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Regular Research Article

The Impact of Transportation Disruptions, Port Congestion, and Freight Restrictions on the Distribution Capability of Indonesian Footwear Supplier

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Abstract: The Trump-era tariffs caused significant disruptions to global maritime supply chains, disproportionately affecting export-dependent archipelagic nations. This study investigates the impact of tariff-induced maritime shocks specifically port congestion, transportation delays, and freight restrictions—on the distribution capabilities of Indonesian footwear suppliers. While previous literature broadly addresses general supply chain risks, this research isolates how these specific maritime bottlenecks translate to supplier-level operations within buyer-driven value chains. Utilizing a quantitative PLS-SEM approach on survey data from 50 tier-1 Indonesian suppliers, the analysis reveals counterintuitive findings. Contrary to expectations, systemic freight restrictions positively catalyzed distribution capabilities by forcing strategic adaptation. Furthermore, port congestion and transportation disruptions yielded non-significant negative effects, suggesting that centralized maritime governance such as FOB contracts buffers suppliers from direct operational shocks while simultaneously enforcing structural dependency. These findings extend maritime logistics literature by highlighting how governance arrangements, rather than just physical constraints, dictate supplier resilience during global trade disruptions.

Keywords: global supply chain disruption, trump tariff, port congestion, footwear supplier, Indonesia, PLS-SEM

1. Introduction

Global disruptions, including pandemics, geopolitical conflicts, and trade-policy shocks, have increasingly exposed vulnerabilities in maritime logistics systems, particularly at ports that function as critical nodes connecting global production networks with international markets. Industries dependent on these systems often operate with narrow profit margins, rely on just-in-time production, and are embedded in long, complex, and interdependent supply chains [1]. The growing frequency of global disruptions [2][3][4] has resulted in delivery delays, excess inventories, factory closures, and financial instability in supplier countries across Southeast Asia. Indonesia, as a major sourcing location for multinational footwear and apparel brands, has been particularly affected by transportation interruptions, port congestion, container shortages, and rapidly increasing shipping costs [5]. These vulnerabilities are further intensified by Indonesia's dependence on foreign-owned shipping carriers, which generally prioritize high-volume and high-profit routes serving developed markets [6] [7].

Trade-policy uncertainty represents another important external risk to Indonesia's export-oriented manufacturing sector. Under the second Trump administration, the United States imposed reciprocal tariffs of up to 32% on Indonesian products, including footwear and apparel [8]. These tariffs increased the cost of Indonesian exports and threatened the competitiveness of domestic suppliers serving international brands. Representatives of labor-intensive industries

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warned that declining orders from the United States could lead to production reductions and layoffs [9]. Economists also projected that these tariffs could reduce Indonesia's economic growth by up to 0.5 percentage points [10]. For multinational companies that rely heavily on Indonesian manufacturing, tariff-related disruptions may interact with existing maritime logistics constraints and further amplify supply chain risks.

Indonesia's historical comparative advantage in cost-efficient labor has also been weakened by limited logistics coordination at the supplier level during periods of disruption [11]. Most Indonesian footwear and apparel manufacturers operate as Tier 1 suppliers in buyer-driven global value chains [12]. Under this arrangement, international brands or third-party logistics providers frequently retain control over shipment planning, carrier selection, port routing, and delivery schedules. Consequently, suppliers have limited authority to modify logistics arrangements when disruptions occur.

This condition is particularly important in the Indonesian context. As the world's largest archipelagic state, Indonesia depends heavily on maritime gateways for its integration into global trade [13]. Unlike manufacturing centers with access to rail networks or cross-border trucking, Indonesian suppliers are largely dependent on ocean freight and port performance. Consequently, general supply chain disruptions frequently appear as port congestion, shipping-capacity shortages, container imbalances, and delays in port–hinterland transportation [14].

Supplier vulnerability is further intensified by asymmetrical power relationships in buyer-driven contracts, especially under free-on-board and cut-make arrangements. In these contractual arrangements, lead firms generally control major maritime logistics decisions, including the selection of carriers, shipping schedules, and export ports [15] [16]. During periods of disruption, buyers may refuse to absorb additional logistics costs, requiring suppliers to bear storage expenses, demurrage charges, detention fees, and idle-labor costs resulting from delayed containers [17][18][19][20].

The expansion of direct-to-consumer business models has also centralized control over international freight coordination and port access, while reducing supplier visibility across maritime transportation processes [21, 22, 23]. In Indonesia, fragmented inland transportation networks and uneven infrastructure development between major industrial zones and peripheral areas further limit supplier flexibility by weakening port hinterland connectivity [24][25][26][27][28][29]. As global disruptions become more frequent, the capacity of suppliers to manage port congestion, freight limitations, and transportation delays has therefore emerged as a critical determinant of distribution continuity.

These vulnerabilities were also evident in the supply chain of a multinational footwear brand, hereafter referred to as the focal firm. Despite its global leadership in branding and distribution, the focal firm reported a 38% decline in revenue during the fourth quarter of 2020 as supply chain disruptions reduced shipment reliability and delayed international distribution. Indonesia, one of the firm's major maritime export bases, also experienced production slowdowns and layoffs in Tangerang as finished products accumulated while outbound shipments were delayed at ports [30]. These conditions demonstrate how port congestion, shipping-schedule uncertainty, and limited freight coordination can translate directly into supplier-level distribution failures.

Although previous studies have extensively examined general supply chain resilience, limited attention has been given to the specific maritime logistics constraints that shape the distribution capability of suppliers in archipelagic developing economies. Existing research generally discusses disruptions at the focal-firm or entire-network level, while the experiences of suppliers with limited autonomy over maritime logistics decisions remain insufficiently explored.

The novelty of this study lies in integrating the supply chain resilience and maritime logistics perspectives to explain supplier-level distribution capability. Rather than treating global disruptions as a single aggregate phenomenon, this study distinguishes three maritime-related disruption dimensions: freight restrictions, port congestion, and transportation disruptions**.** It investigates how these dimensions affect the distribution capability of Indonesian Tier 1 footwear suppliers and how distribution capability subsequently influences supply chain performance.

Although several theoretical arguments in this study draw on research conducted during the COVID-19 pandemic, the empirical focus is placed

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on supply chain disturbances arising from geopolitical and tariff-related trade shocks. Pandemic-related studies are used because they provide established explanations of how transportation interruptions, port bottlenecks, freight-capacity limitations, inventory reallocation, and information instability propagate through global supply chains. The present research extends these mechanisms to a trade-policy context, thereby demonstrating that major maritime logistics disruptions can also arise from changes in trade routes, cargo volumes, regulatory requirements, and sourcing patterns, even in the absence of public-health restrictions.

Accordingly, this study addresses the following research questions:

RQ1: To what extent do freight restrictions, port congestion, and transportation disruptions affect the distribution capability of Indonesian suppliers?

