Export Market Structure and Long-Run Economic Growth: Evidence from Sumatra's Provincial Exports

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Abstract

This study analyzes the impact of export growth from the Sumatra region on Indonesia's Gross Domestic Product (GDP), focusing on Aceh, North Sumatra, West Sumatra, and South Sumatra. Using annual data from 1994 to 2022, the study examines export market structure and its dynamic relationship with economic growth through the Herfindahl–Hirschman Index (HHI), the four-firm concentration ratio (CR4), and the Autoregressive Distributed Lag (ARDL) model. The results indicate that the export market structure of these provinces is largely competitive, characterized by low concentration levels. Among the four provinces, only Aceh's exports exhibit a positive and statistically significant long-run effect on national GDP, although the magnitude of this effect is smaller relative to exports from other provinces outside the study area. Overall, the findings confirm that continued export expansion contributes to Indonesia's economic growth; however, the growth impact is highly dependent on export structure and diversification. The study underscores the importance of strengthening downstream processing and promoting product diversification in resource-based provinces to enhance value creation and ensure inclusive and resilient long-term economic development.

Keywords: Autoregressive Distributive Lag (ARDL), Export, Long-term Economic, Sumatera, Trade
JEL: F14; F43; O47

A. INTRODUCTION

Exports serve as a vital engine of national economic growth. Empirical studies have shown that export expansion positively and significantly impacts labor absorption and public welfare (Feenstra & Sasahara, 2018; Munch & Schaur, 2018). As the primary source of foreign exchange earnings, exports enable countries to finance imports of essential goods and services required for sustainable development. In Indonesia, the export sector is primarily dominated by commodities such as palm oil, coal, rubber, and coffee, all of which enjoy strong demand in international markets (Latifah et al., 2022; Shrestha & Coxhead, 2018; Sulaiman et al., 2020). Strengthening this sector accelerates Gross Domestic Product (GDP) growth, fosters job

creation, and contributes to poverty alleviation. Therefore, a comprehensive understanding of the structural dynamics and constraints of the export sector is essential for designing effective and sustainable economic policies (Edeh et al., 2020; Krammer et al., 2018).

Figure 1 presents the export activities of each province. The export landscape in the Sumatra region reflects the diversity of leading commodities across its provinces. Aceh, renowned for its oil and natural gas sectors, emerges as a major contributor to regional exports, thereby generating substantial added value for the national economy (Hilmawan & Clark, 2019; Risa Shoffia et al., 2022). North
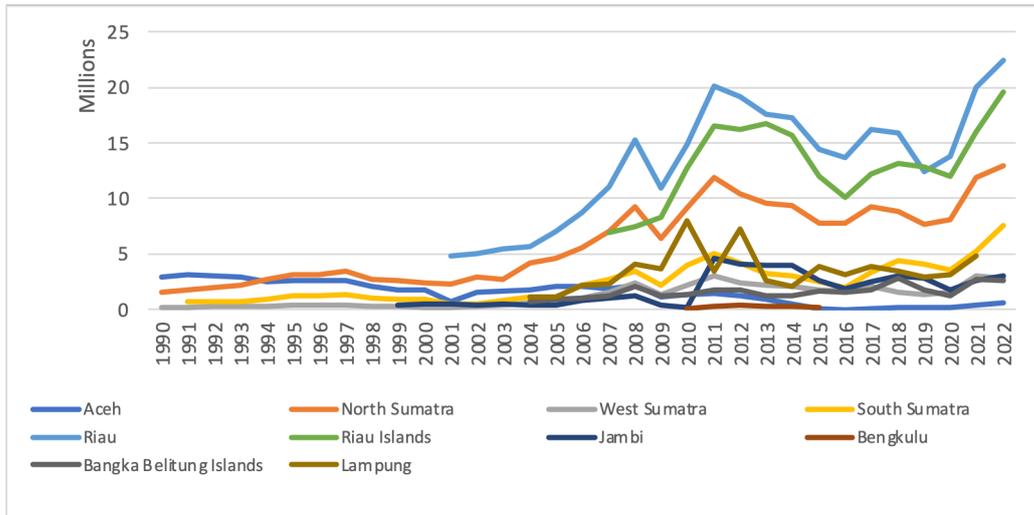
Figure 1. Exports from Sumatra Island
Source: Statistics Indonesia, 2024

Sumatra is distinguished by its exports of agricultural commodities such as palm oil and rubber, which command a significant share of the global market (Novita et al., 2022; Suri et al., 2021). In contrast, West Sumatra capitalizes on its abundant natural resources through the agriculture and fisheries sectors, which form the foundation of its export economy (Hashfi, 2023).

On the other hand, South Sumatra relies heavily on coal and rubber exports, reflecting its important role in meeting global energy demand and supplying the international rubber industry (Mukhyi, 2022). Although each province has unique comparative advantages, several challenges remain in optimizing export potential. Issues such as uneven transportation infrastructure, suboptimal regulatory frameworks, and limited product diversification hamper the region's overall export competitiveness and long-term sustainability.

