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Going West? Spatial Polarization of the North Korean Port System

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Abstract

This paper analyzes North Korean ports in light of existing models of port system evolution. It reviews the economic and political factors shaping port concentration in developed, developing, and socialist countries. A database on vessel movements allows for the analysis of individual North Korean port traffic by total capacity circulated, cargo type, fleet nationality, immediate origin and destination, and berthing time. While ideological factors and military control hamper port modernization and trade openness, traffic concentration at the Pyongyang-Nampo gateway highlights the spatial polarization in the capital region at the expense of Eastern ports for which inland transport limitations and industrial decline have become major issues. The North Korean case only partly fits general models because traffic concentration occurs due to geopolitical isolation and internal limitations rather than economic and trade growth.

Keywords: DPRK, Maritime traffic, North Korea, Port system, Regional development

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1. Introduction

The fate of ports has long been associated with unpredictable circumstances (Jackson, 1983). Throughout the world, the improvement of transport systems and the integration of ports within multimodal transport chains foster port concentration and competition (Slack, 1985; Hoare, 1986). The literature depicts how ports adapt to change through different sets of local and national policies, strengthening their performance and their insertion in intermodal systems and value chains (Notteboom and Rodrigue, 2005; Jacobs and Hall, 2007). While such trends seem to be valid for ports operating in relatively opened economies, it is not yet verified whether they apply to the constrained and autarchic economy that has become the Democratic People's Republic of Korea (DPRK; hereafter referred to as North Korea). Comparing North Korea with other constrained economies would improve our understanding of the relation between port systems and regional change. Most studies of port systems, which focus mainly on developed nations due to more accessible information, have neglected social and political considerations explaining traffic change. Ports in relatively closed or less-developed economies often receive little attention, because they are not performing well enough or are not sufficiently inserted in the networks of global players. This is regrettable because not only periods of growth but also periods of decline shall be analyzed in order to better understand the transport geography of spatial change.

In the 1960s and 1970s, North Korea was regarded as the most dynamic East Asian economy after Japan. However, it started to falter, declining from the 1980s onwards due to geopolitical change and economic mismanagement (Oh and Hassig, 1999). The two major factors are the disappearance of the socialist block in 1991, with which North Korea handled most of its trade, and the death of president Kim Il-Sung in 1994, which led to a political crisis accentuated by natural disasters and famine. In the late 1990s, the regime implemented

important economic reforms, introducing some elements of the market economy¹. The new attitude of the current regime is closely associated with South Korea's efforts for economic cooperation, as seen in the two inter-Korean presidential summits of 2000 and 2007, and the relatively successful development of the Gaeseong and Geumgang special zones near the border (Ducruet et al., 2008). In addition, an industrial corridor is emerging between Pyongyang and Nampo, the capital's gateway, through joint ventures between local and foreign companies (Roussin and Ducruet, 2007). However, there remains a debate among specialists on whether such reforms are paving the way towards a Chinese model or if they remain an accidental survival strategy (Yoon, 2006).

North Korean ports are strategically located in Northeast Asia (Figure 1), notably regarding their potential for connecting the Europe-Asia land bridge in a context of regional economic growth and integration (Choi et al., 2003; Rozman, 2004). However, North Korea remains a barrier rather than a bridge and most land-based shipments from Japan, China, and Korea preferably use either the Trans Siberian or Trans China railroads. The eight international trading ports are regularly distributed along the East and West coasts, in accordance with the configuration of the urban system (Figure 2). The study of North Korean ports is worthwhile for realizing two main objectives:

- a) Confronting existing models of port system evolution to the case of a politically isolated and economically constrained country;
- b) Complementing the general knowledge on North Korean geography and economy by looking at how geopolitical change and regional dynamics are highlighted through the evolving traffic distribution.

¹ Notably in the agricultural sector, price system, entrepreneurship, and foreign investment procedures.

While available information about North Korea remains limited to partial political and economic data (Jo and Adler, 2002a), we propose using a world database on vessel movements provided by Lloyd's Marine Intelligence Unit (LMIU), an independent organization which insures approximately 80% of the world fleet. Aggregating data on vessel capacities makes it possible to obtain a snapshot of the situation of North Korean ports along three main periods: growth and stagnation before the collapse of the USSR (1985-1991), geopolitical isolation (1992-1998), economic reforms, inter-Korean cooperation, and foreign investments (1999-2006). Such information is by far the most accurate source for studying constrained economies, because all other governmental organizations provide only rough estimates of North Korea's maritime trade (Ducruet and Jo, 2008). North Korean ports are controlled by the army that does not provide any information on traffic and infrastructure. Because a comprehensive study of North Korean ports and transport system is lacking, this research also synthesizes numerous and dispersed information from economic intelligence, governmental reports, and press releases published on this country.

The remainder of the paper is organized as follows. Section 2 provides an overview of the relevant literature on port systems in transport geography. Section 3 represents the core of the paper. It first introduces a brief historical background of North Korean ports, then explains the methodology, and goes through the analysis of port traffic distribution along the three main periods. Concluding remarks in section 4 discuss the lessons drawn from the case of the North Korean port system.

2. Port system evolution in transport geography

2.1 General trends

The analysis of port systems is an important part of transport and regional development studies (Hoyle, 1974). Increased globalization has fostered a global

transportation system that redesigns inter-port relationships on various geographical scales (Slack, 1993).

The port system is a rather vague geographical concept. On the one hand, it corresponds to the *port region* or land area within which port activities substantially impact the economic structure (e.g. employment), but it is often confounded with the *hinterland* that reflects the market area in which inbound and outbound port-related transport flows take place. It is also understood as a group of ports situated in geographical proximity, such as the *maritime façade*, which is based on a single and continuous coastline, and the *port range* that is defined by interdependency among ports sharing multiple vessel calls. Finally, the *port network* represents the service coverage of a given carrier, regardless of the geographical proximity.

Table 1 provides an overview of the main port concentration studies. There is a gradual shift from concentration to deconcentration studies. Empirical evidence highlights the limits of excessive concentration in several parts of the world, defined by traffic capture at one main load centre. Concentration, for instance, stems from the path-dependency of large agglomerations (e.g. New York) and the resilience of large load centers (e.g. Hong Kong) implementing efficient urban and port planning policies avoiding congestion. Deconcentration occurs due to new port development, carrier selection, global operation strategies, governmental policies, congestion, and lack of space at main load centers.

Port traffic is related to economic activities and spatially spreads through a transport system. Therefore, changes in traffic distribution are closely related to changes in the spatial organization of the economy. The degree of concentration within a port system can be a good indicator of regional dynamics. For little known countries such as North Korea, lack of information on internal changes may be overcome by examining the distribution of port traffic over time. Before evaluating to what extent port concentration occurs in North Korea and the

implications for such a phenomenon, a closer look at the specificities of port systems in developing and socialist countries is needed.