RQ2: To what extent does distribution capability affect supply chain performance?

2. Theoretical Background and Hypothesis Development

2.1 Six Drivers of Supply Chain Performance

The Six Drivers of Supply Chain Performance framework identifies six major factors that determine the efficiency and responsiveness of a supply chain. These factors are classified into three logistical drivers' facilities, inventory, and transportation and three cross-functional drivers' information, sourcing, and pricing [31][32][33][34][35][36].

Facilities refer to the physical locations at which products are manufactured, stored, processed, or distributed. Facility-related decisions include capacity, location, operational role, and the level of centralization or decentralization used to support transportation and inventory policies [31] [36].

Inventory consists of raw materials, work-in-process items, and finished products held throughout the supply chain. Inventory decisions concern the amount, location, type, and allocation of stock across facilities [32].

Transportation refers to the physical movement of products between supply chain locations. Because products are rarely produced, sold, and consumed at the same location, transportation serves as a fundamental connection between suppliers, manufacturing facilities, warehouses, ports, distributors, and customers [33].

Information includes data, analytical processes, and information systems used to coordinate decisions across the other five drivers [32][35][36]. Information visibility supports demand forecasting, shipment tracking, inventory planning, and coordination among supply chain actors. Digital technologies such as artificial intelligence, augmented reality, digital twins, and the Internet of Things can improve the speed, accuracy, and transparency of information exchange [37].

Sourcing concerns decisions regarding which parties will perform supply chain activities and where products, materials, logistics services, and components will be obtained. Sourcing decisions influence inventory allocation, transportation arrangements, supplier flexibility, and distribution continuity.

Pricing determines how much a company charges for products and services and how logistics costs, demand variations, delivery priorities, and service levels are reflected in commercial decisions. Pricing strategies may be adjusted during disruptions to regulate demand, recover increased logistics expenses, or prioritize high-margin customers and markets [45][46][47].

Supply chain managers must balance efficiency and responsiveness across these six drivers. Their interaction ultimately determines supply chain performance [31][35][37]. Global disruptions can directly affect one driver and subsequently generate cascading effects across the remaining drivers.

For example, freight restrictions, port congestion, and transportation interruptions initially impair transportation capacity and reliability [38][39]. However, firms may subsequently need to increase safety stock, relocate inventory, reconfigure distribution centers, change logistics providers, obtain alternative suppliers, improve information visibility, and adjust prices [40][47]. Therefore, maritime logistics disruptions should be understood not merely as transportation problems but as disturbances capable of affecting the entire configuration of a supply chain.

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2.2 Global Supply Chain Disruption

A supply chain disruption is an unplanned event that restricts or interrupts normal supply chain operations. Such disruptions may arise from economic crises, technological failures, natural disasters, labor strikes, terrorism, geopolitical conflict, or regulatory changes [50]. Because contemporary supply chains are highly interconnected, disruptions occurring at one location may propagate through multiple suppliers, transport nodes, facilities, and downstream markets. This phenomenon is commonly described as a ripple effect [51].

Global supply chain disruptions affect multiple organizations, countries, or supply chain tiers simultaneously. They include economic crises, extensive labor disturbances, pandemics, geopolitical conflict, and major trade-restricting events [52]. These disruptions increase environmental complexity through regulatory instability, trade barriers, transportation uncertainty, and economic volatility, requiring firms to modify their international operations [53].

Their effects are especially severe in fast-cycle and globally fragmented industries such as apparel and footwear, which depend on short product lifecycles, precise seasonal schedules, and geographically dispersed supplier networks [1]. Most global supply chains were historically designed to maximize cost efficiency rather than resilience. Lean inventories, limited redundancy, concentrated sourcing, and extensive globalization reduced operational costs but also increased vulnerability to large-scale shocks [5] [54].

As a result, recent disruptions produced cascading failures because many supply chains lacked visibility, alternative capacity, redundancy, and effective risk-sharing mechanisms [55][58]. Upstream material shortages frequently occurred alongside downstream stockouts and demand uncertainty [38][39][59]. In Southeast Asia, including Indonesia, apparel and footwear factories experienced order cancellations, liquidity problems, production reductions, and layoffs [60] [61].

The literature proposes several resilience strategies, including sourcing diversification, digitalization, collaborative contracts, flexible logistics networks, and additional inventory buffers [5] [38] [62]–[64]. However, small and medium-sized suppliers in emerging economies often lack the financial resources, bargaining power, technological capabilities, and contractual authority required to implement these measures [65] [66]. Their vulnerability is therefore not determined solely by the magnitude of the disruption but also by their limited control over supply chain decisions.

2.3 Freight Restrictions and Distribution Capability

Freight restrictions refer to laws, regulations, policies, or operational barriers that limit, control, or modify the movement of cargo, freight vehicles, shipping services, or cross-border goods. The concept includes local restrictions on delivery vehicles and operating hours, as well as national and international customs regulations, border controls, shipping policies, and trade-related requirements [67][69].

Freight restrictions may reduce transportation capacity, limit available routes, increase compliance requirements, and raise logistics costs. Although such regulations are often introduced to improve safety, environmental performance, or transport efficiency, they may also create barriers to product movement [67]. Relevant indicators include insufficient information, limited planning procedures, inadequate data, additional fees, environmental requirements, and complex stakeholder involvement [68].

During large-scale disruptions, sudden adjustments to trade and transportation policies may reduce freight capacity, force shipments to be rerouted, and extend lead times [70]. These conditions are especially damaging to footwear and apparel supply chains, where delivery schedules are closely aligned with seasonal demand and retail launch windows. Tightened freight regulations and reduced shipment volumes can raise transportation costs and increase uncertainty in order fulfilment [71].

Freight restrictions can affect both maritime and air transportation. Reduced schedule reliability may cause carriers to miss port calls, extend delivery times, and disrupt production and inventory planning [38][72]. Restrictions on passenger travel may also reduce belly-cargo capacity, causing air-freight rates to increase

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while ocean-freight systems face additional congestion [73][74].

Freight restrictions also raise logistics costs through demurrage charges, detention fees, port surcharges, compliance costs, and spot-rate premiums [75][76]. These increases disproportionately affect smaller suppliers because they frequently lack sufficient bargaining power to transfer additional costs to international buyers. Suppliers may also experience delayed payments while remaining responsible for storage, labor, and transportation expenses.

Restrictions may create inventory mismatches when goods accumulate at origin ports while destination markets experience product shortages. Blank sailings, limited equipment availability, and inconsistent shipping schedules may further amplify order variability and the bullwhip effect [39][77] [78].

Customs clearance can also be delayed when inspection and administrative processes depend heavily on human intervention. During major disruptions, reductions in staff availability and limited digitalization can substantially increase container dwell time [77].

