

The following publication Yang, D., Notteboom, T., & Zhou, X. (2021). Spatial, temporal and institutional characteristics of entry strategies in inland container terminals: A comparison between Yangtze River and Rhine River. *Journal of Transport Geography*, 90, 102928 is available at <https://dx.doi.org/10.1016/j.jtrangeo.2020.102928>.

Spatial, temporal and institutional characteristics of entry strategies in inland container terminals: a comparison between Yangtze River and Rhine River

Abstract

Recent decades have brought a growing commitment of investors in the (co-)funding and management of inland terminals, particularly container terminals. However, the actors involved, the forms of third-party entry and the emerging partnerships in inland terminals have only been investigated on a fragmented basis in inland port research. To complement existing inland port research on governance, management and spatial development, this paper analyses entry strategies of actors in inland container terminals on the Rhine and Yangtze in terms of their spatial, temporal and institutional characteristics. The unit of analysis in this paper is the inland container terminal, not necessarily the entire inland port (which might have more than one terminal). The entry strategies and the drivers behind these strategies are examined using a conceptual framework focused on five questions, i.e. who, where, when, why and which way. The empirical application is based on a large dataset of all container terminals on the Rhine and Yangtze. Our findings suggest clear differences between the two rivers in terms of the type of operators, the sequence of inland port development and also the major actors shaping the inland terminal landscape. Despite these differences, there is also some level of similarity, including a low presence of international players, the absence of deepsea (landlord) port authorities and observed waves of single acquisition, multiple-site acquisition, and capital entry in the terminals. Government policies, institutional frameworks and the nature of shipping network development are determinants of inland port investment and the entry strategies adopted by relevant actors. The findings contribute to a better understanding of the drivers and contextual environment guiding entry strategies in inland ports and can help policy makers and port operators in inland rivers to assess and benchmark their strategy. [The paper adds to existing literature by considering spatiotemporal aspects of terminal ownership and the strategic considerations of and institutional drivers and impediments to the inland terminal strategies of the corresponding actors.](#)

Keywords: *Inland port, Port entry strategy, Terminal operator, Port Governance, Port system development*

1. Introduction

Over the past few decades, scholars have been occupied with the strategic role of inland ports within increasingly globally integrated supply chains. Various terms have been used to refer to the inland port concept: dry port, inland clearance depot, inland container depot, intermodal freight centre, inland terminal, hinterland terminal, transfer terminal, extended gate, freight village, etc. (Notteboom and Rodrigue, 2009; Cullinane et al., 2012). The resulting conceptual ambiguity originates from temporal and spatial dimensions that make the concept of inland port time and place dependent and subject to forces of path dependence and spatial embeddedness (Notteboom et al., 2017). Still, in broad terms, an inland/dry port can be defined as “an inland facility with or without an intermodal terminal and logistics companies, which is directly connected to seaport(s) with high capacity transport mean(s) either via rail, road or inland waterways, where customers can leave/ pick up their standardized units as if directly to a seaport” (Witte et al., 2019 based on Roso et al., 2009 and Wiegmans et al., 2015).

Recent review papers have extensively analyzed and commented on the evolution in inland port research, complementing and extending earlier review work by e.g. Roso and Lumdsen (2010). In particular, Miraj et al. (2020) argue more research is needed in the field of inland port investment; inland port governance, strategy and competitiveness; and sustainability. Witte et al. (2020) identify three phases in the evolution of inland port research and point to a shift in attention to governance and management of inland ports, as well as their spatial and economic impacts to surrounding regions.

From a governance, management and spatial perspective, an inland port can be made up of discrete terminals, each with their own operators, with different operating strategies. Wiegmans et al. (2015) argue that the presence of a container terminal can be considered an additional pull-factor for activities in inland waterway ports. As terminals are a key part of competitive strategy, the study of these cargo handling facilities as part of an inland port deserves closer analysis. More than a decade ago, several scholars made a plea for developing a stronger focus on the ‘terminal’ as a relevant unit of analysis instead of the (sea)port, see e.g. the concept of ‘terminalisation of seaports’ by Slack (2007) and the terminalisation of supply chains by Rodrigue and Notteboom (2009). The increased terminal focus resulted among other in a strong surge of research on terminal operator strategy (such as the emergence of global terminal operators) and more operational aspects such as terminal productivity and optimisation. Within this stream of seaport studies, we find papers providing an analysis of entry strategies of

terminal operators in seaports and their impact on corporate growth patterns as well as port system efficiency improvement. The main focus has been on private entry and public-private partnerships in deepsea container terminals (Olivier, 2005; Parola et al., 2013; Panayides et al., 2015), investment strategies of terminal operators (Wang et al., 2019), entry mode choice of terminal operators (Satta and Persico, 2015), regional port integration (Notteboom and Rodrigue, 2005; Dong et al., 2018; Marasco and Romano, 2018) and the impact of port authority strategies and policies on operator entry (van der Lugt et al., 2013; de Langen and Lugt, 2017; Parola et al., 2018). Cruise terminal entry has also attracted a growing interest. Wang and Pallis (2014) and Pallis et al. (2018) studied private entry in and entry barriers to cruise terminals.

Recent decades have brought a growing commitment of investors in the (co-)funding and management of inland terminals, particularly container terminals. However, the actors involved, the forms of third-party entry and the emerging partnerships in inland ports have only been investigated on a fragmented basis in extant literature, primarily relying on individual case studies of specific inland ports (see e.g. Rodrigue et al., 2010 on a handful of North American and European inland ports). This is surprising as the actors involved in inland terminals can have a major influence on the role and development trajectory of an inland port and the structuring of its interdependencies with gateway seaports. The vast majority of these studies follow a seaport-based approach to inland terminal development and governance, largely because inland port research initially was taken up primarily by scholars with a port geography or economics background.

In more recent years, some level of conceptualisation has taken place in this area particularly with respect to the directional development of inland ports within their specific local, regional and (inter)national contexts. Based on the type of vertical control of the development process, Wilmsmeier et al. (2011) distinguished between inside-out development, whereby inland intermodal terminals seek greater integration with their seaports (often driven by public body intervention) and outside-in development whereby inland terminals are used by seaport actors to expand their hinterland. This conceptualisation initially applied to Scotland, Sweden and the USA, has been extended, refined and applied in later works, e.g. the outside-in port hinterland integration in Veracruz as analysed in Wilmsmeier et al. (2015). Also here, empirical work has mostly relied on country-based or individual terminal case studies, with only few exceptions such as the global dry port dataset in Nguyen and Notteboom (2019) used to examine the

relations between dry port characteristics and regional port-hinterland settings. Furthermore, Witte et al. (2019) rightly observe that most work has followed an outside-in approach.

To complement existing inland port research on governance, management and spatial development, this paper analyses entry strategies of actors in inland container terminals in terms of their spatial, temporal and institutional characteristics. The entry strategies are examined using a conceptual framework focused on five questions related to inland terminal entry, i.e. who, where, when, why and which way. In line with the ‘terminalisation’ approach, the unit of analysis in this paper is the inland container terminal, not necessarily the entire inland port (which might have more than one terminal). The empirical application focuses on presenting a comparative analysis of the entry strategies in all inland container terminals located along the Yangtze and Rhine rivers, two of the most important inland barge networks in the world. By using large and comprehensive sets of inland terminals, we not only cover broad geographic regions, but also avoid having to draw conclusions on only a few data points. With this in mind, this study aims to testify the different modes of inland terminal investment along the Yangtze and Rhine rivers and to discuss the possible influential factors explaining these differences. The study contributes to a better understanding of the drivers and contextual environment guiding entry strategies in inland terminals and the similarities and differences in entry strategies between different regions. The findings can help policy makers and inland river port operators to benchmark and develop their strategy on inland port investment.

The following part is divided into four sections. Section 2 introduces the relevant literature on the research subject, i.e. the inland port systems on the Rhine and the Yangtze rivers. Section 3 elaborates the research design including research framework, data structure and data collection methods. Comparisons of port entry strategies and discussion are detailed in section 4. Section 5 draws the conclusions.

2. Research subject: the Yangtze and Rhine river systems

Two of the world’s most important inland rivers in volume terms, i.e. Yangtze River and Rhine River are selected as our research subject. Both rivers have witnessed a wave of single acquisition, multiple-site acquisition, and (foreign) capital entry in their inland container terminals, but until now no study has systematically analyzed the resulting developments. The inland port industries along the Yangtze river and Rhine river have experienced an

unprecedented transformation driven by multiple factors, including port reform, regional economic development and market restructuring, albeit at different speeds and following different time paths (see Notteboom et al., 2020 for a more detailed analysis). While the initial stages of inland container terminal development along the Rhine dates back to the late 1960s, the developments along Yangtze river only really took off in the new millennium. In 2016, the national government of China issued The National Plan for the Yangtze River Economic Belt Development to encourage the integration of resources of Inland Waterway Transportation (IWT) into holistically economic and environmental governance, which further accelerated inland port expansion and improvement.

Given their scale and importance, the Rhine and Yangtze river basins have always formed a key focus area in extant literature on the development and governance of inland ports along river systems. Rimmer and Comtois (2009) studied the inland penetration of containerization along the Yangtze River, strongly facilitated by state-owned COSCON, as one of the main factors driving the development of Shanghai port. Other scholars discussed the policy impact on inland river transport development. For example, Li et al. (2014, 2017) analyzed the impacts of Chinese national fiscal reforms and the transfer of power from the national to local governments on the governance of inland waterway transportation of the Yangtze River Delta and the Pearl River Delta, respectively. The spatial dynamics of container barge network in the Yangtze have also been widely examined. Veenstra and Notteboom (2011) used the port regionalization concept introduced by Notteboom and Rodrigue (2005) to analyze the development of the inland port system of the Yangtze. Wang and Ducruet (2012) examined the impact of Yangshan port on the spatial pattern of the Yangtze River Delta since the 1970s. Yang et al. (2017) and Notteboom et al. (2020) analyzed the drivers in the reshaping of the shipping network in the Yangtze River. Notteboom and Konings (2004) are among the early works studying container operations and inland terminals on the Rhine, presenting several phases in barge network development. More recently, Notteboom (2017) conceptualized the interdependency between port systems and barge networks by examining the Benelux seaport system and the Rhine basin as a case study. Only a few studies provide a comparative analysis of the Yangtze and Rhine rivers, i.e. Notteboom (2007) and Notteboom et al. (2020).

The above studies addressed different aspects of inland river port system development, including management, institutional intervention and spatial evolution. However, no study has addressed the specific entry strategies of terminal operators along inland port systems. As

already indicated in the introductory section, the transformation processes in terms of inland terminal governance, ownership and operations have received only little attention in academic literature. Additionally, most studies on inland port systems were conducted on a regional or national level. There is an overall lack of comparative studies considering different inland port regions.

3. Research design

3.1 Research framework

The entry strategies of actors in inland container terminals are examined using an analytical framework inspired by and adapted from the work of Pallis et al. (2018), see Figure 1.

