



Print ISSN: 1738-3110 / Online ISSN 2093-7717
 JDS website: <http://accesson.kr/jds>
<http://doi.org/10.15722/jds.25.05.202505.55>

Hinterland development to enhance Hinterland Connectivity and Boost Seaport Competitiveness in Ho Chi Minh City

Hien Thi Dieu VO¹, Ho Phi DINH², Quyet Xuan NGUYEN³

Received: March 17, 2025. Revised: April 04, 2025. Accepted: April 07, 2025.

Abstract

Purpose: This paper focuses on analyzing the role of hinterland development in enhancing hinterland connectivity and improving the competitiveness of Ho Chi Minh City (HCMC) seaports and propose strategic solutions to strengthen the port system's competitive position in the context of regional and global economic integration. **Research Design, Data, and Methodology:** This study utilizes a mixed research approach, combining both qualitative and quantitative methods. Data were collected from a sample of 360 individuals employed in the maritime transport industry in HCMC. The analysis was conducted using a 5-point Likert scale and structural equation modeling (SEM). **Results:** The results of the study indicate that four factors - the capability of logistics service providers, transport network, inland logistics nodes, and hinterland reach - have a positive and significant impact on hinterland connectivity and port competitiveness. Additionally, the study highlights the crucial role of hinterland connectivity in enhancing port competitiveness. **Conclusion:** This study emphasizes the importance of hinterland and hinterland connectivity in promoting the competitiveness of HCMC seaports, particularly amid increasing competition from Cai Mep seaport and other ports in the region. It also contributes to refining and adjusting the measurement scale for certain concepts to better suit the seaport industry in Vietnam.

Keywords : Hinterland development, Hinterland connectivity, Seaport competitiveness, Transport Network, logistics service providers

JEL Classification Code: M10, M21, M19, R41

1. Introduction[¶]

When it comes to expanding the domestic market share, previous studies have suggested that seaports should develop multimodal networks to reach distant domestic markets (Parola et al., 2017; Yap, 2019). Traditionally, this expansion has been viewed as the development of multimodal transport, connecting seaports with various

types of logistics centers. However, in recent years, the hinterland connectivity strategies of ports have gone beyond expanding multimodal networks to remote areas and have focused on integrating closely with inland logistics centers (Lee et al., 2017; Zhang et al., 2018). Some ports have chosen to build their own inland logistics centers and connect them to the port via large-scale rail networks or barge transport. Meanwhile, other ports have prioritized

1 First Author. PhD candidate, Faculty of Business Administration, Ho Chi Minh City University of Industry and Trade, Vietnam.
 Email: 6013220003@huit.edu.vn

2 Corresponding Author. Vice Rector, Board of Management, University of Phan Thiet, Vietnam.
 Email: dinhphiho57@gmail.com

3 Third Author. Lecturer, Faculty of Business Administration, Ho Chi Minh City University of Industry and Trade, Vietnam.
 Email: quyetnx@huit.edu.vn

© Copyright: The Author(s)
 This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

connecting multiple inland logistics nodes with medium or low intermodal service frequencies. In general, each port has its own approach in shaping hinterland connectivity, aiming to expand market share and enhance competitiveness. This includes a combination of developing multimodal transport and integrating with logistics hubs to optimize the supply chain and increase operational efficiency (Deshmulk & Song, 2023; Lee et al., 2017).

Studies on the relationship between ports and their hinterlands have revealed that the development of containerization has not only expanded the reach of ports' hinterland but has also intensified competition between ports on multiple levels. With the expansion of inland coverage, the traditional model of a single port controlling the flow of goods in its exclusive hinterland has shifted to a competitive model where multiple ports serve the same area. This shift has fundamentally changed the way port markets are perceived. It has also placed ports in a new competitive landscape, where the connectivity of their hinterlands plays a crucial role in attracting cargo and enhancing their position. As a result, most ports today are no longer just cargo handling points, but have evolved into strategic transshipment nodes, connecting transcontinental transport routes with the inland logistics network (Fleming & Hayuth, 1994; Yap, 2023).

In this context, modern seaports are constantly searching for and implementing suitable hinterland connectivity strategies to increase market share, optimize supply chains, and enhance competitiveness locally, regionally, and globally. Expanding multimodal transport networks, developing dry port systems, and integrating with logistics centers are becoming key solutions for seaports to maintain their competitive advantage in a volatile environment. New and increasingly complex developments in the port-inland relationship not only open up new opportunities but also pose many challenges, requiring researchers to approach the issue more deeply. Redefining and contextualizing the relationship between hinterland, hinterland connectivity, and seaport competitiveness is crucial to gaining a deeper understanding of the development dynamics of the logistics and shipping industry in the modern era (Deshmulk & Song, 2023). Notably, previous studies often focus on ports in Europe, North America, or East Asia that have relatively complete infrastructure and policies, while this study examines the emerging context of HCMC port, where inland connection infrastructure is still under development and increasingly subject to competitive pressure from rival ports in the region.

Ho Chi Minh City is in the southern region of Vietnam, specifically in the Southeast region. It is situated 1,730 km from Hanoi by road and 50 km from the East Sea in terms of geodesic distance. Due to its central location in Southeast Asia, HCMC serves as a crucial transportation hub,

connecting various provinces in the region and serving as an international gateway. The city's seaport is the largest in Vietnam in terms of cargo throughput, according to data from the Vietnam Seaports Association (VPA). However, there has been a slight decrease in its market share compared to the entire southern region, from 54.98% in 2019 to 56.13% in 2022, and a sharp decrease in 2023 to 48.90%. Similarly, when considering the national market share, there has been a decrease from 35.09% in 2019 to 30.39% in 2023. Notably, the market share of container throughput at HCMC seaport has continuously decreased for both the southern region and the entire country. The southern market share decreased from 60.19% in 2019 to 51.87% in 2023, the lowest in five years. This indicates the competitive pressure faced by HCMC seaport from other seaports in the region.

2. Literature Review

2.1. Seaport Competitiveness

The competitive environment of ports has experienced substantial changes over time, leading to a shift in the understanding of seaport competitiveness. While previously focused on attracting port users, port competitiveness now involves providing value to supply chain consumers. To remain competitive and effectively integrate into global supply chains, ports must enhance their supply chain coordination and collaboration capabilities (Song & Panayides, 2008). The definition of seaport competitiveness is often based on the port's role in supply chain management and maritime logistics. However, there are various definitions of seaport competitiveness in research, each with a different perspective. For instance, Chang and Talley (2019) define it as the extent to which a port competes with other ports, while Huang et al. (2003) view it as the ability to create value at the port and its surrounding area. From the perspective of port selection, Merk (2013) argues that a port with good competitiveness is understood as a port that is easier for customers to choose than other ports, thus promoting growth in the port's market share. This study, in line with existing literature, considers seaport competitiveness as a multidimensional concept, particularly in terms of its relationship with stakeholders.

