# The changing relations between foreland and hinterland at North Korean ports (1985-2006)

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*Paper presented at the 6th Inha & Le Havre International Conference, Inha University, Incheon, Republic of Korea, October 10-11.*

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**Abstract**

Being one of the few remaining communist States in the world, North Korea offers a good example of a constrained economy facing dramatic internal and external pressures. Although land transport dominates in North Korea due to border trade with China and Russia, maritime transport better reflects its position in the global economy. Based on worldwide vessel movements at all ports connected to North Korea between 1985 and 2006, indicators of maritime connectivity closely match the country's evolution according to its political and economical changes. Alongside with a spatial contraction of forelands stemming from diplomatic isolation, industrial decline, trade embargo, and infrastructure dereliction after the collapse of the USSR (1991) and the nuclear crisis (1993-1994), results also show a process of regionalization and port concentration in Northeast Asia at a time of increased openness, cooperation projects, and foreign investments following the inter-Korean summit (2000) and the economic reforms (2002). Finally, comment are given about internal factors such as inter-regional disconnection, transport system dereliction, logistics costs, and accessibility that result in a growing divide between East and West coasts.

*Keywords: Connectivity, DPRK, Hub, Maritime transport, North Korea, Port system*

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## INTRODUCTION

The growth and extension of seaborne trading links are widely recognized as reflecting the dynamism of a maritime country. Recent changes in the operation of sea transport have altered this linear relation, because of port concentration and selection stemming from the strategies of main carriers and technological changes in sea transport (Slack, 1993; Hoffmann, 1998), resulting in more concentrated port ranges and the development of hub ports.

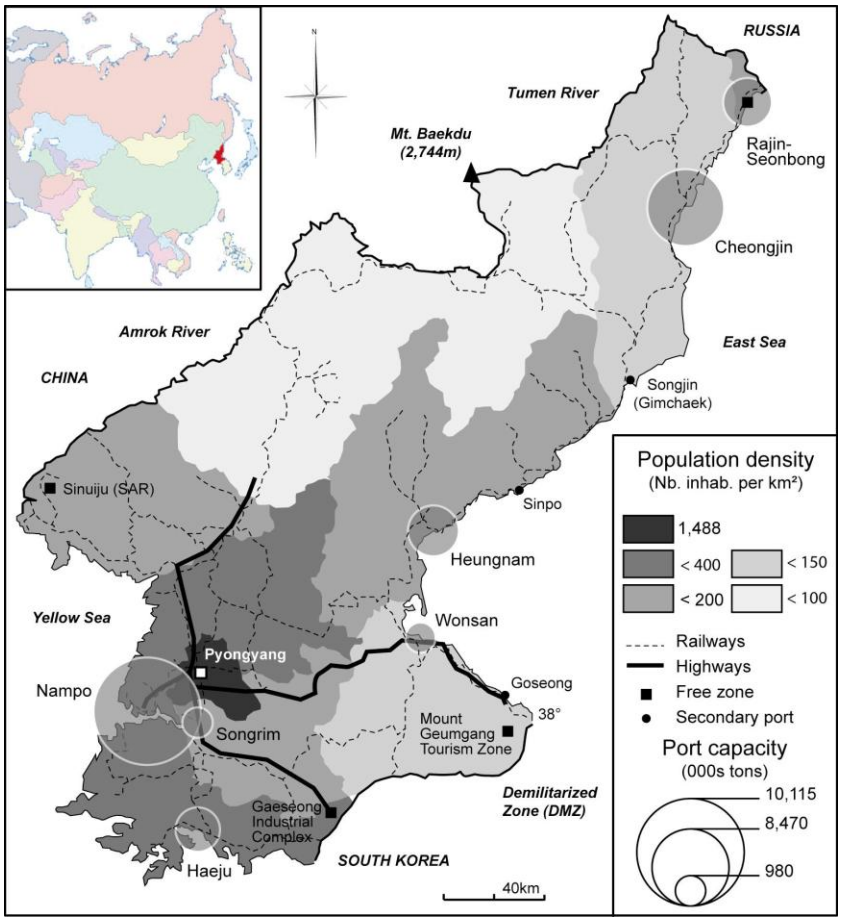
While a vast literature depicts such phenomenon, there has been little efforts analysing the hub dependence of a given country or port. Most studies focus on individual port traffics rather than on inter-port relationships, with results identifying the main hub ports of a given area. The obvious lack is that it ignores how much the traffic of other ports depends on those hubs. Only estimations from the press give approximate figures of hub dependence, such as the 80% of Indonesian imports and exports passing through Singapore and Malaysia (Ghani, 2006). This shows that hub dependence is a major issue for several ports of the world, for which reducing such dependence necessitates large investments in new infrastructures. The majority of research emphasises the evolution of hub dependence through qualitative case studies. For example, the cases of Indonesia (Airriess, 1989), South China (Wang, 1998), and post-soviet countries (Ledger and Roe, 1996; Thorez, 1998), all highlights how technical, institutional, and cultural barriers have been overcome to reduce the dependence on neighbouring transit ports (Singapore, Hong Kong, Rotterdam) in accessing the world economy through more direct calls of global ocean carriers. Conversely, other studies show the increased hub dependence of some countries such as Japan, with the concentration of hub services in Busan and Gwangyang, South Korea (Fremont and Ducruet, 2005).