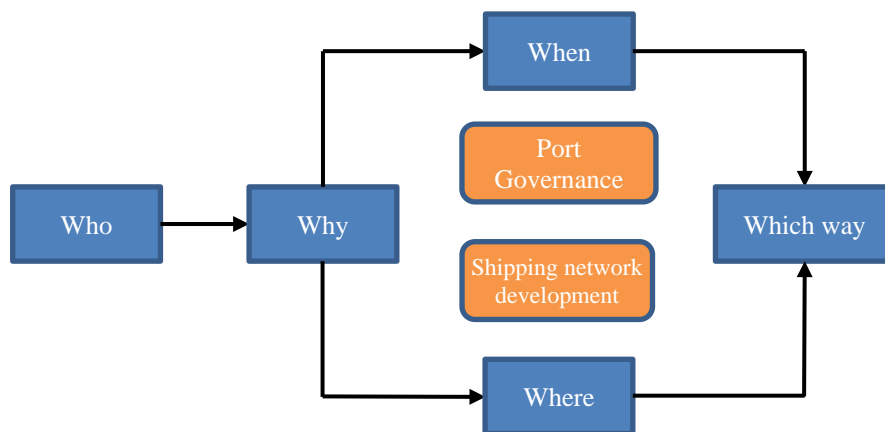


Figure 1. Analytical framework of this study

The starting point of the analytical framework is the **‘who’ question**: who are the major owners and operators of terminals along the two rivers, namely Rhine and Yangtze? In this paper, the investors mainly indicate the owners and terminal operators, they are responsible in operating the terminals, either by their own or through hiring operators. Given the large diversity in owner types, a typology of possible inland port operators was developed including their characteristics such as public or private, foreign or domestic, their major functions, resources and so on. Namely, we detail the leading actors and their drivers of entry in the case of each category of actors. This exercise resulted in 14 distinct categories of owners of inland terminals along the Rhine and Yangtze River. Next, we identified the main drivers of entry for each type of actor in terms of specific investment goals and motivations (i.e. the **‘why’ question**). Table 1

summarizes the major possible inland port owners ('who') and their motivation/rationale of entry ('why'). The analysis only considers actual terminal ownership. However, we are aware that actors do not necessarily have to own a terminal facility in view of exerting some influence over inland terminals. For example, a shipping line might opt for a cooperation scheme with an independent inland terminal operator in view of developing specific port-hinterland logistics solutions, instead of aiming for partial or full ownership. Also, a deepsea terminal operator might set up partnership agreements with a few inland terminals in view of rolling out an extended gate strategy without actually owning all inland terminal facilities (e.g. not all the inland terminals included in the European Gateway Services concept of deepsea terminal operator ECT - part of HutchisonPorts - in Rotterdam are partially or fully owned by ECT). However, such arrangements are not included in the analysis presented in this paper as data on such formal and informal arrangements between actors and inland terminals is not readily available, making it very hard to distinguish between an actor having a preferred relationship with an inland terminal used and an actor simply using the same inland terminal as part of its service offering to the customer. The focus in our study on ownership only allows for an objective comparison of the direct financial/investment commitments of actors involved, and excludes possible bias and noise linked to less far-reaching and sometimes fuzzy formal and informal arrangements between actors and inland terminals.

Table 1 Possible actors in inland river terminals and drivers behind terminal ownership

	Who	Why
A	Independent inland terminal operator	Core activity; Investment in container terminal for expansion and diversification.
B	Public-owned investment company	Invest in inland terminal/port as a strategic asset to promote regional economics.
C	International (deepsea) terminal operator	Offering integrated port-hinterland solutions; ‘Extended gate’ concept (Rodrigue and Notteboom, 2009; Franc and Van der Horst, 2010; Wilmsmeier et al., 2011; Veenstra et al., 2012).
D	Port infrastructure investment companies and real estate companies	Operating and maintaining port facilities mostly based on land concessions. Inland terminal development often integrated in wider development of transport infrastructures and commercial (logistics) zones.
E	(Industrial) conglomerate	Terminal investment as part of supply chain control and tool for integration of production and logistics.
F	Third-party logistics company	One-stop shop; asset management; ‘terminalisation’ of supply chains (Rodrigue and Notteboom, 2009); greening of supply chains (Bergqvist & Monios, 2019; Notteboom et al., 2020)
G	Local, regional/provincial or national government	Inland terminal/port as a strategic asset to trade facilitation and import/export competitiveness
H	Banks, insurance companies & PE Funds	Portfolio management; ROI.
I	Inland shipping line/barge operator	Vertical integration: ensure terminal capacity (dedicated or priority-based) (Notteboom, 2017).
J	Inland port corporation, public inland port authority or terminal/logistics subsidiary thereof	Node for maritime/land interface (Rodrigue et al., 2010); transfer, bundling and storage of cargo, control of cargo flows (Vejvar et al., 2018)
K	Deepsea shipping line	Empty depot; vertical integration strategy: ‘push’ containers inland (Bill of Lading inland port); greening of container transport chains (see also Heaver, 2002; Notteboom, 2004; Notteboom and Merckx, 2006; Franc and Van der Horst, 2010; Van den Berg and De Langen, 2015)
L	Deepsea (landlord) port authority	Port regionalisation strategy (Notteboom and Winkelmanns, 2001; Notteboom and Rodrigue, 2005)
M	Railway company or intermodal operator (rail/truck)	Build upon complementarity between rail and barge; deliver trimodal solutions and access
N	Container lease, repair, production or sale company	Empty depot; hub for repair operations; possibly connected to box production facility

The applied classification of owner types and their underlying entry drivers builds further on earlier works. In their analysis of global container terminal operators, Notteboom and Rodrigue (2012) made a distinction between pure stevedoring companies (such as PSA from Singapore), carrier-related terminal operators (such as Terminal Investment Limited with MSC as majority shareholder) and financial holdings (such as Macquarie Infrastructure or RREEF). In analyzing cruise terminals, Pallis et al. (2018) identified the following possible owner types each with specific motivations: pure cruise terminal operators; cruise lines; international terminal operators (ITO); port companies; real estate and infrastructure managers; shipping agency, travel operator and logistics companies; chambers of commerce; shipping companies; conglomerates; and banks, insurance companies and PE Funds. While many of these categories also have relevance in an inland port setting, our typology includes additional owner types such as (inland) port authorities, government agencies at different administrative levels, inland shipping companies, rail and intermodal operators, etc.

Concerning the drivers behind entry, Parola et al. (2013) focused on the factors underlying foreign entry strategies of terminal operators in container seaports, thereby distinguishing between firm-specific variables (e.g. firm size and business model), terminal-related variables (e.g. size and number of partners involved), external variables (e.g. market openness) and cross-cultural variables (e.g. cultural proximity). Other authors have discussed the hinterland strategies of individual actors, including the rationale behind their involvement in the development and operation of inland terminals, see the references in the last column of Table 1. The list of actors and drivers clearly demonstrates that both outside-in and inside-out approaches to inland terminal ownership can occur, with shipping lines, seaport terminal operators and seaport authorities acting as the main representatives of the outside-in approach.

Barge operators might invest in inland terminals to achieve a functional vertical integration of the container transport chain and to obtain a better synchronization in the asset deployment of ships and terminal equipment (Notteboom, 2017). Nowadays, barge operators often form part of larger logistics conglomerates that offer integrated logistics solutions for manufacturing supply chains. Many **shipping lines** and **seaport terminal operators** have engaged in vertical integration processes into inland logistics markets to minimise coordination costs or to gain competitive advantage (Franc and Van der Horst, 2010). Rodrigue and Notteboom (2009) and Veenstra et al. (2012) analyzed the investment of global deepsea terminal operators in inland terminals as part of ‘extended gate’ strategies in view of offering integrated port-hinterland

solutions using the ‘terminal haulage’ concept. While some of the leading deepsea container lines deploy the carrier haulage principle to push containers to inland terminals, they typically do not own inland terminal facilities (Heaver, 2002; Notteboom and Merckx, 2006; Frémont, 2009).

Industrial conglomerates, third-party logistics providers and real estate companies might participate in the development of logistics parks and terminals in the hinterland (Flämig and Hesse, 2011). The investment of 3PL companies in inland terminals is particularly driven by the increasing ‘terminalisation’ of supply chains (Rodrigue and Notteboom, 2009) and the need to develop green supply chain management (GSCM) solutions for the shippers (Bergqvist and Monios, 2019; Notteboom et al., 2020). **Railway company or intermodal operators** might also invest in inland terminals as a way to integrate their supply chain and develop intermodal transportation. As inland terminal development is often integrated in the wider development of transport infrastructures and commercial (logistics) zones, **infrastructure investment and/or real estate companies** might show interest in investing in inland ports, mostly through land concessions. **Container lease, repair, production or sales companies** could consider inland port investments to streamline empty container depot and repair operations, or to connect to box production facilities.

Publicly owned capital of **state-owned companies** might also be found in inland ports. These parties invest in an inland terminal as a strategic asset to promote regional economic development. **Local, regional/provincial or national governments** might consider a direct involvement in the development of inland terminals (see e.g. empirical studies such as Bask et al., 2014 and Monios and Wilmsmeier, 2012a).

Notteboom and Rodrigue (2005) pointed out that **deepsea (landlord) port authorities** might invest in inland ports in order to realize a port regionalization strategy. Port authorities can act as catalysts (Notteboom and Winkelmanns, 2001), coordinators (De Langen, 2008), facilitators or entrepreneurs (Verhoeven, 2010) in improving the logistics integration between ports and the hinterland. While, in principle, it should be relatively easy for (larger) port authorities to take on the development of terminals in the hinterland, recent empirical evidence demonstrates they hardly ever do so (Magnan and Horst, 2020). Landlord seaport authorities typically are reluctant to invest in inland platforms as they do not want to distort the market mechanism and as they are aware that such investments do not guarantee that the flows handled in the inland platform will pass through the seaport (Notteboom and Rodrigue 2005). Also, in quite a few

cases, port authorities do not have the discretionary powers to invest beyond the port area boundaries. However, managing bodies of seaports that do not follow the landlord model can develop other investment strategies as concerns inland terminals. This is exemplified by the port groups in China (such as SIPG in Shanghai) who combine port authority functions with a direct involvement in deepsea terminal operations (see later in this paper). They typically have been given more leverage and a stronger mandate to invest in hinterland regions beyond their port area jurisdiction.

Finally, **banks, insurance companies & PE funds** could also show interest in inland port investments in the framework of a diversified portfolio management.

The **‘when’ question** in figure 1 refers to the time of port/terminal entry. The year the transaction occurred may be guided not only by the strategy of the operator but also by events including institutional environment change or the economic situation occurring at that year. When analyzing terminal entry in container ports, Jacobs and Notteboom (2011) underlined the role of territorial institutions and strategic action in opening windows of opportunity at different competing locations for terminal investment and growth. A window of opportunity for entry at one location can trigger a response at another competing location. When combined with a favorable economic and institutional environment, such action-reaction processes can result in a noticeable investment wave in a specific year or period.

The **‘where’ question** refers to the location of entry. We use two geographical scales of location: the city where the terminal is located and the navigation area of the river. In line with Notteboom et al. (2020), we make a distinction between three navigation areas on the Rhine and the Yangtze: the lower river section, the middle river section and the upper river section. The aggregation of port entry location data provides insight into the geographic distribution of port investments and associated regional development variations with respect to port entry.

The **‘which way’-question** in figure 1 covers the range of possible entry modes such as minority shareholding, joint ventures, partially owned subsidiaries and wholly owned subsidiaries. We also make a distinction between single acquisitions and multiple acquisitions. Through multiple-site acquisitions, firms enter several sub-markets along the river simultaneously, in most cases through the acquisition of an existing public or private inland terminal operator who operates multiple terminals. Multiple-site acquisitions can imply a wide enlargement of a firm’s geographic scope and terminal investment portfolio which adds to the

managerial concerns and organizational complexities. Existing studies dealing with the container port industry demonstrate that multiple-site acquisitions allow companies to rapidly obtain a strong position in the terminal operating market, or might be used to bypass economic, institutional or other barriers for entering new markets (Olivier et al., 2007; De Langen and Pallis, 2007; Parola et al., 2015).

The decisions at the level of the five questions in Figure 1 are influenced by (local) port governance issues and institutional settings (Notteboom et al, 2020) and the phases in port system development along Yangtze and Rhine as described in Notteboom (2001) and Notteboom and Konings (2004). These studies distinguish four separate phases in barge network development, considering growth, concentration and dispersion of inland container terminals in the network in connection to port system development.