2.2. Hinterland Connectivity

Chen et al. (2016) argue that the relationship between ports and their hinterlands is not solely dependent on the transport network, but also on the global supply chain and the involvement of various stakeholders. The connectivity of the hinterland plays a crucial role in the competitiveness of container ports. However, there is no precise definition of

hinterland connectivity. According to these scholars, hinterland connectivity refers to a network of integrated transport infrastructure and services that facilitate the movement of containers between the port and the hinterland. Deshmukh and Song (2023) argue that, in the context of port competitiveness, the concept of hinterland connectivity should be considered from two main perspectives. The first perspective views this connection as an integral part of the overall connectivity of the port, encompassing both maritime and road transport routes. This approach primarily focuses on factors such as land transport costs, the availability and capacity of transport modes to and from the port, and the transport infrastructure system in the region. The flow of goods from the port to different hinterland areas is a key factor in analyzing hinterland connectivity using this approach. Ports that are strongly connected to multiple hinterland areas with low costs and high transport capacity are often considered to have an efficient hinterland connectivity system. Therefore, this perspective is often referred to as the economic perspective of hinterland connectivity (Wang & Cullinane, 2016).

On the other hand, the second approach focuses on the intermodal network connecting the port to the hinterland, which includes multiple modes of transport such as rail, road, and inland waterways. This approach delves into the scope and coverage of the intermodal network extending from the port to various downstream areas, providing a more geographically detailed view of hinterland connectivity. This is why it is referred to as the "network perspective" (Wang & Cullinane, 2016). Ports that are connected to multiple logistics nodes, including dry ports and inland container hubs, are typically seen as having a higher level of hinterland connectivity (Deshmukh & Song, 2024). This study aligns with the second approach, which considers hinterland connectivity from a network perspective.

Since the 1980s, numerous studies have been conducted to identify the various factors that influence port selection decisions. These factors include the spatial separation between ports, location near inland cities, hinterland connectivity, port infrastructure, tariff systems, average waiting times, geographical location, inland transportation systems, and road and maritime container routes (Collison, 1984; McCalla, 1994; UNCTAD, 1992; Willingale, 1981). Among these factors, hinterland connectivity has consistently been recognized as a key indicator in port evaluation (Gattuso et al., 2023; Parola et al., 2017; Sdoukopoulos & Boile, 2020; Tijan et al., 2022). In recent years, there has been a growing focus on the importance of hinterland connectivity in port-hinterland integration, as it has become a crucial factor in determining seaport competitiveness (Notteboom & Rodrigue, 2005; Sdoukopoulos & Boile, 2020).

The multifaceted aspect of seaport competitiveness is not only influenced by a variety of factors, but also by the differing perceptions of port users (Brooks et al., 2011). According to Acosta et al. (2007), shippers consider port location and hinterland connectivity to be the most crucial factors in determining competitiveness. Tarkowski et al. (2021) argue that the recent significant improvement in the competitiveness of Polish ports can be attributed to infrastructure upgrades, particularly the strong development of inland connectivity. Specifically, the rail transport system plays a crucial role in maintaining the competitive advantage of Polish ports, especially in the constantly evolving modern industry that demands large-scale and highly efficient transport solutions. Thus, it is evident that comprehending the significance of hinterland connectivity in seaport competitiveness is crucial for developing successful port development strategies. Sharing the same view, Gamassa and Chen (2017) argue that multimodal transport, ports, and hinterland are interconnected. Therefore, when discussing ways to improve port competitiveness, it is essential to consider the development of efficient connections between ports and their hinterlands. Recently, Ho et al. (2024) conducted a study on the determinants of competitiveness of HCMC seaports. They highlighted the significance of "connectivity" as one of the two key factors. Specifically, hinterland connectivity is deemed a crucial criterion for port selection in container transport. The competition between ports primarily relies on their capability to offer "door-to-door" services, rather than just "port-to-port" services.

2.3. Port Hinterland

Geographers were the pioneers in studying and analyzing seaport hinterlands. The term "hinterland", derived from the German word for "the land behind". Morgan (1948) developed the concept by discussing the presence of overlapping hinterlands - areas that may be served by different ports. He emphasized that this overlap could potentially lead to trade conflicts and even impact national interests. As a result, Morgan argued that economic geography was the most suitable field for studying seaport hinterlands.

Partly agreeing with the view mentioned above, Notteboom (2009) argues that a port hinterland is the area where the majority of its business is attracted. However, he also emphasizes that it is extremely difficult, and even impossible, to determine the exact boundaries of a port hinterland. The extent of the hinterland is not fixed but varies depending on factors such as the type of goods, time, and mode of transport. Additionally, the constant fluctuations of the market make it impractical to have a completely precise and fixed definition of the hinterland.

Deshmulk and Song (2023) proposed that the concept of port hinterland should be approached from two perspectives: geographical and operational research. According to them, the geographical perspective defines the port hinterland as the area where the port conducts its business activities. On the other hand, the operational research perspective defines it as the area with the lowest transportation costs, time, and distance to the port. However, Ferrari et al. (2011) argued that while distance may be a factor in delineating the port hinterland, the quality of port accessibility is more crucial than distance alone. These differing views highlight that the concept of port hinterland is not solely geographical, but also influenced by economic, commercial, and operational factors. Therefore, a multidimensional approach is necessary to fully understand the port hinterland and its current logistics and supply chain practices.

According to Yeo et al. (2008), as the port's hinterland reach expands, its competitiveness also increases. In order for hinterland expansion to be effective, certain conditions must be met, such as having a pool of experts and skilled workers in the logistics sector, as well as having logistics centres that are of sufficient size and performance. These factors play a crucial role in promoting the port's ability to reach and expand its domestic market (Lee et al., 2017). Van der Horst and Van der Lugt (2011) argue that in order for the port's inter-hinterland reach to operate smoothly, efficient transport operators are needed to provide a variety of inland transport services that meet the needs of customers.

In addition, Deshmulk and Song (2023) have emphasized that inland logistics centers serve different purposes and have distinct functions. However, these functional differences may hinder their ability to attract goods from surrounding areas effectively. As a result, the level of integration with ports varies among logistics centers. In fact, some ports have taken the initiative to build their own inland logistics centers in order to establish direct connections with domestic markets, improve supply chain efficiency, and have better control over cargo flows (Zhang et al., 2018).

