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Trade Factor Intensity and Economic Growth in ASEAN and SAARC: Assessing the Moderating Role of Transportation Systems

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ABSTRACT

This study examines how transportation systems influence the relationship between factor-intensity in trade and economic growth across ASEAN and SAARC nations. Based on panel data over the period 2008-2019, the model framework of semi-endogenous growth (Jones, 1995) is applied for the analysis. According to the UNCTAD's standard international trade classification (SITC), export data are broadly grouped into 10 categories. This study applies to 4 integrated categories trade products based on labor-intensive (SITC0, 4, and 6), resource-intensive (SITC2-3), capital-intensive (SITC5, and 8), and technology-intensive (SITC7). The findings with fixed effects and GMM indicate that the impacts of capital-intensive and technology-intensive exports on economic growth are enhanced by well-established transportation infrastructure in the efforts of sea cargo and airfreight towards digital platforms. On the other hand, the weak evidence of infrastructure does not have any role in the impacts of resource-and labor-intensive trade engaged in land-based transport services.
Keywords: *Trade Factor Intensity, Transportation Systems, Economic Growth, ASEAN-SAARC.*

1. Introduction

The purpose of this study is to examine the impact of transportation systems on the relationship between trade factor intensity and economic growth within ASEAN and SAARC

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economies. The core relationship between trade patterns and economic growth has been a central theme in development economics and contemporary trade policy, particularly in the context of trade-led productivity growth across developing countries. Traditionally, previous literature categorizes trade based on potential factor intensity (e.g., labor-abundant vs. capital-abundant economies) and examines its impact on growth without adequately accounting for the role of transportation systems (Frankel & Romer, 1999). These studies implicitly assume that different transportation systems affect all trade products in similar ways, and overlook incremental distinctions in trade performance and growth effects arising from specific transportation and infrastructure systems. While such assumptions may be reasonable for certain trade flows, such as air-transported high-value goods, they fail to capture the complexities associated with bulk commodities like minerals and agricultural products, where the nature of trade success may depend heavily on infrastructure conditions and transportation costs related to containerized shipments (Hummels, 2007).

The Association of Southeast Asian Nations (ASEAN) and the South Asian Association of Regional Cooperation (SAARC) economies feature a mixed geography of landlocked and coastal nations with highly diverse transportation systems and deficient infrastructures. Given the variation in resource endowments and production frontiers through economic integration, trade competitiveness is shaped not only by trade factor intensities but also by transportation costs and logistics efficiency. Ignoring these realities would result in biased evaluation and leads to poorly informed policy recommendations that fail to account for infrastructure bottlenecks (e.g., inadequate road and rail networks in landlocked economies like Bhutan, Lao PDR, and Nepal) or excessive reliance on seaports for coastal economies like Indonesia, Sri Lanka, Vietnam, etc. According to Anderson & Van Wincoop (2003), trade flows are solely influenced by bilateral trade costs, distortions, and multilateral resistance. The country's access to regional and global markets extends beyond direct trade barriers related to market size and geographical conditions. In addition, Limao & Venables (2001) emphasize that inadequate infrastructure disproportionately increases transportation costs and hinders international trade and economic growth, particularly in developing and landlocked nations. Broadly, the transport-economy linkages currently need to be developed in the sense of mechanisms associated with market expansion, trade, technological shifts, urbanized clusters, and agglomeration (Lakshmanan, 2011). Inadequate transport infrastructure remains a barrier to economic development and optimal production mix, as a constraint for regional trade-led growth in South Asia (5% of the world trade, the lowest intra-regional trade based on Liyanage et al., 2017). In ASEAN, various modes of transport and logistics connectivity lead to highly comprised financial costs for trade and time delays in supply chains due to inadequate quality systems and chronic infrastructure bottlenecks (Smith et al., 2019).

Despite these insights, previous studies on ASEAN and SAARC trade often undervalue the significance of various types of transportation infrastructure and deficiencies in cross-border transport systems, and thus do not reflect actual trade-growth relationships. According to the standard international trade classification in commodities of export and import are broadly grouped into the following categories in 1-digit level; food and drink (Section 0 -1), raw materials (Section 2 and 4), energy products (Section 3), chemicals (Section 5), machinery and transport equipment (Section 7), other manufacturing products (Section 6 and 8), and other products and transactions (Section 9) based on UNCTAD (2025). The impact of trade on economic growth differs not only by specific trade category (factor trade intensity) but also by type of transport infrastructure. In addition, as Appendix B and C show, specific trade categories (e.g., labor-intensive and capital-intensive goods) are connected with appropriate transportation modalities (e.g., air, rail, maritime). Capital-intensive sectors, for instance, often rely on maritime transportation and containerized trade specifications, while high-value and time-sensitive goods depend on air-freight transport frequency. The omission of these linkages skews policy implications. Targeted infrastructure investments should be strategically aligned with sectoral trade patterns of industrialization intensity for economic growth across the regions. Critically, the previous studies do not consider the interaction effects of trade factor intensities with the potential transport infrastructure being served in the economy.

This study addresses the above issue by extending the previous studies on economic growth models and examining how appropriate transportation systems can moderate the growth effects of trade factor intensity across ASEAN and SAARC countries. Specifically, it focuses on the interaction between trade categories (e.g., resource-intensive, labor-intensive, and capital-intensive) with transportation modalities (e.g., maritime shipping for bulk goods, air cargo for high-value products, and road/rail for regional trade). Based on the frameworks of Anderson & Van Wincoop (2003) and Limao & Venables (2001), this study incorporates transportation-specific factors to provide new insights into the role of infrastructure choices in facilitating trade-driven growth productively. Hence, this study explores what potential types of transportation modes can play a key role in trade intensity categories of industrialization for sustained economic growth.

Empirically, Phoutvichay et al. (2025) investigate the impact of similar types of infrastructure connectivity on economic growth with ASEAN data over the period 2006-2019. This study extends a semi-endogenous growth framework (Jones, 1995) and applies a fixed effects model to control for unobserved heterogeneity in the regions. In addition, the generalized method of moments (GMM) is used to consider endogeneity issues. These approaches enable the study to make clear the role of transportation infrastructure in moderating trade-driven development and offer valuable implications for contemporary trade policy and infrastructure planning in emerging economies across ASEAN and SAARC regions.

The remainder of the organized paper is as follows: Section 2 overviews economic growth theories and their previous empirical studies. Section 3 delves into the theoretical model, data, and methodology. Section 4 presents the empirical results, and Section 5 discusses the findings. The conclusion is in Section 6 with policy implications.

2. Economic Theories and Literature Review

Section 2.1 overviews three types of economic growth models (Solow growth model, endogenous growth model, semi-endogenous growth model), especially focusing on how the technical progress is treated, and discusses which type of growth model is more appropriate for the empirical study in developing countries. Section 2.2 considers the importance of specialization of trade based on resource endowments and industrial sectors. Section 2.3 examines how specialization of trade (or trade factor intensity) is linked to long-run economic growth. Section 2.4 is the discussion on the role of transportation systems in enhancing the impact of the trade factor intensity on economic growth. The summary of the literature review and the scope of this study are provided in Section 2.5.

2.1. Economic Growth Framework and the Role of Trade Openness

Economic growth represents economic progress and reflects the level of income distribution in consequence of welfare and economic development (Weil, 2016). Based on economic growth theory (Solow and Swan, 1956), physical capital and labor play key drivers of economic growth, population growth is in the labor force, and technological progress is treated as exogenous. The model emphasizes the efficiency of physical capital and labor based on labor productivity. The aggregate production function in the Solow model exhibits constant returns to scale in labor and capital, thus, the model leads to diminishing returns and convergence to a steady state level of per capita income. However, developing countries may not reach the convergence because of path-dependent processes related to their trade structure and heterogeneity of infrastructure implementations. Since these heterogeneities cause divergence of growth patterns, the Solow model may not fully capture the growth dynamics because the model ignores the important factor of economic growth.

To overcome the limitation of the Solow model. Romer (1990) introduces the fully endogenous growth model where technological progress is driven by internal factors. Knowledge spillovers from the innovative idea in research and development (R&D) create externalities (increasing returns to scale) to sustain economic growth. Romer's model highlights that knowledge grips with a public good, and the knowledge accumulation through R&D investments (learning by investing) is an innovative source of driving economic growth (Romer, 1989; Rivera-Batiz & Romer, 1991). However, the model is primarily relevant for pursuing the industrial growth process in developed countries. For developing countries, factors like inadequate infrastructure, poor institutions, and market inefficiencies may hinder economic growth, and these countries often rely more on acquiring technology from the trade sphere rather than generating it domestically. Therefore, this endogenous growth approach may not be pursued in developing countries or may not focus on R&D to the same extent. Instead, ASEAN and SAARC may benefit via external technology transfers facilitated by trade openness and economic integration.

A suitable framework for developing countries could be applied as a semi-endogenous growth model proposed by Jones (1995). This model suggests that long-run economic growth is driven by technological progress, which is influenced by both the population size (or labor force growth) and the efforts devoted to research, but with diminishing returns to R&D. Thus, technological progress is partially determined within the model and partially by the external factors. In this model, economic growth is linked to the productivity of research, and fundamental policies can affect R&D, which in turn influences total factor productivity (TFP) growth. The assumption of a semi-endogenous growth model approaches a balanced growth path and considers the dynamics of scale effects based on the productivity growth from the research division (Jones, 1995). For developing countries, this analytical framework can be specifically extended by replacing the role of R&D with trade openness as a channel for the diffusion of technological change. In this context, trade specialization and efficient transportation systems facilitate the transfer of external knowledge and capital, thereby shaping the long-run productivity growth. Hence, the semi-endogenous growth model is particularly relevant for understanding how trade liberalization can drive economic development in these emerging countries.

