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ECONOMIC DRIVERS AND INFRASTRUCTURE IMPACT ON VIETNAM'S ASEAN EXPORTS

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Abstract. The present study investigates the determinants of Vietnam's export performance to ASEAN countries, with a specific focus on the roles of economic factors and trade-related infrastructure. As the phenomenon of regional economic integration intensifies within the context of frameworks such as the ASEAN Free Trade Area (AFTA), the comprehension of the dynamics that influence bilateral and multilateral trade flows becomes progressively imperative, particularly in the case of developing economies such as Vietnam. In this context, the primary objective of the study is to empirically examine the impact of macroeconomic variables and infrastructure conditions on Vietnam's export flows to its ASEAN partners over time. In order to achieve this objective, the study employs a panel dataset covering the period from 2006 to 2021, encompassing trade data between Vietnam and nine ASEAN countries. The methodological framework is built upon the Feasible Generalised Least Squares (FGLS) model, which is well-suited to address key econometric issues commonly found in panel data, such as heteroskedasticity and autocorrelation. This approach is intended to ensure the robustness and reliability of the estimated coefficients. The empirical results obtained have yielded several noteworthy findings. Firstly, it was established that both Vietnam's GDP (β = 9.21e-06, $p < 0.001$) and the GDP of ASEAN countries (β = 2.95e-06, $p < 0.001$) have a statistically significant and positive impact on Vietnam's exports. This finding serves to reinforce the notion that economic growth plays a pivotal role in the stimulation of regional trade. Secondly, in contrast to prevailing expectations, Vietnam's Liner Shipping Connectivity Index (LSCI), which serves as a proxy for trade-related infrastructure, exhibits a negative and statistically significant effect on exports (β = -12351.15, $p < 0.05$). This result suggests the existence of inefficiencies or mismatches in Vietnam's shipping infrastructure that may hinder export competitiveness. Furthermore, conventional trade policy variables such as tariff rates and border effects have been found to exert negligible influence on Vietnam's export flows within the ASEAN region. This phenomenon may be indicative of the diminished significance of tariffs in the context of ongoing regional liberalisation, thereby suggesting that non-tariff barriers or structural impediments may assume a more substantial role. The findings emphasise the necessity of promoting sustained economic growth and enhancing the quality and efficiency of trade infrastructure in order to improve Vietnam's export performance. The present study makes a contribution to the broader literature on international trade by providing fresh empirical insights into the complex interactions between economic and infrastructural determinants of export activity in Southeast Asia.

Keywords: ASEAN countries, FGLS model, GDP, Liner Shipping Connectivity Index, average tariff rates, border effects.

JEL Classification: F13, F15

1. Introduction

Vietnam's exports within ASEAN have shown significant growth and diversification in recent years. As a member of the Association of Southeast Asian Nations (ASEAN), Vietnam's trade is facilitated by regional economic integration agreements, which help reduce tariffs and increase trade flows among member states. Vietnam's main exports to ASEAN include electronics, textiles and garments, agricultural products and machinery. The strategic geographical location of Vietnam, coupled with its robust manufacturing capabilities, has enabled the country to strengthen its trade relations with other ASEAN nations, contributing to economic development and integration within the region. Nevertheless, challenges such as trade barriers, competition, and the necessity for enhanced

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infrastructure and logistics persist as areas demanding continuous enhancement to further boost export performance.

A plethora of studies have analysed the factors influencing Vietnam's exports within ASEAN, focusing on various economic, structural, and policy-related determinants. A number of key factors have been identified, including economic scale, tariffs, and geographical proximity. These factors have been shown to play significant roles in shaping trade patterns. Research utilising econometric models, such as Fixed Effects Models (FEM) and Random Effects Models (REM), has highlighted the importance of trade agreements and regional integration in reducing barriers and facilitating smoother trade flows. Moreover, studies have identified the impact of administrative costs and procedural inefficiencies, particularly in countries such as Malaysia, the Philippines and Vietnam, which can impede the optimal utilisation of Free Trade Agreements (FTAs). The size of a firm and the dynamics specific to its industry are also critical factors. It has been demonstrated that larger firms and those operating in sectors such as textiles and garments are more effective in leveraging FTAs than those in the electronics and machinery industries. The prevailing consensus in the extant literature is that, while Vietnam's trade within ASEAN has grown, it is essential to address structural and administrative challenges if the full potential of exports is to be realised and more balanced regional trade integration to be achieved.