A deep understanding of the characteristics and challenges of each province in Sumatra is essential to formulate strategic actions to drive inclusive and sustainable export growth. The challenges facing Indonesia's export sector are deeply rooted in a complex set of structural and external factors. One major constraint is global market uncertainty, often driven by fluctuations in international commodity prices, which can significantly impact national export earnings (Putra et al., 2021; Sugiharti et al., 2020). In addition, evolving international trade policies are another risk factor, especially for a highly open economy like Indonesia, which is highly dependent on global trade (Wicaksana, 2021; Olilingo & Putra, 2020).

Beyond global market uncertainty, the country's efforts to develop export-oriented downstream industries remain a pressing concern. These efforts, which aim to increase the value of products through further processing before export, continue to face persistent obstacles (Fahmid et al., 2022). Among the main obstacles are inadequate infrastructure, limited access to modern technology, and regulatory inefficiencies that fail to support industrial development fully. Addressing these challenges requires strong government commitment and strong collaboration between public and private stakeholders to foster an ecosystem conducive to advancing a competitive and sustainable downstream industry.

Indonesia is strategically positioned globally due to its extensive comparative advantages. As the world's largest archipelagic state, Indonesia possesses vast natural resources, including palm oil, coal, and mineral deposits, which serve as vital commodities in international trade (Maria, 2022;

Warburton, 2017; Yusuf et al., 2018). Furthermore, the country is globally recognized as the leading producer of several key commodities, such as palm oil, coffee, and rubber.

Amid the rapid transformations in global market dynamics, Indonesia continues to make significant progress in expanding its international market penetration. With a large consumer base and consistent economic growth, the domestic market represents a compelling opportunity for foreign investors seeking access to emerging market potentials. However, Indonesia's role in the global economic landscape is challenged by multiple external pressures.

Unpredictable fluctuations in commodity prices, evolving international trade regulations, and intensifying global competition necessitate adaptive and forward-thinking policy strategies. In this regard, formulating progressive economic policies and establishing robust international partnerships are critical to enhancing Indonesia's competitiveness and reinforcing its position as a central player in the global economy.

This study, therefore, seeks to investigate the export market structure of Sumatra Island by focusing on the involvement of four key provinces. More specifically, it aims to analyze the contribution of Sumatra's exports to the national economy through the lens of market structure and to assess their long-term economic implications at the national level.

B. LITERATURE REVIEW

Several studies have examined the market structure of exporters in various contexts. Yi et al. (2018) examined the structure of the palm oil industry in Malaysia from 2005 to 2013 using the Herfindahl-Hirschman Index (HHI) and the Concentration Ratio (CR4). Their findings suggest that the industry falls into the oligopoly category, although in recent years, there has been a clear trend towards a decline in oligopoly concentration.

Similarly, Nendissa et al. (2019) analyzed the concentration of the beef cattle market in East Nusa Tenggara (NTT), also using the HHI and CR4. The study revealed that the market structure at the farmer level exhibits characteristics of perfect competition, while at the trader level, the market tends to function as an oligopsony in the NTT context.

Basyigit and Kart (2022) examined the market structure of base metal exports in Turkey, applying the HHI and CR to assess the level of concentration. Their analysis suggests that the Turkish base metal export market is moderately to highly concentrated, making it vulnerable to monopsony risks. Furthermore, Putro and Hidayat (2023) studied the market structure of Indonesian black tea exports to Japan from 2002 to 2021 using HHI and CR4. Their findings revealed that black tea exports in packaging and bulk are characterized by an oligopoly market structure, dominated by a few competitive countries and characterized by high market concentration.

Zhou and Fan (2022) show that concentrated export structures negatively impact export stability through the channel of import demand elasticity. Minetti et al. (2021) find that bank-oriented financial systems with weak regulatory environments tend to entrench incumbent exporters and reduce market dynamism, thereby contributing to more concentrated export market structures.

Steinberg (2023) analyzes export market penetration dynamics and finds that persistent dominance by incumbent exporters leads to concentrated market structures and limited entry by new firms across export destinations. Zhou et al. (2022) demonstrate that broadband infrastructure significantly boosts export growth in Chinese cities by lowering trade costs and information frictions, thus enabling broader exporter participation and potentially altering the structure of export markets.

Finally, Osmaleli et al. (2023) analyzed the market structure of tuna exports in ASEAN from 2017 to 2021 using HHI and CR4. The results showed that the Indonesian tuna export market both fresh and frozen operated under perfect competition conditions.

There are several previous studies that reveal the role of exports in economic growth. Faridi (2012) analyzed the contribution of agricultural exports to economic growth in Pakistan from 1972 to 2008. His empirical findings indicate that agricultural exports have a negative and significant effect on economic growth. Therefore, it is necessary to increase exports of downstream products to improve the national economy. Nguyen (2016) analyzed the effect of exports on economic growth in Vietnam from 1990 to 2015. The empirical results show that current year exports have a significant and positive effect on GDP growth in the current year and the following two years.