Regardless of the chosen model, the core objective of ports is to increase their domestic market share through the development and improvement of logistics connectivity. Several studies have shown that the development of dry ports in hinterland areas can help to relieve congestion and improve the hinterland connectivity of seaports (Zeng et al., 2013). Playing an indispensable role in the logistics system connecting ports to hinterland, dry ports have become important gateways to seaports. The linkage between seaports and inland ports aims at the ultimate objective of establishing an efficient and integrated port network (Van den Berg & De Langen, 2011). In their comprehensive examination of the role of dry ports in connecting seaports and hinterlands, Thai & Grewal (2005) highlight that in the

southern region of Vietnam, dry ports account for approximately 40% of the throughput through seaports. By developing dry ports as crucial intersections in the logistics chain, not only is the transportation of goods between domestic markets and seaports facilitated, but congestion is also reduced, and logistics costs are optimized.

In North America and Europe, there is a strong collaboration between seaports and inland logistics nodes. This partnership not only optimizes transport capacity but also attracts more investment and subsidies. This is due to the highly integrated inland logistics system, which effectively improves service quality and expands customer reach (Nguyen et al., 2021). However, recent research by Saha (2023) on the connectivity between seaports and inland container terminals in Bangladesh has highlighted that intermodal freight transport alone is not sufficient for efficient container transportation from the source to the ultimate destination. As a result, there is a growing urgency to build inland container depots (ICDs) to facilitate strong and synchronized inland connectivity for seaports.

3. Methodology

3.1. Hypotheses and Research Model

3.1.1. Hypotheses Development

The team of experts and skilled workers in the logistics sector plays a crucial role in enhancing the port's inland connectivity (Yeo et al., 2008; Van der Horst & Van der Lugt, 2011). When this team is highly specialized and skilled, they can optimize operational processes, improve service quality, and ensure effective coordination throughout the supply chain. This, in turn, enhances the port's ability to access and expand the domestic market, thereby increasing its competitiveness in the inland area.

Building upon the above views, this study proposes the following hypothesis:

H1: The capability of logistics service providers have a positive impact on hinterland connectivity.

The transport network plays a crucial role in improving the connectivity of the port with its hinterland. It serves as the link that connects ports with various inland markets, even those that are far away, thus creating a comprehensive port logistics network. In other words, this has transformed the traditional logistics model from a linear structure to a more efficient, but discontinuous network (Deshmulk & Song, 2023; Van Klink, 1998). To ensure smooth intermodal transport operations, it is essential to have a well-developed road, rail, and inland waterway network, as well as efficient connection systems. Multimodal transport is particularly important in supporting the growth of hinterland seaports

(Jeevan et al., 2020; Lee et al., 2017; Van den Berg et al., 2012). Building upon the above views, this study proposes the following hypothesis:

H2: Transport Network has a positive impact on hinterland connectivity.

In recent years, the ability to access the hinterland has been greatly improved through efficient inland logistics and connections, which ensure the speedy flow of goods (Gattuso et al., 2023). In addition, ports have expanded their intermodal networks and integrated with various inland logistics nodes in the hinterland (Álvarez-SanJaime et al., 2015; Zhang et al., 2018). According to Deshmulk and Song (2024), the connectivity between ports and their hinterlands can be measured by the frequency of intermodal services from the port and the number of different types of inland logistics centers in the hinterland. Therefore, developing strategic logistics nodes can greatly enhance a port's ability to coordinate cargo flows, improve hinterland connectivity, and increase market share (Saha, 2023; Van den Berg & De Langen, 2011; Lee et al., 2017; Yeo et al., 2008; Zhang et al., 2018). Building upon the above views, this study formulates the following hypothesis:

H3: Inland Logistics Nodes have a positive impact on hinterland connectivity.

Simultaneously, through a review of previous studies and expert consultations on the seaport industry, the authors believe that the capacity of the port to extend its reach to inland areas not only helps expand the flow of goods but also creates favorable conditions for the circulation of goods more quickly and effectively. Accordingly, the authors have proposed a new factor that can affect hinterland connectivity, referred to as Hinterland Reach., this study formulates the following hypothesis:

H4: Hinterland Reach has a positive impact on hinterland connectivity.

In a competitive environment, customer satisfaction with a container port is influenced by various factors, including organizational and physical capabilities, integration in the logistics chain, hinterland connectivity, type of terminal handling equipment, and hinterland services and connected shipping networks (Tongzong and Heng, 2005). Hinterland connectivity has consistently been identified as a crucial factor in enhancing port competitiveness (Acosta et al., 2007; Gamassa & Chen, 2017; Gattuso et al., 2023; Notteboom & Rodrigue, 2005; Parola et al., 2017; Tijan et al., 2022; Tarkowski et al., 2021). Building upon the above views, this study formulates the following hypothesis:

H5: Hinterland connectivity has a positive impact on Seaport competitiveness.

3.1.2. Research Model

Based on the theoretical frameworks of hinterland connectivity and seaport competitiveness, as well as previous research, a new factor has been identified that can potentially impact hinterland connectivity. Accordingly, the authors have proposed a research model consisting of five hypotheses, which are outlined below:

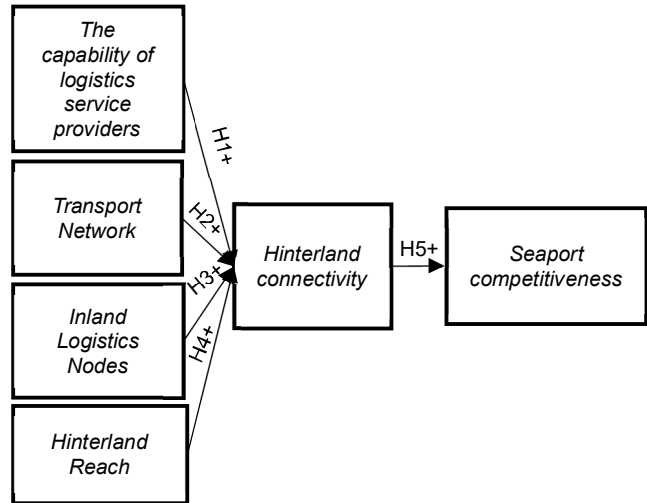


Figure 1: Propose Research Model

3.2. Survey Design and Measurement

Measurement: All scales were adapted from previous studies to ensure their appropriateness for the research context in Vietnam.