The literature recommends freight-mode diversification, alternative routing, regional distribution centers, nearshoring, and digital freight-forwarding platforms as potential resilience strategies [43] [79]. However, suppliers may be unable to implement these alternatives when freight decisions are centrally controlled by the focal firm or by third-party logistics providers [18].

Within the Six Drivers framework, freight restrictions directly weaken transportation capacity and indirectly affect inventory, facilities, sourcing, information, and pricing. Reduced route availability and schedule reliability impair the ability of suppliers to dispatch products on time, fulfil orders, respond to changes in demand, and coordinate downstream deliveries. Consequently, greater freight restrictions are expected to reduce supplier distribution capability.

H1: Freight restrictions have a negative effect on distribution capability.

2.4 Port Congestion and Distribution Capability

Port congestion occurs when vessels, cargo, trucks, containers, and other maritime stakeholders compete for limited port resources, resulting in queues, extended dwell time, additional voyage time, and lower service levels [80]. Although congestion is frequently described as vessel waiting time before berthing, it may involve several operational categories, including berth congestion, vessel-working congestion, gate congestion, cargo-yard congestion, inland-vehicle congestion, and channel-entry or exit congestion [81].

Port congestion interrupts the continuity of maritime transportation and may generate both immediate and long-term consequences. Immediate effects include delayed berth, prolonged cargo handling, missed vessel schedules, and reduced port productivity. Long-term effects include higher operating costs, declining revenue, increased financial risk, and reduced competitiveness [80]. Previous studies have shown that congestion may substantially increase container freight rates and reduce export volumes [82] [83].

Large-scale disruptions have demonstrated that even major international ports remain vulnerable to sudden shocks [84]. Following the outbreak of COVID-19, anchoring and berthing times increased considerably for several vessel categories, causing vessels to queue offshore and extending loading and unloading operations [85].

These problems can be more severe in countries with limited infrastructure capacity and uneven digitalization. Tanjung Priok, for example, has experienced congestion associated with limited facilities, equipment constraints, and high cargo volumes [86] [87]. However, congestion is not limited to developing economies; major ports such as Los Angeles and Rotterdam have also experienced significant bottlenecks [72].

Infrastructure expansion alone may not fully resolve congestion. Some ports have experienced longer vessel waiting times even when cargo volumes were below pre-disruption levels, indicating that labor shortages, scheduling problems, equipment availability, container imbalances, and inland transportation constraints may also become binding factors [88].

Port congestion also affects hinterland logistics. Bottlenecks at terminals can disrupt empty-container repositioning, reduce warehouse availability, create chassis shortages, and increase pressure on trucking and warehousing labor [89]. Footwear suppliers operating under strict delivery schedules may

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therefore fail to meet export deadlines when finished products remain idle at factories, inland depots, or port terminals [90].

Congestion also imposes substantial financial costs. Demurrage and detention charges accumulate when containers remain at terminals or outside ports beyond the permitted period [75] [76]. These costs can be especially damaging for suppliers with limited cash flow, restricted warehouse capacity, and weak bargaining positions.

Smart-port technologies, integrated information platforms, real-time scheduling, the Internet of Things, and public-private investment in port modernization have been proposed as mitigation strategies [86] [91][94]. Nevertheless, implementation remains uneven. Indonesian ports continue to face challenges associated with outdated infrastructure, limited numbers of major commercial ports, and high logistics expenses [95]. Although INAPORTNET was introduced to digitalize port services, its implementation remained incomplete across Indonesia's port network. Moreover, digital adoption alone may not automatically improve business sustainability unless it is supported by institutional coordination, infrastructure readiness, and user capability [96].

Distribution capability depends on the synchronized movement of goods from factories through ports and onward to international markets. Port congestion undermines this capability by reducing lead-time reliability, delaying order fulfilment, disturbing inventory alignment, and increasing logistics costs [114] [118]. These effects are expected to be especially severe for Indonesian suppliers whose port selection, shipment scheduling, and carrier arrangements are controlled by lead firms or third-party logistics providers.

H2: Port congestion has a negative effect on distribution capability.

2.5 Transportation Disruptions and Distribution Capability

Transportation disruption refers to an unexpected interruption, delay, or stoppage in the movement of products or materials between supply chain locations [97]. Unlike a production disruption, which may stop the creation of goods, transportation disruption primarily prevents goods that have already been produced from moving to the next supply chain node [98].

Although production and other operations may continue temporarily, prolonged transportation interruptions create mismatches between manufacturing output, inventory availability, warehouse capacity, and customer demand. Transportation disruptions may also damage products and generate broader consequences, including late delivery, plant shutdowns, lost sales, declining financial performance, reduced organizational performance, and reputational damage [99]–[104].

Transportation disruptions may result from route closures, carrier-capacity shortages, container scarcity, schedule unreliability, infrastructure failure, labor problems, customs delays, or cost-related rescheduling. They are frequently modeled as random events using historical probability distributions or scenario-based disaster models. However, such approaches are less effective when historical information is limited or when the disruption is structurally different from previous events [105].

Within the Six Drivers framework, transportation disruptions directly affect the transportation driver but also generate secondary adjustments across the remaining drivers. Firms may increase safety stock [107] relocate or repurpose manufacturing, warehousing, and shipping facilities [108] diversify suppliers or logistics providers [109] strengthen digital information systems [110] or apply flexible pricing and premium-freight arrangements [45] [111].

These adjustments indicate a transition from lean supply chain principles toward more resilient operating models [106]. However, such changes may be costly and difficult to implement, particularly for suppliers with limited authority over logistics arrangements.

The effects of transportation disruptions become more severe when uncertainty is prolonged rather than temporary. Extended disruptions may invalidate historical planning assumptions, destabilize inventory policies, and weaken the coordination between manufacturing, warehousing, transportation, and retail operations [105] [112].

Distribution capability requires reliable transportation flows, accurate inventory positioning, and timely information. Interruptions in product movement therefore reduce the ability of suppliers to fulfil orders,

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meet delivery schedules, respond to market changes, and maintain product availability across downstream channels [106] [116] [119].

H3: Transportation disruptions have a negative effect on distribution capability.

2.6 Product Distribution Capability

Distribution is the supply chain function responsible for moving goods and services toward downstream customers and final consumers [113]. It encompasses both distribution channels and supply chain management activities. Distribution channels concern institutional relationships with wholesalers, retailers, distributors, and other intermediaries. Supply chain management concerns the operational processes supporting those relationships, including warehousing, transportation, inventory management, shipment coordination, and information exchange [114].