Verter & Becvarova (2016) studied agricultural exports on economic growth in Nigeria using Ordinary Least Squares (OLS), Granger Causality, Impulse Response Function, and Variance Decomposition regression. The results of their analysis indicate that agricultural exports drive economic growth in Nigeria. Conversely, the results show an inverse relationship between the level of agricultural openness and economic performance in Nigeria. Mamba & Ali (2022) analyzed agricultural exports on agricultural growth and overall economic growth in the Economic

Community of West African States (ECOWAS) countries from 1996 to 2018. The results of the analysis show that agricultural exports significantly increase agricultural growth and overall economic growth. In addition, the effects differ significantly from agricultural growth equation to economic growth equation. Moussaooui (2022), employing a VAR and Granger causality approach on Tanzania's trade data from 1962 to 2019, revealed that while

exports influence GDP in a unidirectional manner, imports exhibit a bidirectional causality with economic growth, underscoring the differential dynamic linkages among trade components. In a similar vein, Istaiteyeh et al. (2023) examined the case of Jordan using time-series data and found no long-run cointegration among exports, imports, and GDP, but identified short-run causal relationships, particularly from capital formation and GDP to exports, suggesting the relevance of growth-led trade mechanisms in the short term.

Focusing on the structure of trade, Carrasco and Tovar-García (2021) argued that export composition and diversification, while often emphasized in development strategies, do not significantly influence growth in developing countries; instead, high-tech and capital goods imports were found to have a more robust positive association with economic performance. In the specific context of Indonesia, Arifah and Kim (2022) highlighted that agricultural exports not only remained resilient during the COVID-19 pandemic but also positively contributed to economic growth, providing empirical support for the export-led growth hypothesis in crisis conditions.

In general, previous studies on international trade related to market structure and the impact of exports on the economy show three main patterns. First, most previous studies analyze market structure in the context of specific products, thus focusing more on specific commodities. Second, studies on the impact of exports in a more detailed geographic context are still relatively limited. Third, there has been insufficient elaboration on how market structure and export performance operate differently in regions with diverse economic characteristics.

These three findings indicate that although the issue of exports has been widely discussed, no research has specifically examined this phenomenon at the provincial level within a single heterogeneous region, especially regions with significant differences in export

composition, economic size, and market dependence. Provincial exports boost national GDP by generating foreign exchange and increasing domestic production, particularly involving value-added processing. Furthermore, product and market diversification enhances resilience and strengthens the positive contribution of exports to long-term economic growth.

Therefore, this study fills this gap by examining the structure of export markets and analyzing how exports from each province affect long-term economic growth through a case study of Sumatra Island, a key region for export commodity development, particularly in the agriculture and plantation sectors. Thus, the main contribution of this study is to provide new insights into the asymmetry in the impact of exports across provinces and to confirm that the effectiveness of exports as a driver of growth is strongly influenced by the characteristics of the market structure in each region.

C. RESEARCH METHODS

This research framework explores how exports from provinces on Sumatra Island contribute to the national economy by looking at two objectives, namely: 1) The structure of export markets in the provinces on Sumatra, and 2) The influence of exports from each province on Sumatra Island on the national economy. Based on literature searches, the analysis techniques for both objectives are HHI-CR and ARDL, which aim to determine the contribution of exports from Sumatra Island to the national economy.

The data are categorized as secondary data because they are obtained from official publications rather than directly collected by the researcher. Specifically, data on GDP growth, gross fixed capital formation (GFCF) growth, and labor force growth are taken from the World Development Indicators (WDI), while export data for the four selected provinces in Sumatra (Aceh, North Sumatra, West Sumatra, and South Sumatra) as well as import data are obtained from the Statistics Indonesia (BPS) at both provincial and national levels.

Several analytical techniques are employed in this study, namely: (1) the Herfindahl-Hirschman Index (HHI), (2) the Concentration Ratio (CR), and (3) the Autoregressive Distributed Lag (ARDL) model. Each analytical method is described in detail below.

1. Herfindahl-Hirschman Index (HHI)

This technique is used to measure market concentration, specifically in the context of export activities across several provinces in Sumatera Island, particularly in market competition and efficiency (Kvalseth, 2018). The HHI formula is presented as follows:

$$HHI = 10,000 \times \sum Si2 \qquad (1)$$

Si is the market share of province i in total exports, i represents Aceh Province, North Sumatra Province, West Sumatra Province, and South Sumatra Province. The HHI ranges from 0 to 10,000: values near 0 indicate a highly competitive, unconcentrated market, while values near 10,000 reflect a highly concentrated or near-monopoly market.

2. Concentration Ratio (CR)

This analytical method calculates the percentage of total market share held by the top exporting provinces. In this study, the CR is applied using the four largest exporting regions and is therefore referred to as CR4 (Sembiring et al., 2021; Johantri et al., 2023; Savagar et al., 2024; Silva et al., 2024). The formula for calculating the Concentration Ratio is as follows:

$$CR4 = S1 + S2 + S3 + S4 \qquad (2)$$

where $S1^2$, $S2^2$, $S3^2$, and $S4^2$ are each export shares of Aceh Province, North Sumatra Province, West Sumatra Province, and South Sumatra Province. A low CR4 value can be indicated as

having relatively high market competition. Otherwise, the high CR4 value indicates that one of the provinces in Sumatra dominates Indonesia's export market.