[Insert Table 1 about here]

2.2 Port system evolution in developing and socialist countries

Defining thoroughly the notions of developing country and socialist country would reach beyond the scope of this paper. Nevertheless, the two emerged in the specific context of the Cold War era, defined as the Second World (socialist) and the Third World (developing), by comparison with the First World (developed or capitalist). Different categories have been proposed, notably after the Cold War, such as *socialist developing countries*, applying to the world's only five remaining communist countries i.e. China, Vietnam, Laos, Cuba, and North Korea. The main differences between socialist and developing port systems involve land transport, traffic distribution, and traffic type (Table 2). In the former Soviet Union, the spatial division of port functions serving the continental hinterland centralized in Moscow formed a star-shaped railway network aimed at controlling access to the different seas (Thorez, 1998a). Although socialist leaders often expressed their disregard for sea transport, maritime trade in socialist economies grew from 2% in 1939 to 9% in 1991 (Vigarié, 1995), reflecting the extension of their influence to countries only accessible through sea transport (e.g. Cuba, Vietnam, and Africa). After the collapse of the USSR, ports located in newly independent countries (NICs) adapted to new hinterland patterns by diversifying traffic and modernizing infrastructure (Thorez, 1998b). Maritime transport in socialist countries was long perceived as costly, of little use, and limited to coastal shipping. The new geopolitical context forced Russia to develop long-distance trades with remote trade partners such as Cuba (Vigarié, 1995). In China, following the Open Door Policy (1978), port development occurred

despite inland transport limitations with the development of special economic zones and open cities along the coast (Lo, 1989).

Since the 1960s, literature on port systems has emphasized the impact of containerization on Asian colonial and post-colonial port cities (Basu, 1985; Murphey, 1989; Kidwai, 1989). Technological changes in shipping and globalization processes caused port concentration and selection, questioning the notion that the amount of cargo handled by the port was strictly proportional to the economic weight of the surrounding region (Todd, 1993). The model proposed by Taaffe et al. (1963) shows the degradation and disappearance of minor ports due to the growth of gateway ports at the head of transport corridors, where agglomeration economies are intensified. The argument of Smolensky and Ratajczak (1965) about the shift of larger cities from centre to periphery is questioned by Stern and Hayuth (1984), who observed that remotely located ports have limited local impact due to their dependence on inland core regions. Although port development relates to the existing urban structure of a given country, attempts to develop peripheral regions through port activities in developing countries have been rather limited (Fujita and Mori, 1996). Spatial concentration of population, economic activity, and port traffic also appeared in socialist countries such as Cuba (Alfonso, 2001).

Besides the aforementioned issues, port development in developing and socialist countries is dictated by wider mechanisms of state planning, resource allocation, and settlement structure. The relative absence of property rights, lack of international openness and human capital, limited infrastructure and manufactured inputs, small market size, and complex governance often result in a lack of incentives and innovation (Edwards, 1993; Tybout, 2000). This is exactly the case in North Korea, where reliance on heavy industries and military control prevented the emergence of a competitive advantage in the world economy (Jo, 2000). Limited foreign trade, protectionism, and capital stock resulted in small

port capacity, outdated infrastructure, and inadequate cargo handling facilities (Ahn, 2001; Yoon and Babson, 2002; Ahn, 2003). As seen in Table 3, North Korean ports remain relatively small, poorly equipped, and specialized in the handling of bulky products, while limitations of nautical accessibility indicates wide gaps with global shipping standard requirements. As a result, most cargo is loaded and unloaded by hand using a large quantity of workforce at the docks (Ducruet and Roussin, 2007a). This situation can be accentuated by bureaucratic obstacles and institutionalized corruption that is defined by favored military and power-holding elites having better access to information, foreign manufactured goods, travel opportunities, nepotism, and cronyism (Bermudez, 2006). In Indonesia, cumbersome customs regulations once hampered the spread of containerization (Airriess, 1989) and still nowadays more than 80% of Indonesian trade is transshipped through Singapore due to low port capacity locally (Ghani, 2006). Similarly, the national renovation policy of Vietnamese ports faces low technical standards and port capacity (Vinh, 2004). In other cases such as Baltic ports, port reforms and increased private participation in port management allows a steady modernization (Brodin, 2003). Whether such trends are reflected in a socialist developing country like North Korea is verified in the next sections.

[Insert Table 3 about here]

3. Port concentration in North Korea

3.1 Background and research perspectives

Centrally located for economic, trade and cultural exchange amongst neighboring powers, the Korean peninsula has always been under pressure for geopolitical control, resulting in the reluctance of Korean elites opening the country (Roussin, 2008; Yoon, 2008). Following successive short periods of expansion and long periods of closure over centuries,

the Treaty of Ganghwa (1876) forced Korea opening its main ports to foreign trade. Japan seizes Korea's transportation system in 1905 and further develops ports during the occupation period (1910-1945), notably on the East coast. After the Korean War (1950-1953) during which many port sites were heavily damaged, the regime of Kim Il-Sung remains focused on developing primarily inland transportation for border trade with China and the Soviet Union (Ahn, 2003), while the few improvements at ports resulted from Soviet, Chinese, and Japanese support, such as the creation of Rajin port, storage facilities, and oil piers in the 1970s (Cotton, 1996).

The legacy of contemporary port development in the northern part of the Korean peninsula directly results in a concentration of traffic on the East coast (Figure 3). However, the share of the West coast has constantly increased until nowadays. What are the factors leading to such reversal? Is it only explained by geopolitical change, or is it also related to internal factors? This phenomenon of concentration shift that is made evident by measuring Gini coefficient based on container traffic is, primarily, the result of changing political relations and trade patterns. The loss of socialist trades after the fall of the USSR in 1991 would explain the cease of shipments with Russian neighboring ports such as Vladivostok and Nakhodka, resulting in the decline of the East Coast. But this cannot account for the continuous growth of traffic of the country in general. Eventually, North Korea maintained trade relations with Japan and China, and also with South Korea with which 90% of shipments use sea transport due to persisting inland blockade at the DMZ. Thus, other factors shall be researched internally.

The internal changes in the country's spatial organization and the successive planning policies are not well-known, notably with regard to port activities. The governmental Korea

Ocean Shipping Agency (KOSA)² that is based in Pyongyang is responsible for all ship-related services, but there is no existing information about the country's port policy. By looking at the evolution of urban population of main North Korean cities, existing studies point at a major demographic concentration in Pyongyang and other western cities (Jo and Adler, 2002b). This phenomenon of urban primacy, which is typical of developing countries, may constitute the very cause of the westward shift of port traffic. Because Nampo is the main port on the west coast and is well connected by road to the core economic region, it has become the country's main maritime gateway. From a relatively balanced situation due to the dynamism of both maritime facades, there is a dramatic increase of concentration (0.8) after 1992 onwards. Only a detailed analysis of the weight, composition, distribution, origin, and destination of port traffic by main period between 1985 and 2005 may shed light on the respective roles of local and global factors underlying port concentration in North Korea.