2.2. Trade Factor Intensity and Economic Growth

While economic development is all about how an economy grows in various structures of transformed systems and improves people's lives in society, previous studies show that trade potential is a core driver of economic growth and the process of industrialization in mature economies (Kaldor et al., 2022). It not only helps countries get richer but also brings new technologies and makes production system more efficient. Lucas (1988) mentions that international trade can help to produce more than the current production capacity by exposing it to new ideas and technologies. When countries are open to trade, they can benefit from technological advancements from other countries because making more stuff can lead to lower costs in the economy and drive higher growth.

International trade enables economies to better use their resources and outsourcing. Through international trade, countries can specialize in what they are good at, based on their abundant resources, like labor or capital intensity. This specialized trade leads to a more efficient process of production and higher growth with the determinant productivity. The Heckscher-Ohlin theory (Syrquin & Urata, 1986; Jones, 2002; Krugman et al., 2012) reveals that countries may export products based on their use of abundant factors and import those that use factors they have less. So, developing countries with sufficient labor and economic geography, such as those in Southeast Asia and South Asia, should export labor-intensive goods like textiles and import capital-intensive goods like machinery. Effective trade performance based on Heckscher-Ohlin's perspective requires a good functioning of transportation systems. Unfortunately, these regions often have inefficient infrastructure and poor transport connectivity, which may hinder smooth trade. It's important to understand how different types of goods—whether they are labor-intensive, resource-intensive, capital-intensive, or technology-intensive trade—affect productivity, income distribution, and long-term growth. Kaldor (1981) and Kaldor et al. (2022) suggest that developing countries may overcome existing constraints from specialized export of primary products and industrial manufacturing based on their resource endowments, and enlarge labor division and technological progress in favor of trade-led growth intensively.

2.3. Empirical Evidence on Trade Intensity and Economic Growth

Sachs & Warner (2001) extend Heckscher-Ohlin's perspective on trade-intensive categories, and reveal that evidence of large natural resource endowments explains the curse of natural resources. Countries with natural-abundant resources sometimes face stagnated economic growth. The high-price commodity natural resources, in some cases, could partially cause resource-abundant countries to lead to export-led growth. Among resource-abundant countries in particular, mineral-intensive ones, their experience with natural resource-led growth is associated with lower savings and investment. Consequently, the resource-abundant countries have resulted in experienced stagnation since the 1970s. In these countries, the abundant resources hinder the development of the manufacturing sectors, which are enhanced by entrepreneurial activities, higher labor skills, innovation, and the result is a lack of competitiveness. Thus, except for the direct contribution of the natural resource to the rapid growth, resource-abundant intensity has not been connected systematically to sustainable economic growth or productivity growth towards technological progress of knowledge spillovers.

Rodrik (2016) provides crucial evidence of the deindustrialization trend of labor-intensive manufacturing in recent decades. The relationship trend between industrialization (labor-intensive in the workforce or output shares) and incomes has shifted downwards. Consequently, countries focusing on labor-intensive industries run out of industrialization opportunities and have lower income levels than advanced economies. The movement of labor intensity across sectors of economies had led to deindustrialization for decades, and the employment share in manufacturing declines. In developing countries, the turning points to downward shift may arrive at lower levels of income nowadays. Manufacturing in Asian countries has begun to shrink at income levels when advanced economies started to de-industrialize, and typically grows along the path of the inverted U-shaped (Rodrik, 2016). As labor-intensive movements have occurred earlier than historical processes, premature deindustrialization may have detrimental growth effects. Labor-saving technological progress across labor skills, potential skills, and R&D is an element of industry influenced by trade flows (Shahidul & Shazali; Islam & Shazali, 2011). Thus, manufacturing productivity varies differently in developing economies. For transforming and upgrading labor-intensive industries to enhance productivity growth, the development of employment quality may be required, while higher wages may decrease labor demand to enhance human capital factors (Dai et al., 2022).

Hausmann et al. (2007) emphasize specialization patterns in higher productivity levels determined by the fundamentals of production. Especially, information externalities play a key role in trade-led growth and explain the importance of different specialization patterns. Information externalities (cost discovery) generate knowledge spillovers that partly determine productivity growth from internalized forces of entrepreneurship, economy-wide. While productivity relative to exports grows more rapidly, economic growth results by the transfer of resources from lower-productivity activities to higher-productivity ones, driven by entrepreneurial cost-discovery. Although these fundamentals generally help produce qualified products, countries may face entrepreneurship's challenges in cost discovery entailed by important externalities. To overcome these externalities, entrepreneurs in new activities can reap the benefits of higher economic growth. Where goods are placed, a higher quality of products leads to better gains from trade advantage via capital-intensive patterns.

As capital-intensive patterns of trade, Corrado et al. (2017) support the channel of intangible capital that affects productivity growth in the market sector of 10 European countries from 1998–2007. The intangible capital is applied as knowledge capital that consists of investments in R&D, design, brand equity, firm-specific training, and organizational change. Thus, their framework adjusts value-added, factor shares, and TFP with addition al investment. The findings confirm that intangible capital depends upon ICT intensity, consistent with complementarities of ICT. The country's investments in intangible capital are relatively strong in its ICT-intensive industries. Capital-intensive trade facilitating knowledge spillovers and technology diffusion aligns with a prediction of a semi-endogenous growth (Jones, 1995), where external R&D is divided to influence productivity. Hence, the intangible capital as knowledge spillovers and human capital of the workforce could play distinct roles in externalities. A country's 'knowledge economy' plays a vital role in generating productivity and growth outcomes.

2.4. Transportation Systems as a Moderating Factor in Trade-Driven Growth

Recognizing emerging transportation systems as key facilitators of economic growth in trade patterns, their prioritized infrastructure development is essential to enhance trade competitiveness. As noted by Grossman & Helpman (1991; 1994), trade openness fundamentally provides a crucial framework for facilitating the exchange of production factors among nations. Furthermore, the cross-border flow of production factors and movements plays a crucial role in shaping economic development, a process deeply intertwined with trade openness (Weil, 2016). The intensity of trade factors influences the movement and mobilization of factors engaged in trade flows, as well as the diffusion of technology and knowledge. Effective transportation systems contribute to alleviating inefficiencies of international trade stemming from restrictions and disruptions, such as tariff barriers and logistics bottlenecks. These effective systems lead to increased international trade activities. By involving complementary transport logistics, the growth effects of trade are thus productively driven by the substantial flow of varied resources between sectors across countries. Based on the ASEAN evidence (Phoutvichay et al., 2025), the infrastructure connectivity and logistics endowments play fundamental drivers in the trade-growth performance. The synergized intermodal transport connectivity may shape the trade-growth nexus sufficiently to integrate the regional economies into international markets. Whereas, seaport infrastructure is not fully captured to influence the trade-led growth among developing countries (Lee & Pak, 2022).

While international trade has possibility to move up the production frontier, empirical evidence indicates that trade has several deficiencies in stimulating economic growth. Its impediment come from insufficient function of the tronsportation process under trade conditions (Krugman et al., 2012). The effective process in transportation systems could influence supply chains. While the well-functioning of transportation and logistics infrastructure depends on the facilitation of trade factor intensities, trade patterns and economic growth are implicitly related to specified transport modes to leverage the technological change in economies of scale. Trade factor intensities interacting with the well-organized transportation systems through adequate usage of trade facilitation would be a key element to solve trade distortions and drive fundamental forces in the long-term economic growth.

The relationship between economic geography and trade specialization has remained critical in economic development. Krugman (1991) presents the theory of new economic geography (NEG) to explain spatial economic agglomerations and regional imbalance levels of trade. The NEG's aspects are pursued to imperfect competition, increasing returns to scale, and transportation costs. Spatial structure economy imposes that the microeconomic mechanism is applied to urban economics and location theory. By increasing returns to scale, the firm concentrates its production on transport costs reduction across plants. Under the situation of low transportation cost, product differentiation is consequently forced by agglomeration, while dispersion forces high transport costs. This pattern indicates a similar role to transport in NEG. Thus, increasing returns of scale and transport costs are core factors for explaining the phenomenon in the space economy. With trade openness, spatial heterogeneities remain a challenge with regional economic consequences (Fujita & Thisse, 2009). The immobile resources (natural harbors, etc.) and amenities (climate) are unevenly distributed, while critical spatial heterogeneities appear in the locations of transport nodes (transshipment points) and trading places (central business districts). These different heterogeneities may generate comparative advantages across regions. Specialization and trade may raise a cluster economy (central business or monocentric-city model of urban economics), while the endowments of production factors are based on the Heckscher-Ohlin theory. Even though spatial heterogeneities cannot explain the formation of large agglomerations and spatial inequalities, they should be treated as endogenous. Essentially, the NEG framework is effective with the Heckscher-Ohlin theory, where trade specialization interacts with infrastructure connectivity and determines the industrial location and agglomeration effects. As a new perspective, the NEG framework emphasizes more relevant economic activities in developing countries than advanced economies (intangible source and information spillovers), with regional integration driving regional specialization (Behrens & Thisse, 2007; Krugman, 2011).