3. Autoregressive Distributive Lag (ARDL)

The research model developed in this study is based on the neo-classical growth model from Solow in 1956. The neo-classical growth model equation starts from the Cobb-Douglas production function as follows:

$$Y_t = f(L_t, K_t) \qquad (3)$$

where Y_t is the aggregate production in the economy in period t, L_t = the number of workers in period t, and K_t is the availability of capital in period t. The purpose of this study is to analyze the effect of export growth in four Sumatran provinces on the long-term economic growth rate. Therefore, there are several modifications in equation (1) by adding trade elements as additional inputs in the model, so that the modified equation can be written as follows:

$$Y_t = f(L_t, K_t, XACEH_t, XSUMUT_t, XSUMBAR_t, XSUMSEL_t, XOTHER_t, M_t) \qquad (4)$$

where $XACEH_t$ is export from Aceh province in period t, $XSUMUT_t$ is export from North Sumatra province in period t, $XSUMBAR_t$ is export from West Sumatra province in period t, $XSUMSEL_t$ is export from South Sumatra province in period t, $XOTHER_t$ is export from other provinces outside the four provinces in Sumatra, and M_t is Indonesia's import in period t.

In this study, we use econometric analysis with the Autoregressive Distributive Lag (ARDL) approach. The difference with previous studies is the use of growth variables in all variables in this model, so that the equation can be written as follows:

$$GDPG_t = B_0 + B_1 GFCG_t + B_2 LABG_t + B_3 XGACEH_t + B_4 XGSUMUT_t + B_5 XGSUMBAR_t + B_6 XGSUMSEL_t + B_7 XGOTHER_t + B_8 MG_t + e_t \qquad (5)$$

where $GDPG_t$ is the percentage of economic growth in period t representing Y_t, GFCG is the growth of gross physical capital formation in period t representing K_t, $LABG_t$ is the growth of the number of workers in period t representing L_t. While $XGACEH_t$, $XGSUMUT_t$, $XGSUMBAR_t$, $XGSUMSEL_t$, and $XGOTHER_t$ are the export growth rates of each province, namely Aceh, North Sumatra, West Sumatra, South Sumatra, and all other provinces in Indonesia exclude four provinces in period t. In addition, MG is the import growth rate in period t and e_t is the error term.

Before applying ARDL, we need to evaluate the stationarity of time series data using the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979). The stationarity test is carried out first at the level then the difference first to determine the existence of the unit root and the order of integration of all variables. In addition, the selection lag is also applied as one of the ARDL criteria by utilizing LR, FPE, AIC, SC, and HQ. After conducting the stationarity test, a cointegration test is conducted to ensure whether the model developed in this study has a long-term relationship using the F-bound test. The ARDL model in this study, both long-term and short-term, can be written as follows:

$$\Delta(GDPG_t) = B_0 + B_1 GFCG_{t-1} + B_2 LABG_{t-1} + B_3 XGACEH_{t-1} + B_4 XGSUMUT_{t-1} + B_5 XGSUMBAR_{t-1} + B_6 XGSUMSEL_{t-1} + B_7 XGOTHER_{t-1} + B_8 MG_{t-1} + \sum B_1 \Delta GFCG_{t-i} + \sum B_2 \Delta LABG_{t-i} + \sum B_3 \Delta XGACEH_{t-i} + \sum B_4 \Delta XGSUMUT_{t-i} + \sum B_5 \Delta XGSUMBAR_{t-i} + \sum B_6 \Delta XGSUMSEL_{t-i} + \sum B_7 \Delta XGOTHER_{t-i} + \sum B_8 \Delta MG_{t-i} + e_t \qquad (6)$$

where Δ is the change in variables. This test involves the F test to determine the significance
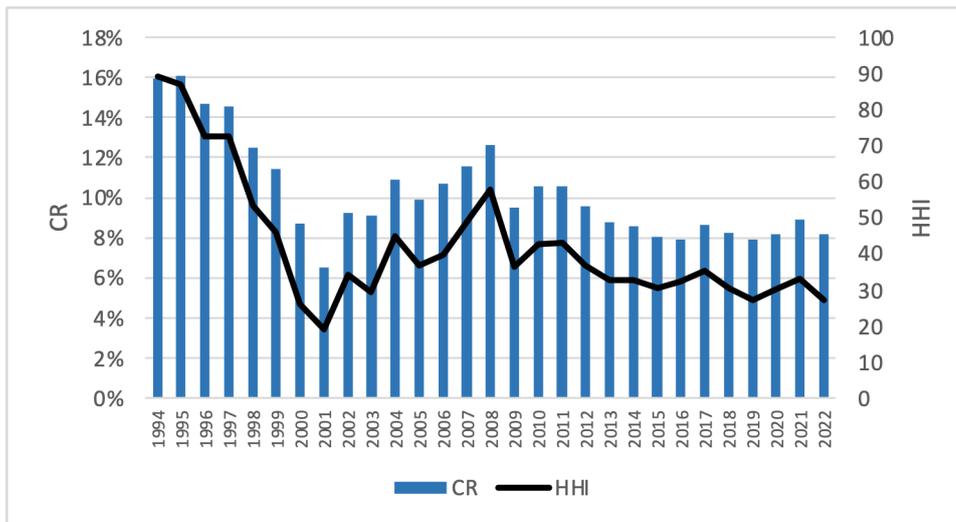
Figure 2. The Market Structure through HHI and CR4
Source: Processed by Author (2024)