Data was calculated in identical ways for each period, based on the agglomerated vessel movements: traffic volume and composition, direct origin and destination, average berthing time, average vessel size, and share of North Korean vessels. All indicators express one aspect of port performance. By complementing the results with other sources and field study³, the distribution and evolution of this performance shall shed new light on the possible relations between economic and political factors affecting port concentration.

3.2 Soviet influence: the dominance of East coast ports (1985-1991)

During the heyday of the North Korean economy, traffic is relatively balanced between East and West coasts of the country (Figure 4). Total traffic is slightly more concentrated in Nampo, but container traffic clearly indicates the dominance of the East coast.

² The KOSA is notably responsible for permit delivery, cargo handling management, quay booking, surveying, ship repair and inspection, bunkering and crew salvation, as well as administrative documentation, customs, bills of lading, and receives complains in case of good damage during shipping or stevedoring.

³ Two of the authors made regular visits to North Korea including Nampo, Pyongyang, and Gaeseong during the research period.

Notably, Cheongjin and Rajin have the highest share of regular shipping. This deviates from the general situation defined by a dominance of bulky products in North Korea. A recent study estimates the share of raw materials (e.g. mine products) in domestic transport around 71% of domestic transport flows were raw materials (e.g. mine products), carried dominantly by rail and road that occupied 74% and 18% of the modal split respectively in 1989 (Tsuji, 2005). Their role as important links between Japan and mainland China is notably due to their advantage as North Korea's only ice-free ports during winter, in comparison with neighboring Russian competitors which have less capacity. Indeed, eastern ports show a dominant share of their traffic with Japan, except for Heungnam and Songjin that are more connected outside Northeast Asia. Eastern ports also have a lower share of North Korean vessels, showing their higher degree of openness to foreign trade. Finally, Cheongjin and Rajin have a higher share of general cargo shipments, probably due to their location in a forestry area but also due to their role as transit ports. At that period, Wonsan stood by far as North Korea's largest coastal petrochemical complex, what is reflected in its large share of tanker traffic and highest average vessel size. Because of its good inland transport links with Pyongyang and is also an important naval base, it acquired a strategic commercial and military role for energy storage and supply, transportation, shipbuilding and repair, and production of railroad rolling stock.

In comparison, the west coast has a rather secondary role in the port system. Of course, as the gateway to Pyongyang, Nampo has the biggest traffic volume, and a diversified portfolio in terms of traffic origin and destination. It has a higher proportion of bulk traffic to cover the needs of Pyongyang for construction materials (e.g. cement), but this is also the case for ports located nearby large cities (e.g. Heungnam, Cheongjin). Although the problem of low equipment is already widespread in North Korea during this period, Nampo is permanently constrained by the West Sea Barrage, completed in 1986, through which vessels larger than 50,000 deadweight tons cannot pass. West coast ports, but also Wonsan, also have

the particularity to suffer more than other ports from political instabilities, due to their location near the inter-Korean border area. Their higher share of North Korean vessels may illustrate the tension between North Korea and South Korea, resulting in the limited permission given to foreign vessels accessing those ports. Indeed, Nampo has developed as a key military and industrial complex whose proximity with the capital city makes very strategic. Overall, both façades show relatively high average berthing periods, except for Wonsan due to the regular ferry link with Niigata, Japan.

3.3 Isolation: the shift to the West (1992-1998)

The second period (Figure 5) shows a major concentration of traffic at Nampo. East coast ports have greatly declined. The loss of socialist trades undoubtedly harmed the relations between eastern ports and former Soviet ports. Heungnam has most declined probably due to heavier dependence on Soviet trades. Local factors also explain this trend, as in the case of Wonsan, from which numerous factories were moved in the mid-1990s so as to create a new and secured military and industrial complex in the mountainous northern areas. As a result, Wonsan's total traffic and share of tanker traffic have both greatly reduced. The deterioration of roads and obstruction of tunnels also started to impact negatively on the dynamism of Wonsan that is increasingly isolated from the capital region (Roussin and Ducruet, 2006). In fact, the country is isolated geopolitically, while internal areas have become less connected internally (Ducruet and Roussin, 2007b).

The decline of the East coast is counterbalanced by some exceptions. For instance, the special economic zone of Rajin-Seonbong was opened in 1991 as part of the larger United Nations Tumen River Development Programme, resulting in a higher traffic growth than other ports. A recent study concluded that such increase was due to the construction of the project rather than to its operation (Jo and Ducruet, 2007), as seen in the large share of bulk products.

The study also demonstrated that the absence of a manufacturing base would be a better explanation of the limited success than geographical remoteness and political tensions. Thus, increased trade flows were mostly explained by land-based traffic with neighboring Chinese provinces. From the mid-1990s, China started improving Rajin's road connections while building new container facilities for improving its access to the Pacific (Cotton, 1996). Notably, Rajin provides Japan with direct maritime connection to the Trans-Siberia-Railroad (TSR) and Trans-China-Railroad (TCR). Rajin, Cheongjin, and Wonsan keep the highest share of regular shipping (that is also high in Heungnam), the first due to their inland connections with China, while Wonsan maintains its regular ferry service with Niigata, avoiding too much decline.

Comparatively, the traffic structure of western ports has not much changed since the previous period. General cargo remains dominant in general, while bulk traffic is more needed at larger urban and industrial agglomerations. The specificity of Nampo is to have kept a wide diversity of maritime connections, while other ports are becoming dominantly connected with Japan. Isolation and geopolitical change provoked a retreat of North Korea from the international scene, resulting in more short-sea and less long-distance connections, except for Nampo, the gateway to Pyongyang. Paradoxically, the share of North Korean vessels remained higher for southern ports due to prolonged political tensions, but it has slightly reduced in Haeju. Also, the general increase of average berthing time that also reflects North Korea's isolation is not matched by Wonsan that keeps privileged relations with Japan through the ferry link. Not only the changes in international trade relations are highlighted, but also the internal factors that are based on limited openness and self-sufficiency. This situation was about to change with the growing involvement of China and South Korea in North Korean affairs.

3.4 Chinese and South Korean influence: the dominance of West coast ports (1999-2006)

The last period is marked by important changes in the country's behavior toward the outside world. Although tensions have been exacerbated due to nuclear crisis and prolonged embargo, international trade and foreign investments increased substantially after the first inter-Korean summit of 2000. At the same time, China exerts a growing influence on the development of North Korea, in the manufacturing and mining sectors for instance, and has become its leading trade partner with almost 40% of North Korea's international trade in 2005, while South Korea, the second largest trade partner, occupies 25%.