As another critical evidence of air cargo which boosts growth of international trade, the choice of exporting goods is faster with expensive air cargo than maritime transport shipments (Hummels & Schaur, 2012). While the time to trade in each day transit is merely increased in the ad-valorem tariff percentage, shorter time to trade is the most time-sensitive flows involving trade intensities related to capital and manufacturing in the vehicle parts and components trade. Despite the fast and expensive shipments and transports, the air cargo is relatively important in increasing international trade and trade bulk competition. The link between price decline of air cargo shipping and rapid growth in trade relativity may stimulate economic growth in the worldwide fragmentation of production and reflect the changes in international specialization and trade.

Given the importance of trade performance for economic growth, transportation systems play a critical role in determining the effectiveness of trade intensities. The effectively intra-regional trade connectivity enables ASEAN and its partners to have higher economic growth and trade regionalization through the path-dependent process of trade-intensity, trade-interlink, and infrastructure connectivity development (Vidya & Taghizadeh-Hesary, 2021). While trade factor intensities dominate bulk of resource-intensive exports, the transportation systems remain constrained by inefficient infrastructure connectivity across ASEAN and SAARC regions. Based on the data summary in Appendix B and C, freight transport (rail and road networks) may not touch some aspects of trade factor intensities in the majority lists of trade categorized among ASEAN and SAARC economies. They are essential for labor-intensive trade and might play important role in economic activities and society domestically, required by manufacturing industries. The freight industry may not be responsible for the relative transportation costs to keep its level playing in the trade-bulk competitiveness, particularly in landlocked countries. Air cargo and sea container shipments are dominant in capital-intensive and technology-intensive trade. These transportations are linked to the logistics industry, with responsibility for transportation costs, while coastal countries rely on their seaborne trade at relatively low costs.

2.5. Summary and Gaps in Literature

As already discussed, previous empirical studies that focus on the impact of trade on economic growth do not include the full range of transportation systems in trade intensities across developing countries (Lee & Pak, 2022), or means of connectivity in ASEAN (Phoutvichay et al., 2025). While this aspect of consideration is important to investigate the impact of trade on economic growth in ASEAN and SAARC countries, few studies focus on the potential transportation modalities in the framework of economic growth. Through regional-specific constraints and opportunities, this study therefore intends to overcome the limitations of previous literature by linking sectoral trade intensities to distinct transport modes and underscoring how physical infrastructure can shape the growth outcomes beyond traditional trade theories. This focus may clarify why uniform policy prescriptions overlook logistical bottlenecks in transport-moderating trade, reinforcing the need for context-specific strategies.

3. Methodology: Model, Estimation Technique and Data

3.1. Model Specification

The model specification is based on the semi-endogenous growth model, as articulated by Jones (1995) in the analytical framework. This model highlights that technological advancement is predominantly driven by trade factor intensities (TFI) and transportation infrastructure systems (TRS), which lead to productivity increase. Trade specialization, market integration, and the efficiency of infrastructure serve as key pathways for the transmission of knowledge, technology, and capital flows to less developed economies and landlocked countries. For application to developing nations, this framework extends by substituting trade diffusion channels for traditional research and development (R&D) inputs. The effectiveness of trade channels in facilitating the absorption of foreign technological spillovers is contingent upon factors such as logistics infrastructure, institutional quality, and sectoral trade patterns. This model starts from the Cobb-Douglas (CD) production function, which demonstrates the moderating role of infrastructure in the long-run growth driven by factor-intensive trade. The production function is thus written as:

$$Y_{i,t}=A_{i,t}K_{i,t}^{\alpha}L_{i,t}^{\beta} \tag{1}$$

Where Y_{it} represents the output at country i and time t, $K_{i,t}$ is the physical capital, $L_{i,t}$ is labor force. While $A_{i,t}$ is technological progress. The parameters denote the elasticity of physical capital and labor, assuming $0<\alpha+\beta<1$. Technological progress is determined by trade-driven technology (TFI) and transportation efficiency (TRS).

The semi-endogenous growth model asserts that long-run economic growth is driven by exogenous labor-force growth, with short-run technological progress being endogenous but ultimately limited by demographics. Unlike fully endogenous models, this model acknowledges diminishing returns to knowledge, which makes population growth a crucial factor in sustained knowledge accumulation. Trade factor intensity (TFI) and transportation infrastructure systems (TRS) support boosting productivity through knowledge diffusion and capital deepening, in developing economies like ASEAN and SAARC. Importantly, in the modified semi-endogenous growth framework adopted in this study, trade factor intensity works for the effective usage of transportation infrastructure. Resource-intensive goods, for instance, are bulky and often benefit from maritime modes if port facilities are adequate and congestion is minimized, but they face relatively high transport costs if road or rail infrastructure is poor. Capital-and technology-intensive goods, by contrast, typically rely on faster and more specialized transport options, such as air freight or containerized shipments, to avoid scale inefficiency and delayed delivery risks. As a result, the elasticity of growth with respect to each trade sector depends on whether potential infrastructure adequately meets the logistics needs of trade categories, echoing the congestion- and scale-sensitive mechanisms outlined in new economic geography models (Krugman, 1991) and trade cost studies (Hummels & Schaur, 2012).

For example, if a country invests heavily in modern seaports but neglects its air freight network, capital-intensive exporters of high-value machinery may face higher transaction costs than those exporting heavy resource-based commodities via maritime routes. Conversely, a robust air cargo infrastructure can facilitate time-sensitive goods—often technology-intensive trade—by reducing lead times and amplifying returns to scale from knowledge spillovers, as posited in semi-endogenous frameworks (Jones, 1995). These differential outcomes highlight how factor-intensity-based comparative advantages only fully materialize when transportation systems address the shock scale, bulk, and timeliness requirements of each trade sector, thus reinforcing the need to model trade factor intensity alongside mode-specific infrastructure. Therefore, the model of technological progress is driven by TFI and TRS.

$$A_{it}=A_0 TFI_{it}^{\lambda_1} TRS_{it}^{\lambda_2} \qquad (2)$$

The A_0 represents the baseline productivity level, and the corresponding elasticities of trade intensities and transportation systems are λ_1, $\lambda_2>0$, respectively. This assumption[1] is consistent with the view of Jones (1995).

Eq. (2) is substituted into Eq. (1) and take a natural log-linearized production function. The modified model is given by:

$$\ln Y_{i,t}=\ln A_0+\lambda_1 \ln TFI_{i,t}+\lambda_2 \ln TRS_{i,t}+\alpha \ln K_{i,t}+\beta \ln L_{i,t}+\varepsilon_{i,t} \quad (3)$$

To simplify consolidated terms, the interaction term captures the complementarity between TFI and TRS to amplify dynamic growth. In the ASEAN context, geographical or institutional differences (such as coastal vs. landlocked status, historical ties to major trading partners) should be accounted for the analysis. Hence, allowing for such specific heterogeneity (μ_i), we arrive at:

$$\ln Y_{i,t}=\beta_0+\alpha \ln K_{i,t}+\beta \ln L_{i,t}+\lambda_1 \ln TFI_{i,t}+\lambda_2 \ln TRS_{i,t}+\lambda_3 \ln (TFI_{it} x TRS_{it})+\mu_i+\varepsilon_{i,t} \quad (4)$$

Where β_0 ($\ln A_0$) is a constant term, α and β are the output elasticity responses to capital and labor, respectively. λ_1 and λ_2 are the output elasticity of trade factor intensities ($TFI_{i,t}$) and transportation systems ($TRS_{i,t}$), while λ_3 represents the output elasticity of interaction between TFI and TRS. The parameter μ_i indicates fixed country-specific heterogeneity, and $\varepsilon_{i,t}$ is the idiosyncratic error term (time-varying part).

It should be noted that this formulation, given in Eq. (4), remains consistent with the logic of Jones' (1995) semi-endogenous model: the exogenous demographic growth anchors in the long-run outcome, while TFI and TRS influence productivity.

In addressing the country heterogeneity, fixed effects estimation is used. In addition, to deal with these remaining endogeneity issues-particularly reverse causality and time-varying omitted variables. The research often applies a dynamic panel using the generalized method of moments (GMM) (Arellano & Bond, 1991; Blundell & Bond, 1998; Santos & Barrios, 2011). A dynamic specification introduces a lagged dependent variable to capture persistence in output. Thus, the GMM model is established as follows:

$$\begin{aligned}\ln Y_{i,t}=&\beta_0+\varphi \ln Y_{i,t-1}+\alpha \ln K_{i,t}+\beta \ln L_{i,t}+\lambda_1 \ln TFI_{i,t}+\lambda_2 \ln TRS_{i,t}\\&+\lambda_3 \ln (TFI_{i,t} x TRS_{i,t})+\mu_i+\varepsilon_{i,t}\end{aligned} \quad (5)$$

This method combines equations in levels and differences, exploiting additional moment conditions to improve efficiency and reduce potential weak-instrument problems. This system GMM framework thus helps to address endogeneity challenges beyond the fixed effects model that can be handled by harnessing internal instruments and carefully modeling the dynamic structure of economic output. Additionally, trade openness ($TRD_{i,t}$) is included as a control variable, while trade factor intensity ($TFI_{i,t}$) and transportation systems ($TRS_{i,t}$) are extracted into each type for exploring the potential matching in trade-driven growth and partial effects.