The survey procedure consisted of three steps: 1. Discussion with 15 experts with over 10 years of experience to determine the appropriate scale and observed variables for the reality of seaport logistics in HCMC. 2. Preliminary research with 100 samples to assess reliability and construct validity. 3. Conducting the main study with a sample size of 410 individuals, yielding 360 valid questionnaires. The target population was maritime transport workers in HCMC. A non-probability (snowball) sampling method was used, with respondents identified through direct interviews and provided a formal questionnaire. The collected data was analyzed using exploratory factor analysis (EFA), tested with confirmatory factor analysis (CFA), and hypotheses were examined using structural equation modeling (SEM). SEM is a statistical technique that tests relationships between observed and latent variables by integrating regression, factor analysis, and analysis of variance. Therefore, the authors employed SEM for both the measurement model and the structural model of the proposed framework. Estimation was conducted using the bootstrap technique, a suitable alternative when large

sample sizes are not feasible. Bootstrap is a resampling method generating random samples from the original dataset, with at least 1,000 samples recommended (Hair et al., 2019).

All observed variables were measured on a 5-point Likert scale, with response options ranging from “strongly disagree” to “strongly agree” to ensure accurate and consistent data collection. Data were analyzed using SPSS (version 26) and AMOS (version 28).

To assess the capability of logistics service providers, the questionnaire includes five observed variables adapted from Evangelista et al. (2023). The transport network scale consists of four observed variables, while the scale for inland logistics nodes includes three observed variables which are based on the Model of Port Hinterland Connectivity by Deshmukh and Song (2024). Some new observed variables were also added based on expert discussions, such as "The close coordination between railways, roads, and inland waterways enables efficient and flexible operation and conversion of goods to meet domestic demands." Additionally, the authors proposed a new scale, "Hinterland Reach" which includes four observed variables. For the scale of hinterland connectivity, three observed variables were adapted from Arvis et al. (2018) and some new observed variables were developed through discussions with experts, such as "The capacity of domestic logistics service providers is high." The questionnaire also includes three observed variables for seaport competitiveness, mainly adapted from Da Cruz's (2012) study on the competitiveness of seaports in the Iberian region. The authors also added some new observed variables through discussions with experts, such as "The port's market share is high" and "The port's revenue increases rapidly every year".

4. Results

4.1. Descriptive Statistics of the Sample Characteristics

The total number of survey forms issued was 410, after collecting and cleaning the data, the authors eliminated 50 survey forms due to invalid responses, such as uniform answers across all questions. 360 complete samples were used for formal quantitative analysis as detailed in Table 1.

4.2. Scale Reliability Analysis

The criteria used to evaluate the reliability of the scales through the Alpha coefficient are as follows: (i) The overall Alpha coefficient of the research constructs should be greater than 0.6; (ii) The corrected item-total correlation should exceed 0.3 (Nunnally & Burnstein, 1994).

Based on the results of the reliability analysis of each component scale, all six scales (CLP, TNN, ILN, HDR, HIC,

and SPC) have Cronbach's alpha coefficients greater than 0.6. Specifically, CLP has a coefficient of 0.864, TNN has a coefficient of 0.836, ILN has a coefficient of 0.792, HDR has a coefficient of 0.802, HIC has a coefficient of 0.844, and SPC has a coefficient of 0.832. Furthermore, the Cronbach's Alpha if Item Deleted are smaller than the overall Cronbach's alpha, indicating that no items need to be removed. Additionally, all corrected item-total correlations are above 0.3, suggesting that the scales are suitable for exploratory factor analysis (EFA).

Table 1: Statistical Summary of the Official Research Sample (n = 360)

Classification Criteria	Sample size	%	Classification Criteria	Sample size	%
Gender			Experience		
Male	282	80	< 5 years	39	18
Female	78	20	5 – 10 years	127	36
Total	360	100	11 – 20 years	142	33
Age			> 20 years	52	13
< 25	60	20	Total	360	100
26-35	138	55	Type of Enterprise		
36-45	130	16	Shipping Company	50	54
>45	32	9	Forwarding Company	220	32
Total	360	100	Management Officials of Departments	30	8
Educational Level			Exporter/Importer	60	6
Vocational/College	35	12	Total	360	100
University	195	25	Marital Status		
Postgraduate	103	56	Single	118	36
Other	27	7	Married	242	64
Total	360	100	Total	360	100

4.3. Exploratory Factor Analysis

According to Hair et al. (2019), when conducting exploratory factor analysis (EFA), it is important to ensure that certain criteria are met. These include a Kaiser-Meyer-Olkin (KMO) coefficient between 0.5 and 1, suggesting that the data are suitable for EFA, and a significance level of less than 0.05 for Bartlett's test, indicating a linear correlation between the observed variables and the representative factor. Additionally, factor loadings should meet the following thresholds based on sample size: greater than 0.3 for samples over 350, greater than 0.5 for samples between 100 and 350, and greater than 0.7 for samples under 100 (Anderson & Gerbing, 1988). To achieve a satisfactory level of explanation, total variance explained should be greater than 50% and each factor's Eigenvalue should be greater than 1 (Anderson & Gerbing, 1988).

Table 2 shows that the factors of independent variables are extracted into four factors corresponding to the measured variables of the theoretical model. The total variance extracted is 66.516% at an Eigenvalue of 1.813; EFA of HIC is extracted into three observed variables with an extracted variance of 76.216% at an Eigenvalue of 2.286. The EFA of SPC is extracted into three observed variables with an extracted variance of 74.957% at an Eigenvalue of 2.249; and the promax rotation method used.

Table 2: Pattern Matrix

	Component					
	1	2	3	4	5	6
CLP3	0.827					
CLP5	0.824					
CLP2	0.821					
CLP1	0.781					
CLP4	0.769					
TNN2		0.836				
TNN3		0.831				
TNN4		0.823				
TNN1		0.786				
HDR4			0.828			
HDR2			0.798			
HDR3			0.787			
HDR1			0.750			
ILN3				0.853		
ILN2				0.846		
ILN1				0.815		
HIC2					0.897	
HIC3					0.862	
HIC1					0.859	
SPC1						0.878
SPC3						0.874
SPC2						0.845
KMO Measure of Sampling Adequacy			0.827	0.718	0.720	
Bartlett's test of Sphericity			0.000	0.000	0.000	
Eigenvalues			1.813	2.286	2.249	
% of Extracted variance			66.516	76.216	74.957	

4.4. Confirmatory Factor Analysis

According to Gefen et al. (2011), a measurement model must fit the actual data by meeting five measures: (i) CMIN/df, (ii) TLI, (iii) CFI, (iv) NFI, and (v) RMSEA.

The CFA results in Figure 2 demonstrate that the model meets these criteria: CMIN/df = 1.248, indicating a good fit (Bentler & Bonett, 1980; Bagozzi & Jy, 1988); TLI = 0.983, indicating excellent fit (Hu & Bentler, 1995); CFI = 0.986, indicating excellent fit (Hu & Bentler, 1995); NFI = 0.934, indicating a good fit (Hu & Bentler, 1995); and RMSEA = 0.026, indicating an excellent fit (Browne & Cudeck, 1993).