A paucity of studies has hitherto been observed with regard to the geographical characteristics of ASEAN countries, transportation connectivity, and the impact of border effects on export outcomes in the context of Vietnam's exports within ASEAN. These factors are of pivotal significance, given their substantial impact on trade efficiency and costs. The geographical proximity and well-developed transportation networks of the region have been demonstrated to enhance trade flows by reducing transit times and logistics costs. In a similar manner, border effects, encompassing the ease of crossing borders and associated administrative procedures, have the capacity to either facilitate or impede trade. Nevertheless, a discernible lacuna persists within the extant literature addressing the relationship between these factors and Vietnam's export performance. The present research aims to address this lacuna by examining the influence of geographical characteristics, transportation networks, and border dynamics on Vietnam's exports within ASEAN. Specifically, the objective is to provide answers to key questions such as the impact of the geographical features of ASEAN countries on Vietnam's exports, the role of transportation connectivity in reducing export costs and transit times, and the effect of border-related factors on export outcomes. The overarching objective of this study is to provide a more comprehensive understanding of the determinants of Vietnam's export performance and to offer strategic recommendations for improving export efficiency within the region.

2. Literature Review

The gravity model is a widely used analytical framework in international trade research to examine the factors influencing export activity. Derived from Newton's law of gravity, the model posits that the volume of trade between two countries is directly proportional to their economic size, typically measured by gross domestic product (GDP), and inversely proportional to the distance between them. As a result, the model has been used extensively to understand bilateral trade flows, taking into account various factors such as economic size, distance, common language, colonial history and trade agreements.

Specifically, in the context of analysing Vietnam's exports within ASEAN, the gravity model provides a robust tool for quantifying the impact of economic scale, geographical proximity, transportation connectivity, and border effects on trade volumes. The integration of these variables enables the model to elucidate the impact of infrastructure quality, administrative efficiency, and regional integration policies on Vietnam's export performance. This approach enables a comprehensive evaluation of both traditional economic determinants and more nuanced geographical and logistical factors, thus offering valuable insights into the dynamics of intra-ASEAN trade. Consequently, the gravity model's flexibility and empirical robustness render it an indispensable method for enhancing comprehension of the intricacies inherent in international trade, particularly within a multifaceted and interconnected region such as ASEAN.

Moreover, extensive research has been conducted on Vietnam's export activities in general, and its exports within ASEAN in particular. The study by Nhã, Oanh & Thu (2019) employs statistical analysis methods to evaluate the export situation of various Vietnamese commodity groups to the EU market. The findings of the study indicate that factors such as trade policies, product quality, and market demand are primary determinants influencing Vietnam's exports to the EU. Consequently, this research offers a comprehensive overview of the export structure and puts forward several solutions with the aim of enhancing export activities.

Furthermore, Diệp, Thảo & Thu (2018) applied the gravity model to analyse the factors affecting Vietnam's exports to the EU market. The study's findings underscore the significance of geographical distance, the GDP of the importing nation, and

non-tariff barriers as crucial determinants of export performance. Consequently, the gravity model has been demonstrated to be a suitable analytical framework for examining the impact of these factors, thereby providing specific recommendations to enhance export efficiency.

Additionally, Yuliadi, Sari, Setiawati & Ismail (2024) utilised regression methodologies to examine the impact of exchange rates, inflation, interest rates, and imports on exports in ASEAN countries. The findings of the study demonstrate that exchange rates and inflation have a considerable impact on exports, while interest rates and imports exert a lesser effect. The present study underscores the pivotal role of macroeconomic stability in fostering international trade.

Adry (2023) employs economic integration analysis to evaluate the impact of international trade liberalisation on import-export growth in five ASEAN countries. The findings suggest that trade liberalisation exerts a positive influence on import-export growth, though the extent of this impact varies across different nations. The study thus suggests that policy adjustments are necessary to optimise the benefits of economic integration.

In a similar vein, Thangavelu (2010) conducted an analysis of non-tariff barriers, economic integration, and export growth within the ASEAN framework. The findings indicate that non-tariff barriers are substantial impediments to export growth. In conclusion, it is evident that economic integration and the reduction of non-tariff barriers can strongly promote exports among ASEAN countries.

Furthermore, the findings of Giuliano, Spilimbergo & Tonon (2014) underscore the significance of the correlation between geographical proximity and economic variables, proposing that a comprehensive understanding of these factors is imperative for the elucidation of trade patterns. Moreover, their research also highlights the historical influence of geographical factors on current transportation costs, which can explain the correlation between trade flows and genetic distances.

Finally, Gallego & Llano (2014) estimated internal and external border effects using a new dataset capturing both domestic and international shipments between Spanish regions and regions in eight European countries. The present study employed a range of alternative methods to address the nonlinear relationship between distance and trade, thereby illustrating the significant impact of borders on trade flows.

In summary, the extant literature provides a multi-faceted perspective on the factors influencing Vietnam's export activities within the ASEAN and EU. However, a paucity of research exists on the impact of geographical features, transportation connectivity, and border effects on Vietnam's export performance with ASEAN countries. The objective of this forthcoming research is to address this lacuna by focusing on these aspects to provide a more comprehensive and in-depth understanding of Vietnam's export activities within ASEAN.

3. Aims

The research aims to achieve the following objectives:

Assess the impact of economic factors. To analyse how economic indicators, such as the GDP of Vietnam and ASEAN countries, affect Vietnam's export performance to ASEAN countries. This includes assessing whether an increase in GDP in these countries contributes to an increase in exports from Vietnam.