3.2 Data structure and collection

To realize our research objective, we built a database covering all container terminals along both the Yangtze river and Rhine river. The study includes 51 terminals in 23 ports along the Yangtze river with data for the period 1995–2018 and 37 terminals in 27 ports along the Rhine River for the period 1970–2018. The dataset only covers container terminals along the two rivers. A total of 90 terminal investors have been identified for the Yangtze river. For the Rhine, this figure amounts to 34 different investors throughout the 1970-2018 period of observation. Note that some of these companies do no longer exist today due to past mergers or acquisitions, or because they have left the inland terminal market.

The dataset includes information on terminal name, terminal location, TEU throughput, the terminal operator and owner, time and mode of entry and entry motivations. The database contains a lot more entries than the number of inland ports as many ports have more than one terminal and many terminals changed ownership multiple times. The dataset is used to thoroughly summarize the entry patterns and reveal its underlying temporal, spatial and institutional determinants and drivers. We provide a descriptive analysis combined with an explanatory analysis to realize our research objective. The descriptive analysis states and compares the entry patterns of the two rivers, while the explanatory analysis explores the factors which affect the evolutionary patterns of the two rivers. In particular, we attempt to

explain the entry patterns grounding on port governance and shipping network development factors.

Data collection was particularly difficult. In addition to a review of the major national databases, statistical reports and inland port websites, we also searched for extensive media archives including newspapers, magazines and websites combined with company tax registration information and personal contacts with actors involved in the inland ports and terminals.

The major Chinese databases that were consulted include: National Bureau of Statistics of China (2018); Ministry of Transport of China (2018); China ports year book (2018); the reports include 'Fifty Year Statistics Compilation of New China Traffic (1949–1999)', 'Compilation of National Transport Statistics of China (2001–2018)'. For the Rhine basin, some fragmented information could be obtained from Destatis (2018) for Germany, Regional statistical offices (such as Information und Technik Nordrhein-Westfalen (2017), inland port associations and co-operation schemes (such as European Federation of Inland Ports (EFIP) and Upper Rhine Ports) and statistics and reports published by organizations such as the Central Commission of the Navigation on the Rhine (see e.g. CCNR, 2018), European Barge Union (EBU), Inland Navigation Europe (INE) and Verein für europäische Binnenschifffahrt und Wasserstraßen (VBW).

We also reviewed all the homepages of port authorities, port groups and other types of port investors along the Yangtze River (e.g. SIPG, local inland port groups, etc.) and Rhine (e.g. Duisport - Duisburg, Swissterminal, Rhine Europe Terminals, DP World, Hutchison Ports, neska, Contargo). The changes in ownership shares along the Yangtze were collected from qichacha.com and tianyancha.com.

A last data source consists of (partial) datasets and anecdotal evidence on the current status and history of inland terminal operations as reported in existing academic studies on the Yangtze and Rhine rivers. This includes the works of Van Driel (1993); Notteboom and Konings (2004); Konings (2006); Konings and Priemus (2008); and Notteboom (2017) for the Rhine, and Veenstra and Notteboom (2011); Li et al. (2014), Zheng and Yang (2016), and Notteboom et al. (2020) for the Yangtze.

4. Port entry strategies in Yangtze and Rhine River

4.1 Who and why: Typology of operators and rationale behind entry

Tables 2 and 3 provide an overview of the number of entries and the number and type of operators involved throughout the history of container barge terminals on the Rhine and Yangtze rivers.

4.1.1. Situation on the Yangtze

We identified 121 terminal entries along the Yangtze River in the period of observation (Table 2). Next to providing the total number of entries per type of operator, Table 2 also reports on the number of entries by domestic actors and international players, the number of operators per respective type and the average entries per operator type. Most entries (i.e. 28) have been made by independent inland terminal operators. They are all local port operators at province or city level and are either wholly or partially publicly owned. Chongqing Gangjiu Co., Ltd. and Wuhan Harbor Affairs Group Co., Ltd. are two operators who have the most entries. As the cities of Chongqing and Wuhan are economic centres at the upper Yangtze and the middle Yangtze respectively, the two companies own ports not only in their own cities but also in the cities nearby, but all limited to the areas centered around the city.

Public investment companies contributed 23 entries to the total. The China development fund Co., Ltd, a national investment capital had the most entries (i.e. 5 times). All the others had no more than 2 entries, and most of these companies are regional companies. For example, we notice that 4 entries were made by companies from Shanghai and 7 from companies in Hubei Province.

Table 2 Typology of operators and their information on the Yangtze River

Shareholder typology (who)	Sample entries		Domestic entries		Foreign entries		No. of operators		Avg. entries per operator
	No.	%	No.	% ¹	No.	% ²	No.	%	
<i>Independent inland terminal operator</i>	28	23.14%	28	100%	0	0.00%	19	21.11%	1.47
<i>Publicly owned investment company</i>	23	19.00%	23	100%	0	0.00%	17	18.89%	1.35
<i>International (deepsea) terminal operator</i>	19	15.70%	16	84.21%	3	15.79%	12	13.33%	1.58
<i>Port infrastructure investment companies and real estate companies</i>	11	9.09%	10	90.90%	1	9.10%	9	10.00%	1.22
<i>(Industrial) conglomerate</i>	11	9.09%	8	72.73%	3	27.27%	11	12.22%	1.09
<i>Third-party logistics company</i>	10	8.26%	7	70.00%	3	30.00%	9	10.00%	1.11
<i>Local, region/provincial or national government</i>	9	7.44%	9	100%	0	0.00%	4	4.44%	2.25
<i>Banks, insurance companies & PE Funds</i>	3	2.48%	3	100%	0	0.00%	3	3.33%	1
<i>Inland shipping line/barge operator</i>	3	2.48%	3	100%	0	0.00%	2	2.22%	1.5
<i>Inland port corporation, public inland port authority or terminal/logistics subsidiary thereof</i>	2	1.65%	2	100%	0	0.00%	2	2.22%	1
<i>Deepsea shipping line</i>	2	1.65%	2	100%	0	0.00%	2	2.22%	1
<i>Deepsea (landlord) port authority</i>	-	-	-	-	-	-	-	-	-
<i>Railway company or intermodal operator (rail/truck)</i>	-	-	-	-	-	-	-	-	-
<i>Container lease, repair, production or sale company</i>	-	-	-	-	-	-	-	-	-
Overall sample of which related to	121	100%	111	91.7%	10	8.3%	90	100%	1.34

¹ denotes the percentage of domestic entries over total entries. 91.7% is the average percentage of domestic entries over total entries.

² denotes the percentage of foreign entries over total entries. 8.3% is the average percentage of foreign entries over total entries.

International (deepsea) terminal operators made 19 entries in total. Shanghai International Port Group (SIPG), who is the biggest international seaport operator in China, had 8 entries covering the entire Yangtze River. It is also the largest port operator in the Yangtze River. SIPG is followed by COSCO Shipping Ports with 4 entries. Besides these two, we also found other big port operators like Shenzhen Yan Tian Port Holdings Co.,ltd. and Ningbo Zhoushan Co., Ltd., but they only had one entry respectively. It is interesting that two foreign operators are in the list. The first one is Singapore Xinghua Port Holdings Limited and the other company is Shanghai Container (Macao) One Person Co., Ltd. They are also responsible for only one entry each. Third-party logistics companies had only 10 entries in total. Most of them have only one entry, except for Sinotrans (Hong Kong) logistics co., LTD, who had two. The entries of the third-party logistics companies started from 2004, after the second port reform in China when the inland port industry was already much more developed than in its early stage during the 1990s.

The foreign entries only account for a very small percentage of 8.3% of all entries. Most foreign investment is made in the category of the third-party logistics companies, accounting for 30%, followed by 27% for the (industrial) conglomerate. Foreign port operators and shipping lines have no entry in inland ports along Yangtze River.

Among all types of operators, the local, region/provincial or national government shows the highest number of average entries, which is 2.15. The number of average entries for all operators is only 1.34 (Table 2). This is because only few operators had multiple entries and most of the terminals are operated by local companies. This implies that the degree of marketization of port industry along the Yangtze River is still low.

From the entries in Yangtze River, we can find two characteristics: 1) Most of the operators are publicly owned with private companies only having a limited number of entries; 2) Most operators only have one entry and very few operators have more than 3 entries.

4.1.2. Situation for the Rhine

The situation for the Rhine is depicted in Table 3 covering a total of 89 entries in the period 1970-2018 involving 37 terminals. To facilitate comparison, the table structure is similar to Table 2. Contrary to the Yangtze, third-party logistics companies are responsible for an elevated 31 entries or 35% of the total number of entries. These logistics companies

also show the highest number of entries per company, i.e. more than 6. Some major multi-site acquisitions shaped terminal ownership along the Rhine. The most influential multi-site events were the acquisition of barge operator Rhenania by international logistics company Wincanton in 2003 and the sale of six terminals of Wincanton to Contargo (part of Rhenus) in 2012. Throughout the Rhine's history only five logistics companies were involved in terminal entries, i.e. Contargo, Wincanton, SRN Alpina, Conteba and Haeger & Schmidt. At present, Contargo of Rhenus is the only large logistics player left on the Rhine terminal scene (Table 4). Third-party logistics companies typically operate medium-sized inland terminals (Appendix 1).

Table 3 Typology of operators and their information on the Rhine River

Shareholder typology (who)	Sample entries		Domestic entries		Foreign entries		No. of operators		Avg. entries per operator
	No.	%	No.	%	No.	%	No.	%	(single or multiple-site)
<i>Third-party logistics company</i>	31	34.8%	26	83.9%	5	16.1%	5	14.7%	6.2
<i>Inland port corporation, public inland port authority or terminal/logistics subsidiary thereof</i>	18	20.2%	18	100.0%	0	0.0%	9	26.5%	2.0
<i>Inland shipping line/barge operator</i>	14	15.7%	14	100.0%	0	0.0%	3	8.8%	4.7
<i>Independent inland terminal operator</i>	12	13.5%	12	100.0%	0	0.0%	7	20.6%	1.7
<i>International (deepsea) terminal operator</i>	7	7.9%	1	14.3%	6	85.7%	6	17.6%	1.2
<i>Railway company or intermodal operator (rail/truck)</i>	5	5.6%	5	100.0%	0	0.0%	3	8.8%	1.7
<i>Deepsea shipping line</i>	2	2.2%	2	100.0%	0	0.0%	1	2.9%	2.0
<i>(National) state-owned investment company</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>Port infrastructure investment companies and real estate companies</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>(Industrial) conglomerate</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>Local, region/provincial or national government</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>Banks, insurance companies & PE Funds</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>Deepsea (landlord) port authority</i>	0	0.0%	0	-	0	-	0	0.0%	-
<i>Container lease, repair, production or sale company</i>	0	0.0%	0	-	0	-	0	0.0%	-
Total	89	100%	78	87.6%	11	12.4%	34	100%	2.6

The category of inland port corporations, public inland port authorities or terminal/logistics subsidiaries thereof is the second most important with 18 terminal entries. The biggest player in recent years is the neska group with a particularly strong presence on the lower Rhine (see also Table 4)¹. Since 2015, neska is fully owned by

¹ Neska evolved from private to public shareholders. In 1982 the shares were in the hands of SHV Vermögensverwaltungsges. (50%) and Krupp Handel GmbH (50%). In 1985, new shareholders emerged, i.e. Knoche & Barth Vereinigte Speditionen GmbH (25%), Harpen AG (25%) and Krupp Handel GmbH (50%). By 1990, 1990: Krupp Lonrho GmbH (65%) and Harpen AG (35%) owned the company. In 1991, nestrans Logistik was set-up in the Krupp-group with nestrans Logistik GmbH (65%) and Harpen Transport AG (35%). In 1999, the shareholding changed to Imperial Logistics International GmbH & Co. KG (65%) and Harpen Transport AG (35%). In 2015, HGK Häfen und Güterverkehr Köln AG obtained all shares of neska GmbH.