In this paper, the Democratic People's Republic of Korea (DPRK, hereafter North Korea) is chosen as an example of an isolated and declining economy. The impact of such evolution on maritime trade is worth analysing although the latter is not a top priority in North Korea, due to the influence of the soviet development model and the preferential landward relations with China and Russia. All other relations with more distant trade partners such as Japan, South Korea, Cuba, and Thailand, occur by sea using the eight trading ports located along the east and west coastlines (Figure 1).

Given the specific evolution of the North Korean economy, which has not yet been recovered due to political tensions harming transition as in other socialist - or former socialist - countries, is there a specific impact on the pattern of maritime transport? Is North Korea a unique case? Such questions can be related to previous works on the linkages between maritime systems, industrial development and spatial cycles in general (Rodrigue et al., 1997), and on the specific changes brought by political shifts to the geographical pattern of maritime networks and inter-port

relations within a regional area, as seen in the post-Soviet Baltic (Brodin, 2003), and post-Apartheid South African (Iheduru, 1996) cases. However, due to the lack of data, analytical framework, and applied research using space-time statistics, those studies have been limited to qualitative assessments and speculative conclusions about the link between economic and spatial change in the case of maritime systems.

**Figure 1: General layout of the North Korean transport system**




Source: authors, compiled from various sources

A first section introduces the data source, the methodology used, and the preliminary outcomes showing the main trends affecting North Korean maritime trade in the last two decades. A second section focuses more on the geographical evolution of North Korean maritime linkages on a world and Northeast Asian scales, based on trading cargo vessels calling at this country. A third section discusses the outcomes of the research for North Korea's port and regional development. Finally, conclusive remarks are given about the implications of the research for maritime studies.

## 1. GENERAL TRENDS OF NORTH KOREAN MARITIME TRADE

### 1.1 Data sources and methodology

Although broad evolutions of the North Korean economy are well addressed in various papers and official reports, there is a huge lack of information on detailed sectors, and notably the transport sector. Recent studies have managed to estimate the domestic modal split (Roussin and Ducruet, 2006) and the relative importance of sea transport in total trade (Jo and Ducruet, 2006). It confirms that maritime trade in North Korea is likely to oscillate between 10% and 20% in the last two decades, and this share has been quite stable except from a slight increase during the peak period of humanitarian aid in the late 1990s. Since a detailed overview of the available sources to study the North Korean transport system is provided elsewhere (Ducruet and Jo, 2007), this paper focuses only on the maritime part. Some seaborne traffic figures are provided by the *International Road Transport Union* (Switzerland) up to 1990, are estimated until 2020 by the *Korea Maritime Institute* (South Korea), and are also provided for inter-Korean shipments by the *Ministry of Unification* (South Korea). There are also some estimates of port traffics in various South Korean governmental reports[3] but it is limited to estimates of total tonnage with no time series. However, all figures are difficult to use since they are not comparable with each other due to different periods and areas covered. Regular media announcements[4] provide also figures on inter-Korean sea transport and North Korean port traffics, but these offer such contrast with official sources that we have chosen not to include them in the analysis.

In this paper, North Korea-related vessel movements provided by Lloyd's Marine Intelligence Unit, a world leader in maritime insurance activities and shipping information, are chosen as the only possible source to address the evolution of shipping, as no data exists about port traffics apart from estimates provided by governmental organisations. Moreover, vessel movements allow studying the inter-port linkages that can be used as a surrogate for maritime trade linkages.