3.2. Data Description and Descriptive Statistics

Various sources of data are used in ASEAN and SAARC countries during 2008–2019. Output ($Y_{i,t}$) represents the dependent variable, applying GDP at purchasing power parity (PPP constant-2021 USD) as the level data across different countries. $K_{i,t}$ represents the capital stock, while $L_{i,t}$ is labor force (age from 15 to 64).

Trade openness (TRD_{it}) is measured by the sum of export-import of goods and services shared in the GDP. The trade share in GDP is a proxy for international trade openness.

Data for trade factor intensities (TFI_{it}) are solely taken from the United Nations Conference on Trade and Development (UNCTAD)[2]. The UNCTAD 1-digit level of the standard of international trade classification (SITC) is grouped into 10 categories. Following the idea of the Heckscher-Ohlin theory of relative factor endowments (Syrquin & Urata, 1986; Jones, 2002), this study picks up the main categories of trade, integrates them into 4 main categories to treat as trade factor intensities: labor-intensive trade (SITC0, 4 and 6), resource-intensive trade (SITC2 and 3), capital-intensive trade (SITC5, and 8), and technology-intensive trade (SITC7), respectively.

Transportation systems (TRS_{it}) are transport modes and infrastructure that are engaged in supply chains and trade relativity. Transportation systems consist of road, railways, airfreight ($AIRF_{it}$), and sea-cargo container ($CONT_{it}$), transport services in commerce ($TRSC_{it}$), while digital platforms consist of digital services ($DISM_{it}$) and digital telecommunications ($DITELM_{it}$), based on previous studies (Smith, et al., 2019; Lee & Pak, 2022; Phoutvichay et al., 2025).

Annual data of variables are collected from the World Bank (WDI), the Penn World Ta-

Table 1: Sources and indicators of key variables

Variable name	Acronym	Measurements	Sources
Output	Y_{it}	Gross Domestic Product (USD in PPP, 2021 Constant-Price)	WDI
Capital Stock	K_{it}	Capital stock at PPPs (Millions USD, 2017)	PWT
Labor force	L_{it}	Labor force participation in economy (age 15–64)	WDI
Trade share in GDP	TRD_{it}	Trade (%) in GDP, the sum of exports and imports of goods and services shared in GDP (trade ratio)	UNCTAD
Trade Factor Intensity	TFI_{it}	Trade factor intensity (%) in total trade, breakdown into UNCTAD's categories (primary, agriculture, manufacturing, and technology) based on labor-intensive (SITC0, 4 and 6), resource-intensive (SITC2, 3), capital-intensive (SITC5, 8), and technology-intensive (SITC7)	UNCTAD
Transportation Systems	TRS_{it}	Transportation systems (total transports in sea, air, rail, road, transport services in trade, and digital platforms) and breakdown into each transportation.	ASEAN UNdata

Note: PPP = Purchasing Power Parity; UNCTAD = United Nations Conference on Trade and Development.

Table 2: Descriptive statistics

Variables	Obs	Mean	StdDev.	Min	Max	VarCoef.
Ln GDP ppp (Y_{it})	N = 204	26.315	1.910	22.451	30.030	0.0726
Ln Capital Stock (K_{it})	N = 204	13.459	1.9044	9.2117	17.345	0.1415
Ln Labor Force (L_{it})	N = 204	16.189	2.2016	11.751	20.071	0.1360
Ln Trade (TRD_{it})	N = 204	17.7246	1.9745	13.8405	20.5370	0.1114
SITC0 ($SC0_{it}$)	N = 204	1.3016	0.4243	0.5873	2.5729	0.3260
SITC2 ($SC2_{it}$)	N = 204	0.3166	0.1584	0.104	0.8698	0.5003
SITC5 ($SC5_{it}$)	N = 204	0.6651	0.1576	0.1568	0.8831	0.2370
SITC7 ($SC7_{it}$)	N = 204	0.4924	0.2551	0.1068	1.143	0.5181
Ln Air Freight ($AIRF_{it}$)	N = 200	4.3676	3.2845	−4.3428	8.9080	0.7520
Ln Container Port ($CONT_{it}$)	N = 168	14.807	1.8984	10.812	17.431	0.1282
Ln Transport E ($TRSCX_{it}$)	N = 188	2.7166	0.7528	0.7965	4.3519	0.2771
Ln Transport M ($TRSCM_{it}$)	N = 188	3.4634	0.5794	1.1127	4.4446	0.1673
Ln Dig Service-M ($DISM_{it}$)	N = 194	7.4033	2.354	2.7726	11.8631	0.3180
Ln Dig Telecom-M ($DITELM_{it}$)	N = 194	5.4339	2.2569	0.6931	10.1917	0.4153

Source: Authors' computed summary.

bles (PWT), the UNCTAD, ASEAN, and UNdata. Table 1 presents data descriptions and sources for ASEAN and SAARC countries between 2008-2019.

Table 2 indicates descriptive statistics for ASEAN and SAARC countries. The total sample size of data is N = 204 (number of countries n = 17 (10 ASEAN and 7 SAARC) and time period T = 12). The missing values in some countries make the panel data unbalanced. While different unit in each variable makes comparison of their variation difficult, using the variation of coefficients (standard deviation divided by mean) in the last column (VarCoef.) enables comparison with each other. The first four variables' group takes smaller values than the other groups. Especially, LnGDP is the lowest (0.0726) among them. Overall, the group of trade factor intensity takes the highest value. While the value of the group of transportation infrastructure is smaller than that of trade factor intensity, the Air Freight records the largest one (0,7520).

4. Empirical Results and Discussion

4.1. Empirical Results

Table 3 shows the estimated results of the fixed effect model[3)] based on Eq. (4). The coefficient of capital stock is significantly positive in most specifications, while that of labor force remains statistically insignificant. Trade is positively significant at the 1% level. The result of column (1) indicates that the coefficients of capital and trade are positive and statistically significant at the 5% and 1% levels. The 1% increase in capital and trade has impacts to bound the GDP by 0.09% and 0.16% respectively. In addition, the technology-

Table 3: Fixed effects (Dependent variable: Output), ASEAN + SAARC sample 2008-2019

Variables	Acronym	(1)	(2)	(3)	(4)	(5)
$\ln K_{it}$	Capital Stock	0.0878** (0.0369)	0.189*** (0.0525)	0.0127 (0.0613)	0.194*** (0.0534)	0.0959** (0.0383)
$\ln L_{it}$	Labor Force	−0.0128 (0.1344)	−0.1024 (0.1487)	0.0647 (0.1907)	−0.1129 (0.1472)	0.0781 (0.1356)
$\ln TRD_{it}$	Trade	0.1646*** (0.0467)				0.1455*** (0.0348)
$\ln SC0_{it}$	SITC0 Labor-intensive	0.0214 (0.0578)	−0.0649 (0.0765)	0.1038 (0.1187)	−0.0682 (0.0615)	0.0558 (0.0535)
$\ln SC2_{it}$	SITC2 Resource-intensive	−0.0184 (0.0450)	0.0228 (0.0393)	−0.0093 (0.0605)	0.0516 (0.0236)	−0.0454 (0.0427)
$\ln SC5_{it}$	SITC5 Capital-intensive	−0.0554 (0.0630)	−0.1168 (0.0835)	−0.151*** (0.0501)	−0.1053 (0.0759)	0.0181 (0.0211)
$\ln SC7_{it}$	SITC7 Techno-intensive	0.0274* (0.0149)	0.0582** (0.0226)	0.049*** (0.0114)	0.0507** (0.0194)	0.0011 (0.0109)
$\ln AIRF_{it}$	Air Freight			0.0016 (0.0024)		
$\ln CONT_{it}$	Container Port Traffic			0.2502** (0.0890)		
$\ln TRSCX_{it}$	Transport Service in Commerce-X				−0.0111 (0.0204)	
$\ln TRSCM_{it}$	Transport Service in Commerce-M				0.0391 (0.0446)	
$\ln DISM_{it}$	Digital Service-M					−0.0485* (0.0265)
$\ln DITELM_{it}$	Digital Telecom-M					0.0249* (0.0122)
Time	Dummy	yes	yes	yes	yes	yes
_cons		−49.79***	−53.26***	−46.758***	−56.25***	−54.59***
No. obs		204	204	164	188	194
No.group id		17	17	14	16	17
within R^2		0.9455	0.9272	0.9450	0.9380	0.9681
Pro>F		0.0000	0.0000	0.0000	0.0000	0.0000

Standard-error in parentheses *p< .10, **p< .05, ***p< .01.
Note: *, **, and *** imply statistical significance on the 10%, 5%, and 1% level, respectively.

intensive trade (SITC7) is statistically significant in columns (1)-(4). In column (3), when transportation systems (air freight and sea container) are taken into account, the capital becomes insignificant and the capital-intensive trade (SITC5) is negative and statistically significant, while the coefficient of technology-intensive trade (SITC7) is still positive and statistically significant at the 1% level. On the other hand, transport services in commerce (export $TRSCX_{it}$ and import $TRSCM_{it}$) are not significant in column (4). When the digital platforms are included in the regression in column (5), the capital and trade are positive and statistically significant at the 5% and 1% levels, respectively. While digital service has a negative and statistically significant, digital telecommunication has a positive and significant in stimulating the GDP.