Häfen und Güterverkehr Köln AG (HGK), which is owned by the Cologne Public Services Group (Stadtwerke Köln GmbH, part of Stadt Köln) 54.5%; Stadt Köln 39.2% and Rhein-Erft-Kreis 6.3%. Note that HGK is also one of the most important regional railway companies in Germany. At present, 8 of the 37 inland terminals on the Rhine are owned by inland port corporations, public inland port authorities or terminal/logistics subsidiaries thereof. Another 6 are owned by consortia in which public inland port authorities team up with private companies (see bottom part of Table 4). A good example of the latter is the terminal in Bonn. In 2004, Bonn Terminal was partly privatized by creating Bonner Hafenbetriebe GmbH (BHB), a joint venture between Am Zehnhoff-Söns GmbH and Stadtwerke Bonn GmbH.

Table 4 Terminal ownership on the navigation areas of the Rhine, situation in 2018

Type operator	Code	Total No. Share	Lower Rhine Share Comment	Middle Rhine Share Comment	Upper Rhine Share Comment
Independent inland terminal operator	IITO	4 10.8%		2 13.3%	2 25.0% All Swissterminal
International (deepsea) terminal operator	ITO	3 8.1%	1 7.1% HutchisonPorts	2 13.3% All DP World	
Local, regional/provincial or national government		<i>Only in second order (e.g. Duisport)</i>			
Inland port corporation, public inland port authority or terminal/logistics subsidiary thereof	PIPA	8 21.6%	5 35.7% All neska	1 6.7% Aschaffenburg	2 25.0% RET - Strassbourg
Deepsea (landlord) port authority		<i>Nihil</i>			
Third-party logistics company	3PL	14 37.8%	3 21.4% All Contargo/Rhenus	8 53.3% All Contargo/Rhenus	3 37.5% 2x Contargo/Rhenus
Railway company or intermodal operator (rail/truck)	RC	<i>Only in combinations</i>			
Deepsea shipping line	DSL	<i>Only in combinations</i>			
Inland shipping line / barge operator	ISL	1 2.7%		1 6.7%	
Port infrastructure investment companies and real estate companies		<i>Nihil</i>			
(national) state-owned investment company		<i>Nihil</i>			
Banks, insurance companies & PE funds		<i>Nihil</i>			
(industrial) conglomerate		<i>Nihil</i>			
Container lease, repair, production or sales company	CLR	<i>Only in combinations</i>			
Combinations					
IITO + RC		1 2.7%	1 7.1% DCH Düsseldorf		
PIPA + 3PL + RC		1 2.7%	1 7.1% DIT Duisburg		
PIPA + DSL+ CLR		1 2.7%	1 7.1% D3T Duisburg		
PIPA + RC		2 5.4%	2 14.3% CTS Cologne		
PIPA + IITO		1 2.7%		1 6.7% Bonn Terminal	
PIPA + 3PL		1 2.7%			1 12.5% Weil Am Rhein
Total number of terminals		37 100%	14 100%	15 100%	8 100%

Inland barge operators realized 14 entries. However, most of these entries go back many decades. In the 1970s and 1980s, inland barge companies had a strong position in terms of ownership of Rhine terminals. For example, Notteboom (2001) reported that Combined Container Service (CCS) was a key player on the Rhine which started up its first terminal in Ginsheim in 1976. This was followed by terminals in Ludwigshafen (opened in 1983), Koblenz (1986), Emmerich (1995), Valenciennes (1996), Frankfurt-Höchst (1998), Aschaffenburg (1999), Krefeld (2000) and Béthune (2004). In 2008, Contargo was formed through the merger between CCS and Interfeeder B.V and fully integrated within logistics

company Rhenus. Rhenania was another leading barge operator with terminal investments on the Rhine, before it was acquired by logistics company Wincanton in 2003.

Independent inland terminal operators remain a rather uncommon sight on the Rhine, i.e. only 4 terminals in full control and 1 in partnership with a railway company (Table 4). From a historical perspective, this category performed 12 entries covering 7 different companies.

Since the new millennium, international deepsea terminal operators have increased their presence on the Rhine. Although the absolute number of entries remains low, Appendix 1 reveals that deepsea terminal operators typically opt for the development of large inland terminals. Note that our 1970-2018 dataset excludes the take-over of Swissterminal by DP World in early 2020, adding two more terminals to the Dubai-based company's inland terminal portfolio. Deepsea terminal operators who entered the inland terminal business and exited later include APM Terminals and Unikai. In some cases, an inland terminal changed hands because of a much-wider international transaction mainly focused on acquiring a portfolio of deepsea container terminals, e.g. the take-over of Rotterdam-based ECT by Hutchison Port Holdings in 1999 (impacting the ownership of the DeCeTe terminal in Duisburg) and the acquisition of CSX World Terminals by DP World in 2004 (impacting the ownership of the terminal in Germersheim)².

Only a few railway companies and intermodal operators were or are involved in inland terminals, mostly as a minority shareholder (e.g. Kombiverkehr and Transfracht). The same applies to deepsea shipping lines with only Hapag-Lloyd having been involved in a few past transactions.

The remaining actors in the ownership typology have not entered the inland terminal market on the Rhine (Table 3). The only exception is the current small minority stake of Progeco S.A.S. in terminal D3T (Duisburg Trimodal Terminal) where it offers container repair services (Table 4).

² Germersheim provides a good example. In 1984, ICG (Inland CT Germersheim) started with 11 shareholders such as ECT, Port of Rotterdam, Transfracht, Gerd Buss, etc. The terminal was taken over by the Network-group in 1988. In 2000, CSX World Terminals acquired the terminal. In 2004, DP World acquired the terminal network of CSX World Terminals. DeCeTe Duisburg is another good example. In August 1999, deepsea terminal operator ECT from Rotterdam acquired the terminal. In September 1999 ECT got new owners, i.e. Hutchison Port Holdings, the Port of Rotterdam Authority, ABN AMRO & Stichting Werknemersaandelen ECT. In January 2002, HPH became the only shareholder of ECT. The terminal was integrated in the European Gateway Services (EGS) strategy of Hutchison in 2012. In 2016, Hutchison Ports Holdings changed its name to Hutchison Ports.

4.1.3. Who and why: comparison between Rhine and Yangtze

In summary, clear differences can be observed between the Rhine and the Yangtze. On the Rhine, logistics companies are much more dominant while international port operators such as SIPG have a much stronger presence on the Yangtze. In China, there were no large nationwide logistic companies during the early development of the river port system. Most logistic companies operated their business inside their province. In comparison, German (and to a lesser extent Swiss) logistics companies were among the pioneers in developing a European and later global reach. Some of these logistics companies (such as Rhenus) soon increased their grip on the inland terminal market by acquiring terminals from barge operators and smaller local independent operators. Another major difference between both river systems relates to the involvement of publicly owned investment companies, port infrastructure investment companies and (industrial) conglomerates. These categories have played a key role in shaping the inland terminal landscape on the Yangtze, while they are absent on the Rhine.

Despite the above clear differences between the two river basins, there is also some level of similarity. In both cases, domestic actors dominate the inland terminal landscape with 88% of all entries on the Rhine and 92% of all entries on the Yangtze (see Tables 2 and 3). This observation implies that river systems are not very prone to an internationalisation in ownership. We believe international players might be more reluctant to consider entering a foreign inland terminal as this requires very specific market knowledge and experience in dealing with the local cargo base and customers. Furthermore, specific institutional factors such as rules and regulation might prevent foreign companies of acquiring domestic terminal facilities. Another similarity relates to the absence of deepsea (landlord) port authority in inland ports. In China, port interests are guaranteed by the terminal operating divisions of the managing bodies of the ports (e.g. SIPG). The situation in Europe confirms the earlier discussion in section 3.1.

4.2 Where and when: spatial and temporal dimensions of terminal entry

4.2.1. Situation for the Rhine

The first inland terminals on the Rhine emerged in the early 1970s to facilitate container transport by barge between large industrial centers in Germany, France and Switzerland

and the large seaports of Antwerp and Rotterdam. The middle section of the Rhine was the first to adopt containerization in the early 1970s with the development of container terminals as barge operators took the view that barge container transport on the Rhine could only effectively compete with road transport over distances of at least 500km (distance between gateway port and inland port), given the comparatively high fixed costs and low variable costs of barges. (Van Driel, 1993; Notteboom and Konings, 2004). Also, the Middle Rhine at that time was the only river stretch generating enough container volume to allow the development of frequent barge services to gateway ports Antwerp and Rotterdam. In the second half of the 1980s, the lower Rhine area generated more and more containerised trade flows which enabled the deployment of larger vessels and higher service frequencies. As a result, the lower Rhine, and particularly the port of Duisburg, started to develop inland terminals as well. This brought a surge in large-scale terminal initiatives and scheduled barge services from 1985 onwards (Figure 2). The upper Rhine section has always been the smallest in volume terms, with its containerised cargo share fluctuating between 10 and 16% of total Rhine volume. The rapid increase in the number of terminals continued until the end of 1990s. Since the early 2000s, almost no new terminals have been built. The total number of terminals levelled off at 37 handling a total throughput of about 2.4 million TEU in 2018. As new terminal development has become scarce since the new millennium, market players mainly focus on acquiring existing facilities to strengthen their position in the inland terminal market. As mentioned earlier, the take-over of Rhenania by Wincanton in 2003, the merger between CCS and Interfeeder in 2008 to form Contargo and the take-over of 6 terminals of Wincanton by Contargo in 2012 are the main multiple-site acquisitions in the history of the Rhine (Figure 2).

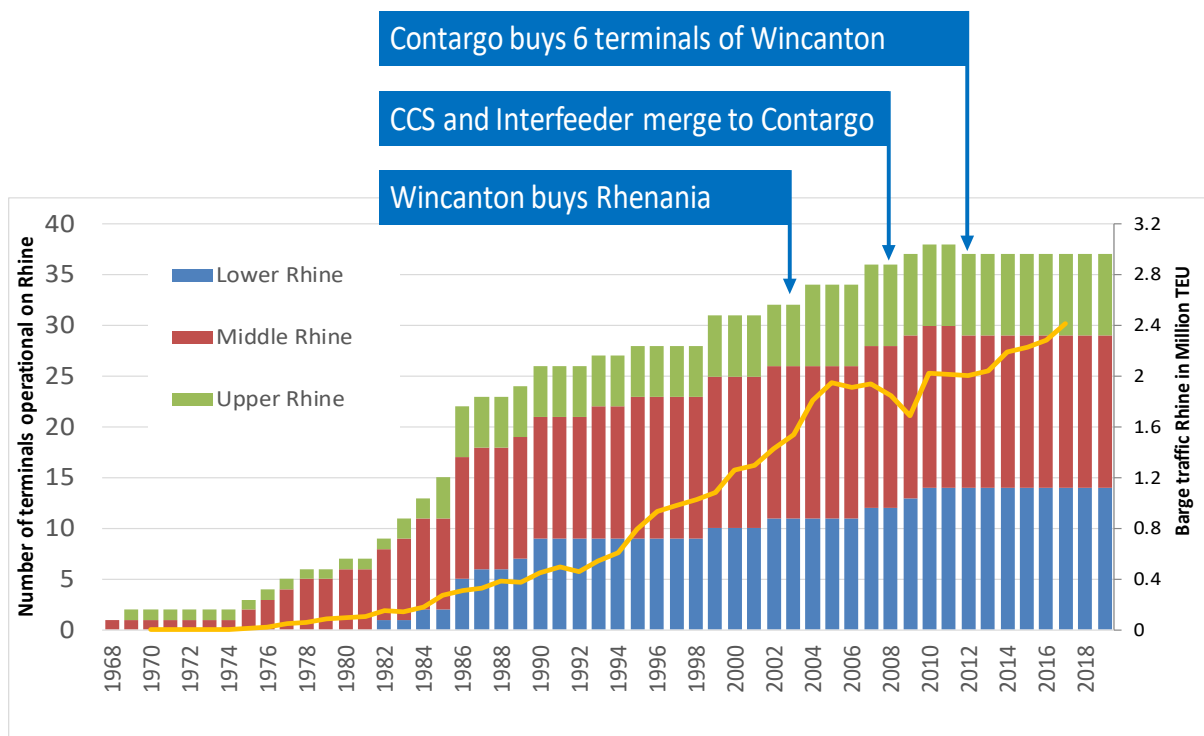


Figure 2 Number of terminals, total barge traffic and major port entries on the Rhine river

Note: The bars refer to the number of terminals operational on the Rhine (left axis) while the line presents the evolution of total barge traffic on the Rhine in million TEU.