The total capacity of all vessels calling at North Korea has been summed by foreign port and by type of ship on a yearly basis, so as to get a global snapshot of the seaborne linkages of North Korea. We are aware of the limits of such methodology. First, the summing of vessel capacities at the ports connected by sea to North Korea only reflects broadly the real amount of loaded and unloaded cargoes in each port. Second, the spatial pattern of connected ports cannot overlap perfectly with the pattern of trading ports, as some vessels call at multiple ports in order to serve different markets or to bunker. Third, the data source is not based on the different services offered

[3] e.g. Korea Transport Institute (KOTI)
[4] e.g. Yonhap News, Korea Times, Joongang Daily, People's Daily, Korean Central News Agency

by shipping lines, but on the movements of ships. It means that there is no possibility to distinguish ports of origin and ports of destination from other ports.

Although it may appear very cautious to use such data to study the evolution of shipping for a given area, there are many advantages. First, it can be argued that any company willing to call at North Korea will have a specific behaviour in terms of service and cargo, i.e. reflecting preferential linkages with specific countries which have commercial relations with North Korea. Second, it has a global coverage, as no spatial limit has been addressed to the data collection. Thus, it may reveal over time how shipping lines and regions have seen their activity modified with regard to the evolution of the North Korean economy. Thus, maritime connectivity is seen in this paper as a means to highlight multi-scalar changes in the relations between North Korea and its global and regional environment. Here, connectivity is understood through its general meaning in economic and transport geography: "*aggregate measure of the extent to which the nodes of a network are linked (directly or indirectly) to other nodes. Connectivity always refers to characteristics of a whole network, not to those of a single node*" (Krumme, 2005). Therefore, connectivity is different from other network measures such as *connexity*, which is port-based, or *inter-connectedness*, that better reflects the relations between components or nodes within a firm's environment.

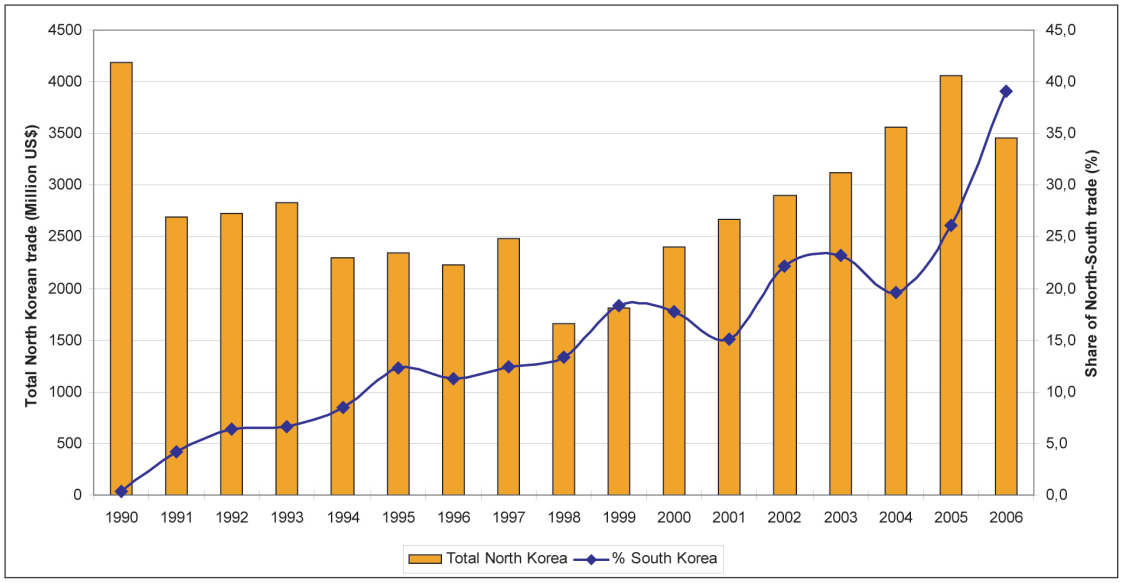
### 1.2 North Korean economy and international trade

Following the Korean War (1950-1953) and the separation from the then-called Republic of Korea (hereafter South Korea), the North Korean economy has officially adopted the ideology of self-sufficiency while sustaining predominant commercial relations with other socialist countries, of which China and the USSR were also border neighbours. While the steady growth of the North Korean economy until the 1970s can be explained by massive investments in heavy industries and construction, it has been supported since then through friendly energetic support from USSR and, later, China. Such system has started to falter after 1987 – the heyday of the North Korean economy – but the decline really starts from the fall of the Berlin Wall (1989), and accelerates with the collapse of the USSR and the socialist block in 1991.