Examine the role of infrastructure. To investigate how the Liner Shipping Connectivity Index (LSCI) affects Vietnam's export performance. The study aims to understand the relationship between Vietnam's shipping infrastructure and its ability to export goods to ASEAN countries.

Assess trade barriers and border effects. To determine the impact of average tariff rates and border effects on Vietnam's exports to ASEAN countries. This includes assessing whether these factors create significant barriers or facilitate smoother trade flows.

Identify implications for trade policy. To provide insights into how trade policy, infrastructure improvements, and regional economic cooperation can be used to enhance Vietnam's export potential. The study aims to offer recommendations on strategic trade approaches to support sustainable economic growth.

By focusing on these aims, the research seeks to offer a comprehensive understanding of the economic and infrastructural factors that shape Vietnam's export performance, and to provide actionable recommendations for optimising trade relations with ASEAN countries.

4. Methodology

In summary, the research model encompasses economic size, trade barriers, logistical connectivity, and geographical factors in order to deliver a comprehensive analysis of the determinants influencing Vietnam's export activities within ASEAN. The objective of the present study is to provide detailed insights and actionable recommendations to improve Vietnam's export performance in the region. To this end, the study focuses on specific variables. The empirical model of interest is formulated as follows:

$$EXPij = a0 + a1GDPi + a2GDPj + a3TRFi + \\ + a4TRFj + a5LSCIi + a6LSCIj + a7BEij + eij$$

Where:

EXP – export value from Vietnam to ASEAN countries;

GDP – gross domestic product;

TRF – tariff rate;

LSCI – Liner Shipping Connectivity Index;

BE – border effect, a dummy variable indicating whether the ASEAN country shares a border with Vietnam (1 if yes, 0 if no);

ε – error term capturing other unobserved factors affecting exports;

i – ASEAN countries;

j – Vietnam.

Gross domestic product (GDP) at purchaser prices is the total gross value added by all resident producers in an economy, plus any taxes on products and less any subsidies not included in the value of products. It is expressed in current US dollars. As a key indicator of economic strength and market size, GDP is expected to be positively correlated with trade volumes, as larger economies tend to have more import and export activities. This variable, documented for the years 2006 to 2021 and sourced from the World Bank, can influence trade both positively and negatively.

The tariff rate is the unweighted average of the effective rates applied to all products subject to tariffs. In general, lower tariffs facilitate higher trade volumes by reducing the cost of imported goods and promoting exports. This variable denotes the applied simple average tariff rate for all products annually from 2006 to 2021, expressed as a percentage. Similar to GDP, the tariff rate can have a positive or negative impact on trade and is taken from the World Bank.

The Liner Shipping Connectivity Index (LSCI) is a metric used to assess the extent of a nation's integration within global shipping networks. The index is derived from five key components: the number of ships, container-carrying capacity, maximum vessel size, number of services, and the number of companies deploying container ships in ports. Higher LSCI values are indicative of enhanced connectivity, which may result in increased trade volumes due to optimised shipping logistics. The value of each component is then normalised to its maximum in 2004, averaged per country, and scaled to generate an index where 100 represents the highest level of connectivity. The data for LSCI, provided by Containerisation International Online and sourced from the World Bank, covers the period from 2006 to 2021.

The border effect variable is employed to measure the impact of shared borders on trade volumes. The phenomenon of proximity and shared borders has been demonstrated to have a significant impact on transportation costs, with the result that trade relationships are enhanced due to easier logistics and stronger economic ties. The border effect on Vietnam's trade within ASEAN is examined by this variable. The border effect is coded as 1 if the ASEAN country shares a border with Vietnam and 0 otherwise. The impact of this variable on trade can be either positive or negative.

The present study employs a panel data model to analyse the factors influencing Vietnam's exports to ASEAN countries. The model is developed with the utilisation of panel data, a methodological framework that facilitates the encapsulation of both cross-sectional variability, which is defined as the inherent differences between ASEAN countries, and temporal changes, which are variations that occur over the period from 2006 to 2021. This methodological approach facilitates enhanced control of unobserved heterogeneity, optimises the efficiency and precision of estimates, and addresses potential endogeneity issues. Specifically, the empirical model assesses the impacts of GDP, tariff rates, Liner Shipping Connectivity Index (LSCI), and border effects on export performance. The objective of this comprehensive analysis is to provide actionable insights and recommendations to enhance Vietnam's export capacity and promote sustainable economic growth.