The decline in the number of terminals in 2012 was caused by the closure of the Karlsruhe terminal right after this terminal was acquired by Contargo (one of the six Wincanton terminals acquired in 2012). The activities were moved to the nearby terminal of Gustavsburg which was already in operation.

At the same time, some deepsea terminal operators started to enter the market such as DP World with a small terminal network on the Middle Rhine and Hong-Kong based Hutchison Ports with one of the terminals in Duisburg. The upper Rhine section is mainly controlled by independent operators such as Swissterminal AG, an independent family-owned logistics company and terminal operator based in Switzerland, Am Zhenoff Söns and Rhine Europe Terminals, the fully-owned terminal division of the Port Autonome de Strasbourg, controlled by the city of Strasbourg.

Figure 3 shows the current port investment location map along the Rhine River while Table 4 already provided more details on the type of operator per navigation area. As mentioned before, Contargo (Rhenus) owns terminals along the entire Rhine river, from Emmerich at

the lower Rhine to Basel at the upper Rhine. Neska's network is concentrated on the lower Rhine.

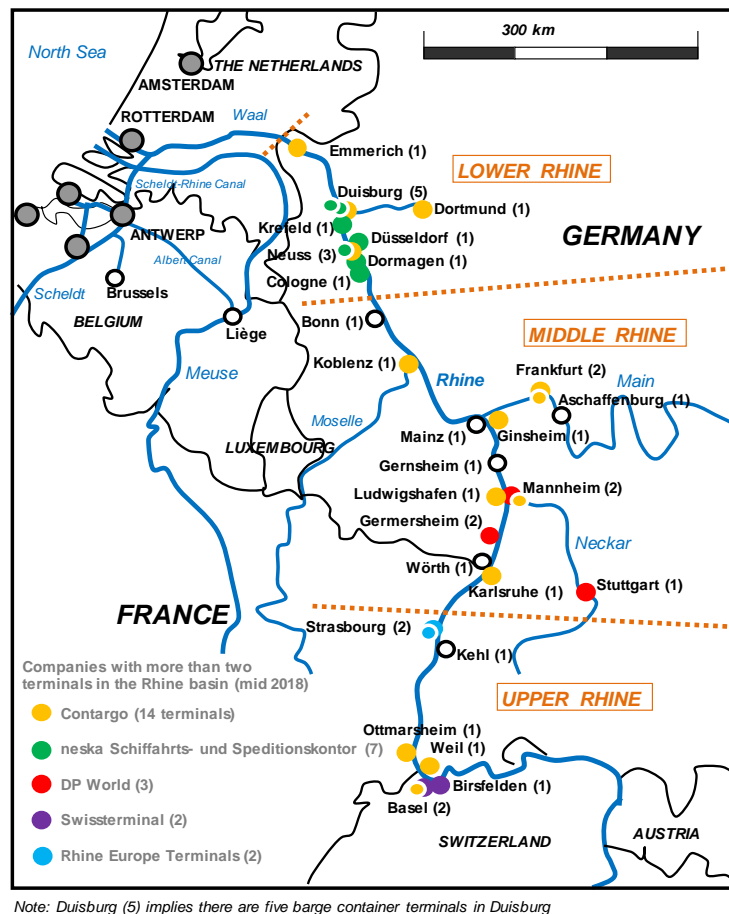


Figure 3 Ownership of terminals along the Rhine River

4.2.2. Situation for the Yangtze

The timeline and spatial direction of inland terminal development on the Yangtze is quite different. Figure 4 shows terminal investments and entries along the Yangtze River from the 1990s to 2010s. Chinese inland ports came into a high-speed development period in the middle of 2000s when most entries happened, first on the lower Yangtze but soon also moving to the middle and upper Yangtze sections. China has implemented two port reforms in 1984 and 2004, aiming to give more power to local governments to manage ports, through promoting the marketization of the ports. Yang et al. (2017) found that the reform of port governance in China has lasting positive effects on port throughput. The first reform changed the centralized management mode to semi-decentralized. The second reform, which is

consequence of China's accession to WTO, untied the port through enabling them to be fully self-administrated. The second reform significantly helped the Chinese ports to attract investment and the number of ports has achieved rapid growth since then (Yang et al., 2017). The global financial crisis in 2008-2009 did not hit the port industry of China in a significant way. Instead, with 4 trillion RMB investment in infrastructure as economic incentive plan, the growth of Yangtze River ports continued until 2016 when port overcapacity emerged and the waste of resources became a serious issue (Chen et al., 2020). The national council issued the "The National Plan for the Yangtze River Economic Belt Development" in the same year, encouraging the integration of resources of Inland Waterway Transportation (IWT) into a holistically economic and environmental governance.

Along with China's entry into WTO and port reform, seaport operator Shanghai International Port Group (SIPG) initiated an inland port development strategy. Most of the transshipment cargo of SIPG is from/to inland ports along Yangtze River. SIPG started its Yangtze River port integration strategy as early as 2005 when SIPG invested in terminals at Nanjing and Wuhan. Nanjing and Wuhan are capital cities in two of the most developed provinces, i.e. Jiangsu and Hubei. They are the most important river hub ports at the middle and lower Yangtze River with the largest port throughput at their segments respectively. In 2014, SIPG further invested in Chongqing, which is the largest port in the upper Yangtze River. At the same year, it also invested in medium-sized and small ports like Taicang, Wuhu and Yueyang at the lower, middle and upper reaches of the Yangtze respectively.

After the "The National Plan for the Yangtze River Economic Belt Development" was issued in 2016, the local government responded to it quickly. Chongqing port group in 2017 and Jiangsu port group and Wuhan port group in 2018 integrated (invested) ports in their administrative region in succession with the help of the state or locally owned investment companies.

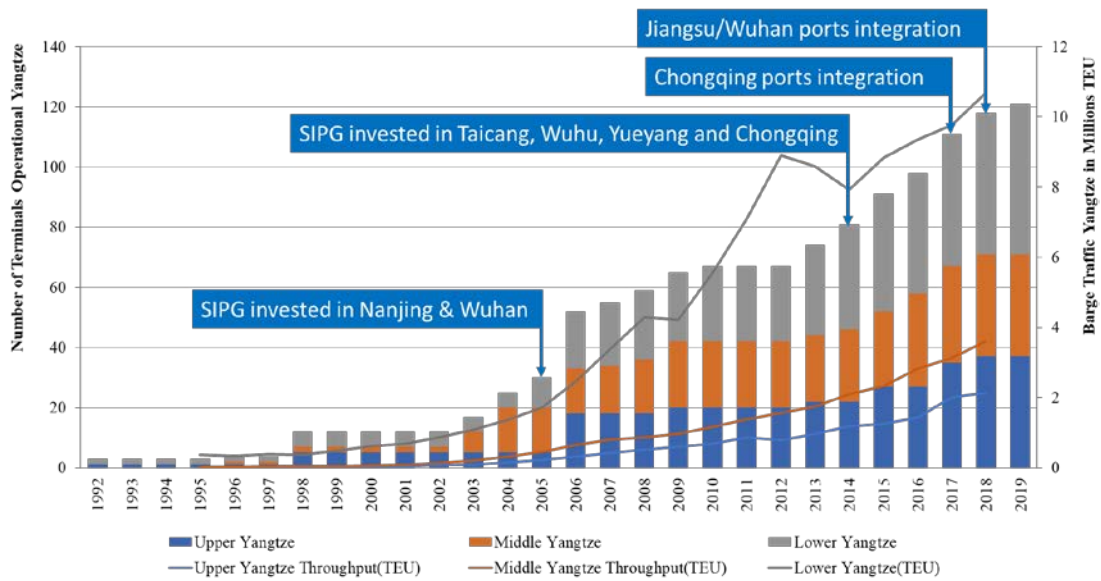


Figure 4 Number of terminals, total barge traffic and major port entries on the Yangtze river

Appendix 2 shows the time of entries at different reaches of the Yangtze River. A sudden increase of entries occurred during the 2002-2006 period along the entire Yangtze River basin, shortly after China joined the WTO and the second port reform was implemented. There was also an increasing number of entries at the upper Yangtze River from 2012 to 2019. During this period, a transfer of manufacturing activities from East China to West China happened due to the increase of labour cost in the East against the background of the “Go West” strategy initiated by the nation. As a result, the terminals at the upper Yangtze needed to be developed urgently, eventually resulting in an increase of terminals from 2 to 11. Among the 11 entries, two entries were made by local port operators and one by a stevedoring company, one by the Chongqing Transportation Commission in 2013 and five by China development Fund Co., Ltd in 2015. SIPG was involved in one entry. It is not difficult to see government played an important role in the observed increase in the number of inland container facilities. From 2017 to 2019, 5 out of a total of 9 entries were associated with Chongqing Transportation Commission in the context of the port integration policy.

Many entries are also found at the lower Yangtze River during the 2012-2019 period. Since 2013, SIPG has invested in some ports close to Shanghai, to build them into inland river transshipment hubs for the Yangshan port complex. This development was supported by the launch of container shuttle services between these ports, e.g., between Taicang and Yangshan. Taicang port witnessed four entries during this period: SIPG in 2014, Suzhou port Co., Ltd. and two entries by the Taicang port investment group in 2013. From 2017, the port integration at Jiangsu Province kicked off. Jiangsu port group made a total of four entries at Suzhou, Nanjing, Zhenjiang and Changzhou in its administrative area. The continuous increase of port entry at the lower Yangtze River attributed to the rapid development of ports close to the sea at the mouth of the Yangtze River. Deep-sea container vessels which are not allowed to go deeper into the Yangtze river can tranship their containers from the ports at the mouth of the Yangtze River to deepsea ports. For example, Nantong attracted three entries in 2017, i.e. one by local port corporation Nantong Port Group Co., Ltd., and the other two by COSCO Shipping Port (Nantong) Co., Ltd.

Figure 5 presents the current ownership of inland terminals on the Yangtze River. Several actors own multiple terminals along the Yangtze River. Among them, SIPG is the only investor who owns terminals along the entire Yangtze River. Its objective to maintain a strong position along the Yangtze River is supported the priority it receives through national strategy. Another seaport operator COSCO Shipping Ports also has multiple terminals along the Yangtze River, but all them are located at the lower Yangtze functioning as extended gates. Instead, COSCO Shipping, an international shipping line, invested in terminals at the middle and upper Yangtze but has no terminal involvement at the lower Yangtze. It aims to attract international cargo from the deep hinterland. The cases of Chongqing Port Group, Wuhan Port Group and Jiangsu Port Group are similar to neska and RET on the Rhine: they own multiple terminals in a specific section of the river.