The primary objective of distribution is to provide an appropriate level of customer service while maintaining manageable operating costs. Distribution capability therefore represents a firm's ability to organize and execute product movement efficiently, reliably, and responsively. Distribution capability includes network coverage, the identification of suitable distribution points, inventory handling, shipment coordination, order tracking, delivery-speed management, and responsiveness to customer requirements [115][117]. Advanced distribution capability enables companies to ship products rapidly, monitor orders in real time, and provide customers with reliable delivery information [118].

From the resource-based perspective, distribution capability can be treated as an organizational resource embedded in routines, systems, relationships, and operational knowledge. It enables firms to respond rapidly to different market segments, distribute broad product assortments, and maintain service quality under changing conditions [116]. Distribution systems depend on synchronized coordination among manufacturers, logistics providers, warehouses, ports, distributors, and retailers [120]. Consequently, a delay at one supply chain node may generate ripple effects throughout the network, resulting in interrupted supply, delivery delays, product inconsistency, and reduced availability [106] [121].

Global disruptions frequently expose the absence of adequate distribution contingency plans. Firms may experience unpredictable delays in receiving materials and sending finished products when ports, airports, warehouses, or transportation routes are unavailable [119]. Even when production capacity remains operational, limited distribution capability may prevent existing inventory from reaching customers, thereby producing shortages independently of manufacturing output.

Distribution problems are especially serious for fashion and seasonal products. Long replenishment cycles and rapidly changing consumer demand may create mismatches between finished inventory and market requirements, reducing supply chain resilience and increasing the risk of unsold products [123]. Industry 4.0 technologies can improve distribution capability by supporting real-time information collection, demand analysis, shipment visibility, production flexibility, and supply chain agility [124]. These technologies can complement innovative business models and product strategies [125] while brand equity may increase a company's ability to sustain premium prices and coordinate global distribution networks [126].

2.7 Supply Chain Performance

Supply chain performance refers to improvements in the operational results of individual firms and the supply chain [127]. Organizations seek to improve supply chain performance by reducing non-value-adding activities, excessive production, long delivery times, quality failures, unnecessary resource use, and coordination inefficiencies [128]. Supply chain performance can be evaluated through the efficiency and effectiveness of supply chain relationships and processes. Performance measurement provides information concerning resource utilization, operational reliability, process health, coordination quality, emerging problems, and areas requiring improvement [129].

Because supply chain management differs across industries and organizational contexts, no single performance measure is universally applicable [130]. Nevertheless, common dimensions include responsiveness, reliability, delivery performance, cost efficiency, flexibility, inventory performance, service quality, and

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customer satisfaction. These outcomes are shaped by the interaction of the six supply chain drivers [37]. Global disruptions can reduce supply chain performance by interrupting material and information flows, increasing lead times, reducing delivery reliability, generating inventory imbalances, and increasing reliance on expensive emergency logistics [131]–[135]. Disruptions may also propagate across supply chain tiers and force companies to maintain excessive buffer inventory, suspend production, or use redundant suppliers [136]. These effects generally reduce responsiveness, reliability, service quality, and cost performance unless the supply chain possesses adequate resilience and recovery capabilities [52].

2.8 Distribution Capability and Supply Chain Performance

Distribution capability is expected to have a direct and positive effect on supply chain performance because it determines how efficiently, reliably, and responsively products move through downstream networks. Strong distribution capability supports timely delivery, inventory accuracy, order visibility, coordination between production and market demand, and effective use of warehousing and transportation resources [113] [114] [116]. These capabilities are particularly important in footwear and apparel industries, where short product lifecycles, volatile demand, and seasonal market windows increase the financial consequences of delivery delays [119] [123].

Within the Six Drivers framework, effective distribution reflects the coordinated operation of transportation, inventory, facilities, information, sourcing, and pricing. Reliable transportation supports timely product movement; appropriate inventory positioning reduces stockouts; adequate facilities support storage and handling; accurate information enables shipment visibility; effective sourcing provides dependable logistics services; and appropriate pricing supports the recovery of distribution costs [31] [37].

Distribution systems supported by digital tracking, flexible logistics arrangements, coordinated decision-making, and alternative delivery configurations can reduce lead-time variability, limit stockouts, and improve customer service under uncertain conditions [106] [134] [136]. Because supply chain performance is generally assessed through responsiveness, reliability, cost efficiency, and service quality [127] [130] improvements in distribution capability should contribute directly to better supply chain outcomes.

H4: Distribution capability has a positive effect on supply chain performance.

2. Materials and Methods

2.1 Research Design and Empirical Context

This study employed a quantitative cross-sectional design to examine the effects of maritime-related global supply chain disruptions on distribution capability and supply chain performance. Data were collected at a single point in time, enabling the study to identify patterns and statistically assess the relationships among freight restrictions, port congestion, transportation disruptions, distribution capability, and supply chain performance.

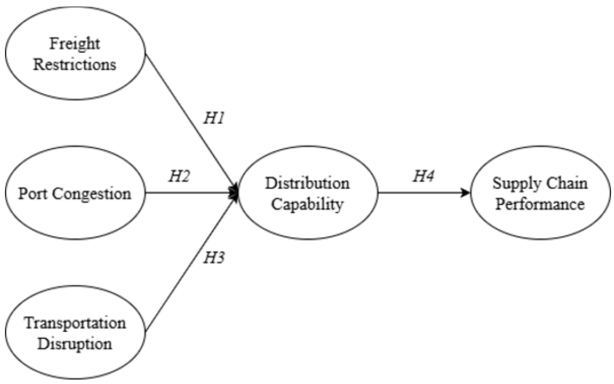

Figure 1. Research Model

The empirical setting comprised Indonesian Tier 1 suppliers operating within the supply network of a multinational footwear company, hereafter referred to as the focal firm. The suppliers were involved in export-oriented activities and depended extensively on maritime transportation for delivering footwear products to international markets. The analysis specifically focused on employees with direct responsibilities in export–import operations, trade compliance, logistics, transportation, warehousing, procurement, and distribution management.

Figure 1 presents the proposed research model, in which freight restrictions, port congestion, and transportation disruptions are specified as exogenous variables affecting distribution capability. Distribution capability is

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subsequently modeled as an antecedent of supply chain performance.

2.2 Population and Sampling

The target population consisted of active Indonesian suppliers within the focal firm's footwear supply network. A non-probability purposive expert-sampling technique was applied using a closed sampling frame. Respondents were selected because they possessed direct professional experience and practical knowledge of logistics and distribution activities within the focal firm's supply chain.

The sampling frame was developed in consultation with industry practitioners to ensure that only verified supplier representatives with relevant responsibilities were invited to participate. Access to the supplier network was supported by professional experience within the focal firm and assistance from industry practitioners in confirming the eligibility of potential respondents.

Restricting participation to verified members of the focal firm's supplier network reduced the likelihood of responses from anonymous, unqualified, or unrelated participants. This procedure also helped reduce coverage and self-selection problems commonly associated with open online surveys while maintaining respondent anonymity and confidentiality.