Nampo maintains its position as North Korea's main port (Figure 6). While South Korea's plans to build a container terminal and freight station in Nampo have failed due to politics, China has been more successful in supporting the construction of a new container berth (Lloyd's Register, 2006). Nampo concentrates most new investments, such as the new Songgwan terminal (2001) but North Korea's plan designing the Wawoo port district as a special economic zone was cancelled (see Figure 2). Other ports have kept declining dramatically. Heungnam still generates more traffic due to its situation within the large Hamheung industrial complex. The decline of Rajin confirms the preference for border trade with China, the limited success of the special economic zone, and the limited use of the port for transit trade with the Pacific. Another important phenomenon is the dramatic shift of population and economic activities from East to West in a context of de-industrialization (Ducruet and Roussin, 2007c). A good example is Haeju's growth due to sand barging from the Han River, in cooperation with South Korea. However, the decision made at the second inter-Korean presidential summit to build a second industrial complex in Haeju has not yet been implemented.

One of the main impacts of humanitarian aid is the increase of tanker traffic at all North Korean ports. It is, in fact, limited to one peak from 1999 to 2001 and relies mostly on

United States' food and oil assistance. One exception is the case of Songjin where tanker traffic better relates to the KEDO⁴ project, but the latter was officially cancelled in 2006. The growth of aid traffic was interestingly supported by a shift of maritime connections towards South Korean ports, resulting in hub dependence (Ducruet, 2008). South Korean ports are well located to handle North Korean flows in terms of centrality - proximity to the North Korean market - and intermediacy - facilitation of transshipment for ocean carriers. This situation is made evident because of the growing technical discrepancy between northern and southern ports, and is reinforced by South Korea's strategy of becoming Northeast Asia's logistics hub.

Despite this trend of hub concentration at South Korean ports, important connections remain with Japanese and Russian ports, notably for East coast ports. For instance, Rajin is well located for Russian trade, which increased threefold from US \$68 million in 2001 to US \$232 million in 2005 (Ministry of Unification in South Korea, 2005). Wonsan has kept connections with Japan, although trade declined twofold from US \$474 million in 2001 to US \$194 million in 2005. Overall, the share of South Korean connections has increased in all North Korean ports, resulting in an unprecedented share of regular shipping, notably in the East. Whether caused by the establishment of inter-Korean hub traffic in Heungnam (Joongang Daily, 2006) or other phenomena, Heungnam welcomes the largest ships on average. Given the intermingling of aid traffic and inter-Korean shipments, it is difficult to separate the two processes at stake in North Korean port traffic change.

Some aspects of the North Korean port system have not much changed. Despite trade growth and openness, the North Korean fleet remains dominant in ports close to South Korea. This share is high in Nampo despite infrastructure modernization and increased links with the

⁴ The Korean Peninsula Energy Development Organization was founded in 1995 by the US, South Korea, and Japan to construct a light water reactor to be completed in 2003.

South Korean port of Incheon following the inter-Korean maritime agreement⁵ of 2005. This indicates that the army maintains its control on vessel selection at strategically located ports. The share of North Korean vessels increased in Cheongjin, but this is better explained by its general decline as it was recently qualified as a dormant port (Pons, 2006). Rajin also showed a retreat of foreign vessels and an increase of berthing time. The general reduction of long distance connections (i.e. outside Northeast Asia) marks the continued decline of the country, while it remains important for Cheongjin and Heungnam only due to humanitarian aid from developed countries.

Beside changes in trade patterns and geopolitics, one major restrictive factor affecting East coast ports is the deterioration of the domestic land transport system. The road network is only 7% paved nowadays; most highways are concentrated in the west around the capital region, where 20% of the operating factories are located (Bang, 2004). This is confirmed by the distribution of domestic inland traffic: 30% in the South Pyongan province, 10% in the North Pyongan province, 24% in the North Hamgyeong province, and 17% in the South Hamgyeong province (Tsuji, 2005). The lack of inland connectivity between the different provinces also reflects military concerns: the army keeps a firm control on interurban movements and plans the road network for defense rather than economic purposes (Roussin and Ducruet, 2006). Therefore, railways remain the only transportation mode capable of carrying the goods generated by mines, and of reaching remote, mountainous areas (Tsuji, 2004). The limited internal connectivity has gradually resulted in the concentration of traffic at Nampo, Pyongyang's main (and only) maritime gateway, between which the 10-lane Youth Hero motorway was built in 2000. Overall, this concentration results from the complex intervention of physical, economical, and political factors on various scales, from the local to the global.

⁵ This agreement is designed to open new shipping routes between the two Koreas, while allowing the free calling of northern and southern vessels in respective ports.

4. Conclusion

The analysis of traffic distribution within the North Korean port system is fruitful in many ways. It has overcome the scarcity of data that often characterizes constrained and closed economies. Although measuring traffic in deadweight tonnage or slot capacities cannot account for the real volumes handled at the docks, the excessive costs that characterize shipping to and from North Korean ports provide a sufficient argument in favor of considering those shipments as an indicator of the level and nature of port activities.

This study complements our understanding of port system concentration in general (see Table 4 for a synthesis). The classic process of economic polarization of the core region in developing countries is verified in North Korea by the concentration of traffic at one main load centre, Nampo. North Korean authorities failed to sustain the principle of regional balance that was based on the polycentric urban system. Before the isolation, the transport system could provide the capital region with a good access to East and West coasts. Thus, traffic shift and concentration in North Korea resulted from the impact of geopolitical crisis rather than from the spatial agglomeration of economic activities.

[Insert Table 4 about here]

Internal political crisis and natural disasters contributed to the dereliction of the transport system, resulting in disconnection amongst North Korean provinces. As a result, the core region has become increasingly isolated. Only Nampo and other Western cities located near the capital city have sustained their activities. Distance and elevation also played an important role, resulting in excessive concentration. The relative failure of socialist planning

principles and the search for short-time economic survival provoked concentration in the port system.

This is why the observed trends affecting the North Korean port system are both universal and exceptional. On the one hand, the concentration trend shows that North Korea fits quite well with the general models of port concentration in developing and transition countries. On the other hand, the North Korean case shows that concentration may occur despite the absence of economic growth, unlike other countries. Perhaps the peace treaty with the US and the lifting of the trade embargo in the foreseeable future may pave the way for further evolution of the port system.

Future research shall develop towards three main directions. First, the international comparison of port system evolution in constrained economies is necessary to better verify the uniqueness of particular contexts and their possible common trends. Second, surveying the interested shipping lines calling at North Korean ports in recent years would improve our knowledge about the current state of port infrastructures and shipping in North Korea. The names and contact information of the shipowners are also provided by Lloyd's database on vessel movements. Third, a better understanding of North Korea's internal spatial change would greatly benefit from active collaboration with non-governmental organizations, transport companies involved in border trade (e.g. Russian, Chinese), and foreign companies investing in North Korea (e.g. European).