These results should be compatible with market data without the need for any modifications.

CMIN/df=1.248; TLI=.983;CFI=.986; NFI=.934;RMSEA=.026

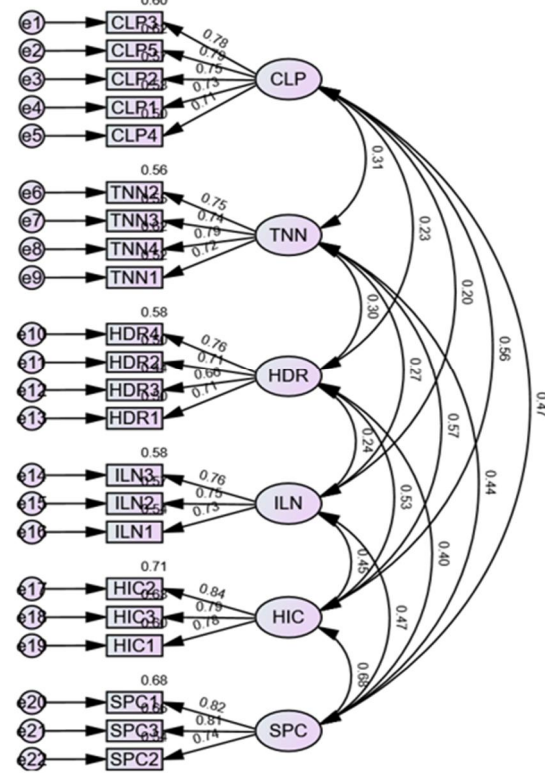


Figure 2: Confirmatory Factor Analysis Results

In addition, it is crucial to consider composite reliability (CR), convergent validity, and discriminant validity when conducting research. According to Hair et al. (2019), the composite reliability should be above 0.60 in exploratory research and above 0.70 as a general guideline, but not exceed 0.95. Table 4 clearly illustrates that all constructs used in this study satisfy these criteria, as they have both composite reliability values and Cronbach's alpha greater than 0.7. This suggests that all values fall within an acceptable range, indicating strong reliability.

According to Fornell and Larcker (1981), a minimum AVE of 0.5 is necessary for convergent validity. As shown in Table 3, all of the scales have an Average Variance Extracted (AVE) value greater than 0.5, indicating that they have achieved convergent validity. Furthermore, Table 4 also demonstrates that the Maximum Shared Variance (MSV) is less than the Average Variance Extracted (AVE) and the square root of AVE (SQRTAVE) is greater than the Inter-Construct Correlations. This suggests that the concepts are distinct from each other, as stated by Fornell and Larcker (1981).

Table 3: Composite Reliability (CR), Convergent Validity, and Discriminant Validity of Constructs

	CR	AVE	MSV	MaxR(H)	1	2	3	4	5	6
1	0.866	0.564	0.315	0.868	0.751					
2	0.838	0.564	0.323	0.839	0.312***	0.751				
3	0.803	0.505	0.28	0.807	0.235***	0.301***	0.711			
4	0.793	0.56	0.224	0.793	0.204**	0.270***	0.235***	0.749		
5	0.846	0.647	0.459	0.85	0.561***	0.568***	0.529***	0.447***	0.804	
6	0.834	0.626	0.459	0.839	0.465***	0.437***	0.397***	0.473***	0.678***	0.791

4.5. Structural Equation Modeling

The results of the Structural Equation Modeling (SEM) analysis showed the following fit indices: CMIN/df = 1.685, TLI = 0.954, CFI = 0.959, NFI = 0.907, and RMSEA = 0.044. These values indicate that the model is a good fit for the collected market data. Additionally, the estimation results in Table 4 demonstrate that all relationships are statistically significant, with p-values less than 0.05.

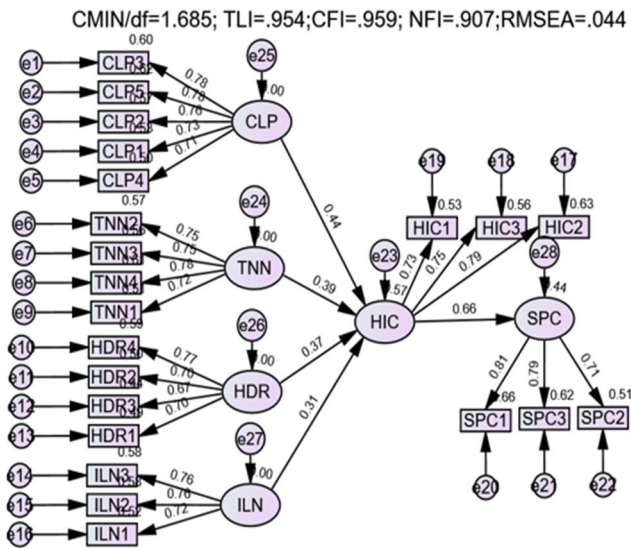


Figure 3: Results of SEM

Table 4 displays the factors that affect "hinterland connectivity" listed in descending order of influence. These factors include the capability of logistics service providers, the transport network, hinterland reach, and inland logistics nodes. It is worth noting that "hinterland connectivity" also plays a crucial role in determining the competitiveness of seaports.

4.6. Testing the Estimation of the Theoretical Model Using Bootstrap

The model's robustness was assessed using the Bootstrap method with 1,000 resamples. The average estimates and biases from these 1,000 samples are presented in Table 5.

According to Ho and Thuong (2023), an absolute C.R value ≤ 1.96 (with a confidence level of 95% or higher) is acceptable. Therefore, the research model is significant with a large sample size (1,000 observations), ensuring that the data analysis results are reliable and can be generalized to the population.

Table 4: Hypothesis Testing Results from the Structural Model

Hypothesis	Path	Estimate	S.E.	C.R.	P	Decision
H1	HIC <- CLP	0.474	0.059	7.982	***	Accepted
H2	HIC <- TNN	0.414	0.059	7.039	***	Accepted
H4	HIC <- HDR	0.367	0.055	6.649	***	Accepted
H3	HIC <- ILN	0.344	0.061	5.654	***	Accepted
H5	SPC <- HIC	0.693	0.068	10.156	***	Accepted

Table 5: Estimation Results Using Bootstrap with N=1000

Parameter	SE	SE-SE	Mean	Bias	SE-Bias	C.R
HIC <- CLP	0.059	0.001	0.474	0	0.002	0.00
HIC <- TNN	0.064	0.001	0.417	0.003	0.002	1.50
HIC <- HDR	0.059	0.001	0.366	-0.001	0.002	-0.50
HIC <- ILN	0.06	0.001	0.345	0.001	0.002	0.50
SPC <- HIC	0.061	0.001	0.695	0.002	0.002	1.00

*C.R (Critical Ratios) = (Bias) / (SE-Bias)

5. Discussion

HCMC seaport is operating in an increasingly competitive business environment, especially in the face of global economic integration and regional supply chain shifts. However, this competition does not stop at the level of individual ports but mostly takes place in the ability to dominate and connect with the domestic market, which supplies goods and promotes import and export demand. Research has shown that hinterland connectivity has a strong and direct impact on the competitiveness of HCMC seaport. This shows that the development of hinterland connectivity is a strategic factor, determining the ability to maintain and expand the port's market share in the long term.