5. Results

Descriptive statistics of variables in the research model

Table 1

Descriptive statistics of variables in the research model

Variable	Obs	Mean	Std. dev.	Min	Max
EXP	128	2071871	1522833	0	6066102
GDP_i	128	2.72e+11	2.75e+11	7.27e+09	1.19e+12
GDP_j	128	2.15e+11	9.51e+10	6.64e+10	3.66e+11
TRF_i	128	5.295469	3.664616	0.04	13.73
TRF_j	128	7.437188	2.074324	4.22	12.14
$LSCI_i$	128	38.87379	34.73409	3.409882	113.775
LSCIj	128	48.87726	17.86911	20.93025	79.77808
BE_{ij}	128	0.125	0.3320184	0	1

Source: Result from stata 14 sofware

The descriptive statistics of the variables in the research model in Table 1 reveal several important characteristics that suggest the dataset is well-suited for panel data analysis. The dataset is balanced, with 128 observations for each variable, thus ensuring consistency across cross-sectional units and periods. The export values (EXP) demonstrate significant variation, with a high standard deviation, indicating differences in trade activity across countries and over time. The GDP of both ASEAN countries (GDPi) and Vietnam (GDPj) also exhibits substantial variation, reflecting the diverse economic sizes within the region.

Tariff rates (TRFi and TRFj) demonstrate discrepancies between the ASEAN and Vietnamese contexts, with Vietnam's tariff rates exhibiting a marginal increase but reduced variability. The Liner Shipping Connectivity Index (LSCIi and LSCIj) is indicative of discrepancies in logistical infrastructure, with Vietnam demonstrating superior and more consistent shipping connectivity in comparison to other ASEAN countries. The border effect (BEij), a binary variable, is applicable to a limited proportion of the data, indicating that border-related factors are pertinent in only a restricted number of instances. The dataset displays sufficient variation in economic, logistical, and policy-related variables, making it suitable for a panel data model that can capture the dynamic relationships between these factors over time and across ASEAN countries.

The export turnover chart of Vietnam to ASEAN countries from 2006 to 2021 (see Figure 1) illustrates noticeable trends in trade relations with individual ASEAN members. Cambodia, Malaysia, and Singapore have been identified as key trading partners, with a notable increase in export values over time. Cambodia, in particular, has demonstrated a marked and consistent increase in export turnover, reaching a peak in recent years. In contrast, the value of Vietnam's exports to Brunei Darussalam has remained relatively insignificant, exhibiting fluctuations and lower values throughout the observed period. As demonstrated by the cases of Indonesia, the Philippines and Thailand, there is evidence to suggest that moderate yet stable growth is exhibited by countries in the region. This is indicative of Vietnam's diverse trade relationships within the region. Furthermore, the observed fluctuations in export values to countries such as Myanmar and Laos may be indicative of economic variability or the impact of external factors on trade. The chart demonstrates the strengthening of Vietnam's economic ties with ASEAN nations, particularly with neighbouring Cambodia and larger economies such as Malaysia and Singapore.

In order to provide a more profound understanding of these trends and their underlying factors, it is necessary to conduct further analysis using panel data models. This approach would facilitate a more comprehensive examination of the influence of macroeconomic indicators, trade policies, and other variables on Vietnam's export dynamics over time and across different ASEAN markets.

Estimation by regression model using least squares method (POOL OLS)

Table 2

Estimation results by regression model using standardised least squares method (POOL OLS)

EXP	Coef	Std. err.	t	P>|t|	Beta
GDP_i	3.79e-06	9.39e-07	4.03	0.000	.6846901
GDP_j	.0000108	4.07e-06	2.65	0.009	.6736225
TRF_i	23622.88	32500.71	0.73	0.469	.0568472
TRF_j	162829.8	100154.5	1.63	0.107	.2217983
$LSCI_i$	-12865.89	4351.805	-2.96	0.004	-.2934564
LSCIj	-9220.019	21666.63	-0.43	0.671	-.1081888
BE_{ij}	-1867662	690580	-2.70	0.008	-.4072003
_cons	-1433400	1275382	-1.12	0.263	

Source: Result from stata 14 sofware

The regression analysis conducted using Stata 14 software in Table 2 indicates that both the GDP of ASEAN countries and the GDP of Vietnam have a statistically significant and positive impact on