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Table 1: Selected studies on port system concentration, 1963-2008

Author(s), year	Year	Area	Concentration factor(s)	De-concentration factor(s)
Taaffe, Morrill & Gould	1963	Africa	Inland transport corridors	
Rimmer	1967a, 1967b	Australia, New Zealand	Inland transport corridors	
Kenyon	1970	United States	Metropolitan dominance (New York)	Hinterland-foreland changes
Hilling	1977	Ghana	Spatial consolidation and rationalization	
Hayuth	1981, 1988	United States	Development of large load centres, intermodalism	Peripheral port challenge
Slack	1985, 1990	United States	Level of intermodalism	Port selection by carriers
Barke	1986			Congestion, lack of space for further expansion
Hoare	1986	United Kingdom	European integration, national connectivity	
Charlier	1988	Belgium	Stable structure of port hierarchy	Traffic specialization
Airriess	1989	Indonesia	Exogenous development through hinterland penetration	
Kidwai	1989	India		New port construction (bulk)
Kuby & Reid	1992	United States	Technological innovations, disappearance of smaller ports	
Todd	1993	Taiwan	Export-led policy and growth poles	Balanced regional development
Starr	1994	United States	Economies of scales in liner shipping, decreased port calls	
Hoyle & Charlier	1995	East Africa	Concentration of investments	
Charlier	1998	Benelux		Hinterland development (railway), port selection (Zeebrugge)
Notteboom	1997	Europe		Traffic shifts to medium-sized (new) ports
Wang	1998	Hong Kong, China	Technological advance of Hong Kong	Port competition, congestion, modal shift, high handling costs
Hoyle	1999	Kenya	Primate city polarization (Mombasa)	New port development
Brunt	2000	Ireland	Metropolitan dominance (Dublin)	National development plans
Wang & Slack	2000	Pearl River Delta		Carriers' pressures, port policy
Slack & Wang	2003	Asia		Strategies of transnational operators
De & Park	2003	World		Port competition, new technologies
Notteboom & Rodrigue	2005	Developed countries		Development of 'off-shore' hubs and inland terminals
Ducruet & Lee	2006	World		Urban growth, regional port competition
Notteboom	2006a	Europe, North America	Stability of concentration	
Notteboom	2006b	East Asia		New port development
Ducruet & Lee	2007	Europe	Core-periphery pattern	Modal specialization of port cities
Frémont & Soppé	2007	North European Range	Stable traffic concentration	Shipping line concentration
Joly & Lemarchand	2007	World	Regional integration, maritime range, traffic growth maturity	National systems, intra-regional trade barriers
Ducruet	2008	Northeast Asia	Hub dependence	Military control, logistics barriers
Ducruet & Rozenblat	2008	World	Graph centrality	
Lee, Song & Ducruet	2008	Hong Kong, Singapore	Technological differentials, efficient planning policy	Congestion, lack of space, port competition

Source: realized by authors based on various sources

Table 2: Ports and maritime trade in socialist and developing countries

Issues	Socialist country	Developing country
Modal split	Inland transport dominance (70-90%)	Maritime transport dominance, low hinterland coverage
Port system	Traffic specialization	Traffic concentration (50-90% in one main port)
Port traffics	Bulky products, low-valued goods	Bulk imports and manufactured goods exports
Trade pattern	Among socialist partners	Extraverted (e.g., free-trade zones)
Equipment	Lack of container handling facilities	Poor technical standards
Governance	Centrally planned, bureaucracy and protectionism	Cumbersome customs regulations, port and terminal privatization
External connections	Coastal and short-sea shipping	Dependence on external hubs for long-distance shipping

Source: authors, compiled from various sources

Table 3: Infrastructure characteristics of North Korean ports

Port	Stevedoring capacity (tons)	Crane capacity (tons)	Number of cranes	Berth capacity (000s tons)	Total quay length (m)	Nautical depth (m)	Storage (000s sq.m.)	Main cargo handled
Cheongjin	800	185	12	20	3,700	8.5 ~ 10	N/A	General cargo, grain, coal, steel
Haeju	240	45	4	10	1,300	7 ~ 12	21.8	Cement, ore, zinc, concentrates
Heungnam	400	50	2	20	1,850	6.7 ~ 13	23.3	Fertilizers, magnesium clinker
Nampo	750	170	3	25	2,100	10 ~ 13.5	20.8	Coal, cement, container, ore, grain, sundries
Rajin	300	10	1	15	3,300	10 ~ 11	26.0	Coal, fertilizers, timber, sundries
Seonbong	200	-	-	5	1,500	7 ~ 23	26.0	Crude oil, petrochemical products
Songrim	100	18	1	15	550	10 ~ 11	10.4	Iron ore, coal
Wonsan	169	109	5	10	3,400	6.1 ~ 12.8	14.5	Cement, marine products

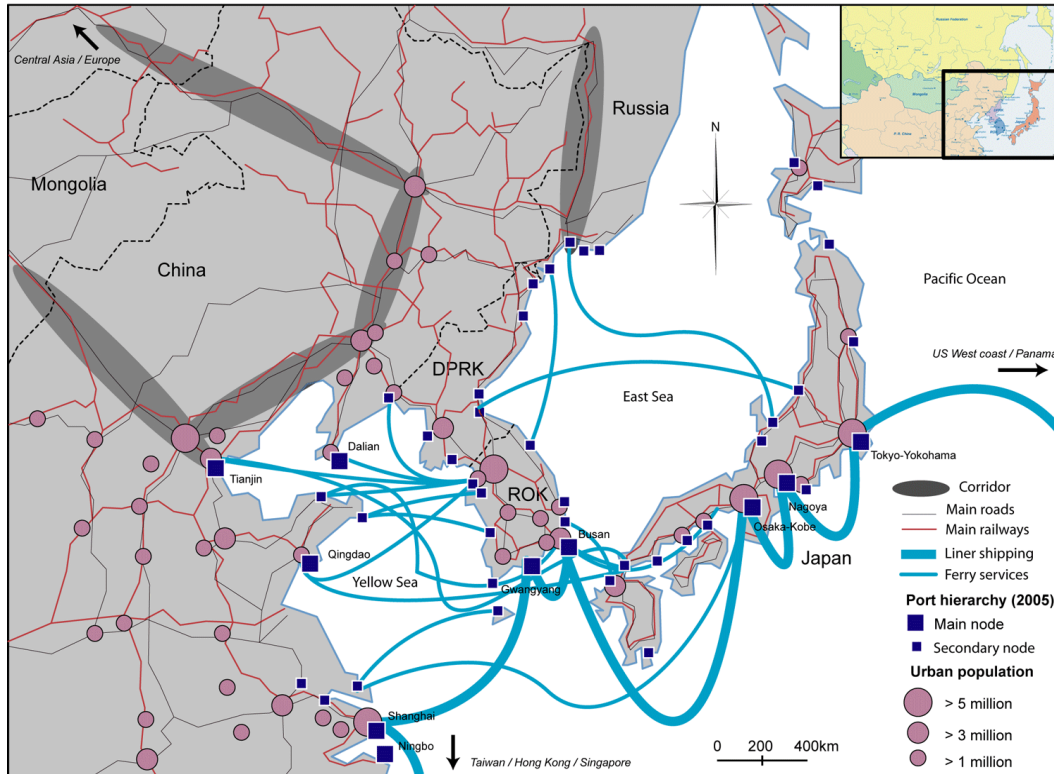
Source: authors, compiled from various sources