of the combined coefficients of the lagged variables in order to test the existence of a long-run relationship between variables. The null hypothesis regarding the absence of a long-run relationship between variables (Ho: $\beta 1 = \beta 2 = \beta 3 = \beta 4 = \beta 5 = \beta 6 = \beta 7 = \beta 8 = 0$) is examined by following Pesaran et al. (2001). The decision to reject or accept Ho is based on the following provisions: if the F value > upper limit, then reject Ho and the variables are cointegrated, if the F value < lower limit, then accept Ho and the variables are not cointegrated. -integrated, but if the F value ≥ lower limit and ≤ upper limit, then decision we cannot be concluded. The error correction model for short-run relationship estimation is determined as:

$\Delta(GDPGt) = B0 + \sum B1\Delta GFCGt\text{-}i + \sum B2\Delta LABGt\text{-}i + \sum B3\Delta XGACEHt\text{-}i + \sum B4\Delta XGSUMUTt\text{-}i + \sum B5\Delta XGSUMBARt\text{-}i + \sum B6\Delta XGSUMSELt\text{-}i + \sum B7\Delta XGOTHERt\text{-}i + \sum B8\Delta MGt\text{-}i + \lambda_1 ECM_{t-1} + e_t$ (7)

where the negative and significant ECM_{t-1} coefficient ($\lambda 1$) implies that any short-term imbalance between the dependent and explanatory variables will converge back to the long-term equilibrium relationship. The data in this study were obtained from various sources. Data on GDP growth, GFCF growth, and LAB growth were obtained from the World Development Indicator (WDI). Meanwhile, export data from four provinces and imports were obtained from the Statistics Indonesia (BPS) at the provincial and national scales. The analysis period in this study is 1994 to 2022 for all analysis techniques applied.

D. RESULTS AND DISCUSSION

The results of the Herfindahl-Hirschman Index (HHI) and Concentration Ratio (CR) analyses for four provinces on Sumatra Island are presented in Figure 3. The findings suggest that the market structure in these provinces tends toward perfect competition, as indicated by low concentration levels. Furthermore, the analysis reveals a downward trend in market concentration, implying a declining share of these provinces in Indonesia's total export performance.

Table 1. shows the descriptive analysis covering the Mean, Median, Maximum, Minimum and Standard Deviation (Std. Dev) values. The results of Table 1 show that only LABg has a low

Table 1. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std.Dev
GDPG	0.094	0.112	0.467	-0.558	0.175
GFCFG	0.100	0.162	0.394	-0.603	0.181
LABG	0.018	0.018	0.048	-0.013	0.013
XGACEH	0.115	0.014	2.397	-0.816	0.669
XGSUMUT	0.082	0.055	0.577	-0.303	0.212
XGSUMBAR	0.131	-0.006	1.006	-0.436	0.329
XGSUMSEL	0.138	0.013	0.922	-0.437	0.357
XGOTHER	0.087	0.075	0.408	-141	0.146
MG	0.101	0.058	0.735	-0.344	0.239

variation compared to other variables because the Mean value is greater than Std. Dev. Therefore, the variables in this study as a whole can be said to be normally distributed.

The results of the stationarity test of this model can be seen in Table 2 through the ADF test. The stationarity results in this study indicate that all variables are stationary at both the level and first-difference levels so that the model is free from spurious regression. After conducting the stationarity test, this study determines the ARDL analysis's lag length.

Table 2. Stationary Test

Variable	Augmented Dicky-Fuller Test (ADF-Test)	
	Level	First-Difference
GDPG	-5.468***	-7.139***
GFCFG	-3.671***	-7.101***
LABG	-4.588***	-6.457***
XGACEH	-4.796***	-5.435***
XGSUMUT	-5.473***	-6.718***
XGSUMBAR	-4.881***	-6.001***
XGSUMSEL	-4.692***	-5.599***
XGOTHER	-4.373***	-6.535***
MG	-5.157***	-5.469***

Table 3 shows several lags determined from several determination methods: LR, FPE, AIC, SC, and HQ. According to Sen Liew (2004), FPE and AIC are criteria that can be used as references if the sample size is small (ranging below 60). This study uses FPE so that lag one is selected to estimate the results of the ARDL analysis.

Table 3. Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	32.982	NA	0.009	-1.919	-1.480	-1.797
1	44.808	14.192*	0.004*	-2.785	-2.297*	-2.650*
2	45.565	0.847	0.004	-2.765	-2.229	-2.616
3	46.966	1.458	0.004	-2.797*	-2.212	-2.635
4	47.071	0.100	0.004	-2.726	-2.092	-2.550

In Table 4, it is found that there is a long-term relationship between variables through the calculation of F statistics which is above the lower critical value at I(0) and the upper critical at I(1) at 10%, 5%, 2.5%, and 1% in the significance level. This shows that GFCFG, LABG, XGACEH, XGSUMUT, XGSUMBAR, XGSUMSEL, XGOTHER, and MG are cointegrated with GDPG.