Paradoxically, it is because of trade dependence that North Korea has become suddenly isolated and unable to develop and modernize its own transport and economic system. Without oil and capital, most activities including agriculture, mining, transport, and various industries have stopped throughout the country (Roussin and Chabaud-Latour, 2006). Moreover, the lack of investment in light industries and consumer goods due to the predominance of heavy and defence industries have avoided the development of a competitive advantage in the world economy (Jo, 2000). Additionally, the mid-1990s have accentuated this dramatic situation with the political crisis

after the death of president Kim Il-Sung, because of the vacancy left until the empowerment of leader Kim Jeong-Il (1994-1996). Massive floods due to deforestation resulted in spreading famines, and the first nuclear crisis was condemned by the US with the Wassenaar Agreement (1996), putting a commercial embargo on North Korea. The effects of such difficulties are clearly visible on the evolution of North Korean trade (see figure 2).

**Figure 2: Evolution of North Korean and inter-Korean trade, 1990-2006**




Source: authors, calculated from Korea Trade and Investment Promotion Agency (KOTRA)

*N.B. Total trade in 2006 comprises only trade with China, Japan, South Korea, Russia and Germany*

It is only since 2000 that signs of change have appeared, notably with the historical inter-Korean summit, the economic reforms of July 2002, the growing foreign investments, and the cooperation projects of which the Gaeseong Industrial Park financed by South Korea and opened in 2004, which employs 10,000 North Korean workers in 15 factories at the end of 2006 (Ministry of Unification in South Korea, 2006). Also, the Mount Geumgang International Tourism-Free Zone (2004) has attracted important volumes of South Korean tourists since its creation. This is also reflected in the constantly growing relative share of South Korean trade in overall North Korean trade, as seen in figure 2.

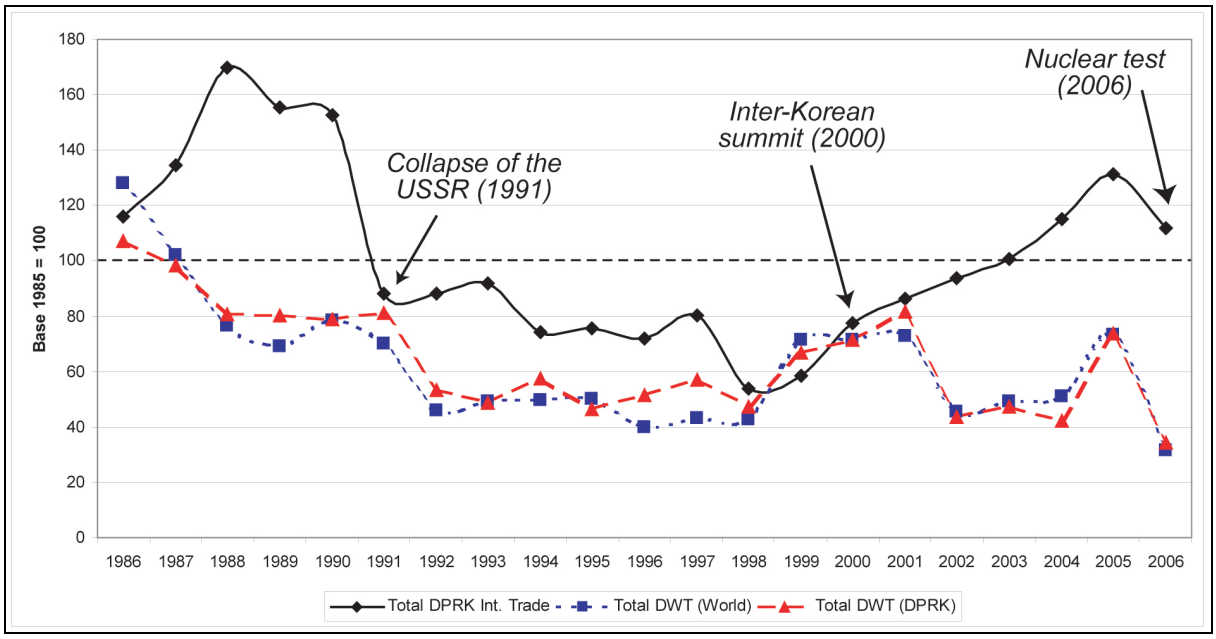
Other projects, such as the Rajin-Seonbong free-trade zone (1991), the Korean Peninsula Energy Development Organization (KEDO, 1995), and the Sinuiju Special Administrative Region (SAR, 2002) have all provided limited results due to politics. For Rajin-Seonbong, further research has infirmed the usual argument of remoteness to explain the relative failure of the project, that is better explained by lack of management as selected industries – casino, telecommunications,