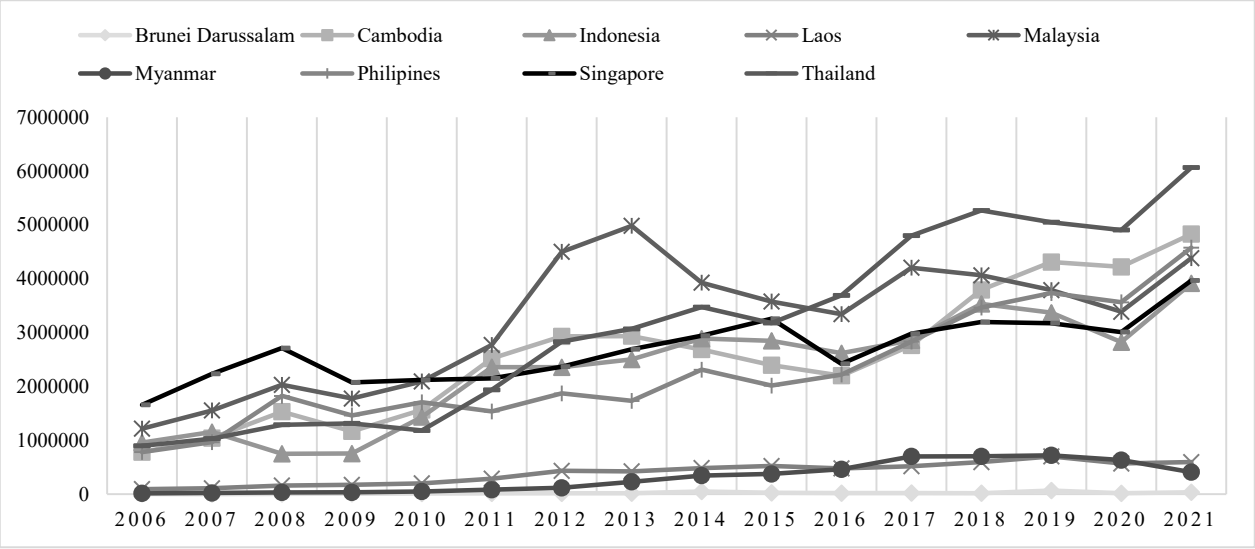

Figure 1. Vietnam's export values to ASEAN countries from 2006 to 2021

Source: TradeMap (www.trademap.org)

Vietnam's export values within the ASEAN region. This finding suggests a positive correlation between economic scale and export volume. Conversely, the Liner Shipping Connectivity Index for ASEAN countries and the border effect demonstrate significant negative impacts on exports, suggesting that logistical constraints and border frictions may impede trade. However, the analysis indicates that tariff rates in ASEAN countries and Vietnam, as well as Vietnam's Liner Shipping Connectivity Index, do not demonstrate a statistically significant effect on export values. This finding suggests that tariffs and Vietnam's shipping connectivity may exert a lesser influence in this particular model.

The variance inflation factor (VIF) analysis, utilised to evaluate multicollinearity among the independent variables, discloses that both Vietnam's GDP and its Liner Shipping Connectivity Index possess a VIF of 13.00, signifying a substantial degree of multicollinearity. Given that a VIF value exceeding 10 generally indicates significant multicollinearity, it can be concluded that these two variables exhibit a high degree of correlation with other factors within the model, which may result in a distortion of the reliability of the regression coefficients. The GDP of ASEAN countries exhibits moderate multicollinearity, as evidenced by a VIF of 5.79, while the border effect demonstrates a VIF of 4.56, suggesting a certain degree of multicollinearity. Meanwhile, the tariff rates of Vietnam and ASEAN countries, as well as the Liner Shipping Connectivity Index of ASEAN, show low levels of multicollinearity with VIF values of 3.74, 1.98, and 1.23, respectively. The mean VIF for the entire model is 6.19, suggesting that although multicollinearity is present, the primary concerns lie with the GDP of Vietnam and its Liner Shipping Connectivity Index.

Furthermore, White's test was employed to evaluate the presence of heteroskedasticity, thereby testing the null hypothesis of homoskedasticity (constant error variance). The test yielded a chi-squared value of 72.00 with a p-value of 0.0002, thereby leading to the rejection of the null hypothesis. This provides compelling evidence of heteroskedasticity in the model, indicating that the error variance is not constant. Additionally, the Wooldridge test for autocorrelation in panel data was employed to evaluate the presence of first-order autocorrelation. The statistical analysis yielded an F-statistic of 47.004 with a p-value of 0.0002, falling below the 0.05 threshold. Consequently, the null hypothesis of no first-order autocorrelation is rejected, suggesting that the model exhibits autocorrelation, whereby errors are correlated across time.s

In summary, the findings emphasise the pivotal role of GDP and economic scale in influencing Vietnam's export performance, while logistical challenges and border effects emerge as significant impediments. The presence of multicollinearity, heteroskedasticity, and autocorrelation highlights potential challenges in interpreting the model's results, suggesting that further refinement of the model or the adoption of alternative estimation techniques may be necessary to improve the robustness of the estimates.

Estimation according to fixed effects and random effects models

Table 3
Estimation results by fixed effects model (FEM)

EXP	Coef.	Std.err.	t	P>|t|	[95% Conf. interval]	
GDP_i	3.18e-06	7.62e-07	4.17	0.000	1.67e-06	4.69e-06
GDP_j	8.93e-06	2.23e-06	4.00	0.000	4.51e-06	.0000134
TRF_i	-90356.85	60614.49	-1.49	0.139	-210433.7	29719.99
TRF_j	4544.771	50995.46	0.09	0.929	-96476.84	105566.4
$LSCI_i$	-4855.488	12862.56	-0.38	0.707	-30336.12	20625.15
LSCIj	-18613.61	10788.74	-1.73	0.087	-39986.02	2758.801
BE_{ij}	0 (omitted)					
_cons	825955.1	791929.5	1.04	0.299	-742851.2	2394761

Source: Result from stata 14 sofware

In conclusion, the fixed-effects regression model in Table 3 demonstrates a robust fit, as evidenced by a high within R-squared and a significant F-statistic. Specifically, GDP_i and GDP_j have been shown to exert statistically significant positive impacts on EXP, thus indicating that higher GDP levels are associated with increased export value. In contrast, variables TRF_i, TRF_j, $LSCI_i$, and $LSCI_j$ do not demonstrate statistically significant effects on EXP within this model.