Table 4: Synthesis of port concentration and de-concentration factors in North Korea

	Concentration factors	De-concentration factors
Political	<ul style="list-style-type: none"> • Collapse of the USSR and loss of socialist trades • Chinese influence spreading to Pyongyang markets (e.g. Daean Friendship Glass Factory) • Realization of Gaeseong Industrial Complex near the border and projection of Haeju Special Economic Zone near the Yellow Sea • Liberalization of inter-Korean shipments (e.g. Incheon-Nampo shuttle) 	<ul style="list-style-type: none"> • Ideological principle preventing excessive traffic concentration at the core region (Nampo-Pyongyang) • Ports developed under military control for defence rather than economic purpose; entry barriers to foreign ships (e.g. special license) • Geopolitical isolation and trade embargo limiting trade activities and traffic growth • Humanitarian shipments to less accessible populated regions (e.g. Cheongjin, Heungnam)
Economical	<ul style="list-style-type: none"> • Decline of heavy industries in specialized cities (rust belt) • Demographic and economic polarization of Pyongyang core region concentrating skilled labour and most of the 20% maintained factories • Labour shift to western plains returning to agricultural activities (e.g. rice paddy fields) • Formation of the Nampo-Pyongyang industrial corridor through foreign investment 	<ul style="list-style-type: none"> • Maintained economic activities of large industrial concentrations outside Pyongyang and prospects for reactivating mines close to seaports (e.g. Danchon) • Resilient proximity trade with Japan and Russia through Eastern ports (e.g. ferry service, fisheries) • Development projects at border and coastal areas (e.g. Sinuiju, Raseon, Tumen, KEDO, Gaeseong, Geumgang, Namyang, Wihwa-Bidan) • Self-contained urban areas relatively independent from the core economic region (socialist planning)
Logistical	<ul style="list-style-type: none"> • Remoteness of Eastern ports from the core region vs. centrality of Pyongyang (highways, Sunan international airport) • Inland transport limitations (e.g. tunnel obstruction, army tolls, lack of oil supplies, pavement dereliction) • Increased impact of natural factors on domestic circulations (e.g. climate, elevation) • Modernisation and good accessibility of Nampo (e.g. new container terminal, Songgwon terminal, Young Hero highway) 	<ul style="list-style-type: none"> • Two separate coasts with five main ports in the East and three in the West • Pyongyang traffic dominantly land-based through Sinuiju (80% of North Korean exports) • Technical limitation of the West Sea Barrage for Nampo up to 50,000 DWT and low potential for barging on Daedong River (e.g. sands) • Natural advantage of Rajin as ice-free port and strategic location for Japanese, Chinese, Russian and Mongolian transit trade between Europe and Pacific