Table 4. F-Bound Test

Test Statistics	Value	Significant	I(0)	I(1)
F-Statistic	166.599	10%	1.85	2.85
K	8	5%	2.11	3.15
		2.5%	2.33	3.42
		1%	2.62	3.77

The results of the ARDL estimation, both long-term and short-term, can be seen in Table 5. From the long-term estimation aspect, the estimation results show that the growth variable of gross physical capital formation (GFCFG) and other export growth variables XGOTHER have a positive and significant effect on GDPG. The results of this study are in accordance with the findings of previous studies that found the same results (Murindahabi et al. 2019; Mlambo et al.

2019; Suroso et al. 2024). On the other hand, import growth has a negative and significant

The long-run estimation results show that the coefficients for the export contributions from North Sumatra (XGSUMUT), West Sumatra (XGSUMBAR), and South Sumatra (XGSUMSEL) are relatively small and statistically insignificant. In the sign of effect, Aceh's export growth (XGACEH) has a positive coefficient, while North, West, and South Sumatra (XGSUMUT, XGSUMBAR, XGSUMSEL) have negative coefficients. This indicates that, over the long term, exports from these provinces do not meaningfully contribute to Indonesia's national economic growth. The lack of impact may be attributed to the concentration of their exports in primary commodities without sufficient diversification toward higher value-added products. In the short-run estimation, labor force growth (LABG) and import growth (MG) display significant negative effects on GDP growth (GDPG).

Table 5. ARDL Estimation

Long-Run Estimation				
Variables	Coefficient	Std. Error	t-Statistics	Probability
GFCFG	0.968	0.062	15.452	0.000
LABG	0.426	0.700	0.608	0.552
XGACEH	0.019	0.010	1.915	0.075
XGSUMUT	-0.116	0.070	-1.669	0.112
XGSUMBAR	-0.030	0.049	-0.622	0.543
XGSUMSEL	-0.025	0.028	-0.872	0.397
XGOTHER	0.757	0.107	7.109	0.000
MG	-0.535	0.092	-5.816	0.000
CONSTANT	-0.006	0.014	-0.381	0.709
Short-Run Estimation				
Variables	Coefficient	Std. Error	t-Statistics	Probability
D(LABG)	-0.860	0.287	-2.993	0.009
D(XGOTHER)	0.387	0.045	8.668	0.000
D(MG)	-0.243	0.026	-9.364	0.000
CointEq(-1)*	-1.191	0.023	-51.629	0.000
R-Squared	0.992			
Adjusted R-Squared	0.991			
Durbin-Watson Stat	2.600			

effect. Only Aceh province was found to have a positive and significant effect on long-term GDPG.

The negative coefficient for labor force growth suggests potential inefficiencies arising from insufficient employment opportunities relative to labor supply. Similarly, the negative effect of import growth implies that rising imports, without supporting domestic industry, may suppress short-term economic performance. Conversely, export contributions from other Sumatran provinces (XGOTHER) show a positive and significant effect on GDP growth, suggesting that these provinces benefit from a more diversified and dynamic export structure. The error correction term CointEq(-1)* is negative and highly significant, confirming that the system is readjusting to long-term equilibrium. The estimated readjustment rate of approximately 119.1 percent or 1.191 indicates a rapid correction within a single period. While this value is relatively high, such overadjustment can occur in small samples or in systems with fast dynamic responses.

The empirical findings of this study indicate that the export contributions from major provinces in Sumatra, specifically North Sumatra, West Sumatra, and South Sumatra, do not exert a statistically significant long-term influence on Indonesia's national economic growth. Conversely, export activities from other Sumatran provinces display a positive and statistically significant relationship with economic growth, both in the long and short term. These results corroborate and extend the insights derived from prior research regarding the critical role of export diversification in promoting sustainable economic development. A closer examination of these findings suggests that reliance on traditional export structures without progressive diversification may limit a region's ability to stimulate broader economic dynamism, particularly in the context of an increasingly volatile global trade environment.

Previous empirical studies have consistently emphasized that diversification in export portfolios contributes significantly to economic resilience and growth. Basile, Parteka, and Pittiglio (2018) demonstrated that spatial diffusion and spillover effects reinforce the impact of export diversification, particularly within developing economies characterized by regional complementarities. The significance of such externalities suggests that the capacity of regions to connect and benefit from neighboring economic activities is a crucial factor in leveraging export growth into sustained development outcomes. The findings observed in this study, where "other" Sumatran provinces perform better in influencing national GDP growth, reflect the possible presence of such spatial synergies within lesser-known, emerging provincial economies.

Research focused on Sub-Saharan Africa similarly revealed that dependence on primary commodities without sufficient diversification heightens economic vulnerability rather than fostering long-term growth (Oyebanjo, 2017; Verter & Bečvářová, 2016). These findings resonate with the current study's observation that dominant exporting provinces in Sumatra,

Analyses at the industrial level by Jongwanich (2020) further reinforce the importance of distinguishing between intensive and extensive margins of export growth. Expansion into new products or new markets — the extensive margin — appears critical for sustaining export-driven economic growth beyond short-term cycles. The positive effect observed in "other" Sumatran provinces suggests that successful diversification along the extensive margin is underway, allowing these regions to capture emerging opportunities and mitigate the adverse effects of sector-specific volatility. This dynamic highlight the importance of fostering entrepreneurial capacities and export market intelligence at the regional level as critical enablers of sustained economic performance.

presumably reliant on commodities such as crude palm oil, rubber, and coal, fail to make significant contributions to broader economic expansion. The implications of these patterns are profound, suggesting that without deliberate efforts to restructure export portfolios toward more complex and diversified outputs, regions risk entrenching structural fragilities that hinder convergence to higher-income trajectories.