One of the key findings from the study is the port's ability to attract inland cargo. This is crucial for the port's

success, as it relies on a steady flow of goods to maintain efficient operations. By establishing connections with important economic regions in the South, such as Dong Nai, Binh Duong, Long An, and the Central Highlands, the port can increase its domestic cargo volume and enhance its overall competitiveness.

The strength of domestic logistics service providers is also an indispensable factor. Domestic logistics companies play an important role in the supply chain, ensuring that goods are transported quickly and efficiently from ports to final destinations. The development of modern logistics service providers, integrating technology and optimizing the supply chain will help reduce transportation costs, increase delivery speed and improve customer experience. Therefore, attracting and developing an ecosystem of high-quality domestic logistics service providers is an urgent requirement for HCMC seaport to enhance hinterland connectivity to improve competitiveness.

Gateway operations and multimodal networks combining road, rail, and waterways are increasingly becoming a key driver of port throughput growth. This model not only helps reduce dependence on a single mode of transport but also increases flexibility and efficiency in the movement of goods. Seaports with robust hinterland connectivity and intermodal integration often gain a competitive edge in attracting large import-export businesses, thereby increasing both port throughput, market share and revenue.

In addition, expanding and improving connectivity with inland areas, especially those far from the city center, is an important strategy that HCMC seaport needs to prioritize. This is even more urgent in the context of increasing competitive pressure from Cai Mep seaport - a deep-water port with a strategic location, the ability to receive large tonnage ships and sharing the inland area with HCMC port. Strengthening hinterland connectivity not only helps expand the influence of HCMC port but also facilitates the attraction and circulation of goods, thereby improving competitiveness in the regional supply chain.

Finally, the port should vigorously promote the enhancement of connectivity with logistics centers in the inland area. In particular, the port should consider investing in its own logistics centers to provide high-quality services at optimal costs, thereby enhancing customer experience and creating sustainable competitive advantages.

6. Conclusions

The research results have contributed to the refinement and expansion of measurement scales for certain concepts relevant to the seaport exploitation industry in Vietnam. The scales for the capability of logistics service providers,

transport network, inland logistics nodes, hinterland connectivity, and seaport competitiveness were developed based on the model proposed by Deshmukh and Song (2024) and the studies conducted by Arvis et al. (2018), Da Cruz (2012), and Evangelista et al. (2023). Notably, the study has successfully developed a measurement scale for a new variable, hinterland reach. All of the scales achieved are unidimensional and have demonstrated reliability, as well as convergent and discriminant values. The study provides researchers with a basic theoretical framework on connectivity and seaport competitiveness. Additionally, it clarifies the interrelationships among hinterland, connectivity, and competitiveness, thus deepening the understanding of the mechanisms underpinning seaport performance.

From a practical standpoint, the findings offer valuable insights for port administrators and policymakers in Vietnam, particularly those involved with the HCMC seaport system. The validated scales can also serve as diagnostic tools for performance benchmarking and policy evaluation in the maritime transport industry.

However, due to data limitations and information security, the study could not consider aspects such as the ability to reduce costs through productivity improvement, take advantage of additional advantages or the potential to become a key economic driver of the port. These factors, if added, could clarify the competitive position of HCMC seaport. Therefore, future studies can focus on analyzing and explaining the remaining aspects, in order to complete and expand the theoretical framework on seaport competitiveness.

References

- Acosta, M., Coronado, D., & Mar Cerban, M. (2007). Port competitiveness in container traffic from an internal point of view: The experience of the Port of Algeciras Bay. *Maritime Policy & Management*, 34(5), 501–520. Doi: 10.1080/03088830701585381
- Álvarez-SanJaime, Ó., Cantos-Sanchez, P., Moner-Colonques, R., & Sempere-Monerris, J. J. (2015). The impact on port competition of the integration of port and inland transport services. *Transportation Research Part B: Methodological*, 80, 291–302. Doi: 10.1016/j.trb.2015.07.011
- Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin*, 103(3), 411. Doi: 10.1037/0033-2909.103.3.411.
- Arvis, J. F., Vesin, V., Carruthers, R., & Ducruet, C. (2018). Maritime networks, port efficiency, and Hinterland connectivity in the Mediterranean. Washington D.C.: World Bank Group, *Chapter 3. Hinterland Connectivity* (pp.47–67). DOI: 10.1596/978-1-4648-1274-3.

