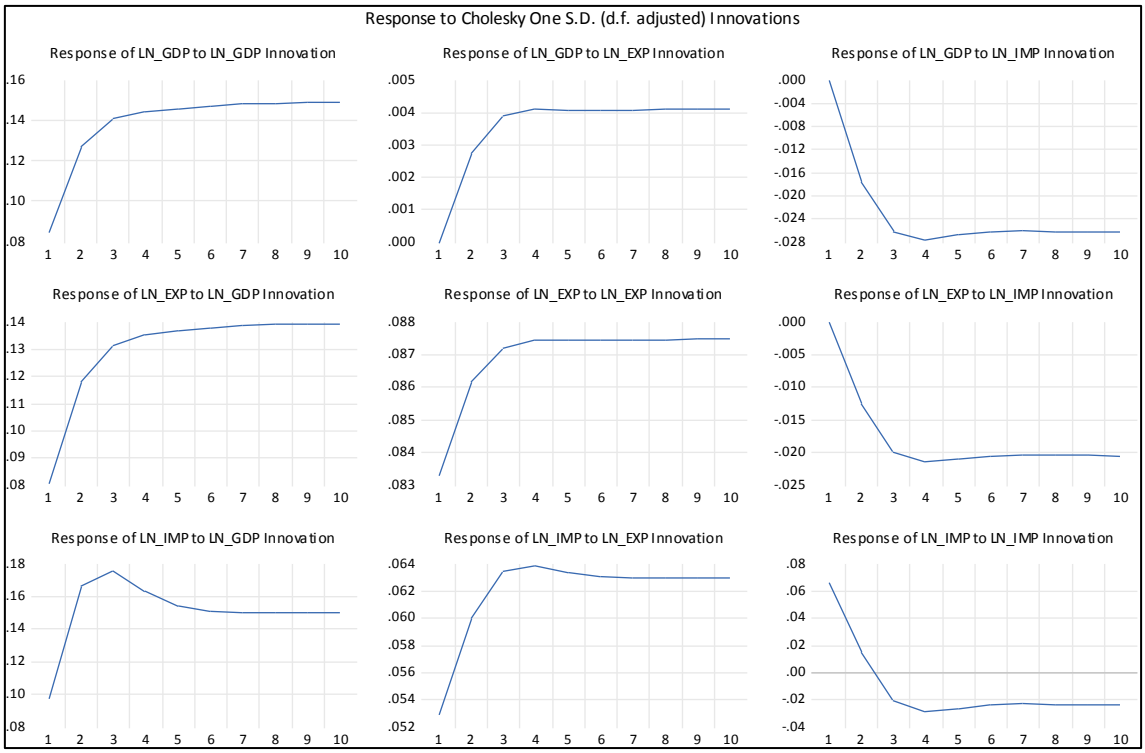

***Figure 5**: Impulse Responses of GDP, Exports & Import*

If there is shock from LN_GDP the response of LN_GDP will increase sharply until time-lag 3. Also if there is shock from LN_EXP the impact to the LN_GDP will be increasing until lag-3 and will go back to equilibrium fatly as compare to LN_GDP. However the shock from LN_IMP will results in quick decline in LN_GDP up-to time-lag 3 and uniformity will be reflected after lag 7. Moreover, if there is any shock from LN_EXP to LN_GDP & to itself (LN_EXP), it will reflect approximately similar response to LN_EXP i-e, the curve will keep increasing until time-lag 2 and will achieve equilibrium. Furthermore, the shock from LN_IMP to LN_EXP will result a clear downward trend till lag 3. Lastly, the shock from LN_IMP to LN_GDP will impact in increase in LN_GDP up to lag term 2 & decrease till lag 6, after that it will obtain uniformity. However same pattern will be reflected by LM_EXP to LN_IMP but the effect will return to equilibrium fatly as compared to LN_GDP. Interestingly, the shock from LN_IMP to itself will give negative impact till time-lag 3.

4.9 Diagnostics Checks

I. Serial Correlation

Since the probability value of both LRE Stat & Rao-F test are higher than 5%, indicating the evidence of no overall serial correlation in the model.

***Table 9**: VEC Residual Serial Correlation LM Tests*

Lag	LRE* Stat	df	Prob.	Rao-F-stat	d.f	Prob.
1	9.458569	9	0.3961	1.060949	(9, 124.3)	0.3964
2	13.82528	9	0.1287	1.577878	(9, 124.3)	0.1289

II. Normality

A commonly use test to check the normality is Jarque-Bera test, VEC residual normality test confirms the value of Jarque-Bera test is higher than p-value of 5%. Thus, residuals are normality distributed.