A total of 50 valid responses were obtained. Although this sample is relatively small for broad population-based quantitative research, it represents a specialized and finite business-to-business population consisting of Tier 1 footwear suppliers directly involved in maritime export and distribution activities.

The largest number of structural paths directed toward a single endogenous construct was three, namely the paths from freight restrictions, port congestion, and transportation disruptions to distribution capability. Based on the commonly used ten-times heuristic, the suggested minimum sample size was therefore 30 observations [138]. The final sample of 50 exceeded this requirement. The sample was also considered appropriate for an exploratory and prediction-oriented PLS-SEM model involving a highly specialized industrial population [137], [141].

2.3 Instrument Development and Data Collection

Data were collected through an online questionnaire administered using Google Forms from August 17 to August 24, 2025. The survey link was distributed to verified respondents through email and direct messaging.

All questionnaire items were measured using a five-point Likert scale ranging from 1, representing strong disagreement, to 5, representing *strongly agree*. The five-point scale was selected because it is straightforward for respondents, provides a neutral midpoint, and is widely applied in organizational and supply chain research.

The questionnaire was developed by adapting measurement items from established literature and refining them through consultations with relevant industry experts. Before the main data collection, a pre-test was conducted with industry practitioners to evaluate:

- clarity of wording;
- ambiguity of statements;
- appropriateness of response options;
- clarity of instructions;
- questionnaire length; and
- logical sequence of the items.

The questionnaire was subsequently revised based on expert feedback and respondent debriefing. Potential common method bias was addressed procedurally through respondent anonymity, clear instructions, item refinement, and the use of concise and neutral wording.

2.4 Construct Operationalization

Five reflective constructs were included in the research model: freight restrictions, port congestion, transportation disruption, distribution capability, and supply chain performance. The initial instrument consisted of five indicators for each construct.

Table 1. Constructs and measurement indicators

Construct	Initial indicator codes	Measurement focus	Sources
Freight Restrictions	FR1–FR5	Customs documentation requirements, tariff-related compliance, regulatory changes, additional charges, and restrictions affecting freight capacity	[67]

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Construct	Initial indicator codes	Measurement focus	Sources
Port Congestion	PC1–PC5	Vessel queuing, anchoring and berthing delays, cargo dwell time, terminal congestion, and customs-clearance bottlenecks	[80]
Transportation Disruption	TD1–TD5	Unexpected transportation interruptions, shipment delays, stoppages in physical flows, and reduced schedule reliability	[99]
Distribution Capability	DC1–DC5	Timely dispatch, order fulfilment, delivery flexibility, shipment coordination, and responsiveness under logistics constraints	[116]
Supply Chain Performance	SCP1–SCP5	Operational efficiency, service quality, delivery reliability, cost performance, and resilience against delays	[128]

2.5 Data Analysis

The data were analyzed using partial least squares structural equation modeling with SmartPLS. PLS-SEM was selected because the study was prediction-oriented, involved a relatively small and specialized sample, and did not require strict multivariate normality assumptions [137].

The analysis was conducted in two stages. First, the reflective measurement model was evaluated to determine indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Second, the structural model was evaluated to examine collinearity, explanatory power, and the statistical significance of the hypothesized relationships.

Indicator reliability was assessed using outer loadings. Indicators with loadings of 0.70 or higher were considered satisfactory. Internal consistency reliability was evaluated using Cronbach's alpha, rho_A, and composite reliability, with values above 0.70 regarded as acceptable. Convergent validity was evaluated using average variance extracted, with an AVE value above 0.50 indicating adequate convergent validity.

Discriminant validity was assessed using the Fornell–Larcker criterion and the heterotrait–monotrait ratio. Under the Fornell–Larcker criterion, the square root of the AVE for each construct should exceed its correlations with other constructs. HTMT values below 0.90 were used as the principal threshold for discriminant validity.

Structural collinearity was evaluated using inner variance inflation factor values. VIF values below 5.00 were considered preferable. The explanatory power of the endogenous constructs was assessed using the coefficient of determination, or R^2.

The statistical significance of the structural paths was evaluated through bootstrapping. A two-tailed critical t-value of 1.96 at the 5% significance level was used to determine whether a relationship was statistically significant.

3. Results

3.1 Measurement Model Assessment

The reflective measurement model was initially assessed using indicator outer loadings. FR1 and TD1 were removed because their outer loadings were below the recommended threshold. The remaining indicators were retained for subsequent analysis.

Table 2. Outer loadings of retained indicators

Indicator	Freight Restrictions	Port Congestion	Transportation Disruption	Distribution Capability	Supply Chain Performance
FR2	0.825				
FR3	0.851				
FR4	0.870				
FR5	0.906				
PC1		0.948			
PC2		0.919			
PC3		0.934			
PC4		0.949			

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Indicator	Freight Restrictions	Port Congestion	Transportation Disruption	Distribution Capability	Supply Chain Performance
PC5		0.887			
TD2			0.905		
TD3			0.895		
TD4			0.909		
TD5			0.713		
DC1				0.846	
DC2				0.853	
DC3				0.874	
DC4				0.829	
DC5				0.891	
SCP1					0.874
SCP2					0.900
SCP3					0.881
SCP4					0.769
SCP5					0.878

As shown in Table 2, all retained indicators had outer loadings above 0.70. Freight Restrictions recorded loadings ranging from 0.825 to 0.906, while Port Congestion recorded loadings between 0.887 and 0.949. These values demonstrate strong indicator reliability. Transportation Disruption retained four indicators with loadings ranging from 0.713 to 0.909. Although TD5 had the lowest loading of 0.713, it remained above the recommended threshold and was therefore retained. The Distribution Capability indicators recorded loadings ranging from 0.829 to 0.891, while the Supply Chain Performance indicators ranged from 0.769 to 0.900. These results indicate that the retained indicators adequately represented their respective latent constructs.

3.2 Internal Consistency and Convergent Validity

Cronbach's alpha, rho_A, composite reliability, and AVE were examined to evaluate construct reliability and convergent validity. All constructs demonstrated satisfactory internal consistency. Cronbach's alpha values ranged from 0.878 to 0.959, while composite reliability values ranged from 0.918 to 0.969. All values exceeded the minimum threshold of 0.70. The AVE values ranged from 0.738 to 0.861, substantially exceeding the recommended threshold of 0.50. Thus, each construct explained more than half of the variance in its retained indicators. These results support the reliability and convergent validity of the measurement model.