- Bagozzi, R.B., & Jy, I. (1988). On the evaluation of structural equation model. *J. Acad Mark Sci*, 16, 74-94. Doi: 10.1007/BF02723327.
- Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88(3), 588–606. Doi: 10.1037/0033-2909.88.3.588.
- Brooks, M. R., Schellinck, T., & Pallis, A. A. (2011). A systematic approach for evaluating port effectiveness. *Maritime Policy & Management*, 38(3), 315–334. Doi: 10.1080/03088839.2011.572702
- Browne, M. W., & Cudeck, R. (1993). *Alternative ways of assessing model fit. In Testig Structural Equation Models*, K. A. Bollen and J. S. Long (eds), Newbury Park, CA: Sage Publication.
- Chang, Y. T., & Talley, W. K. (2019). Port competitiveness, efficiency, and supply chains: A literature review. *Transportation Journal*, 58 (1), 1–20. Doi: 10.5325/transportationj.58.1.0001.
- Chen, S. L., Jeevan, J., & Cahoon, S. (2016). Malaysian container seaport-hinterland connectivity: Status, challenges and strategies. *The Asian Journal of Shipping and Logistics*, 32(3), 127-138. Doi: 10.1016/j.ajsl.2016.09.001
- Collison, F. M. (1984). North to Alaska: Marketing in the Pacific Northwest–Central Alaska linear trade. *Maritime Policy and Management*, 11(2), 99–112. Doi: 10.1080/03088838400000003
- Da Cruz, M. R. P. (2012). Competitiveness and strategic positioning of seaports: The case of Iberian seaports. (Doctoral dissertation, Universidade da Beira Interior (Portugal)). Retrieved Jan 15, 2023, from <https://ubibliorum.ubi.pt/entities/publication/210047a0-dc5b-4a14-9239-fbe23681c2a5>
- Deshmukh, A., & Song, D. W. (2023). A New wine in new wineskins: unfolding dimension of port-hinterland connectivity and market shares. *Maritime Policy & Management*, 52(1), 55-77. Doi: 10.1080/03088839.2023.2271474.
- Deshmukh, A., & Song, D. W. (2024). Probing into hinterland connectivity with a web of transport modes and logistics nodes: A case of Indian container ports. *Transportation Research Part A: Policy and Practice*, 189, 104200. Doi: 10.1016/j.tra.2024.104200.
- Evangelista, P., Kianto, A., Hussinki, H., Vanhala, M., & Nisula, A. M. (2023). Knowledge-based human resource management, logistics capability, and organizational performance in small Finnish logistics service providers. *Logistics*, 7(1), 12. Doi: 10.3390/logistics7010012.
- Ferrari, C., Parola, F., & Gattorna, E. (2011). Measuring the Quality of Port Hinterland Accessibility: The Ligurian Case. *Transport Policy*, 18(2), 382-391. Doi: 10.1016/j.tranpol.2010.11.002
- Fleming, D. K., & Hayuth, Y. (1994). Spatial characteristics of transportation hubs: centrality and intermediacy. *Journal of transport geography*, 2(1), 3-18. Doi: 10.1016/0966-6923(94)90030-2
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 18(1), 39-50. Doi: 10.1177/002224378101800104
- Gamassa, P. K. P. O., & Chen, Y. (2017). Challenges and Strategies of Abidjan Port-Hinterland Connectivity. In *MATEC Web of Conferences* (Vol. 124, p. 05003). EDP Sciences. Doi: 10.1051/mateconf/201712405003
- Gattuso, D., Cassone, G. C., & Pellicanò, D. S. (2023). A Methodology to Identify the Hinterland for Freight Ports by Transportation Cost Functions. *The Open Transportation Journal*, 17(1). Doi: 10.2174/18744478-v17-e230109-2022-26
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8 ed). United Kingdom: Cengage Learning, EMEA.
- Ho, D. P., Hien, V. T. D., Van, P. T. H. & Bich, D. N. (2024). Factors Affecting the Competitiveness of the Seaport: A Case Study in Ho Chi Minh City, Vietnam. *Global Journal of Management and Business Research: A Administration and Management*, 24(A1), 51-66. Doi: 10.34257/GJMBRAVOL24IS1PG51
- Ho, D. P., & Thuong, V. K. (2023). *Application of PLS-SEM model in research for accounting & banking fields and writing scientific articles in Vietnam*. Eliva Press Global Ltd.
- Hu, L. T., & Bentler, P. M., (1995). *Evaluating model fit in R. H. Hoyle (Ed.)*. Structural equation modeling: Concepts, issues, and applications. 76-99. Thousand Oaks, CA: Sage.
- Huang, W.C., Teng, J.Y., Huang, M.J., & Kou, M.S. (2003). Port competitiveness evaluation by fuzzy multicriteria grade classification model. *Journal of Marine Science and Technology*, 11(1), 53–60. Doi: 10.51400/2709-6998.2280.
- Jeevan, J., Othman, M. R., Salleh, N. H. M., Ghani, N. M. A., Noralam, N. A., & Divine Caesar, L. (2020). An analysis on the triadic connection between seaports, inland terminals and hinterland market. *Australian Journal of Maritime & Ocean Affairs*, 13(1), 23-42. Doi: 10.1080/18366503.2020.1834063
- Lee, H. Y., Kong, S., & Seo, Y. J. (2017). Evaluating determinants of effective port-hinterland connectivity in Shanghai ports. *Journal of International Trade & Commerce*, 13(6), 39-54. Doi: 10.16980/jitc.13.6.201712.39
- McCalla, R. J. (1994). Canadian container: How have they fares? How will they do?. *Maritime Policy and Management*, 21(3), 207–217.
- Merk, O. (2013). The competitiveness of global port-cities: synthesis report. OECD Regional Development Working Papers, 48-72.
- Morgan, F. W. (1948). The pre-war hinterlands of the German North Sea ports. *Transactions and Papers (Institute of British Geographers)*, 14, 45-55. Doi: 10.2307/621260
- Nguyen, L. C., Thai, V. V., Nguyen, D. M., & Tran, M. D. (2021). Evaluating the role of dry ports in the port-hinterland settings: Conceptual framework and the case of Vietnam. *The Asian Journal of Shipping and Logistics*, 37(4), 307-320. Doi: 10.1016/j.ajsl.2021.09.001
- Notteboom, T. (2009). The relationship between seaports and the intermodal hinterland in light of global supply chains: European challenges. *Port competition and hinterland connections*, Round table 143, 25-75.
- Notteboom, T. E., & Rodrigue, J. P. (2005). Port regionalization: towards a new phase in port development. *Maritime Policy & Management*, 32(3), 297-313. Doi: 10.1080/03088830500139885
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