Appendix (A1) underscores the critical role of transportation infrastructure in moderating the growth effects of trade factor intensities. The coefficient of capital stock is positively significant in columns (6) and (7), but becomes insignificant in later models, while that of the labor force remains statistically insignificant. Along the trade category, labor-intensive trade (SITC0) and resource-intensive trade (SITC2) exhibit a positive impact on economic growth in some specifications, whereas capital-intensive trade (SITC5) is always negative. When transportation infrastructure is considered, the interaction terms reveal nuanced dynamics: sea container port traffic significantly enhances the growth effects of capital-intensive trade $\ln SC5_{it}$ x $\ln CONT_{it}$ (0.074, $p<0.01$) and technology-intensive trade $\ln SC7_{it}$ x $\ln CONT_{it}$ (0.025, $p<0.01$), while it dampens the growth contributions of labor-intensive trade $\ln SC0_{it}$ x $\ln CONT_{it}$ (-0.139, $p<0.01$) and resource-intensive trade $\ln SC2_{it}$ x $\ln CONT_{it}$ (-0.088, $p<0.01$). Air freight infrastructure marginally supports the growth in capital-intensive trade (0.007, $p<0.10$).

Appendix (A2) indicates the moderating role of digital platforms in shaping the growth effects of trade intensities. Capital stock remains a significant positive in all specifications, while capital-intensive trade (SITC5) is negative. The positive coefficients of interaction terms reveal that: capital-intensive trade amplifies economic growth by both digital service imports (0.34, $p<0.05$) and digital telecom imports (0.023, $p<0.10$), while technology-intensive trade (SITC7) is positively influenced by only digital telecom imports (0.012, $p<0.05$). Digital telecom imports independently exhibit a strong positive effect on economic growth.

Although the fixed effects model could consider heterogeneity issues across countries, the endogeneity problem still exists. Therefore, the system GMM is applied for dynamic growth investigation based on Eq. (5) to consider the possible endogeneity from reverse causality and time-varying omitted. Table 4 shows that the lagged GDP is positive and statistically significant at the 1% level (initial condition factor of growth), whereas capital, labor, and trade intensity are mostly positive and statistically significant at the 1% level in all models, columns (16)-(22). The lagged GDP variable exhibits strong positive significance, indicating a high degree of growth inertia. Capital stock and labor force positively and significantly contribute to growth, reinforcing their fundamental roles in economic expansion, while trade remains a significant growth-driver engine with positive effects. Essentially, the lagged dependence variable is applied as the first explanatory variable to find the initial level of economic growth at the start corresponding set of independent variables.[4)]

Column (17) where categorized trade factor intensities are included in the model. While the labor-intensive trade (SITC0) is found to be statistically significant and negative, the resource-intensive trade (SITC2) is positive and statistically significant at the 5% level. On the other hand, individuals of capital- (SITC5) and technology-intensive trade (SITC7) have no signal in the level of economic growth dynamically. While the impact of categorized trade varies, the system GMM analyzes the dynamic estimations expanded to find combination effects between categorized trade intensities and transportation modes (*TFI x TRS*). The air freight interacting with technology-intensive trade is positive and statistically significant at the 5% level in column (19), while there is no clue effect interaction with capital-intensive trade in column (18). Interestingly, the digital platforms interacting with both capital-intensive and technology-intensive trade are revealed relatively positive and statistically significant at 1% level in accelerating the economic growth in column (20–22)[5].

Hence, the system GMM may reveal interacting trade intensities with targeted transportation infrastructure as key moderating effects: techno-intensive trade (SITC7) benefits from air freight infrastructure of transportation systems (0.0022, $p<0.05$), digital service imports (0.0028, $p<0.10$) and digital telecom imports (0.0016, $p<0.10$), while capital-intensive trade (SITC5) has amplified impact only from digital service imports (0.0076, $p<0.05$). These effects underscore the digital role in connectivity to influence economic growth independently.

Table 4: GMM 2-step system (Dependent variable: Output), ASEAN + SAARC sample 2008–2019

Variables	Acronym	(16)	(17)	(18)	(19)	(20)	(21)	(22)
$\Delta lnGDP_{i,t-1}$	Lagged GDP ppp	0.9076*** (0.0175)	0.921*** (0.242)	0.9029*** (0.0183)	0.8879*** (0.0383)	0.9008*** (0.0274)	0.8909*** (0.0150)	0.8980*** (0.0159)
$\ln K_{it}$	Capital Stock	0.0209*** (0.007)	0.0365* (0.019)	0.0245** (0.0104)	0.0474** (0.0214)	0.0341** (0.0127)	0.0363** (0.0124)	0.0285** (0.0119)
$\ln L_{it}$	Labor Force	0.0410*** (0.0068)	0.039*** (0.009)	0.0440*** (0.0059)	0.0537*** (0.0162)	0.0442*** (0.0127)	0.0460*** (0.0039)	0.0444*** (0.0070)
$\ln TRD_{it}$	Trade	0.0370*** (0.0097)		0.0290*** (0.0082)		0.0342** (0.0139)	0.0307*** (0.0084)	0.0285*** (0.0084)
$\ln SC0_{it}$	SITC0 Labor-intensive	−0.008 (0.0275)	−0.0807** (0.035)					
$\ln SC2_{it}$	SITC2 Resource-intensive	0.0155 (0.0149)	0.0288** (0.0136)					
$\ln SC5_{it}$	SITC5 Capital-intensive	−0.0056 (0.0069)	−0.0147 (0.0096)	−0.0028 (0.0074)		−0.0559** (0.0213)		
$\ln SC7_{it}$	SITC7 Techno-intensive	−0.006 (0.0042)	0.0033 (0.0069)		−0.0055 (0.0048)		−0.0249* (0.0098)	−0.0167** (0.0066)
$\ln AIRF_{it}$	Air Freight			−0.0009 (0.0018)	0.0120** (0.0048)			
$\ln DISM_{it}$	Digital Service-M					0.0017 (0.0034)	0.0068 (0.0063)	
$\ln DITELM_{it}$	Digital Telecom-M							0.0094* (0.0036)
$\ln SC5_{it}$ x $\ln AIRF_{it}$	Capital-intensive x Air Frieght			−0.0015 (0.0019)				
$\ln SC7_{it}$ x $\ln AIRF_{it}$	Techno-intensive x Air Frieght				0.0022** (0.0008)			
$\ln SC5_{it}$ x $\ln DISM_{it}$	Capital-intensive x Digital Service-M					0.0076** (0.0034)		
$\ln SC7_{it}$ x $\ln DISM_{it}$	Techno-intensive x Digital Service-M						0.0028* (0.0015)	
$\ln SC7_{it}$ x $\ln DITELM_{it}$	Techno-intensive x Digital Telecom-M							0.0016* (0.0008)
Time	Dummy	yes	yes	yes	yes	yes	yes	yes
_cons		−1.1772	0.8468	−1.6042	−2.087*	−1.2565	−1.7953	−0.9694
No. obs		187	187	183	183	178	178	178
No. group id		17	17	17	17	17	17	17
No. Instruments		18	17	17	17	17	17	17
AR(2) prob>z		0.396	0.395	0.634	0.483	0.615	0.528	0.419
Sargan-Chi^2		0.482	0.107	0.025	0.240	0.554	0.448	0.550
Pro>F		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard-error in parentheses *p< .10, **p< .05, ***p< .01.
Note: *, **, and *** imply statistical significance on the 10%, 5%, and 1% level, respectively.

4.2. Discussion

The results provide empirical insights into trade categories and transportation modes on the economic growth in ASEAN and SAARC economies. To mitigate the endogeneity issues, the system GMM estimation is robust for dynamic growth to enhance the potential solutions in Eq. (5). The key findings in Table (3) and (4) highlight the importance of specified trade patterns, infrastructure investments, and the aligned matching between trade composition and transport modalities. In every estimation, capital stock emerges as a consistently positive and significant determinant of economic growth, particularly in the fixed effects models (Table 3 and Appendix-A1) and the system GMM (Table 4). The robustness of capital's impact aligns with theoretical expectations in economic growth, reaffirming the importance of investment-driven growth in ASEAN and SAARC countries. Although the coefficient of labor force effects remains largely insignificant in fixed-effect models, they become strongly positive in the system GMM estimation. Labor's contribution is more dynamic and reliant on sectoral shifts in level to reflect the long-run effect of the labor force influenced by population growth. Trade exerts a significant positive effect on economic growth, and its interaction with transportation modes provides deeper insights. The results indicate that growth outcomes depend not only on trade performance but also on the transport system which is aligned with the needs of trade-specific categories.

Critically, labor-intensive (SITC0) and resource-intensive trade (SITC2) display more complex results. While labor-intensive trade exhibits a positive standalone effect (Appendix-A1), its interaction with container port traffic has negative effects. This result may reflect that the current maritime shipping infrastructure may not be adequately tailored to support bulk commodity trade due to inefficiencies in port logistics development or congestion issues. The negative impact of container port traffic on resource-intensive trade suggests that bulk commodity exports may require specialized port facilities or enhanced rail connectivity to ensure efficient movements. Probably, trade costs are barrier to trade connectivity and large-scale logistics competitiveness as previous studies stress (Jouili, 2019; Cho & Lee, 2020; Vidya & Taghizadeh-Hesary, 2021). While maritime shipping supports labor-intensive exports, other constraints—such as regulatory barriers or supply chain inefficiencies related the trade compliance—may limit its full potential. Similarly, labor-intensive trade might be impeded by inefficient road/rail connectivity through supply chains and export processes. Although road and rail infrastructure's role is less implicitly captured in the results, and its indirect effects on transport services in commerce may be limited labor-intensive trade by inefficiencies of inland based transport services.