Table 10: VEC Residual Normality Test

Jarque-Bera	Degree of freedom	prob.
14.71255	6	0.226

III. Heteroskedasticity

The last measure to ensure the effectiveness of VECM is to check heteroskedasticity. Since the p-value of joint test for VEC residual heteroskedasticity is higher than the threshold of 5% so we conclude that there is no overall heteroskedasticity.

Table11*: Joint test for VEC Residual Heteroskedasticity*

Chi-Sq	Degree of freedom	Probability Value
63.96124	48	0.0614

5. CONCLUSION

In 2022, Thailand's economy is mostly dependent on exports, which constituted more than 65% of its GDP. The objective of this study is to examine the enduring and immediate correlation between economic development and commerce, namely imports and exports, within the Asia-Pacific area. The economy derives significant advantages from exports due to their reliance on efficiency and profitability. The notion of "unbalanced growth" posits that an augmentation in output results in a corresponding rise in exports, but an augmentation in GDP leads to an augmentation in spending capacity and imports. Prior research has investigated the influence of Gross Domestic Product (GDP) on macroeconomic indicators, such as imports and exports. Nevertheless, no immediate correlation has been seen. In their study, Baharumshah and Rashid (1999) established a consistent and enduring relationship between exports, imports, and GDP, whereby exports emerged as the predominant catalyst for economic expansion. In their study, Phrakhruopatnontakitti et al. (2020) investigated the relationship between pollutant emissions, energy consumption, and economic production in four Asian countries between 1971 and 2005. They found that investing in energy supply, improving efficiency, and implementing conservation measures could potentially reduce CO2 emissions and promote economic development in energy-dependent MMVT nations.

This research uses a blend of descriptive and inferential statistical methodologies to examine the collected data. Basic graphs are used to visually represent patterns and numerical values present in a given dataset. Regression analysis is then applied to the data with the purpose of investigating the type of all variables' relationship. These are the Augmented Dickey-Fuller and Phillips-Perron unit root test for the stationarity of the data as well as the Optimal Lang-Length criteria for the data size for the model, Johansen Co-integration test for the existence of co-integration rank and the Vector Error Correction Machine for identification of the causality in the series.

The research revealed a consistent trend in GDP, Export, and Import over a span of 63 years, whereby imports and exports made substantial contributions to the overall gross domestic product. Exports accounted for a little larger proportion than imports, despite their similar figures. Thus, to assess the data analyses were conducted including Descriptive statistics, correlation analysis, unit root tests and the Johansen Co-integration test.

The results suggest stability over the period when the system was analyzed with regard to the variables of interest in this paper. Following the periods of stationarity, the analysis undertaken applied the Vector Error Correction Model (VECM) to co-integrated variables where GD P was the dependent variable and imports and exports were independent variables. The result further supported the co-integration analysis showing that import and export has long run causal effect on import as well as export in terms of GDP and there is negative sign indicating that it has permanent effect. The R^2 value, which measures the overall goodness of fit, was strong, suggesting that exports and imports account for 34% of the variations in GDP. The D-W statistics value approached a value of two, suggesting that the residuals were distributed independently.

Hence, it is recommended that the Thailand's government investigate tactics focused on increasing GDP by implementing following policies

1. Export Promotion: Given that exports significantly contribute to Thailand's GDP, the government should enhance policies that promote exports. This includes investing in infrastructure, providing tax incentives for exporters, and negotiating favorable trade agreements.
2. Diversification of Trade Partners: To reduce dependency on a few markets, Thailand should diversify its export destinations. This can mitigate risks associated with economic downturns in specific regions.
3. Import Substitution: While imports also contribute to GDP, the government should encourage the development of domestic industries to replace certain imports. This can be achieved through subsidies, tariffs on non-essential imports, and support for local manufacturers.
4. Technological Advancement: Investing in technology and innovation can boost both the efficiency and profitability of export sectors. Policies should focus on research and development, skill enhancement, and technology adoption.

In order to determine which industries contribute the most significantly to Thailand's GDP and to adjust policy appropriately, future research should concentrate on sector-specific analysis. Additionally, in order to support the creation of strong economic policies, it need to look at how trade wars and recessions affect Thailand's GDP and trade. In order to strike a balance between environmental preservation and economic development, sustainable trade practices should also be investigated.

Because of their unique economic structures and trade dynamics, the conclusions are limited to Thailand and may not be directly transferable to other nations. The attribution of causation may be complicated by the study's causal inference being impacted by changes in domestic policy and worldwide economic events across the 63-year period. Because of the limits of the research, it is also challenging to draw conclusions about causality in light of the dynamic local and international economies.

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