tourism, hotel – had little relation with the port (Jo and Ducruet, 2007). More recently, the July 2006 nuclear tests resulting in increased trade embargo from the United Nations, Japan, and the US, have dramatically affected the positive effects of the reforms, foreign investments, and the ongoing cooperation projects. However, since 2007, the North Korean government has accepted to dismantle its nuclear facilities through the Six-Party Talks process, in exchange of the restart of financial support and peace talks.

### 1.3 The evolution of maritime traffics

A general look at the relative evolution of trade and shipping allows verifying both the accuracy of the data on vessel movements and, beyond, the varying importance of sea transport for international trade.

**Figure 3: Relative evolution of North Korean international trade and shipping, 1985-2006**




Sources: authors, calculated from Korea Trade and Investment Promotion Agency (KOTRA) and Lloyd's Marine Intelligence Unit (LMIU)

*N.B. Total trade in 2006 comprises only trade with China, Japan, South Korea, Russia and Germany*

Figure 3 is based on relative numbers based on 1985 values for three series: total trade, total capacity of the ships on a world scale in all ports connected to North Korea, and total capacity of the ships calling at North Korean ports only. Since the two last series are based on the same source, it is normal that the curves show a very close evolution along the period, while the slight differences are explained by the more or less extended ship movements.

At first glance, we see that shipping activity has been constantly declining and has never gone back to its original level of 1985. Although trade shows a comparable evolution, there are important differences that can be explained as follows:

- along the period, trade has become more land-based, because shipping has declined more and faster than total trade. This can be interpreted as the effect of geopolitical isolation with the loosening of international commercial and diplomatic relations, and the growing unilateral relations with China. The parallel growth of trade and shipping from 1998 to 2001 illustrates the peak of humanitarian aid imports;
- there are two important gaps between trade and shipping (1987-1990 and 2002-2006. The first gap stems from the sudden fall of oil shipments for which sea transport was the dominant mode, at a time of loosening ties with the collapsing Soviet Union and the capitalist converted China.. The second gap is better explained by the increased trade with China, mostly based on land transport as 80% of North Korean exports pass through the border city of Sinuiju;
- one short but noticeable peak of maritime activity between 2004 and 2005 directly reflects the lower shipping costs to and from Nampo, Pyongyang's gateway port, and the inter-Korean maritime agreement (2004) to boost the circulation of Korean ships, notably between Incheon and Nampo ports. However, both trade and shipping have been dramatically affected by the second nuclear tests of mid-2006.