Table 4
Estimated results by random effects model (REM)

EXP	Coef.	Std.err.	t	P>|t|	[95% Conf. interval]	
GDP_i	3.16e-06	7.42e-07	4.26	0.000	1.70e-06	4.61e-06
GDP_j	9.04e-06	2.17e-06	4.17	0.000	4.80e-06	.0000133
TRF_i	-85025.19	58083.8	-1.46	0.143	-198867.3	28816.96
TRF_j	5058.286	49917.78	0.10	0.919	-92778.76	102895.3
$LSCI_i$	-6094.824	11731.15	-0.52	0.603	-29087.46	16897.82
LSCIj	-18567.94	10560.91	-1.76	0.079	-39266.95	2131.064
BE_{ij}	-1400945	3427012	-0.41	0.683	-8117765	5315875
_cons	998063.7	1424806	0.70	0.484	-1794505	3790632

Sourc: Result from stata 14 sofware

The random effects model (REM) employed in this study has facilitated the elucidation of the influence of macroeconomic factors, particularly a country's GDP, on dependent variables such as trade and investment. The findings in Table 4 demonstrate that the GDP variables of both countries have a positive and statistically significant impact, thereby emphasising the pivotal role of a nation's economic size in shaping bilateral economic relations. However, other variables such as tariff rate (TRF), Liner Shipping

Connectivity Index (LSCI), and border effects (BE) do not demonstrate statistical significance within this model, suggesting that these factors may not exert a substantial impact. These could be attributed to factors such as limited sample size, data limitations, or the model's inability to account for other factors, including trade agreements, logistics policies, or diplomatic relations between countries. Furthermore, while the REM is selected to accommodate random discrepancies between countries, the suitability of this model should be further validated through methods such as the Hausman test.

The outcomes of the Hausman test indicate the absence of systematic disparities between the coefficients of the fixed effects (FEM) and random effects (REM) models, as evidenced by a high p-value of 0.9986. This finding suggests that the random effects model (REM) is the more appropriate choice, as it is both consistent and efficient when the null hypothesis cannot be rejected. Nevertheless, in order to guarantee the robustness and reliability of the random effects model (REM), further tests are required. These include the Breusch-Pagan Lagrange Multiplier (LM) test, which is employed to ascertain whether the REM is more suitable than a standard OLS model; a heteroscedasticity test, which is used to check for changing variance; and an autocorrelation test, which is used to detect potential correlations in the residuals over time.

The Breusch-Pagan test indicates the presence of significant random effects across countries, as evidenced by the chibar2(01) value of 496.62 and a p-value of 0.0000. This outcome effectively rejects the null hypothesis of no variation between countries and underscores certain limitations of the random effects model. Furthermore, the Wooldridge test indicates the presence of first-order autocorrelation, with F(1,7) = 47.004 and a p-value of 0.0002, which may distort the estimates and reduce the efficiency of standard models. It is evident that the GLS model is indispensable in correcting two primary issues: random effects across countries and autocorrelation. The implementation of this model ensures the generation of more reliable and accurate estimates.

The research findings presented in Table 5 underscore the correlation between diverse economic and trade factors and the export performance of Vietnam and other ASEAN countries. Initially, it is evident that both Vietnam's GDP and the GDP of other ASEAN nations exert a positive and statistically significant influence on exports. This observation signifies that as the economic magnitude of Vietnam and its regional counterparts expands, so too does the demand and capacity for augmented exports. It is evident that larger economies generally exhibit a higher demand for imports, thereby creating a conducive environment for Vietnam's export growth.

Table 5

Estimated results according to the GLS model

EXP	Coef.	Std.err.	z	P>|z|	[95% Conf. interval]	
GDP_i	2.95e-06	8.41e-07	3.51	0.000	1.30e-06	4.60e-06
GDP_j	9.21e-06	1.87e-06	4.93	0.000	5.55e-06	.0000129
TRF_i	31292.84	36649.24	0.85	0.393	-40538.36	103124
TRF_j	28163	33669.96	0.84	0.403	-37828.91	94154.91
$LSCI_i$	-8062.854	6004.564	-1.34	0.179	-19831.58	3705.875
LSCIj	-12351.15	5143.721	-2.40	0.016	-22432.66	-2269.641
BE_{ij}	-979147.6	757794.3	-1.29	0.196	-2464397	506101.9
_cons	-197353.8	645757.6	-0.31	0.760	-1463015	1068308

Sourc: Result from stata 14 sofware

The surprising and statistically significant effect of Vietnam's Liner Shipping Connectivity Index on exports is worthy of note. While enhanced shipping connectivity is usually indicative of improved trade facilitation, this finding suggests that despite stronger maritime connections, factors such as rising transportation costs, heightened competition from other nations, or inefficiencies within Vietnam's logistics and trade infrastructure may be hindering export growth. However, merely augmenting shipping connectivity may not invariably yield improved export performance, particularly in the presence of persistent issues such as supply chain management inefficiencies or elevated logistics costs.