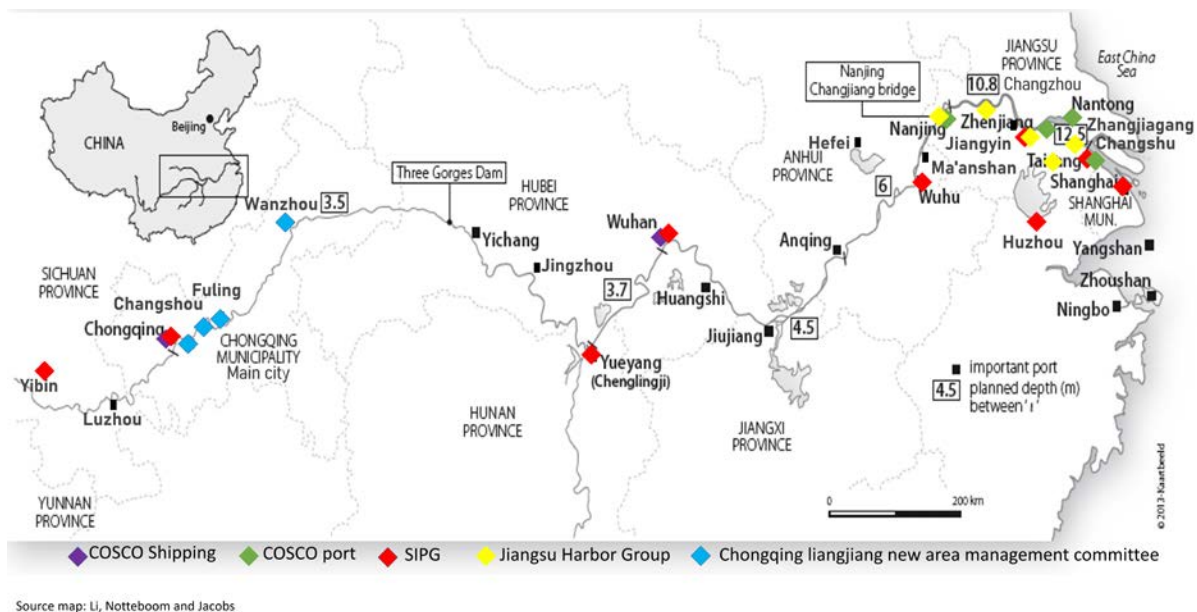


Figure 5 Ownerships of port/terminal along Yangtze River

4.2.3. Where and when: comparison between Rhine and Yangtze

Overall, in both Rhine and Yangtze, there are very few operators who invested in ports along the entire river. The notable exceptions, i.e. Contargo and SIPG, are different types of operators driven by different objectives. Contargo serves the interests of the logistics network of mother company Rhenus and has a strong hinterland-based orientation. SIPG is a seaport operator which has extended its reach to river terminals to offer integrated port-hinterland solutions and to bind hinterland cargo to Shanghai port (see also Table 1 on the drivers for inland terminal involvement).

In general terms, the sequence of port development along the Yangtze River has followed a downstream to upstream direction which might explain why seaport-related and maritime actors have a stronger presence. In contrast, inland terminal development on the Rhine started on the middle reach and only later expanded to the lower and upper reaches with mainly local or regional German, Swiss and French hinterland-based actors leading the way. Using the terminology of Wilmsmeier et al. (2011) and Monios and Wilmsmeier (2012b) on the actor driving terminal development, we can conclude that inland terminal development on the Rhine is mainly “land-driven” following an inside-out approach, while the Yangtze river witnessed a stronger “sea-driven” terminal development path following an outside-in approach.

Another major difference in the time-space development of the two river systems lies in the guidance and direction embodied by national development plans, policy and regulation, e.g., national financial incentives, port reform, port integration plans, etc. Major entries in the Yangtze have been motivated by national policy and initiatives, such as port reform and port integration plans. The majority of terminal operators on the Yangtze are state-run companies, which further facilitates the practical implementation of policies designed by government entities at various geographical scales (central, provincial, local). While the expansion of SIPG was somewhat more spontaneous, the operator has also benefited from wider policies [as discussed earlier in section 4.2.2](#). In Europe, the Rhine countries advocate free market dynamics in inland port development characterized by little government guidance and intervention (Notteboom et al., 2020). The absence of master plans or overall government strategies on where to develop inland ports and which actors to mobilize has resulted in a relatively high number of small inland ports on the Rhine. Private companies and local government agencies and inland port authorities shape terminal development along the Rhine on a rather independent basis.

4.3 Which way: Entry mode

4.3.1. Situation for the Yangtze

Table 5, which follows a table structure similar to Table 4 (Rhine case), summarizes the entry mode of different investors in the Yangtze River. Among all the entries, single entry accounts for 45.1% and two companies' joint entry accounts for 39.2%. These two types of entry represent the majority of entries (84.3%) along the Yangtze River. The formula in inland ports involving more than three investors represents 15.7%.

Independent inland terminal operators, public-owned investment companies and local, region/provincial or national governments are the three types of operators who made the most single entries at different reaches of the Yangtze River. Independent inland terminal operators have more single entries at the lower Yangtze, the publicly owned investment companies invested at the middle and lower Yangtze, and local, region/provincial or national governments made all their entries at the upper Yangtze River. We also notice that (industrial) conglomerates actively invested in ports at the lower Yangtze River. This implies the lower Yangtze River is more market-oriented, while inland port development

at the middle and in particular at the upper Yangtze involves more government intervention.

Table 5 Terminal Ownership structure on the Yangtze River

Type operator	Code	Total No. Share		Lower Yangtze Share Comment		Middle Yangtze Share Comment		Upper Yangtze Share Comment	
Independent inland terminal operator	IITO	5	9.8%	3 ^a	15.0%	2	13.3%	-	
Public-owned investment company	PIC	5	9.8%	3 ^b	15.0%	2	13.3%	-	
International (deepsea) terminal operator	ITO	-		-		-		-	
Port infrastructure investment companies and real estate companies	PIICREC	2	3.9%	1	5.0%	-		1	6.3%
(Industrial) conglomerate	CON	3	5.9%	1	5.0%	-		2	12.5%
Third-party logistics company	TLC	2	3.9%	1	5.0%	-		1	6.3%
Local, region/provincial or national government	LRONG	5	9.8%	-		-		5 ^c	31.3%
Banks, insurance companies & PE funds	BIC&PEF	-		-		-		-	
Inland shipping line/barge operator	ISIO	1	2.0%	-		-		1	6.3%
Inland port corporation, public inland port authority or terminal/logistics	IPC	-		-		-		-	
Deepsea shipping line	DSL	-		-		-		-	
Deepsea (landlord) port authority	DPA	-		-		-		-	
Railway company or intermodal operator (rail/truck)	RCIO	-		-		-		-	
Container lease, repair, production or sale company	CLRPSC	-		-		-		-	
Single entry sum		23	45.1%	9	45.0%	4	26.6%	10	62.5%
Combinations									
2 combination (CON+ISIO, IITO+CON, IITO+IPC, IITO+ITO, IITO+PIICREC, IITO+TLC, ITO+IPC, ITO+LRONG, ITO+PIICREC, ITO+TLC, PIC+ITO, PIC+LRONG, PIC+PIICREC, PIC+TLC)		20	39.2%	7	35.0%	8	53.3%	5	31.3%
3 combination (IITO+ITO+CON, IITO+ITO+TLC, IITO+PIC+PIICREC)		3	5.9%	2	10.0%	1	6.7%	-	
4 combination (IITO+CON+BIC&PEF+DSL, IITO+PIC+ITO+PIICREC, IITO+ITO+PIICREC+CON)		3	5.9%	2	10.0%	1	6.7%	-	
5 combination (IITO+ITO+TLC+ISIO+DSL, PIC+ITO+CON+LRONG+BIC&PEF)		2	3.9%	-		1	6.7%	1	6.3%
Total number of terminals		51	100%	20	100%	15	100%	16	100%
SIPG		8		3		3		2	
COSCO port		4		4		-		-	
COSCO shipping		2		1		1		-	
Wuhan Harbor Affairs Group Co., Ltd.		4		-		4		-	
Chongqing liangjing new area management committee		5		-		-		5	

As for two parties' joint entry, most of the combinations include one terminal operator (independent inland terminal operator, international terminal operator) or public-owned investment company and one outside investor, e.g., third-party logistics company, shipping lines, port infrastructure investment companies and real estate companies and so on. The port operator seeks for cooperation with outsider player in order to utilize the resource of his partner. For example, attract line service to the port from shipping lines, attract cargo from logistics company and conglomerate or attract capital and management experiences from international port operator.

We also look at the control degree of some major investors. Among all the eight terminals SIPG directly invested in, their shares are all less than 50%, ranging from 30% to 45% in six cases and less than 5% in two cases (i.e. Chongqing and Wuhan). In contrast, COSCO Shipping Port has four investments, in three of which, they have more than 50% of the shares. Both Chongqing and Wuhan also own the majority of shares on their invested terminals. This implies the local port operators or collaborators of SIPG don't want to lose their control, otherwise they can only tranship their cargo through Shanghai. In the upper Yangtze River, government or public-owned investment companies made the majorities of investments, accounting for 16 entries out of 20 since 2013. The upper Yangtze can only accommodate ships with a maximum capacity of 350 TEU thus traffic volumes are lower. The port operators invest in ports with the government with the aim of procuring government support in their business.

4.3.2. Situation for the Rhine

On the Rhine, full ownership remains the general rule. Only 7 out of a total of 37 terminals currently have multiple owners. In most of these cases local inland port operators (PIPA) use joint ventures or majority/minority shareholding to team up with private companies active in various parts of the supply chains. These arrangements can primarily be found on the lower section of the Rhine (see earlier Table 4). When taking a historical perspective, we observe that 71 of the 89 entries on the Rhine involved full acquisitions whereby the full ownership of the terminal was transferred to another party. As mentioned earlier, some of these acquisitions involved multiple Rhine terminals (e.g. the take-over of six terminals of Wincanton by Contargo). Eight transactions involved partially-owned subsidiaries, while in seven of the 89 entries companies acquired a minority stake in the

terminal. Pure 50/50 joint ventures are far less common with only three cases throughout the containerisation history of the Rhine.

5. Conclusions

This paper analyzed the entry strategies of inland terminal operators on the Rhine and Yangtze river by focusing on five questions: ‘who’, ‘why’, ‘when’, ‘where’ and ‘which way’. The findings point to differences but also similarities between the two river basins.

First, there is a clear difference in the type of operators active in the river basins. Logistics companies, Contargo in particular, dominates the Rhine scene while international port operators such as like SIPG have a much stronger presence on the Yangtze. Contargo and SIPG are the only actors with a terminal portfolio spanning the entire river. However, Contargo based its investment strategy on a strong inland logistics orientation, whereas SIPG’s investment program emerged out of a desire to offer integrated port-hinterland solutions to strengthen the position of Shanghai port.

Second and related to the above, there is a clear difference in the sequence of inland port development on the two rivers. The Yangtze River has followed a downstream to upstream direction which might explain why seaport-based and maritime actors have a stronger presence. In contrast, inland terminal development on the Rhine started on the middle reach and only later expanded to the lower and upper reaches with mainly local or regional German, Swiss and French hinterland-based actors leading the way.

Third, publicly owned investment companies and port infrastructure investment companies played a key role in shaping the inland terminal landscape on the Yangtze, while they are absent on the Rhine. Most terminal operators on the Yangtze are state-run companies, which facilitates the practical implementation of policies designed by government entities at various geographical scales (central, provincial, local). Shipping lines and global port operators prefer to invest in inland ports at strategic locations, like ports located at the border between two segments of an inland river (i.e. upper, middle or lower navigation areas) and the related changes in nautical accessibility of the respective rivers. In contrast, inland terminal development on the Rhine is characterized by little government guidance and intervention. Most inland terminals along the Rhine are owned and operated by private logistics companies which typically own more than one river terminal and control the

barge companies that serve the terminals. A limited number of inland terminals are controlled by deepsea terminal operators (such as Hutchison Ports and DP World) or local public entities. As a result, there is little or no co-ordination between private companies, local government agencies and inland port authorities active in different inland terminals, resulting in more *ad hoc* developments and, on average, smaller terminals. In general, the inland port development pattern in the Yangtze River is coordinated (policy-driven coordination between port investors) and dispersive (port location) while that of Rhine River is separated (lack of coordination) and junction-oriented (port location).