Theoretical frameworks such as the Product Space theory (Hausmann, Hwang, & Rodrik, 2007; Hidalgo & Hausmann, 2009) provide a robust explanation for these empirical patterns. According to this theory, economic growth prospects are intimately linked to the complexity of products a region can competitively export. Regions entrenched in low-complexity goods are likely to face "capability traps," where limited technological spillovers and low productivity gains undermine long-term growth. The empirical evidence from China, as presented by Jarreau and Poncet (2011), substantiates this assertion by illustrating that domestic-led sophistication in exports fosters stronger regional economic performance, a dynamic potentially absent in the more commodity-dependent Sumatran provinces analyzed in this study.

The negative impact of import growth on GDP, both in the short and long term, is consistent with findings from Ahmad, Draz, and Yang (2018), who identified that imports, when not directed toward enhancing productive capacity, may undermine domestic economic growth. The observation that imports detract from GDP growth in the Indonesian context signals that trade liberalization, without corresponding improvements in domestic productive capabilities, may exacerbate trade imbalances and suppress endogenous growth potential. Such dynamics underscore the necessity for strategic import policies that selectively facilitate the acquisition of capital goods, technological equipment, and inputs critical for industrial

upgrading rather than unsustainably expanding consumer goods imports.

The broader implications of export structures and trade integration are further elaborated by Mania and Rieber (2019), who argued that sustainable economic growth necessitates not only diversification but also structural transformation toward higher-productivity sectors. Structural transformation encompasses the transition from primary sector dependence toward more industrialized and knowledge-intensive activities, which is pivotal for overcoming the middle-income trap frequently faced by emerging economies. The empirical insights from China's prefectures (Egger, Li, & Wu, 2024) illustrate that regions able to upgrade their export composition experience more rapid growth, thereby emphasizing the strategic importance of technological learning and innovation ecosystems within regional economies.

Application of these findings to the domain of regional economic development underscores the necessity of moving beyond volume-centric export strategies. Parteka and Tamberi (2013) emphasized that diversification into more sophisticated, value-added sectors drives true productivity enhancements and fosters robust income convergence across regions. In the Sumatran context, provincial governments must prioritize not only export expansion but also the cultivation of complex industrial capabilities, the development of skilled human capital, and the creation of innovation-driven clusters. Failure to adopt such an integrated development strategy risks perpetuating regional disparities and leaving resource-endowed provinces vulnerable to external commodity price shocks.

The neo-structuralist perspective, as advanced by Cimoli et al. (2010) and reinforced through various empirical studies, advocates for deliberate state interventions aimed at overcoming market failures and structural bottlenecks. In alignment with this view, the current study's findings indicate that spontaneous market forces are unlikely to facilitate the necessary structural upgrading for long-term growth, particularly within provinces predominantly exporting low-complexity goods. Public policy must therefore actively intervene to guide the reallocation of resources toward higher-productivity sectors, support research and development initiatives, and establish infrastructure that connects regional economies more effectively to domestic and international value chains.

The observed dynamics also resonate with contemporary debates surrounding global value chain (GVC) participation. As emphasized by Hidalgo and Hausmann (2009) and further explored in subsequent studies, effective participation in GVCs necessitates a strategic focus on upgrading and functional climbing within production networks. Regions that remain locked into low-value-added stages of production derive limited developmental benefits, despite increased trade volumes. In the Sumatran case, the urgency of developing capabilities that allow provincial firms to move up the value chain is essential to avoid being confined to peripheral, low-income positions within global production systems.

Overall, the empirical results contribute to a growing body of evidence that underscores the critical importance of export structure quality, diversification breadth, and capability development in shaping regional economic growth trajectories. Strategic interventions at the regional level, grounded in a nuanced understanding of comparative advantage evolution and industrial upgrading pathways, are indispensable for ensuring that export-driven growth translates into broad-based economic prosperity. Policymakers must prioritize the creation of dynamic, adaptable regional economies capable of navigating the complexities of global competition and technological change.

After obtaining the estimation results, diagnostic tests are also applied to detect our model has serial correlation and homoscedasticity or vice versa. Table 6 shows that there is no serial correlation in the model confirmed by the Breusch – Godfrey Serial Correlation LM Test. Furthermore, heteroscedasticity through Glejser also shows no signs of autoregressive conditional heteroscedasticity. The normality test through Jarque Bera shows that the data is normally distributed with a probability above 5% significance.