The data indicates that neither Vietnam's average tariff rate nor that of other ASEAN countries exerts a statistically significant influence on exports. This finding suggests that tariffs may not be a significant contributing factor to export performance, at least within the confines of this particular model. It is conceivable that free trade agreements between ASEAN countries have served to diminish the impact of tariffs, or alternatively, that other factors such as market demand and product competitiveness may exert a more substantial influence on the determination of export levels.

In addition, the Liner Shipping Connectivity Index of other ASEAN nations does not exert a substantial impact on Vietnam's exports. This finding indicates that improvements in shipping connectivity among ASEAN countries do not have a direct impact on Vietnam's export performance. This phenomenon can be attributed to the fact that Vietnam's export results are more strongly linked to internal or external factors that are not related to improvements in ASEAN shipping.

Finally, the Border Effect, comprising factors such as border controls, customs regulations, and tariffs at the border, is also not statistically significant. This finding suggests that border-related barriers or controls do not have a significant impact on Vietnam's exports in this context, which may be attributable to the simplification of customs procedures or the presence

of regional trade agreements that mitigate border frictions.

The employment of the Feasible Generalised Least Squares (FGLS) model effectively addresses heteroskedasticity and first-order autocorrelation issues, ensuring more reliable and robust estimates. The model demonstrates a high degree of statistical significance on the whole, suggesting that it provides a satisfactory fit for the data and accurately captures the relationships between the variables. The findings of this study indicate that Vietnam's economic growth and shipping connectivity are crucial factors in determining export performance, while tariffs and border effects are less influential. This prompts further inquiry into the potential adverse impact of enhanced shipping connectivity on exports, underscoring the necessity for additional research to ascertain the full extent of this relationship.

6. Discussion

The research findings can be explained by examining the specific factors influencing Vietnam's exports and the broader ASEAN region. Firstly, it is evident that there is a positive correlation between the GDP of Vietnam and that of other ASEAN countries, as well as the GDP of Vietnam itself, and exports. This is due to the fact that GDP is a reliable indicator of a country's economic size and purchasing power. As the economy grows, domestic demand increases, and so does the nation's capacity for imports, which, in turn, fuels export demand. Conversely, as the economies of ASEAN countries undergo expansion, there is an increase in their demand for imports from Vietnam. Furthermore, it is evident that countries with higher GDPs are generally better equipped to invest in infrastructure and trade relations, thereby enhancing export conditions for partners such as Vietnam.

In contrast, the negative impact of Vietnam's Liner Shipping Connectivity Index on exports is more complex. Whilst improved shipping connectivity should, in principle, facilitate trade, this result suggests that other factors, such as rising competition, high transport costs and inefficiencies in Vietnam's logistics and supply chain management, might be offsetting these gains, despite improvements in maritime connections. For instance, while Vietnam has undoubtedly improved its shipping connectivity, factors such as port congestion, delays, and high freight costs may hinder the actual benefit of this enhanced infrastructure. Furthermore, enhanced connectivity could lead to an increase in competition from other countries that also utilise Vietnam's shipping infrastructure, potentially reducing Vietnam's comparative advantage in exporting certain goods. These inefficiencies in logistics have the potential to result in increased costs and delays, which can have a detrimental effect on export performance despite enhanced connectivity.

Regarding tariffs, the results show that neither Vietnam's average tariff rate nor those of other ASEAN countries have a significant impact on exports. This can be explained by the existence of free trade agreements within ASEAN, which are likely to have minimised the impact of tariffs on trade flows. FTAs typically reduce or eliminate tariffs between member countries, which means that tariffs are not a major barrier to exports in the region. Moreover, factors such as market demand, product quality and competitiveness may play a more important role in driving exports than tariff levels, especially in a region with established trade agreements that facilitate cross-border trade.

In a similar vein, the Liner Shipping Connectivity Index of other ASEAN countries does not exert a significant effect on Vietnam's exports, suggesting that Vietnam's export performance is more dependent on internal factors or perhaps global conditions outside the ASEAN region. This suggests that enhancements in the shipping infrastructure of neighbouring ASEAN countries do not significantly impact Vietnam's export dynamics. It is conceivable that Vietnam's exports may be influenced by factors that are not necessarily associated with the shipping connectivity of its ASEAN partners. These factors may include demand from non-ASEAN markets or the competitiveness of Vietnamese goods in sectors that are not significantly dependent on regional shipping routes.