Table 3. Reliability and convergent validity

Construct	Cronbach's alpha	rho_A	Composite reliability	AVE
Freight Restrictions	0.886	0.892	0.921	0.745
Port Congestion	0.959	0.960	0.969	0.861
Transportation Disruption	0.878	0.877	0.918	0.738
Distribution Capability	0.911	0.913	0.934	0.738
Supply Chain Performance	0.912	0.913	0.935	0.742

3.3 Discriminant Validity

Discriminant validity was first examined using the Fornell–Larcker criterion. The Fornell–Larcker results did not provide complete evidence of discriminant validity. The square root of the AVE for Freight Restrictions was 0.863, which was lower than its correlations with Port Congestion, at 0.902, and Distribution Capability, at 0.887. Similarly, the square root of the AVE for Distribution Capability, at 0.859, was lower than its correlation with Freight Restrictions, at 0.887.

Table 4. Fornell–Larcker criterion

Construct	FR	PC	DC	SCP	TD
Freight Restrictions	0.863				

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Construct	FR	PC	DC	SCP	TD
Port Congestion	0.902	0.928			
Distribution Capability	0.887	0.858	0.859		
Supply Chain Performance	0.710	0.655	0.792	0.861	
Transportation Disruption	0.629	0.577	0.623	0.480	0.859

Note: Diagonal values in bold represent the square roots of AVE.

Port Congestion, Supply Chain Performance, and Transportation Disruption individually recorded diagonal values greater than their respective correlations. Nevertheless, the high correlations involving Freight Restrictions indicate insufficient empirical separation between Freight Restrictions, Port Congestion, and Distribution Capability. Discriminant validity was subsequently assessed using HTMT.

Table 5. Heterotrait–monotrait ratio

Construct	FR	PC	DC	SCP	TD
Freight Restrictions					
Port Congestion	0.977				
Distribution Capability	0.982	0.918			
Supply Chain Performance	0.784	0.696	0.863		
Transportation Disruption	0.712	0.629	0.697	0.532	

The HTMT results confirmed the discriminant-validity concern. The HTMT values for Freight Restrictions–Port Congestion, Freight Restrictions–Distribution Capability, and Port Congestion–Distribution Capability were 0.977, 0.982, and 0.918, respectively. These values exceeded the recommended threshold of 0.90.

In contrast, the HTMT values involving Supply Chain Performance and Transportation Disruption remained below 0.90. Thus, the discriminant-validity issue was concentrated among Freight Restrictions, Port Congestion, and Distribution Capability. The findings suggest substantial conceptual and empirical overlap among these constructs. Therefore, the structural relationships involving Freight Restrictions, Port Congestion, and Distribution Capability should be interpreted cautiously. The high overlap may reflect either closely connected operational phenomena or insufficient differentiation among their measurement items.

3.4 Structural Collinearity

Before testing the hypotheses, inner VIF values were assessed to identify potential multicollinearity among predictor constructs.

Table 6. Inner VIF values

Predictor relationship	Inner VIF
Freight Restrictions → Distribution Capability	5.940
Port Congestion → Distribution Capability	5.380
Transportation Disruption → Distribution Capability	1.657
Distribution Capability → Supply Chain Performance	1.000

Freight Restrictions and Port Congestion had VIF values of 5.940 and 5.380, respectively, exceeding the recommended threshold of 5.00. These results indicate substantial collinearity between the two maritime logistics disruption variables.

Transportation Disruption recorded a VIF of 1.657, while Distribution Capability recorded a VIF of 1.000 in predicting Supply Chain Performance. These values indicate no collinearity concerns for the corresponding relationships. The high VIF values for Freight Restrictions and Port Congestion are consistent with the discriminant-validity concerns identified through the Fornell–Larcker and HTMT assessments. Consequently, the individual coefficients of these constructs may be unstable and should not be interpreted independently without caution.

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3.5 Explanatory Power of the Structural Model

The explanatory power of the model was assessed using $R^2$and adjusted R^2.

Table 7. Coefficients of determination

Endogenous construct	R^2	Adjusted R^2
Distribution Capability	0.811	0.798
Supply Chain Performance	0.627	0.619

Freight Restrictions, Port Congestion, and Transportation Disruption collectively explained 81.1% of the variance in Distribution Capability. The adjusted R^2value of 0.798 indicates that the model maintained strong explanatory power after accounting for the number of predictors.

Distribution Capability explained 62.7% of the variance in Supply Chain Performance, with an adjusted $R^2$of 0.619. These values indicate that the model possesses substantial explanatory relevance for distribution capability and moderate-to-substantial explanatory relevance for supply chain performance. Nevertheless, the high R^2value for Distribution Capability should be interpreted together with the collinearity and discriminant-validity results. Part of the high explanatory value may be associated with the strong empirical overlap between Freight Restrictions, Port Congestion, and Distribution Capability.

3.6 Hypothesis Testing

The structural paths were evaluated using bootstrapping. At the 5% significance level using a two-tailed test, relationships with t-statistics greater than 1.96 were considered statistically significant.

Table 8. Path coefficients and hypothesis-testing results

Hypothesis	Structural relationship	Coefficient	Sample mean	Standard deviation	t-statistic	Decision
H1	Freight Restrictions → Distribution Capability	0.5446	0.5333	0.1874	2.91	Rejected; significant in the opposite direction
H2	Port Congestion → Distribution Capability	0.3074	0.2917	0.1811	1.70	Not supported
H3	Transportation Disruption → Distribution Capability	0.1000	0.0950	0.1110	0.90	Not supported
H4	Distribution Capability → Supply Chain Performance	0.7917	0.7818	0.0629	12.59	Supported

Freight Restrictions had a statistically significant positive relationship with Distribution Capability ($\beta = 0.5446$, $t = 2.91$). However, H1 predicted a negative effect. Therefore, although the relationship was statistically significant, H1 was rejected because the direction of the coefficient was contrary to the hypothesized relationship. Port Congestion had a positive coefficient of 0.3074 but did not reach statistical significance ($t = 1.70$). Accordingly, H2 was not supported. Transportation Disruption had a weak positive coefficient of 0.1000 and was not statistically significant ($t = 0.90$). Therefore, H3 was not supported. Distribution Capability had a strong and statistically significant positive effect on Supply Chain Performance ($\beta = 0.7917$, $t = 12.59$). Thus, H4 was supported. The result indicates that stronger distribution capability was associated with improved operational efficiency, delivery performance, service quality, and overall supply chain performance.

Overall, only the relationship between Distribution Capability and Supply Chain Performance was statistically significant in the hypothesized direction. Freight Restrictions also produced a significant coefficient, but its positive direction contradicted the proposed negative effect.

3.7 Summary of the Results

The measurement model demonstrated satisfactory indicator reliability, internal consistency, and convergent validity. However, the Fornell–Larcker criterion and HTMT assessment identified discriminant-validity problems among Freight Restrictions, Port

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Congestion, and Distribution Capability. Inner VIF values also indicated multicollinearity involving Freight Restrictions and Port Congestion.