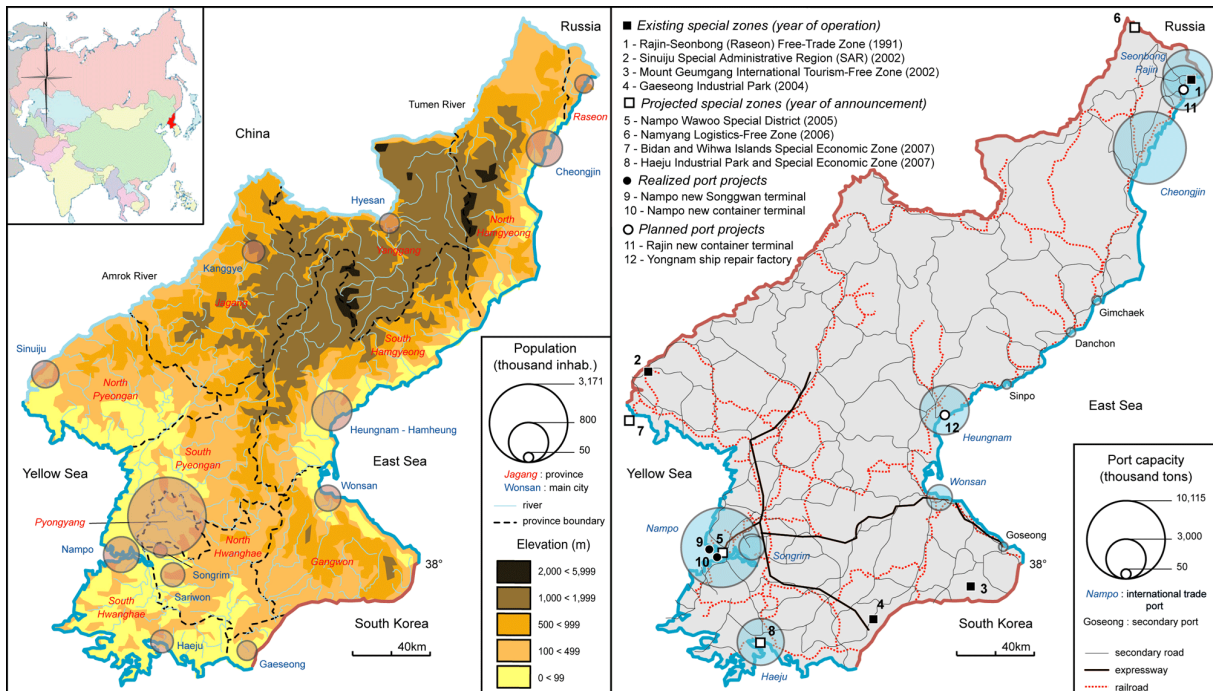
Source: authors

Figure 1: Transportation nodes and corridors in Northeast Asia



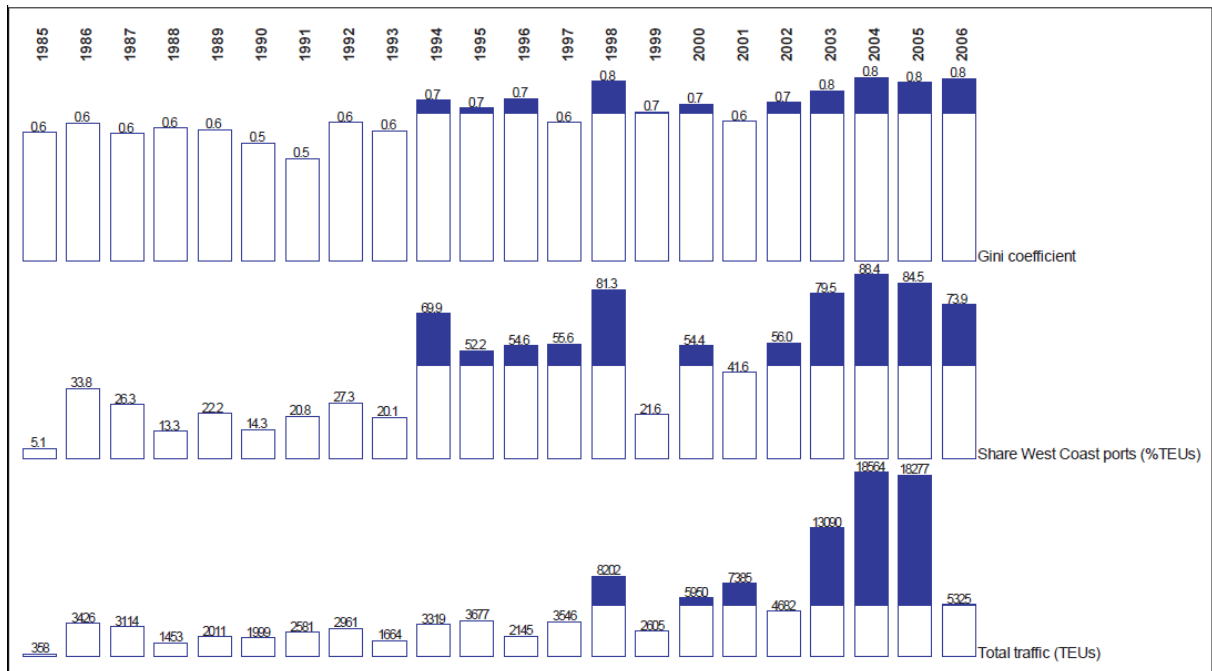
Sources: drawn by authors based on ERINA (2008), Containerisation International (2006), Helders (2008)

Figure 2: Geographical layout of the North Korean territorial and transportation system



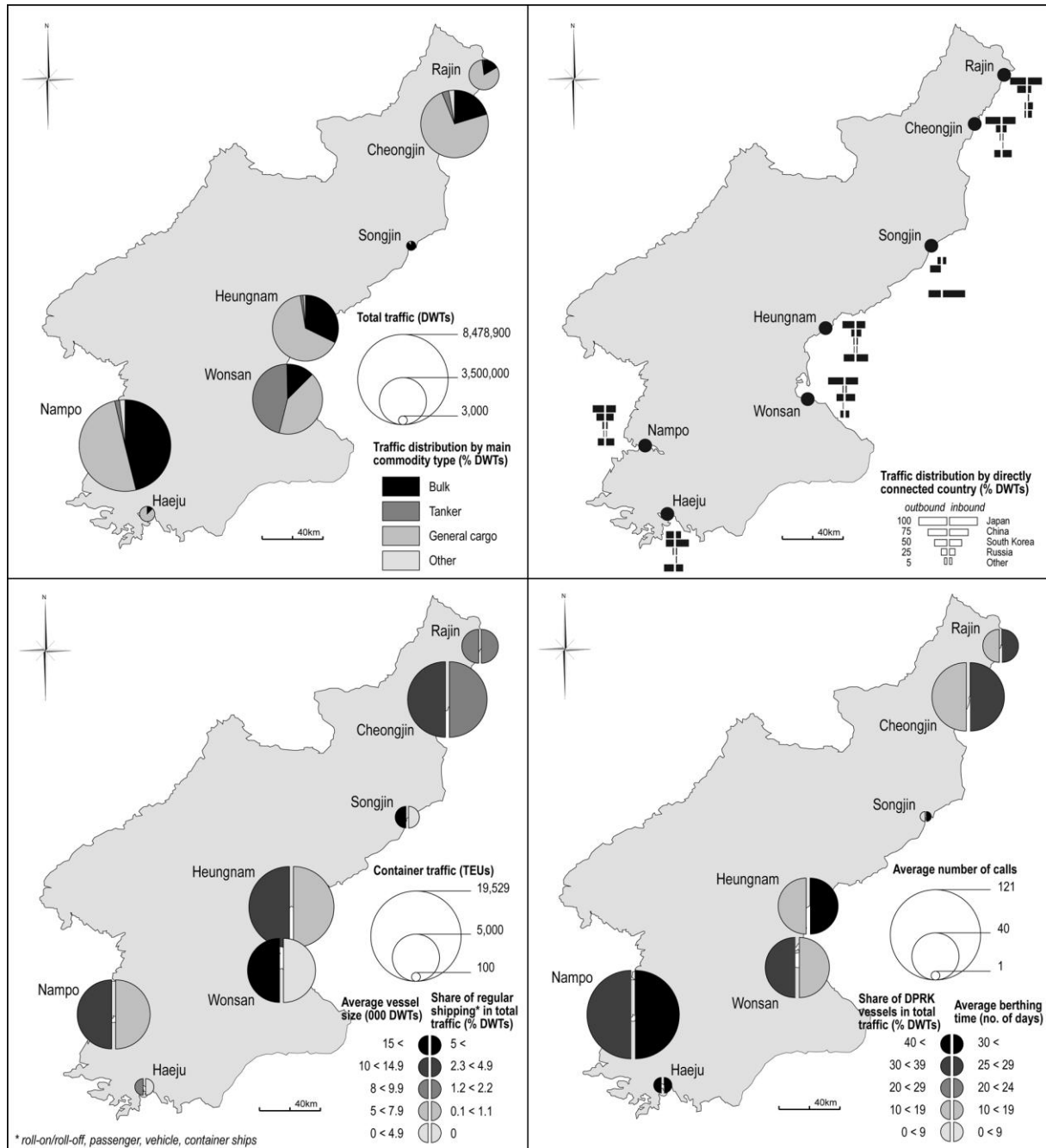
Sources: drawn by authors based on various sources