Essentially, airfreight plays a strong role in supporting capital-intensive and high-tech industries. The positive interaction between capital-intensive trade (SITC5) and air freight highlights the need for efficiency to support advanced manufacturing and high-value exports. The industries that require high-value capital goods rely on efficient logistics for timely delivery and operations. In addition, the efficiency of capital-intensive trade is contingent on the availability of rapid and reliable logistics solutions. Technology-intensive trade (SITC7) positively impacts economic growth, with significant benefits derived from the airfreight infrastructure of transportation. This evidence underscores the need for efficient logistics in high-value, time-sensitive trade categories. Dominantly, the role of airfreight in supporting high-tech industries is particularly pronounced. The interaction between technology-intensive trade and air transport reveals a strong positive relationship, this emphasizing the need for rapid logistics solutions for electronics, pharmaceuticals, and precision machinery. In addition, digital platforms play a crucial role in capital-and technology-intensive trade for the growth efforts. As column (20) of Table 4 shares capital-intensive trade exhibits improvements when digital services and airfreight infrastructure are introduced as targeted moderators.

However, the weak evidence from road/rail transport services in commerce may lead to infrastructure gaps and trade-route bottlenecks. Given inefficiencies in road/rail networks related to commercial services, may underscore the important need to strengthen regional connectivity. The targeted investments in highways, cross-border rail systems, and multimodal logistics hubs are to have better integration of labor-intensive industries in supply chains. Addressing these transport bottlenecks will be crucial for unlocking the full capacity of labor-intensive trade, particularly in manufacturing and textiles, which form a significant portion of ASEAN and SAARC trade portfolios.

The empirical results highlight that growth benefits from trade expansion are conditional across trade composition and transport infrastructure. While maritime shipping is essential for regional trade, its benefits are concentrated in capital-and technology-intensive trade, leaving labor-and resource-intensive industries less advantaged. Therefore, addressing inefficiencies in port operations, investing in bulk commodity handling, and improving hinterland connectivity can mitigate these imbalances. Essentially, airfreight emerges and digital elements are key drivers for high-value trade categories, reinforcing the need for investments in airport logistics and streamlined trade compliance to enhance competitiveness.

5. Conclusion and Policy Implications

This study investigated the role of transportation systems with moderating trade factor with are categorized intensities on economic growth across ASEAN and SAARC countries. Based on the framework of semi-endogenous growth (Jones, 1995), the determinants of GDP are estimated using panel data from 2008 to 2019 with the fixed effects and dynamic GMM model. The findings underscore that the impacts of capital-intensive exports and technology-intensive exports on economic growth are enhanced by well-established transportation systems. On the other hand, transportation infrastructure in land-based transport services does not have any role in the impacts of resource-intensive and labor-intensive exports. Resource-intensive products, though often assumed to fare well via maritime routes, may actually require specialized port facilities or complementary rail connections to accommodate bulk handling and reduce inefficiencies in trade compliance. These results highlight why "one-size-fits-all" investments in transportation systems, without accounting for the logistical needs of different sectors' risk.

When transportation system is matched appropriately to factor-intensity requirements, its transport upgrades may bring higher marginal returns: air freight enhancements, for instance, can drastically reduce delivery time lags for technology-intensive sectors, boosting knowledge diffusion and productivity. Conversely, this study's results also expose where misalignment persists: even if container-port expansions focus predominantly on general cargo and overlook specialized bulk commodities or refrigerated capacity, resource-intensive exporters may face congestion or handling inefficiencies.

Moving forward, policymakers in ASEAN and SAARC countries can focus more on the tailored infrastructure development strategy, which aims to match sectoral trade needs with the most suitable transport modality. Enhancing container-port capacity alongside well-functioning air cargo services, can ensure that both capital-intensive and technology-based exports gain from quick times and reliable shipping routes. Strengthening road and rail economic corridors, particularly to connect special economic zones with main trade gateways across the regions, can bolster labor-intensive manufacturing by reducing internal transportation costs. Coordinated, regional initiatives—such as cross-border transport agreements and multimodal logistics corridors—are critical to address landlocked economies' constraints and trade-route bottlenecks, thereby promoting a more balanced distribution of trade-driven growth. In addition, policymakers could consider not only uniform infrastructure upgrades but also complementary administrative reforms engaged in the trade compliance and connectivity—such as streamlined port customs, digital documentation, or advanced cargo-tracking systems—to maximize the benefits of trade liberalization.

This study contributes to the literature by explicitly linking specific-trade factor intensities based on the UNCTAD's trade categories (resource-, labor-, capital-, and technology-intensive) with distinct transportation modes (maritime, airfreight, digital platforms, etc.) across ASEAN and SAARC economies. These aspects are previously underexplored despite acknowledgment that infrastructure shapes the trade-led growth (Limao & Venables, 2001; Hummels, 2007; Lakshmanan, 2011; Hummels & Schaur, 2012). By taking how sector-specific logistics requirements moderate growth outcomes (broader transport-economy linked) population growth effects engaged in labor force, the paper offers a more crucial perspective on trade openness and economic integration. Future research could extend this framework by incorporating environmental sustainability considerations, by examining more granular logistics data (e.g., quality of ports, customs procedures), or analyzing heterogeneity within technology-intensive trade across the fast-evolving digital economy.

In addition, future research should probe deeper into micro-level logistics surveys to assess the port efficiency, cargo-handling specialization, or scheduling precision in the air-freight industry and to pinpoint how infrastructural bottlenecks specifically shape growth outcomes across trade categories and trade compliance. The integration of environmental considerations and the digital trade economy also presents an important area for further study. Finally, using alternative datasets and extended time horizons could corroborate or refine these conclusions and offer even more clear policy implications. Matching transportation infrastructure to sector-specific trade patterns is useful to investigate whether trade's potential is amplified by economic growth and regional integration.

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Notes

1) The labor force (L_{it}^{β}) is assumed as the exogenous growth at a constant rate (n). Taking logarithmic differentials and recognizing that in balanced-growth-path (BGP) equilibrium, the growth rates of Y, K, and A are constant, we obtain: $\frac{\dot{Y}_{it}}{Y_{it}}=\frac{\dot{A}_{it}}{A_{it}}+\alpha\frac{\dot{K}_{it}}{K_{it}}+\beta n$

To incorporate TFI and TRS, let the evolution of technology $\dot{A}_{it}$ be driven by the log of these factors plus and an additional term capturing the exogenous labor growth (n): $\dot{A}_{it}=\lambda_1 \ln TFI_{it}+\lambda_2 \ln TRS_{it}+\emptyset n$

Where λ_1 and λ_2 quantify the contributions from trade specification and transportation, $\emptyset n$ covers additional effects from unobserved labor growth to yield: $g_Y=\lambda_1 \ln TFI_{it}+\lambda_2 \ln TRS_{it}+\beta n$

As exogenous labor growth anchors long-run growth (a key component of the semi-endogenous framework), endogenized factors of TFI and TRS are substantially modulated in productivity improvements.

2) The UNCTAD trade categories index: SITC0 (Food & live animals); SITC1 (Beverages & tobacco); SITC2 (Crude materials, inedible, except fuels); SITC3 (Mineral fuels, lubricants & related materials); SITC4 (Animal & vegetable oils, fats & waxes); SITC5 (Chemicals & related products); SITC6 (Manufactured goods classified chiefly by material); SITC7 (Machinery & transport equipments); SITC8 (Miscellaneous manufactured articles); SITC9 (Commodities/trasactions in unclassified).

3) Based on the Hausman test, the test result reveals that the null hypothesis is rejected with a highly significant *p-value* of 0.0001 (Prob>Chi^2). Therefore, the fixed effects is properly confirmed as the appropriate model properties (N>T). Thus, the fixed effect model could mitigate country heterogeneity.

4) Dynamically, when economic growth is included in the model with the default between 2 years, taking the log difference in estimated growth rate outcome, the proportional effect is investigated with covariates (the procedure necessarily accounts for the continuous pass impact of regressors). The evidence appeals to the coefficient of lagged GDP ranks (0.888-0.921) relative changes, indicating higher magnitude results. The initial condition is positive and has contemporaneous effects to enhance the economic growth in ASEAN and SAARC economies, where countries have dynamic effects differently.

5) Essentially, the GMM two-step system estimation results in Table 6 confirm the persistence of economic growth, with the validity and stability of the GMM estimates appearing reasonable. The AR (2) test results indicate no second-order serial correlation (p-values>0.10), supporting the use of internal instruments. However, the Sargan test results vary across specifications, with some models (e.g., column 18) showing a p-value close to the rejection threshold (0.025), suggesting potential over-identification issues. The high statistical significance of the lagged dependent variable (near 0.90) suggests strong persistence in economic growth, but further robustness checks (e.g., difference GMM) would be advisable to confirm instrument validity and address any potential endogeneity concerns.

References

Anderson, J. E., & Van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review, 93*(1), 170-192.