The structural model explained a substantial proportion of the variance in Distribution Capability and Supply Chain Performance. Nevertheless, only H4 was supported in the proposed direction. H1 was statistically significant but opposite to the hypothesized direction, while H2 and H3 were not supported. The unexpected positive relationship between Freight Restrictions and Distribution Capability requires further interpretation in the Discussion section. It may reflect adaptive responses by suppliers, such as improved coordination, additional inventory buffers, stronger compliance procedures, or greater logistics flexibility. However, the coding direction of the Freight Restrictions and Distribution Capability indicators should also be verified before drawing a substantive conclusion.

4. Discussion

The findings of this study provide important insights into how global-level supply chain disruptions affect the distribution capability of Indonesian footwear and apparel suppliers, and how distribution capability subsequently shapes overall supply chain performance. Contrary to the initial conceptual framework, the results show that many factors that should theoretically hinder distribution capability exhibit non-significant relationships for port congestion and transportation disruption or even a positive relationship for the case of freight restrictions. Additionally, distribution capability emerges as a critical determinant of supply chain performance, reinforcing its centrality in supplier competitiveness under conditions of global volatility.

First, the significant but positive effect of freight restrictions on distribution capability (H1) contrasts with the conventional view that trade and freight-related restrictions uniformly constrain logistics performance [142], [143], [144]. In the context of this study, freight restrictions primarily reflect tariff-induced trade barriers introduced during the Trump administration, which altered cross-border freight flows for many American-based brands and their suppliers such as the focal firm suppliers in Indonesia [145], [146]. We posit that, unlike episodic transportation disruptions, these tariff-related restrictions constituted a predictable period of instability and highly visible institutional constraint that prompted strategic responses at the level of the lead firm and its third-party logistics providers, as many firms have done [106], [147]. Given the focal firm's centralised control over its global logistics and trade compliance, it is reasonable to assume that Indonesian suppliers, many operating under FOB or CM terms, had limited direct influence over freight routing or tariff mitigation strategies. Instead, these constraints were managed through system-level adjustments, including changes in sourcing allocations, shipment scheduling, customs compliance processes, and distribution network coordination. So, while at the top-level firm perspective, freight restrictions faced by the focal firm might disrupt its distribution capability, that is not the case for local low-level suppliers.

Alternatively, freight restrictions might act as a catalyst for organizational adaptation, prompting firms to strengthen their distribution capabilities in order to maintain service levels under constrained conditions [148]. We can see this happening in the findings of [148] who used the dynamic capabilities perspective to examine how supply chains not only recover quickly from disruptions but also to evolve and learn from disruptions. This is because disruptions provide opportunities and incentives to invest in new technologies [149]. On the flip side, the observed relationship may also reflect a selection effect, whereby firms with superior distribution capabilities are better positioned to operate in environments characterized by stringent freight restrictions, while those that are less productive or capable simply exit the market [150]. This is in line with reports of Indonesian factories and suppliers in the focal firm's supply chain closing due to shocks. Additionally, it is also possible that the measure of freight restrictions captures operational complexity rather than operational limitation, which may be positively associated with the development of advanced distribution capabilities.

Survey respondents consistently reported challenges such as increased customs documentation, tariff-related compliance, reduced access to affordable freight space, and sudden regulatory changes. These factors align with prior studies showing that freight

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restrictions prolong clearance processes, reduce flexibility in shipment planning, and increase logistics costs [67], [70], [71]. The evidence shows that these effects also apply to suppliers in low-power positions. The Indonesian footwear–apparel sector, which heavily depends on international shipping lanes and centrally managed logistics, is particularly vulnerable to such constraints. The strong empirical support for H1 reflects how tariff shocks and freight regulations amplify systemic vulnerabilities already present in supplier-dominated GVC structures.

Second, the effect of port congestion on distribution capability (H2), although positive in direction, did not reach conventional statistical significance. This pattern suggests that while some form congestion was experienced, consistent with global evidence of increased dwell times, vessel queues, and clearance delays [84], [85], its impact varies considerably across suppliers of the focal firm. This is in contrast to previous studies, which show that port congestion negatively affects distribution capabilities, such as increased freight costs [82], reliability [151], and schedule punctuality [152]. We propose some explanations for this discrepancy. Some Indonesian factories operate near major hubs such as Tanjung Priok, where congestion is common but partially mitigated by higher-capacity infrastructure and established freight partnerships. Others operate through smaller ports with more severe bottlenecks. As was mentioned, by [96], ports in Indonesia can vary significantly in the level of infrastructure and technology they use. This heterogeneity may explain the non-significant result.

Another explanation is that port congestion has been a longstanding issue in Indonesia [86], [153]. Due to the occurrence of congestion at ports being a predictable event, it is reasonable to posit that export firms treat such conditions as part of their routine logistics environment and internalize them into planning decisions. Previous findings have shown that in uncertain environments, firms implement supply chain resilience strategies [133], such as buffering strategies [154], and lead time variability [155]. Because not all disruptions translate into capability loss if absorbed by adaptive measures [156], we propose that port congestions has become part of organizational routines for Indonesian exporters such as the focal firm's suppliers, and as a result, they are more capable of adjusting to additional port congestion without significantly feeling its effects [157]. While reports have shown increases in port activities around the world due to Trump's tariffs caused by frontloading and redistribution of vessel capacity [145], [146], the resulting port congestions from additional traffics does not cause systemic port collapse, only negative economic impact [82], [83], [158], which can be absorbed by firms with sufficient supply chain resilience practices.

It is also important to consider the role of statistical power in interpreting the non-significant effect of port congestion. Although the estimated path coefficient is substantively meaningful, the relatively small sample size limits the precision of the estimate and inflates standard errors, resulting in a t-statistic that falls just below conventional significance thresholds. In contexts characterized by substantial heterogeneity in port infrastructure, logistics arrangements, and firm-level adaptation strategies, small samples are particularly susceptible to power limitations. As a result, the findings should be interpreted as evidence of a directional relationship but statistically underpowered effect rather than the absence of a relationship

Third, transportation disruptions did not show a significant relationship with distribution capability (H3). This contrasts with existing literatures' findings where it was shown that there are significant cascading effects of route changes, container shortages, and carrier unreliability on downstream logistics flows [106], [121]. The non-significance in this context most likely can be explained by the high degree of external control exercised by global brands and third-party logistics providers over transport arrangements. Indonesian suppliers, particularly those operating under FOB or CM terms, often have limited visibility and decision-making authority in transportation processes as is common for suppliers from emerging countries due to power differences, as has been explained before. As a result, the respondents, of the focal firm suppliers, may experience transportation disruptions as an externally managed problem by the central firm rather than issues directly affecting their internal distribution capabilities. This limited involvement may have diluted the

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measured effect of transportation disruptions in the model and make sense in the context of our study as the focal firm is indeed a big global brand with distribution networks across the globe. These results are quite interesting, as the lack of control is often portrayed as a negative [17], [18], [19], [20], but the results may also suggest that perhaps being the junior partner of a larger network isn't entirely negative, and can shield firms from some negative external shocks. Additionally, given the relatively small sample size, the reduced variance in suppliers' direct involvement in transportation decisions may further limit statistical power, making it difficult to detect modest effects even if transportation disruptions indirectly influence distribution outcomes.