The above differences are strongly entwined with institutional and governance factors and the nature of shipping network development on the respective rivers. Li et al. (2014) ascertained that the development of inland water transportation, as part of a socio-economic system, is significantly influenced by related government policies and institutional frameworks. Our findings reveal it is also a determinant of inland port investment and the entry strategies adopted by relevant actors. The institutional environment on the Rhine is characterized by the behaviour of private agents in an environment guided by the market mechanism. These private agents grasp emerging windows of opportunities through full acquisitions or majority/minority shareholdings in inland terminals. **In contrast, the institutional and governance context of the Yangtze River is much more guided by the behaviour of state/public agents.** The government exerts strong influence on the entry patterns in the inland terminal market through master plans (such as the 5-year national development plans), investment strategies of state-run enterprises such as SIPG, and periodic intervention through national policies such as the port deregulation process in the period 1998-2002 (government replaced by companies in operating ports) and port integration (mainly intra-provincial) in the 2010s. As for Chinese ports, foreign capital control was forbidden until 2002, when the second port reform was implemented. Moreover, the entry strategy of some port operators may be limited to only one port at a certain geographic location (e.g. a local operator operating a terminal close to a regional hub port).

Despite the observed differences between the two river basins, there is also some level of similarity. First, both rivers share a very low presence of international players. We believe this is the combined result of market-related and institutional entry barriers. The successful operation of an inland terminal requires specific market knowledge in dealing with the local cargo base. Moreover, specific institutional factors such as rules and regulation might prevent

foreign companies of acquiring domestic terminal facilities. Second, deepsea (landlord) port authorities are absent in the analysed inland ports. In China, terminal operating divisions of the managing bodies of the ports (e.g. SIPG) roll out hinterland strategies. Empirical evidence in Europe demonstrates that hinterland strategies of landlord port authorities hardly ever include investments in inland ports. Despite the call in extant literature for a greater involvement of port authorities in promoting collective action in ensuring hinterland access (see De Langen, 2008; van den Berg et al., 2012; Notteboom and Rodrigue, 2015), port authorities do not consider actual ownership of inland terminals as part of such strategies. The reluctance of port authorities to invest in inland terminals can mainly be attributed to the fear of distorting the market mechanism (i.e. loss of the PA's 'neutral' position in the hinterland) and the knowledge that investments in inland terminals do not imply that the flows handled in these platforms will pass through the seaport (i.e. no guarantee of cargo binding potential). Third, the Yangtze and Rhine rivers have both witnessed waves of single acquisition, multiple-site acquisition, and capital entry in their ports/terminals. In some cases, the actors were driven by a vertical integration along the supply chain. For example, a logistics company stretching its door-to-door offer by also owning barging and inland terminal activities or a deepsea terminal operator reaching out to the hinterland by developing inland terminals as extended gates of their deepsea container terminals. In other cases, local public or private actors invested in inland terminals to strengthen their local competitive position or to support the trade potential of the local/regional economy.

This is the first study analyzing the specific entry strategies of terminal operators along inland port systems. We believe the findings enrich extant literature on entry strategies in terminals such as deepsea container terminals and cruise terminals. While deepsea container terminal ownership is dominated by pure stevedoring companies, carrier-related terminal operators, financial holdings and complex partnerships between these actors (Notteboom and Rodrigue, 2012; Parola et al., 2013), this paper demonstrates that the inland terminal landscape on the Rhine and Yangtze shows a much richer pallet and spatial diversity in terms of owner profiles and their motivations behind inland terminal ownership. The inland terminal market is also very different from the cruise terminal business where real estate and infrastructure managers, shipping agency, travel operators, and banks, insurance companies and PE Funds are involved in the ownership of cruise terminals, next to more pure cruise terminal operators and cruise lines (Pallis et al., 2018). Different terminals thus attract a different array of owners, each with

their own drivers and motivations for terminal involvement. The inland port market is characterized by the strong presence of some specific ownership groups such as logistics service providers, transport operators, inland port authorities and government agencies at different administrative levels.

More importantly, this research complements existing literature on the governance, management and spatial development of inland ports, inland river system development and literature on the strategic behavior of public and private actors in terms of investments in and the control of key assets in transport systems. The study of the entry behavior is relevant as actors involved in inland terminals can have a major influence on the role and development trajectory of an inland port and the structuring of its interdependencies with gateway seaports (see e.g. the inside-out vs. outside-in discussion). There is room in inland port/dry port literature to more explicitly consider spatiotemporal aspects of terminal ownership and the strategic considerations of and institutional drivers and impediments to the inland terminal strategies of the corresponding actors when analyzing development paths and nodal interactions. This paper thus presents an inland terminal oriented response to the call in Slack (2007) for developing a stronger focus on the ‘terminal’ as a relevant unit of analysis and the observed shift in attention in inland port research to governance and management of inland ports (Witte et al., 2020).

This research is quite unique in its empirical scope given the large number of inland terminals included as well as its comparative analysis covering two major inland port systems located in two different continents. The findings contribute to a better understanding of the drivers and contextual environment guiding entry strategies in inland ports and the similarities and differences in entry strategies between the Yangtze and the Rhine river, the world’s most important river systems in cargo volume terms.

Due to limited data availability, it is difficult to measure the performance of inland port development patterns on the Yangtze and Rhine rivers. In case more facts regarding port system and inland terminal performance would become available in the future, further research could be developed to examine the advantages of certain port system developments and corresponding ownership strategies. Future studies can also focus on the evaluation of different entry strategies and the efficiency of development patterns of the two rivers using quantitative measurements.

Appendix 1. Terminal ownership on the Rhine per owner type and terminal size, 2018

Container traffic in entire port in 1000 TEU (barge only)

Type operator	0-10	10-20	20-50	50-100	100-200	200-500	>500	Total
Independent inland terminal operator		2			2			4
International (deepsea) terminal operator					2		1	3
Inland port corporation, public inland port authority or terminal/logistics subsidiary thereof	1	1	1		3		2	8
Third-party logistics company			6	3	5			14
Inland shipping line / barge operator					1			1
Combinations			1	2	1	0	3	7

Appendix 2 Time of entries in inland ports along the Yangtze River

Region	Sample entries	1992-1996	1997-2001	2002-2006	2007-2011	2012-2016	2017-2019
Upper Yangtze	38	1	2	13	2	11	9
Middle Yangtze	41	1	1	18	9	8	4
Lower Yangtze	42	2	4	8	4	14	10
Total	121	4	7	39	15	33	23

References

- Bask, A., Roso, V., Andersson, D., Hämäläinen, E., 2014. Development of seaport–dry port dyads: two cases from Northern Europe. *Journal of Transport Geography* 39, 85–95. <https://doi.org/10.1016/j.jtrangeo.2014.06.014>
- Bergqvist, R., Monios, J., 2019. Green Ports in Theory and Practice, in: *Green Ports*. Elsevier, pp. 1–17. <https://doi.org/10.1016/B978-0-12-814054-3.00001-3>
- CCNR, 2018. Market insight: inland navigation Europe. Central Commission for the Navigation of the Rhine (CCNR), Strasbourg April 2018.
- Chen, Y., Chao, Y., Yang, D., 2020. Port Recentralization as a Balance of Interest, *Research in Transportation Business & Management*, 34, 1-9
- China port year book, 2018. <https://data.cnki.net/trade/Yearbook/Single/N2018120384?z=Z014> (in Chinese).
- Cullinane, K., R. Bergqvist, and G. Wilmsmeier. 2012. The Dry Port Concept–Theory and Practice. *Maritime Economics & Logistics*, 14 (1), 1-13. doi:10.1057/mel.2011.14.
- De Langen, P.W. 2008. Ensuring hinterland access the role of port authorities. OECD, International Transport Forum, OECD/ITF Joint Transport Research Centre Discussion Papers.
- De Langen, P.W., Pallis, A.A., 2007. Entry barriers in seaports. *Maritime Policy & Management* 34, 427–440. <https://doi.org/10.1080/03088830701585134>
- De Langen, P.W., van der Lugt, L.M., 2017. Institutional reforms of port authorities in the Netherlands; the establishment of port development companies. *Research in Transportation Business & Management* 22, 108–113. <https://doi.org/10.1016/j.rtbm.2016.12.007>
- Destatis, 2018. Verkehr: Güterverkehrsstatistik der Binnenschifffahrt. Statistisches Bundesamt (Destatis), Berlin Fachserie 8 Reihe 4, May 2018.
- Dong, G., Zheng, S., Lee, P.T.-W., 2018. The effects of regional port integration: The case of Ningbo-Zhoushan Port. *Transportation Research Part E: Logistics and Transportation Review* 120, 1–15. <https://doi.org/10.1016/j.tre.2018.10.008>
- Driel, H. van, 1993. *Kooperation im Rhein-Containerverkehr: eine historische Analyse*. Binnenschifffahrts-Verl, Duisburg.
- European Barge Union, 2018. <http://www.ebu-uenf.org/>
- European Federation of Inland Ports, 2018. <http://www.inlandports.eu/news>.
- Flämig, H., Hesse, M., 2011. Placing dryports. Port regionalization as a planning challenge – The case of Hamburg, Germany, and the Süderelbe. *Research in Transportation Economics* 33, 42–50. <https://doi.org/10.1016/j.retrec.2011.08.005>
- Franc, P., Van der Horst, M., 2010. Understanding hinterland service integration by shipping lines and terminal operators: a theoretical and empirical analysis. *Journal of Transport Geography* 18, 557–566. <https://doi.org/10.1016/j.jtrangeo.2010.03.004>
- Frémont, A., 2009. Shipping Lines and Logistics. *Transport Reviews* 29, 537–554. <https://doi.org/10.1080/01441640802677607>
- Heaver, T.D., 2002. The Evolving Roles of Shipping Lines in International Logistics. *Marit Econ Logist* 4, 210–230. <https://doi.org/10.1057/palgrave.ijme.9100042>