Figure 3: Container traffic concentration in North Korea, 1985-2006



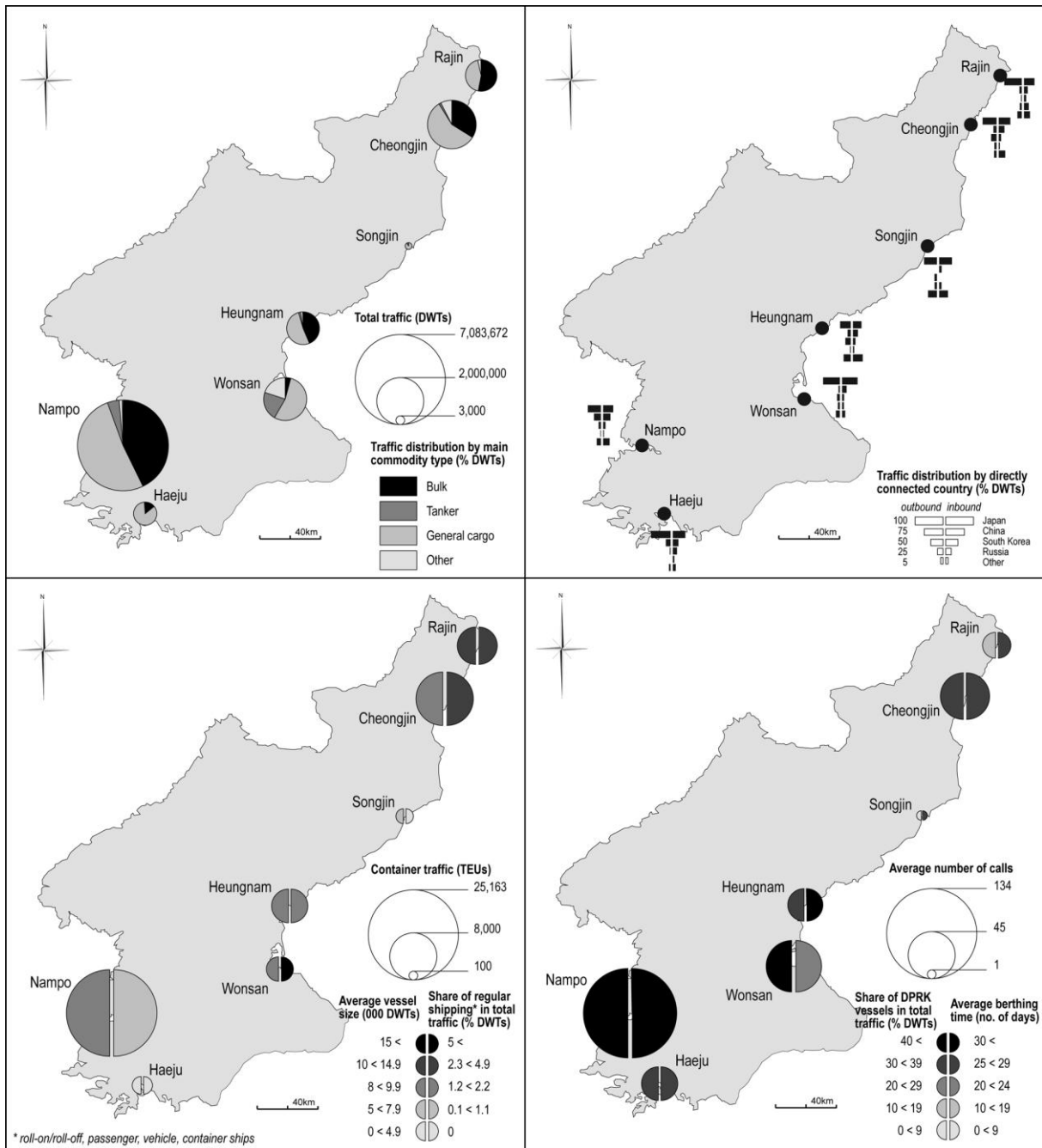
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Figure 4: Vessel traffic at North Korean ports, 1985-1991



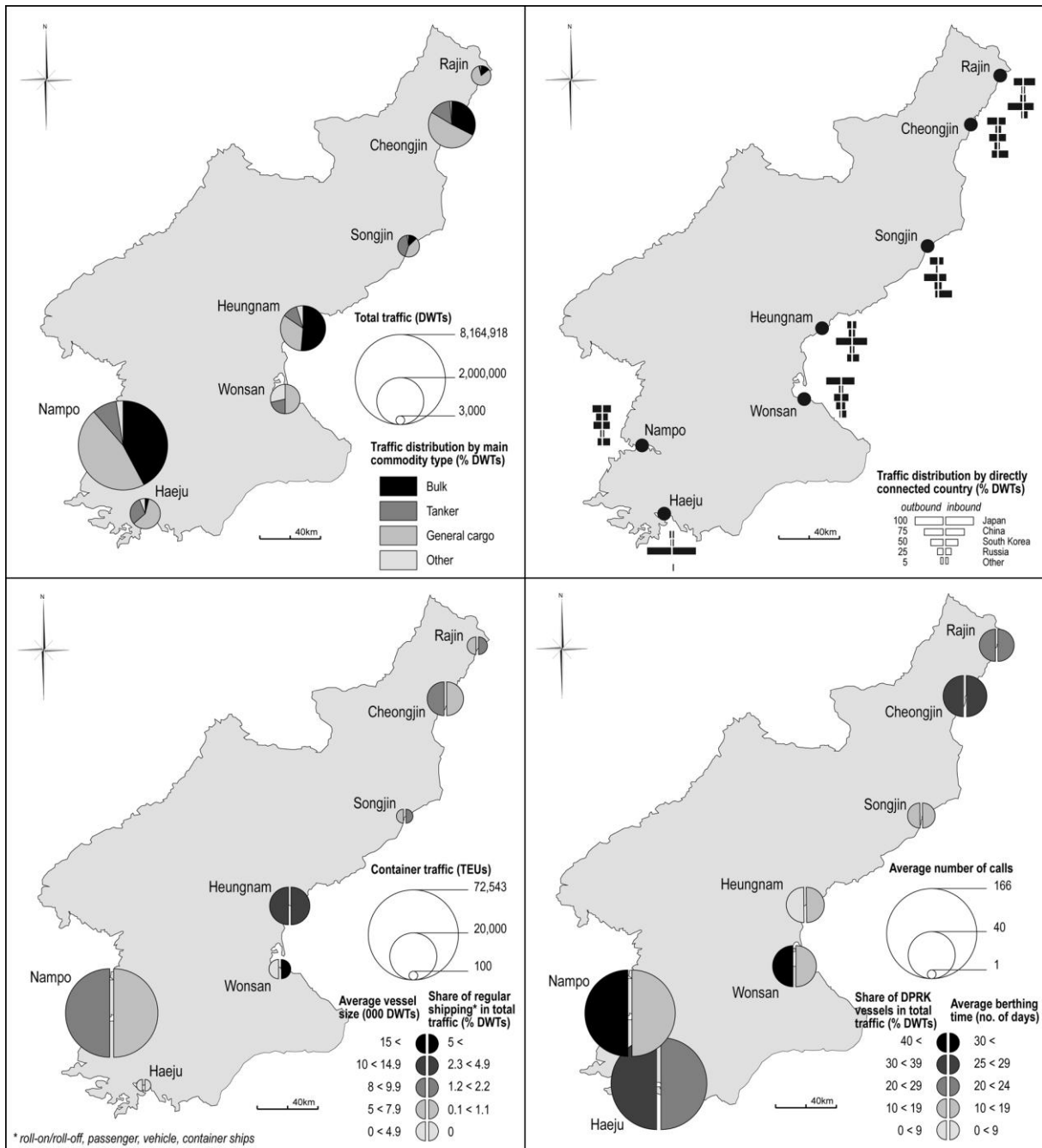
Source: realized by authors based on LMIU data

Figure 5: Vessel traffic at North Korean ports, 1992-1998



Source: realized by authors based on LMIU data

Figure 6: Vessel traffic at North Korean ports, 1999-2006



Source: realized by authors based on LMIU data