Finally, the Border Effect, which encompasses elements such as border controls, customs regulations, and tariffs, also demonstrates no significant impact on exports. This phenomenon can be attributed to the simplification of customs procedures and the liberalisation of trade through ASEAN agreements, which have resulted in a reduction of bureaucratic hurdles and the streamlining of cross-border trade. In this context, border-related factors no longer constitute significant impediments to trade, thereby enabling the seamless flow of goods between ASEAN countries.

In conclusion, the study posits that while economic growth and shipping connectivity in Vietnam are critical factors influencing export performance, tariffs and border effects are less significant due to regional trade agreements and improvements in trade facilitation. The adverse consequences of shipping connectivity underscore the necessity for further investigation into the inherent inefficiencies within Vietnam's logistics and transportation systems. Addressing these challenges may be pivotal to enhancing export performance, as superior connectivity alone does not ensure success

if logistical impediments and high costs persist in undermining competitiveness.

7. Conclusions

The research findings indicate that an increase in GDP is typically accompanied by growth in production and consumption, leading to increased expenditure on goods, which in turn has a positive and significant impact on Vietnam's GDP as well as the GDP of ASEAN countries concerning Vietnam's exports to this region. It is hypothesised that economic growth in Vietnam will enhance both the quality and quantity of exported goods, thereby improving their competitiveness in international markets. However, a statistically significant negative impact on exports to ASEAN countries is exerted by Vietnam's Liner Shipping Connectivity Index. Whilst improved transportation connectivity has been shown to facilitate trade, the negative impact of this phenomenon suggests challenges such as intensified competition from international markets, higher transportation costs, and inefficiencies in logistics and port management. These factors serve to diminish the benefits of enhanced connectivity.

In this context, China's role can be viewed from several perspectives. First, as a major global economic power, China has a significant impact on regional and global supply chains. The expansion of China's production capacity can exert competitive pressure on Vietnamese exports, especially in industries with similar production structures. Second, China is a major trading partner of ASEAN, with an extensive maritime transport network that could overshadow Vietnam's maritime connectivity advantages if Vietnam's logistics infrastructure does not improve at a competitive pace.

Furthermore, an analysis of additional variables, including Vietnam's and ASEAN countries' average customs tariffs, the Liner Shipping Connectivity Index of other ASEAN countries, and the Border Effect, reveals that these factors do not demonstrate statistically significant impacts on Vietnam's exports to ASEAN. This suggests that the transportation connectivity of other ASEAN countries may not directly influence Vietnam's export performance, particularly if Vietnam has diversified its export markets beyond ASEAN. It is noteworthy that China plays a pivotal role as a transshipment hub in global trade. If Vietnam can effectively utilise logistics infrastructure connecting with China, it may be able to mitigate the adverse impact of domestic inefficiencies in its maritime transport system.

From a theoretical standpoint, this study corroborates the notion that economic growth, as evidenced by rising GDP, assumes a pivotal role in the propulsion of exports. This finding is consistent with established trade theories, which posit that larger economies engage in higher trade volumes due to greater demand and purchasing power. However, the findings contradict the prevailing assumption that enhanced maritime connectivity necessarily leads to improved export performance. The negative impact of Vietnam's Liner Shipping Connectivity Index indicates that internal logistical inefficiencies, high transportation costs, or increased competition may counterbalance the advantages of enhanced shipping infrastructure. Moreover, the study provides empirical evidence that tariffs and border effects play a diminished role in influencing exports within ASEAN, likely due to the presence of free trade agreements. This underscores the necessity to shift the policy focus from tariff-centric approaches to broader trade facilitation measures.

From a pragmatic perspective, the findings indicate that Vietnam should prioritise enhancing its logistics system and reducing export-related costs to fully leverage improvements in shipping connectivity. This objective can be realised through the enhancement of port operations, the reinforcement of intermodal transport connections, and the optimisation of customs procedures, with the aim of reducing delays and logistical impediments. The reduction of export logistics costs through government subsidies or private sector investment in infrastructure could also enhance competitiveness. In addition, it is recommended that Vietnam place a greater emphasis on value addition in its exports by allocating resources to research and development (R&D) and cultivating specialised industries, with a view to differentiating its products in the global market.

Within the context of regional competition, China adopts a dual role, functioning as both a significant trading partner and a formidable competitor in multiple sectors. Consequently, Vietnam must adopt a strategic approach to cooperation and competition, leveraging trade agreements, improving market access to China, and simultaneously expanding into non-ASEAN markets such as the EU and North America to mitigate competitive pressures within the region. The implementation of these strategies by Vietnam has the potential to enhance the nation's export performance in the context of a progressively competitive global trade environment.

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data curation, Thi Anh Tuyet Le.; writing – original draft preparation, Thi Anh Tuyet Le.; writing – review and editing, Thi Anh Tuyet Le.; visualization, Thi Anh Tuyet Le.; supervision, Thi Anh Tuyet Le.; project administration, Thi Anh Tuyet Le.; funding acquisition, Thi Anh Tuyet Le. All authors have read and agreed to the published version of the manuscript."

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