Table 6. Diagnostic Test

Autocorrelation and Heterokedasticity Tests	Obs*R-square	F-Statistic (Prob. F)	Probability Chi-Square
Serial Correlation: Breusch-Godfrey Serial Correlation LM Test	4.758	1.331 (0.298)	0.093
Heterokedasticity Test: Glejser	2.747	0.999	0.997
Normality Test			
Jarque-Bera	1.851		0.396

Moreover, for the illustration of that the model parameters in cumulative sum and cumulative sum of squares can be seen in the appendix 2. The result shows cumulative sum and cumulative sum of squares are approximately within the 5% critical line. Thus, we can conclude that our model is stable and allows for estimation.

By using the long-term coefficient of ARDL, this study tries to make predictions with several simulations, namely an increase from each province by 10%, 25% and 50% to see how the contribution of exports from the island of Sumatra which continues to increase will also have implications for the national economy.

The first simulation scenario (S1), which models a 10 percent increase in exports from the four provinces in Sumatra Island, reveals that the impact on national GDP growth remains relatively limited and exhibits a negative trend over several observation periods. Although in some initial years, such as 1994 and 1995, the predicted GDP growth appears slightly higher than the actual recorded growth, this pattern quickly deteriorates in subsequent years. During the Asian financial crisis of 1997 and 1998, for instance, the predicted GDP growth under S1 becomes even more negative compared to actual outcomes. This finding indicates that a modest increase in export volumes from the current composition does not provide sufficient economic stimulus and, under adverse conditions, may even exacerbate vulnerabilities. The results suggest that expanding the volume of primary commodity exports, without upgrading their value-added components, fails to generate resilient or sustainable economic growth contributions at the national level.

The second simulation scenario (S2), representing a 25 percent increase in exports from the selected provinces, similarly produces results that highlight the inadequacy of the existing export structure. Although the magnitude of the simulated GDP growth rates under S2 is marginally higher than in S1, the overall trend remains stagnant or declining relative to actual GDP growth. In critical periods such as 1997 to 1999 and again from 2012 to 2016, the predicted economic growth under S2 consistently underperforms the observed historical data. These patterns indicate that a moderate escalation in export activities, when based on traditional low value-added commodities, does not yield proportionate improvements in national economic performance. The persistent underperformance underscores the structural limitations of Sumatra's current export base, suggesting that without diversification into more sophisticated products, efforts to scale up export volumes will have limited effectiveness in supporting Indonesia's broader growth objectives.

The third simulation scenario (S3), which assumes a 50 percent increase in export contributions from the four provinces, offers further confirmation of the structural challenges identified in the previous scenarios. Even with a

substantial escalation in export activities, the simulated GDP growth rates remain below expectations and, in several years, continue to deteriorate relative to the actual historical performance. The results from S3 reinforce the conclusion that the quality and complexity of exports are more decisive for fostering economic growth than the sheer volume of trade. The failure of even significant export increases to positively alter the growth trajectory indicates that the prevailing export structure, heavily concentrated in unprocessed agricultural and mineral products, limits the potential for dynamic spillovers and value chain development. This outcome emphasizes the critical need for downstream processing, industrial upgrading, and export diversification strategies to transform Sumatra Island's role in supporting sustainable national economic development.

This simulation analysis shows that there needs to be a re-arrangement of the composition of exports in Sumatra Island in order to encourage national economic growth. One form of creating a positive influence from exports is to develop a downstream policy on agricultural products to create added value from exports. With the added value, it will have implications for economic growth along with the value obtained being higher than the product. On the other hand, the simulation results clearly show that increased exports actually have a negative impact on long-term GDP growth. This is reflected in the negative coefficient in Table 5 and the projected decline in GDP growth in Table 7. These findings confirm that the current export structure is detrimental to the economy, making strengthening downstream processing increasingly crucial.

E. CONCLUSION

This study aims to analyze the contribution of exports from Sumatra Island to the national economy. There are two analysis techniques: 1) market structure analysis and 2) ARDL in answering the research objectives. The results of the market structure analysis show that the four provinces in Sumatra Island tend to be low concentration and in the form of perfect competition. The analysis of ARDL found that of the four provinces effect on economic growth: Aceh's export growth has a positive coefficient, while North, West, and South Sumatra have negative coefficients.

However, the coefficient value was lower than North, West, and South Sumatra. On the other hand, export growth from other provinces outside the four provinces positively and significantly affects national economic growth in the long term. To evaluate how the export contribution of the four provinces in Sumatra impacts the national economy, simulations were conducted by increasing each province's export level by 10%, 25%, and 50%.

The results showed that despite the increase in exports, the national GDP growth rate declined, indicating a negative long-term economic impact. It shows that the contribution of exports from the four provinces in Sumatra Island is still relatively small regarding market structure and its influence on the Indonesian economy.

To strengthen export performance in Sumatra, it is crucial to build a more integrated export structure, from upstream production to downstream processing. Policy measures such as improving infrastructure, diversifying products and destination markets, and strengthening trade diplomacy can help expand export opportunities and support long-term economic growth.

A limitation of this study is its focus on only four provinces due to data limitations. This analysis does not cover other provinces in Sumatra, and future studies should include these provinces to provide a more comprehensive understanding of the region's export structure. Moreover, future research should explore leading commodities and export competitiveness to identify sectors with the greatest potential for value-added development and sustainable export performance.

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Appendix