Arellano, M., & Bond, S. (1991). *Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, 58*(2). https://www.jstor.org/stable/2297968

Behrens, K., & Thisse, J. F. (2007). Regional Economics: A New Economic Geography Perspective. *Regional Science and Urban Economics, 37*(4), 457-465. https://doi.org/10.1016/j.regsciurbeco.2006.10.001

Blundell, R., & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics, 87, 115-143.*

Cho, H., & Lee, J. (2020). Does Transportation Size Matter for Competitiveness in the Logistics Industry? The Cases of Maritime and Air Transportation. *Asian Journal of Shipping and Logistics, 36*(4), 214-223. https://doi.org/10.1016/j.ajsl.2020.04.002

Corrado, C., Haskel, J., & Jona-Lasinio, C. (2017). Knowledge Spillovers, ICT and Productivity Growth. *Oxford Bulletin of Economics and Statistics, 79*(4), 592-618. https://doi.org/10.1111/obes.12171

Dai, Z., Niu, Y., Zhang, H., & Niu, X. (2022). Impact of the Transforming and Upgrading of China's

Labor-Intensive Manufacturing Industry on the Labor Market. *Sustainability* (*Switzerland*), *14*(21). https://doi.org/10.3390/su142113750

Fujita, M., & Thisse, J. F. (2009). New Economic Geography: An Appraisal on the Occasion of Paul Krugman's 2008 Nobel Prize in Economic Sciences. *Regional Science and Urban Economics, 39*(2), 109–119. https://doi.org/10.1016/j.regsciurbeco.2008.11.003

Frankel, J. A., & Romer, D. (1999). *Does Trade Cause Growth ?, 89*(3), 379–399.

Grossman, G. M., & Helpman, E. (1991). Trade, Knowledge Spillovers, and Growth. *European Economic Review, 35*(2–3), 517–526. https://doi.org/10.1016/0014-2921(91)90153-a

Grossman, G. M., & Helpman, E. (1994). Endogenous Innovation in the Theory of Growth. *Journal of Economic Perspectives, 8*(1), 23–44. https://doi.org/10.1257/jep.8.1.23

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What You Export Matters. *Journal of Economic Growth, 12*(1), 1–25. https://doi.org/10.1007/s10887-006-9009-4

Hummels, D. (2007). Transportation Costs and International Trade in the Second Era of Globalization. *Journal of Economic Perspectives, 21*(3), 131–154. http://www.bea.gov

Hummels, D. L., & Schaur, G. (2012). Time as a Trade Barrier. *American Economic Review, 103*(7), 2935–2959.

Islam, S., & Shazali, S. T. S. (2011). Determinants of Manufacturing Productivity: Pilot Study on Labor-Intensive Industries. *International Journal of Productivity and Performance Management, 60*(6), 567–582. https://doi.org/10.1108/17410401111150751

Jones, C. I. (1995). R & D-Based Models of Economic Growth. *Journal of Political Economy, 103*(4). https://www.jstor.org/stable/2138581

Jones, R. W. (2002). Trade Theory and Factor Intensities: An Interpretive Essay. *Review of International Economics, 10*(4), 581–603. https://doi.org/10.1111/1467-9396.00352

Jouili, T. A. (2019). Impact of Seaport Infrastructure, Logistics Performance, and Shipping Connectivity on Merchandise Exports. In *IJCSNS International Journal of Computer Science and Network Security, 19*(5). https://www.researchgate.net/publication/335292922

Kaldor, N. (1981). The Role of Increasing Returns, Technical Progress and Cumulative Causation in the Theory of International Trade and Economic Growth. *Économie Appliquée, 34*(4), 593–617. https://doi.org/10.3406/ecoap.1981.4324

Kaldor, N., Author, R., & Gomes, L. (2022). *Munich Personal RePEc Archive Nicholas Kaldor's Economics: a Review.*

Krugman, P. (1991). Increasing Returns and Economic Geography. In *Source: Journal of Political Economy, 99*(3). https://www.jstor.org/stable/2937739

Krugman, P. (2011). The New Economic Geography, Now Middle-Aged. *Regional Studies, 45*(1), 1–7. https://doi.org/10.1080/00343404.2011.537127

Krugman, P. R.,Obstfeld, Maurice., & Melitz, Marc J. (2012). *International Economics Theory and Policy 9th Ed.*

Lakshmanan, T. R. (2011). The Broader Economic Consequences of Transport Infrastructure Investments. *Journal of Transport Geography, 19*(1), 1–12. https://doi.org/10.1016/j.jtrangeo.2010.01.001

Lee, J.-H., & Pak, M.-S. (2022). Revisiting the Nexus of Trade Openness and Economic Growth: A Focus on the Moderating Role of Port Infrastructure. *Journal of Korea Trade, 26*(2), 1–20. https://doi.org/10.35611/jkt.2022.26.2.1

Limao, N., & Venables, A. J. (2001). Infrastructure, Geographical Disadvantage, Transport Costs, and Trade. *The World Bank Economic Review, 15*(3), 451–479.

Liyanage, C., Dias, N., Amaratunga, D., & Haigh, R. (2017). Current Context of Transport Sector in

South Asia: Recommendations Towards a Sustainable Transportation System. *Built Environment Project and Asset Management, 7*(5), 490–505. https://doi.org/10.1108/BEPAM-10-2016-0051

Lucas, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics, 22*(1), 3–42. https://doi.org/10.1016/0304-3932(88)90168-7

Phoutvichay, L., Jean-Claude, M., & Kazuo, I. (2025). Impact of Infrastructure Connectivity and Human Capital in the Trade-Growth Nexus in ASEAN. *The Ritsumeikan Economic Review, 74*(1).

Rivera-Batiz, L., & Romer, P. (1991). *International Trade with Endogenous Technological Change.* https://doi.org/10.3386/w3594

Robert, M., Solow. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics, 70*(1), 65–94.

Rodrik, D. (2016). Premature Deindustrialization. *Journal of Economic Growth, 21*(1), 1–33. https://doi.org/10.1007/s10887-015-9122-3

Romer, P. (1989). *Endogenous Technological Change.* https://doi.org/10.3386/w3210

Sachs, J. D., & Warner, A. M. (2001). The Curse of Natural Resources. *European Economic Review, 45*(4–6): 827–838

Santos, Lorelied. A., & Barrios, E. B. (2011). Small Sample Estimation in Dynamic Panel Data Models: A Simulation Study. *Open Journal of Statistics, 01*(02), 58–73. https://doi.org/10.4236/ojs.2011.12007

Shahidul, M. I., & Shazali, S. T. S. (2011). Dynamics of Manufacturing Productivity: Lesson Learnt from Labor Intensive Industries. *Journal of Manufacturing Technology Management, 22*(5), 664–678. https://doi.org/10.1108/17410381111134491

Smith, M., Wimalasuriya, R., Gunasekera, D., & Voak, A. (2019). Better Transport Connectivity in ASEAN: Impacts on Commodity Trade, *AgEcon Search.* http://ageconsearch.umn.edu

Swan, T. W. (1956). Economic Growth and Capital Accumulation. *Economic Record, 32(2),* 334–361.

Syrquin, M., & Urata, S. (1986). Sources of Changes in Factor Intensity of Trade. *Journal of Development Economics,* 24, 225–237.

Vidya, C. T., & Taghizadeh-Hesary, F. (2021). Does Infrastructure Facilitate Trade Connectivity? Evidence from the ASEAN. *Asia Europe Journal, 19,* 51–75. https://doi.org/10.1007/s10308-021-00614-6

Weil, D. (2016). *Economic Growth International Edition* (3rd ed., pp. 258–347). Routledge.

Appendix A:

Table A1: Fixed effects-Interaction (Dependent variable: Output), ASEAN + SAARC sample 2008-2019

Variables	Acronym	(6)	(7)	(8)	(9)	(10)
lnK_{it}	Capital Stock	0.1514*** (0.0482)	0.1066** (0.0489)	0.0947 (0.0590)	0.0767 (0.0512)	0.0327 (0.0586)
lnL_{it}	Labor Force	0.0531 (0.1309)	0.0598 (0.1582)	0.0484 (0.1766)	−0.0153 (0.1976)	0.0588 (0.1842)
ln$SC0_{it}$	SITC0 Labor-intensive	2.1905*** (0.4959)	0.1816* (0.0961)	0.1261 (0.0847)	0.1523 (0.1047)	0.1239 (0.1071)
ln$SC2_{it}$	SITC2 Resource-intensive	−0.0139 (0.0525)	1.3166*** (0.3533)	0.0216 (0.0463)	0.0225 (0.0584)	0.0102 (0.0605)
ln$SC5_{it}$	SITC5 Capital-intensive	−0.0888** (0.0350)	−0.0888*** (0.0271)	−1.022*** (0.1757)	−0.130*** (0.0426)	−0.154*** (0.0505)
ln$SC7_{it}$	SITC7 Techno-intensive	0.0148 (0.0104)	0.0312*** (0.009)	0.0146 (0.0137)	−0.286** (0.0969)	0.0362** (0.0144)
ln$AIRF_{it}$	Air Freight	−0.0026 (0.0031)	−0.0027 (0.0041)	0.0002 (0.0021)	0.0012 (0.0022)	0.0332* (0.0174)
ln$CONT_{it}$	Container Port Traffic	0.28*** (0.058)	0.15*** (0.043)	0.362*** (0.073)	0.321*** (0.088)	0.241** (0.089)
ln$SC0_{it}$ x ln$CONT_{it}$	Labor-intensive x Container	−0.139*** (0.031)				
ln$SC2_{it}$ x ln$CONT_{it}$	Resource-intensive x Container		−0.088*** (0.027)			
ln$SC5_{it}$ x ln$CONT_{it}$	Capital-intensive x Container			0.074*** (0.015)		
ln$SC7_{it}$ x ln$CONT_{it}$	Techno-intensive x Container				0.025*** (0.007)	
ln $SC7_{it}$ x ln$AIRF_{it}$	Techno-intensive x Air freight					0.007* (0.004)
Time	Dummy	yes	yes	yes	yes	yes
_cons		−29.01**	−31.30**	−35.52***	−41.68***	−45.57***
No. obs		164	164	164	164	164
No.group id		14	14	14	14	14
within R^2		0.9614	0.9596	0.9629	0.9516	0.9465
Pro>F		0.0000	0.0000	0.0000	0.0000	0.0000

Standard-error in parentheses *p < .10, **p < .05, ***p < .01.
Note: *, **, and *** imply statistical significance on the 10%, 5%, and 1% level, respectively.