- Information und Technik Nordrhein-Westfalen, 2017. <https://webshop.it.nrw.de/gratis/Z026%20201700.pdf>
- Inland Navigation Europe, 2018. <http://www.inlandnavigation.eu/home/>
- Jacobs, W., Notteboom, T., 2011. An Evolutionary Perspective on Regional Port Systems: The Role of Windows of Opportunity in Shaping Seaport Competition. *Environ Plan A* 43, 1674–1692. <https://doi.org/10.1068/a43417>
- Konings, R., 2006. Hub-and-Spoke Networks in Container-on-Barge Transport. *Transportation Research Record* 1963, 23–32. <https://doi.org/10.1177/0361198106196300104>
- Konings, R., Priemus, H., 2008. Terminals and the Competitiveness of Container Barge Transport. *Transportation Research Record* 2062, 39–49. <https://doi.org/10.3141/2062-06>
- Li, J.Y., Notteboom, T.E., Jacobs, W., 2014. China in transition: institutional change at work in inland waterway transport on the Yangtze River. *Journal of Transport Geography* 40, 17–28. <https://doi.org/10.1016/j.jtrangeo.2014.05.017>
- Li, J.Y., Notteboom, T.E., Wang, J.J., 2017. An institutional analysis of the evolution of inland waterway transport and inland ports on the Pearl River. *GeoJournal* 82, 867–886. <https://doi.org/10.1007/s10708-016-9696-0>
- Magnan, M., van der Horst, M., 2020. Involvement of port authorities in inland logistics markets: the cases of Rotterdam, Le Havre and Marseille. *Marit Econ Logist* 22, 102–123. <https://doi.org/10.1057/s41278-019-00140-8>
- Marasco, A., Romano, A., 2018. Inter-port interactions in the Le Havre-Hamburg range: A scenario analysis using a nonautonomous Lotka Volterra model. *Journal of Transport Geography* 69, 207–220. <https://doi.org/10.1016/j.jtrangeo.2018.04.018>
- Ministry of Transport of China, 2018. <http://data.stats.gov.cn/english>.
- Ministry of Transport of China, 2019. <http://www.mot.gov.cn/shuju> (in Chinese).
- Miraj, P., Berawi, M.A., Zagloel, T.Y., Sari, M. and Saroji, G., 2020. Research trend of dry port studies: a two-decade systematic review. *Maritime Policy & Management*, 1-20.
- Monios, J., Wilmsmeier, G., 2012a. Giving a direction to port regionalisation. *Transportation Research Part A: Policy and Practice* 46, 1551–1561. <https://doi.org/10.1016/j.tra.2012.07.008>
- Monios, J., Wilmsmeier, G., 2012b. Port-Centric Logistics, Dry Ports and Offshore Logistics Hubs: Strategies to Overcome Double Peripherality?, *Maritime Policy & Management*, 39 (2), 207–226. <https://doi.org/10.1080/03088839.2011.650720>
- National Bureau of Statistics of China, 2018. <http://www.stats.gov.cn/enGliSH/>
- Nguyen, L.C. and Notteboom, T., 2019. The relations between dry port characteristics and regional port-hinterland settings: findings for a global sample of dry ports. *Maritime Policy & Management*, 46(1), 24-42.
- Notteboom, T. and Rodrigue, J.P., 2009. Inland Terminals within North American and European Supply Chains. *Transport and Communications Bulletin for Asia and the Pacific*. United Nations, Economic and Social Commission for Asia and the Pacific 78, 51-57.
- Notteboom, T. and Rodrigue, J.P., 2012. The corporate geography of global container terminal operators. *Maritime Policy & Management*, 39(3), 249-279. <https://doi.org/10.1080/03088839.2012.671970>

- Notteboom, T., 2007. Container river services and gateway ports: Similarities between the Yangtze River and the Rhine River. *Asia Pac Viewpoint* 48, 330–343. <https://doi.org/10.1111/j.1467-8373.2007.00351.x>
- Notteboom, T., 2017. Maritime Gateways and Barge Connectivity: Container Barge Transport on the Rhine, in: Banken, R., Wubs, B. (Eds.), *The Rhine: A Transnational Economic History*. Nomos Verlagsgesellschaft mbH & Co. KG, pp. 311–334. <https://doi.org/10.5771/9783845284736-311>
- Notteboom, T., Konings, R., 2004. Network dynamics in container transport by barge. *Belgeo. Revue belge de géographie* 4, 461–478.
- Notteboom, T., Merckx, F., 2006. Freight Integration in Liner Shipping: A Strategy Serving Global Production Networks. *Growth and Change* 37, 550–569. <https://doi.org/10.1111/j.1468-2257.2006.00340.x>
- Notteboom, T., Yang, D., Xu, H., 2020. Container barge network development in inland rivers: A comparison between the Yangtze River and the Rhine River. *Transportation Research Part A: Policy and Practice* 132, 587–605. <https://doi.org/10.1016/j.tra.2019.10.014>
- Notteboom, T.E., 2001. Spatial and functional integration of container port systems and hinterland networks in Europe. ECMT report Land Access to Sea Ports, Report no. 113, European Conference of Ministers of Transport, Paris.
- Notteboom, T.E., 2004. Container Shipping and Ports: An Overview. *Review of Network Economics* 3. <https://doi.org/10.2202/1446-9022.1045>
- Notteboom, T., Parola, F., Satta, G. and Risitano, M., 2017. A taxonomy of logistics centres: overcoming conceptual ambiguity. *Transport reviews*, 37(3), 276-299.
- Notteboom, T.E., Rodrigue, J.P., 2005. Port regionalization: towards a new phase in port development. *Maritime Policy & Management* 32, 297–313. <https://doi.org/10.1080/03088830500139885>
- Notteboom, T., and J.-P. Rodrigue. 2009. Inland Terminals within North American and European Supply Chains. In: United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), *Transport and Communications Bulletin for Asia and the Pacific*, 78, 1–39.
- Notteboom, T.E., Winkelmanns, W., 2001. Structural changes in logistics: how will port authorities face the challenge? *Maritime Policy & Management* 28, 71–89. <https://doi.org/10.1080/03088830119197>
- Olivier, D., 2005. Private Entry and Emerging Partnerships in Container Terminal Operations: Evidence from Asia. *Marit Econ Logist* 7, 87–115. <https://doi.org/10.1057/palgrave.mel.9100131>
- Olivier, D., Parola, F., Slack, B., Wang, J.J., 2007. The Time Scale of Internationalisation: The Case of the Container Port Industry. *Marit Econ Logist* 9, 1–34. <https://doi.org/10.1057/palgrave.mel.9100169>
- Pallis, A.A., Parola, F., Satta, G., Notteboom, T.E., 2018. Private entry in cruise terminal operations in the Mediterranean Sea. *Marit Econ Logist* 20, 1–28. <https://doi.org/10.1057/s41278-017-0091-7>

- Panayides, P.M., Parola, F., Lam, J.S.L., 2015. The effect of institutional factors on public-private partnership success in ports. *Transportation Research Part A: Policy and Practice* 71, 110–127. <https://doi.org/10.1016/j.tra.2014.11.006>
- Parola, F., Notteboom, T., Satta, G., Rodrigue, J.-P., 2013. Analysis of factors underlying foreign entry strategies of terminal operators in container ports. *Journal of Transport Geography* 33, 72–84. <https://doi.org/10.1016/j.jtrangeo.2013.09.010>
- Parola, F., Notteboom, T., Satta, G., Rodrigue, J.P., 2015. The impact of multiple-site acquisitions on corporate growth patterns of international terminal operators. *IJSTL* 7, 621. <https://doi.org/10.1504/IJSTL.2015.072018>
- Parola, F., Pallis, A.A., Risitano, M., Ferretti, M., 2018. Marketing strategies of Port Authorities: A multi-dimensional theorisation. *Transportation Research Part A: Policy and Practice* 111, 199–212. <https://doi.org/10.1016/j.tra.2018.03.012>
- Rimmer, P.J., Comtois, C., 2009. China's container-related dynamics, 1990–2005. *GeoJournal* 74, 35–50. <https://doi.org/10.1007/s10708-008-9213-1>
- Rodrigue, J.P., Debie, J., Fremont, A., & Gouvernal, E. 2010. Functions and actors of inland ports: European and North American dynamics. *Journal of Transport Geography*. 18(4), 519-529. <https://doi.org/10.1016/j.trangeo.2010.03.008>
- Rodrigue, J.-P., Notteboom, T., 2009. The terminalization of supply chains: reassessing the role of terminals in port/hinterland logistical relationships. *Maritime Policy & Management* 36, 165–183. <https://doi.org/10.1080/03088830902861086>
- Roso, V. and Lumsden, K., 2010. A review of dry ports. *Maritime Economics & Logistics*, 12(2), 196-213.
- Roso, V., Woxenius, J. and Lumsden, K., 2009. The dry port concept: connecting container seaports with the hinterland. *Journal of Transport Geography*, 17(5), 338-345.
- Satta, G., Persico, L., 2015. Entry mode choices of rapidly internationalizing terminal operators: The determinants of the degree of control on foreign ventures. *Marit Econ Logist* 17, 97–126. <https://doi.org/10.1057/mel.2014.32>
- Slack, B. (2007). The terminalisation of seaports. In *International Workshop on Ports, Cities and Global Supply Chains (2005: Hong Kong, China)*.
- Upper Rhine Ports, 2018. <http://www.upper-rhine-ports.eu/fr/actualites/upper-rhine-ports.html>.
- Van Driel, H., 1993. *Kooperation im Rhein-Containerverkehr: eine historische Analyse*, Binnenschiffahrts-verlag GmbH, Duisburg.
- van den Berg, R., de Langen, P.W., 2015. Assessing the intermodal value proposition of shipping lines: Attitudes of shippers and forwarders. *Marit Econ Logist* 17, 32–51. <https://doi.org/10.1057/mel.2014.11>
- van den Berg, R., de Langen, P.W. and 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.

- van der Lugt, L., Dooms, M., Parola, F., 2013. Strategy making by hybrid organizations: The case of the port authority. *Research in Transportation Business & Management* 8, 103–113. <https://doi.org/10.1016/j.rtbm.2013.06.005>
- Veenstra, A., Notteboom, T., 2011. The development of the Yangtze River container port system. *Journal of Transport Geography* 19, 772–781. <https://doi.org/10.1016/j.jtrangeo.2010.09.006>
- Veenstra, A., Zuidwijk, R. and Van Asperen, E., 2012. The extended gate concept for container terminals: Expanding the notion of dry ports. *Maritime Economics & Logistics*, 14(1), 14-32.
- Vejvar, M., Lai, K., Lo, C.K.Y., Fürst, E.W.M., 2018. Strategic responses to institutional forces pressuring sustainability practice adoption: Case-based evidence from inland port operations. *Transportation Research Part D: Transport and Environment* 61, 274–288. <https://doi.org/10.1016/j.trd.2017.08.014>
- Verein für europäische Binnenschifffahrt und Wasserstraßen, 2018. <https://www.vbw-ev.de/de/>
- Verhoeven, P., 2010. A review of port authority functions: towards a renaissance? *Maritime Policy & Management* 37, 247–270. <https://doi.org/10.1080/03088831003700645>
- Wang, C., Ducruet, C., 2012. New port development and global city making: emergence of the Shanghai–Yangshan multilayered gateway hub. *Journal of Transport Geography* 25, 58–69. <https://doi.org/10.1016/j.jtrangeo.2012.07.008>
- Wang, G.W.Y., Pallis, A.A., 2014. Incentive approaches to overcome moral hazard in port concession agreements. *Transportation Research Part E: Logistics and Transportation Review* 67, 162–174. <https://doi.org/10.1016/j.tre.2014.04.008>
- Wang, L., Zheng, Y., Ducruet, C., Zhang, F., 2019. Investment Strategy of Chinese Terminal Operators along the “21st-Century Maritime Silk Road.” *Sustainability* 11, 2066. <https://doi.org/10.3390/su11072066>
- Wiegmans, B., Witte, P., Spit, T., 2015. Characteristics of European inland ports: a statistical analysis of inland waterway port development in Dutch municipalities. *Transp. Res. A Policy Pract.* 78, 566–577.
- Wilmsmeier, G., Monios, J., Lambert, B., 2011. The directional development of intermodal freight corridors in relation to inland terminals. *Journal of Transport Geography* 19, 1379–1386. <https://doi.org/10.1016/j.jtrangeo.2011.07.010>
- Wilmsmeier, G., Monios, J. and Rodrigue, J.P., 2015. Drivers for Outside-In port hinterland integration in Latin America: the case of Veracruz, Mexico. *Research in Transportation Business & Management*, 14, 34-43.
- Witte, P., Wiegmans, B. and Ng, A.K., 2019. A critical review on the evolution and development of inland port research. *Journal of Transport Geography*, 74, 53-61.
- Yang, D., Wang, K.Y., Xu, H., Zhang, Z., 2017. Path to a multilayered transshipment port system: How the Yangtze River bulk port system has evolved. *Journal of Transport Geography* 64, 54–64. <https://doi.org/10.1016/j.jtrangeo.2017.08.011>
- Zheng, J., Yang, D., 2016. Hub-and-spoke network design for container shipping along the Yangtze River. *Journal of Transport Geography* 55, 51–57. <https://doi.org/10.1016/j.jtrangeo.2016.07.001>