- Parola, F., Risitano, M., Ferretti, M., & Panetti, E. (2017). The Drivers of Port Competitiveness: A Critical Review. *Transport Reviews*, 37(1), 116-138. Doi: 10.1080/01441647.2016.1231232
- Saha, R. C. (2023). Inland Container Terminal Development to Increase Seaport's Competitiveness in Bangladesh. *Journal of Maritime Research*, 20(1), 8-19.
- Sdoukopoulos, E., & Boile, M. (2020). Port-hinterland concept evolution: A critical review. *Journal of Transport Geography*, 86, 102775. Doi: 10.1016/j.jtrangeo.2020.102775
- Song, D. W., & Panayides, P. M. (2008). Global supply chain and port/terminal: integration and competitiveness. *Maritime Policy & Management*, 35(1), 73-87. Doi: 10.1080/03088830701848953
- Tarkowski, M., Goliszek, S., & Bocheński, T. (2021). Hinterland connectivity as a driver of the development of competitiveness of Polish ports in the post-EU accession period. *Journal of Geography, Politics and Society*, 11(1), 16-26. Doi: 10.26881/jpgs.2021.1.03
- Tijan, E., Jović, M., Žgaljić, D., & Aksentijević, S. (2022). Factors affecting container seaport competitiveness: Case study on Port of Rijeka. *Journal of marine science and engineering*, 10(10), 1346. Doi: 10.3390/jmse10101346
- Thai, V. V., & Grewal, D. (2005). An analysis of the efficiency and competitiveness of Vietnamese port system. *Asia Pacific Journal of Marketing and Logistics*, 17(1), 3-31. Doi: 10.1108/13555850510672269
- Tongzon, J., & Heng, W. (2005). Port privatization, efficiency and competitiveness: Some empirical evidence from container ports (terminals). *Transportation Research Part A: Policy and Practice*, 39(5), 405-424. Doi: 10.1016/j.tra.2005.02.001
- UNCTAD (1992). Port marketing and the challenge of the third generation port. In *Conference on Trade and Development*, Chapter III. Port Competition, 84-125. Retrieved Jan 17, 2024, from <https://digitallibrary.un.org/record/138429?ln=en>
- Van den Berg, R., & De Langen, P. W. (2011). Hinterland strategies of port authorities: A case study of the port of Barcelona. *Research in Transportation Economics*, 33(1), 6-14. Doi: 10.1016/j.retrec.2011.08.002
- Van den Berg, R., De Langen, P. W., & Costa, C. R. (2012). The role of port authorities in new intermodal service development; the case of Barcelona Port Authority. *Research in Transportation Business & Management*, 5, 78-84. Doi: 10.1016/j.rtbm.2012.11.003
- Van der Horst, M. R., & Van der Lugt, L. M. (2011). Coordination mechanisms in improving hinterland accessibility: empirical analysis in the port of Rotterdam. *Maritime Policy & Management*, 38(4), 415-435. Doi: 10.1080/03088839.2011.588257.
- Van Klink, H. A. (1998). The port network as a new stage in port development: the case of Rotterdam. *Environment and Planning A*, 30(1), 143-160. Doi: 10.1068/a300143.
- Vietnam Seaports Association (VPA) (2020). Summary of goods through seaports 2019. Retrieved Jul 20, 2024, from <http://www.vpa.org.vn/statistics-2019/>
- Vietnam Seaports Association (VPA) (2021). Summary of goods through seaports 2020. Retrieved Jul 20, 2024, from <http://www.vpa.org.vn/statistics-2020>
- Vietnam Seaports Association (VPA) (2022). Summary of goods through seaports 2021. Retrieved Jul 20, 2024, from <http://www.vpa.org.vn/statistics-2021/>
- Vietnam Seaports Association (VPA) (2023). Summary of goods through seaports 2022. Retrieved Jul 20, 2024, from <http://www.vpa.org.vn/statistics-2022/>
- Vietnam Seaports Association (VPA) (2024). Summary of goods through seaports 2023. Retrieved Jul 20, 2024, from <http://www.vpa.org.vn/statistics-2023/>
- Wang, Y., & Cullinane, K. (2016). Determinants of port centrality in maritime container transportation. *Transportation Research Part E: Logistics and Transportation Review*, 95, 326-340. Doi: 10.1016/j.tre.2016.04.002
- Willingale, M. C. (1981). The port-routeing behaviour of short-sea ship operators; theory and practice. *Maritime Policy and Management*, 8(2), 109-120. Doi: 10.1080/03088838100000032
- Yap, W. Y. (2019). Container trade and shipping connectivity of Vietnam: implications of comprehensive and progressive agreement for trans-Pacific partnership and 21st century maritime silk road. *International Journal of Shipping and Transport Logistics*, 11(1), 94-116. Doi: 10.1504/IJSTL.2019.096873
- Yap, W. Y. (2023). Framework for liner shipping connectivity data analytics and research. *Maritime Business Review*, 8(4), 318-331. Doi: 10.1108/MABR-01-2023-0004
- Yeo, G. T., Roe, M., & Dinwoodie, J. (2008). Evaluating the competitiveness of container ports in Korea and China. *Transportation Research Part A: Policy and Practice*, 42(6), 910-921. Doi: 10.1016/j.tra.2008.01.014
- Zeng, Q., Maloni, M. J., Paul, J. A., & Yang, Z. (2013). Dry port development in China: Motivations, challenges, and opportunities. *Transportation Journal*, 52(2), 234-263. Doi: 10.5325/transportationj.52.2.0234
- Zhang, Q., Wang, W., Peng, Y., Zhang, J., & Guo, Z. (2018). A Game-Theoretical Model of Port Competition on Intermodal Network and Pricing Strategy. *Transportation Research Part E: Logistics and Transportation Review*, 114, 19-39. Doi: 10.1016/j.tre.2018.01.008

Appendixes

Appendix 1: Measurement Scale and Observed Variables

No.	Code	Scales and observed variables
1	CLP	The capability of logistics service providers
1	CLP1	Logistics enterprises have good quantity and quality of human resources.
2	CLP2	The capacity of the enterprise's logistics service management team is high.
3	CLP3	Logistics enterprises have a team of skilled direct workers.

No.	Code	Scales and observed variables
4	CLP4	Logistics enterprises have effective training and development of human resources.
5	CLP5	The logistics enterprise's human resources have strong soft skills.
II	TNN	Transport Network
6	TNN1	The port has convenient railway connections, facilitating the swift and reliable transportation of goods from the port to inland areas.
7	TNN2	The port benefits from a well-developed road network, allowing for efficient truck transfers and reducing both time and cost associated with transporting goods inland.
8	TNN3	The port has established effective connections with the inland waterway system, providing favorable conditions for loading goods onto barges and alleviating strain on roads and railways.
9	TNN4	The close coordination between railways, roads, and inland waterways enables the efficient and flexible operation and conversion of goods to meet domestic demands.
III	ILN	Inland Logistics Nodes
10	ILN1	The hinterland has a modern system of warehouses (ICDs, Warehouses) and distribution centers, ensuring efficient storage and circulation of goods.
11	ILN2	The hinterland features domestic freight terminals, multimodal transport terminals, and dry ports, facilitating seamless connections between different transport modes.
12	ILN3	The hinterland integrates logistics platforms, export processing zones (EPZs/IZs), and free trade zones (FTZs/SEZs), effectively supporting both domestic and international supply chains.
IV	HDR	Hinterland Reach
13	HDR1	The port has the ability to connect with various inland areas, including remote regions
14	HDR2	Goods from the port can be easily accessed and distributed to major economic centers in the hinterland.
15	HDR3	Businesses in the hinterland tend to use this port as a primary transit point rather than choosing other ports.
16	HDR4	The port can support the transportation of goods to distant inland areas at reasonable costs and transit times.
V	HIC	Hinterland connectivity
17	HIC1	The domestic transportation system (road, railway, waterway) is clear and uncongested
18	HIC2	The number of goods entering/exiting the inland through the port
19	HIC3	The capacity of domestic logistics service providers is high
VI	SPC	Seaport competitiveness
20	SPC1	The volume of goods through the port increases every year
21	SPC2	The port's market share is high
22	SPC3	The port's revenue increases rapidly every year