Table A2: Fixed effects-Interaction (Dependent variable: Output), ASEAN+SAARC sample 2008-2019

Variables	Acronym	(11)	(12)	(13)	(14)	(15)
$\ln K_{it}$	Capital Stock	0.2109*** (0.0606)	0.2248*** (0.0566)	0.0219*** (0.0560)	0.1976*** (0.0586)	0.222*** (0.0549)
$\ln L_{it}$	Labor Force	−0.0367 (0.1398)	0.1015 (0.1221)	−0.0525 (0.1348)	−0.0085 (0.1290)	−0.0385 (0.1347)
$\ln SC0_{it}$	SITC0 Labor-intensive	−0.0108 (0.0726)	−0.0442 (0.0752)	−0.0208 (0.0671)	−0.0377 (0.0647)	−0.0315 (0.0599)
$\ln SC2_{it}$	SITC2 Resource-intensive	0.2195 (0.1891)	0.0187 (0.0309)	0.0246 (0.0295)	0.0231 (0.0288)	0.0301 (0.0293)
$\ln SC5_{it}$	SITC5 Capital-intensive	−0.0315 (0.0277)	−0.2460** (0.1035)	−0.0495 (0.0333)	−0.1355* (0.0704)	−0.0495* (0.0268)
$\ln SC7_{it}$	SITC7 Techno-intensive	0.0306 (0.0177)	0.0297 (0.0177)	−0.0346 (0.0598)	0.0306* (0.0159)	−0.0129 (0.0251)
$\ln DISM_{it}$	Digital Service-M	−0.0803 (0.0602)	0.0305 (0.0233)	0.0021 (0.0399)	−0.0451 (0.0333)	−0.0487 (0.0365)
$\ln DITEL_{it}$	Digital Telecom-M	0.26** (0.012)	0.24* (0.012)	0.024* (0.012)	0.0815** (0.0345)	0.0834*** (0.0280)
$\ln SC2_{it}$ x $\ln DISM_{it}$	Resource-intensive x Dig Service-M	−0.029 (0.0281)				
$\ln SC5_{it}$ x $\ln DISM_{it}$	Capital-intensive x Dig Service-M		0.34** (0.0142)			
$\ln SC7_{it}$ x $\ln DISM_{it}$	Techno-intensive x Dig Service-M			0.0115 (0.090)		
$\ln SC5_{it}$ x $\ln DITEL_{it}$	Capital-intensive x Dig Telecom-M				0.023* (0.011)	
$\ln SC7_{it}$ x $\ln DITEL_{it}$	Techno-intensive x Dig Telecom-M					0.012** (0.0043)
Time	Dummy	yes	yes	yes	yes	yes
_cons		−53.81***	−47.07***	−53.45***	−50.044***	−48.59***
No. obs		194	194	194	194	194
No.group id		17	17	17	17	17
within R^2		0.9574	0.9621	0.9568	0.9587	0.9591
Pro > *F*		0.0000	0.0000	0.0000	0.0000	0.0000

Standard-error in parentheses *p< .10, **p< .05, ***p< .01.
Note: *, **, and *** imply statistical significance on the 10%, 5%, and 1% level, respectively.

Appendix B: Top five export-import products and transports of ASEAN countries

ASEAN 6	EX	IM	TRS	ASEAN 4	EX	IM	TRS
Brunei	Mineral Products	Mineral fuels, oils	No rail	**Cambodia**	Textiles	Gold	Sea
2	Petroleum gas	Machinery, nuclear reactors	Sea	2	Knit clothes	Refine petroleum	Sea
3	Refined Petroleum	Pharmaceuticals	Sea	3	Trunks, cases	Rubberized knitted fabric	Sea
4	Acyclic alcohol	Vehicles	Sea	4	Cassava	cars	Sea
5	Nitrogenous fertilizers		Sea	5		Semiconductor devices	Sea
Indonesia	Mineral Products	Refine petroleum	Sea	**Lao PDR**	Mineral Products	Petroleum, diesel	Landlocked
2	Coal Briquettes	Crude petroleum	Sea	2	Electricity	vehicles	Grid
3	Ferroalloys	Petroleum gas	Sea	3	Coffee	Mechanical equipment	Shipment
4	Petroleum gas	Motor vehicles, parts	Sea	4	Wood	Steel	Shipment
5	Copper ore	Broadcasting equipment	Sea Air	5	Metals, rubber	Plastic products	Shipment
Malaysia	Machines, electronics	Mineral fuels, oils	Air, Sea	**Myanmar**	Mineral Products	Refine petroleum	Shipment
2	Chemical products	Machinery, nuclear reactors	Sea	2	Natural gas	Crude petroleum	Sea
3	Petroleum products	Plastics	Sea	3	Vegetables, fruits	Special-purpose ships	Sea
4	Natural gas	Vehicles	Sea	4	Rubbers	Rubberized knitted fabric	Sea
5	Palm oil	Medical apparatus	Sea	5	Wood	Palm oil	Sea
Philippines	Machines, equipment	Refined petroleum	Air, Sea	**Vietnam**	Machines, equipment	Electrical machinery	Sea Air
2	Integrated Circuits	Commodities	Sea Air	2	Electronic products	Industry machinery	Sea
3	Copper	Integrated circuits	Sea	3	Textiles, garments	Plastics	Sea
4	Medical apparatus	Cars	Sea	4	Footwear	Oil, mineral fuels	Sea
5	Fruits, nuts	Rice	Sea	5	Wooden products	Iron, steel	Sea
Thailand	Machines	Mill-machinery	Sea	6	Vehicle parts	Motor vehicles	Sea
2	Mineral fuels, oils	Mineral oils-fuels	Sea	7	Seadfood, fishery products		Sea
3	Fruits, nuts, citrus	Industry machinery	Sea, Rail				
4	Meat, fish, seafood	Iron, steel	Sea,Rail				
5	Articles of iron	Plastics	Sea				
Singapore	Machines, equipment	Electronic machinery	Sea Sea Air				
2	Petroleum	Oil, mineral fuels	Sea				
3	Chemical products	Computers, electronics	Sea Air				
4	Manufactured articles	Industry machinery	Sea				
5	Oil bunkers	Precious stones, metals	Sea				

Appendix C: Top five export-import products and transports of SAARC countries

SAARC	EX	IM	TRS
Bangladesh	Garments, textiles	Refined petroleum	Sea
2	Jute products	Raw cotton	Sea
3	Fish, shrimps, prawns	Non-retail pure cotton yarn	Sea
4	Leather products	Scrap iron	Sea
5	Agro products	Palm oil	Sea
Bhutan	Ferroalloys	Oil, fuels	Landlocked
2	Dolomite	Based metals	Rail/Road
3	Gypsum	Machinery, electric appliances	Rail/Road
4	Cement	Vehicles	Rail/Road
5	Electricity	Wood, food	Rail/Road
India	Petroleum products	Petroleum	Sea
2	Chemical substance	Crude, coal	Sea
3	Cotton, textiles	Electronic goods	Sea, Air
4	Pharmaceuticals	Transport equipment	Sea
5	Iron and Steel	Organic chemicals	Sea
Maldives	Planes, Helicopters	Refine petroleum	Sea
2	Non-fillet frozen fish	Planes, helicopters	Sea
3	Petroleum	Broadcasting equipment	Sea
4	Processed fish	Petroleum gas	Sea
5	Fish fillets	Raw iron bars	Sea
Pakistan	Cereals	Refine petroleum	Sea
2	Fruits	Crude petroleum	Sea
3	Sugar	Petroleum gas	Sea
4	Cotton, carpets	Palm oil	Sea
5	Rice	Raw cotton	Sea
Nepal	Palm oil	Mineral fuels, oils	Landlocked
2	Soybean	Iron, steel	Rail/Road
3	Stable fibers yarn	Machinery, nuclear reactors	Rail/Road
4	Knotte carpets	Electrical	Rail/Road
5	Fruit juice	Electronic equipment	Rail/Road
Sri Lanka	Coffee, tea, spices	Petroleum products	Sea
2	Rubbers	Rubberized knitted fabric	Sea
3	Precius stones	Broadcasting equipment	Sea, Air
4	Metals	Semi-finished iron	Sea
5	Electric equipment		Air