Finally, the strong and statistically significant influence of distribution capability on supply chain performance (H4) reinforces its strategic importance for suppliers in volatile global environments, particularly for the focal firm suppliers. The findings support the view that robust distribution systems, characterized by timely dispatching, inventory alignment, responsive logistics coordination, and transparent tracking, are essential for maintaining supply chain performance across reliability, responsiveness, and cost dimensions [114], [116], [136]. In fast-moving industries such as footwear and apparel, where product cycles are short and delivery windows are strict, even minor disruptions can lead to stockouts, reduced order volumes, or cancellations. The large coefficient in this study highlights that suppliers with stronger distribution capabilities were better able to prevent downstream failures, maintain service levels, and mitigate the financial impacts of delays.

From a port and maritime governance perspective, a possible explanation for why transportation disruptions, port congestion, and freight restrictions do not uniformly weaken supplier distribution capability is that their effects may be buffered by centralized control over maritime logistics. In buyer-driven global value chains, this control is often institutionalized through prevailing contractual structures in the footwear industry. Specifically, Indonesian suppliers predominantly operate under Free-On-Board (FOB) terms, meaning lead buyers and third-party logistics providers govern access to shipping capacity, port routing, and clearance processes. This governance structure may help explain why port congestion did not produce statistically negative distribution outcomes at the supplier level; we theorize that maritime bottlenecks might have been managed by lead firms through the reallocation of shipping capacity rather than relying on supplier-led adjustments. However, this insulation comes at the cost of heightened dependency. When global maritime capacity is constricted, these suppliers lack the autonomy to negotiate alternative maritime routes or secure independent vessel space. Because they cannot influence port selection, freight prioritization, or timing decisions during disruptions, their distribution capabilities remain entirely exposed to international maritime bottlenecks. In export-oriented economies such as Indonesia, where manufacturing performance is closely tied to port efficiency and maritime connectivity, supplier distribution capability is therefore shaped less by internal logistics resources than by institutional positioning within buyer-controlled maritime systems. These results extend maritime logistics literature by highlighting governance arrangements at ports and shipping interfaces as critical determinants of how disruption effects are transmitted across global value chains.

It is important to acknowledge the methodological limitations regarding the discriminant validity of the constructs in this study. The statistical analysis revealed high HTMT values (>0.90) and a VIF score exceeding 5.0 between Freight Restrictions and Port Congestion. While this indicates a lack of statistical distinction between these variables, it provides a crucial conceptual insight into maritime logistics in developing nations. From the perspective of Indonesian footwear suppliers, external trade shocks do not occur in isolation; freight restrictions and port congestion are experienced simultaneously as a heavily intertwined, monolithic supply chain crisis. The respondents' inability to distinguish between these constraints reflects the highly coupled nature of global maritime disruptions. Consequently, the findings regarding these specific paths should be interpreted holistically as the impact of an overarching 'External Maritime Constraint' rather than perfectly isolated independent variables. Future research should look to develop more granular measurement scales capable of isolating these overlapping

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maritime phenomena.

5. Conclusions

This study investigated the impact of tariff-induced maritime disruptions on the distribution capability and supply chain performance of Indonesian footwear suppliers. The findings revealed that systemic freight restrictions positively catalyzed distribution capabilities by forcing strategic adaptation. Conversely, port congestion and transportation disruptions yielded non-significant effects. This suggests that in buyer-driven value chains, centralized maritime governance buffers suppliers from direct operational shocks, though it simultaneously enforces structural dependency. Ultimately, maintaining robust distribution capability remains a critical driver of overall supply chain performance during global trade disruptions.

This study has several implications. For port authorities and maritime policymakers, the findings underscore that disruption resilience is shaped as much by governance arrangements as by physical port capacity. The absence of uniformly negative distribution effects suggests that centralized coordination by lead firms and logistics providers can stabilize maritime flows during periods of congestion and freight restriction. However, this stability masks structural dependency, as suppliers remain excluded from maritime decision-making while bearing indirect costs such as storage and demurrage. To address these power asymmetries and enhance system-wide resilience rather than focusing solely on infrastructure expansion, we offer specific practical implications for key maritime stakeholders. For Suppliers, firms must proactively negotiate for greater flexibility within prevailing FOB contracts, potentially seeking shared-risk clauses or demurrage-sharing agreements with lead buyers to offset extreme ocean freight constraints. For lead firms and global brands, relying entirely on centralized maritime control can cripple local supplier distribution during severe bottlenecks. Lead firms should consider decentralizing some routing autonomy or offering alternative port-of-loading options to trusted suppliers to ensure continuous product flow. For Logistics Service Providers (LSPs), LSPs acting on behalf of lead firms should develop more transparent communication channels with tier-1 suppliers, providing real-time visibility into vessel capacity and port clearance status so suppliers can adjust their inland transport and production schedules accordingly. For Port Operators and Policymakers, policymakers must recognize supplier firms as critical indirect stakeholders within port systems. In export-oriented economies like Indonesia, authorities should invest in digital port-clearance systems, integrate inland transport planning to improve port–hinterland connectivity, and design transparent cost-sharing mechanisms that prevent disruption risks from being systematically shifted downstream.

Despite the potential implications as explained, this study also has several limitations. The sample size, though adequate for PLS-SEM, was modest and restricted to Indonesian suppliers within one brand's network, which may affect generalizability. The cross-sectional design captures perceptions at a single point in time, limiting causal inference. Furthermore, the high correlation between freight restrictions, port congestion, and distribution capability, as indicated by HTMT ratios, suggests potential measurement overlap inherent in closely linked logistical constructs. Future research could address these limitations by employing longitudinal designs to trace capability evolution during disruptions, expanding the geographical and industrial scope of supplier studies, and investigating moderating variables such as supplier size, digital adoption level, or contractual power. Qualitative case studies could also deepen understanding of how suppliers adapt to tariff shocks and chronic port inefficiencies. Finally, exploring the role of digital tools and platform-based logistics in decoupling distribution capability from physical disruptions presents a promising avenue for both research and practice. As global disruptions become more frequent and complex, the resilience of supply chains will increasingly depend on the distribution agility of their most vulnerable links. This study reinforces that enhancing supplier-level distribution capability is not merely an operational concern, but a strategic imperative for sustaining performance in an interconnected yet increasingly unpredictable world.

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