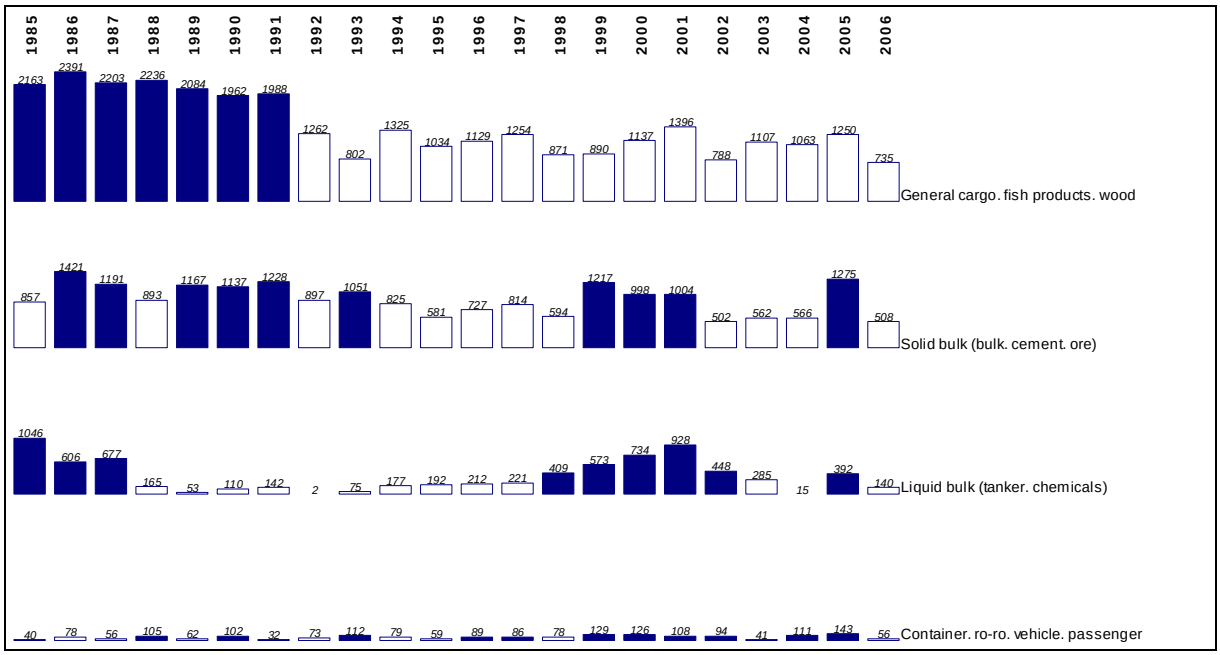
There are also important differences according to the type of commodities (Figure 4). General cargo occupies the largest capacity, probably because maritime transport in North Korea is used as a complement to land transport, which is mostly used for raw materials and bulky products (Roussin and Ducruet, 2006).

Therefore, the two categories on which North Korea is the most dependent, general cargo and liquid bulk (chemical, tanker) have declined more rapidly. The rapid decline of liquid bulk from 1987 to 1988 illustrates the worsening relations with the traditional socialist partners that used to provide oil in exchange of other goods (textiles, fish products, non-ferrous metals, machineries…). Since then, North Korea has not been able to purchase oil on the world market due to the lack of foreign currencies. The peak of liquid bulk traffics between 1998 and 2002 clearly indicates the effect of humanitarian aids that is also the case for solid bulks.

Bulk traffic has been more stable along the period for two reasons. First, North Korea possesses enormous amounts of natural resources such as sands, mine products, ferrous and non-ferrous metals, which could have been exported although the oil-dependent extraction and carriage processes have faced some difficulties. Second, since the North Korean economic system is

dominated by heavy industries, it has continued purchasing low-valued goods on the world market, although it is estimated than only 20% of existing factories are still in operation nowadays. Finally, container and ro-ro ships are of minor concern, due to the lack of container handling facilities in this country, on one side, and to the very limited trade, consumption, and production of finished and semi-finished products.

**Figure 4: Traffic evolution at North Korean ports by main commodity, 1985-2006 (Unit: 000s DWT)**




Sources: authors, calculated from Lloyd's Marine Intelligence Unit (LMIU)

*N.B. Bold color indicates values higher than the row's average*

## 2. A GEOGRAPHICAL ANALYSIS OF NORTH KOREAN MARITIME CONNECTIONS

### 2.1 Maritime connectivity, port performance and external hub concentration

In order to highlight the nature of the evolution of North Korean shipping, a set of indicators has been calculated from the vessel movements on various geographical scales (Table 1). While selected indicators are similar to those used in recent studies of shipping connectivity, such as the number and maximum – or average – size of vessels by port of call, they are not completed by other types of indicators such as port infrastructure characteristics, and inter-port distance tables, freight rates, bilateral trade figures and other economic indicators such as GDP (Hoffmann and Wilmsmeier, 2007). Another difference is that most former research has taken place within a comprehensive geographical area – the Mediterranean or Caribbean basins – where analytical tools such as network theory and central place theory can be applied (Mc Calla et al., 2004; Cisic et al., 2007). Comparatively, our research extends to the world scale, and one would acknowledge that the

information used in former studies does obviously not exist on such level and for a period of 22 consecutive years. In addition, new indicators of are produced for the specific needs of this study, labelled as concentration and performance indicators.

**Table 1: Selected indicators on maritime activity**

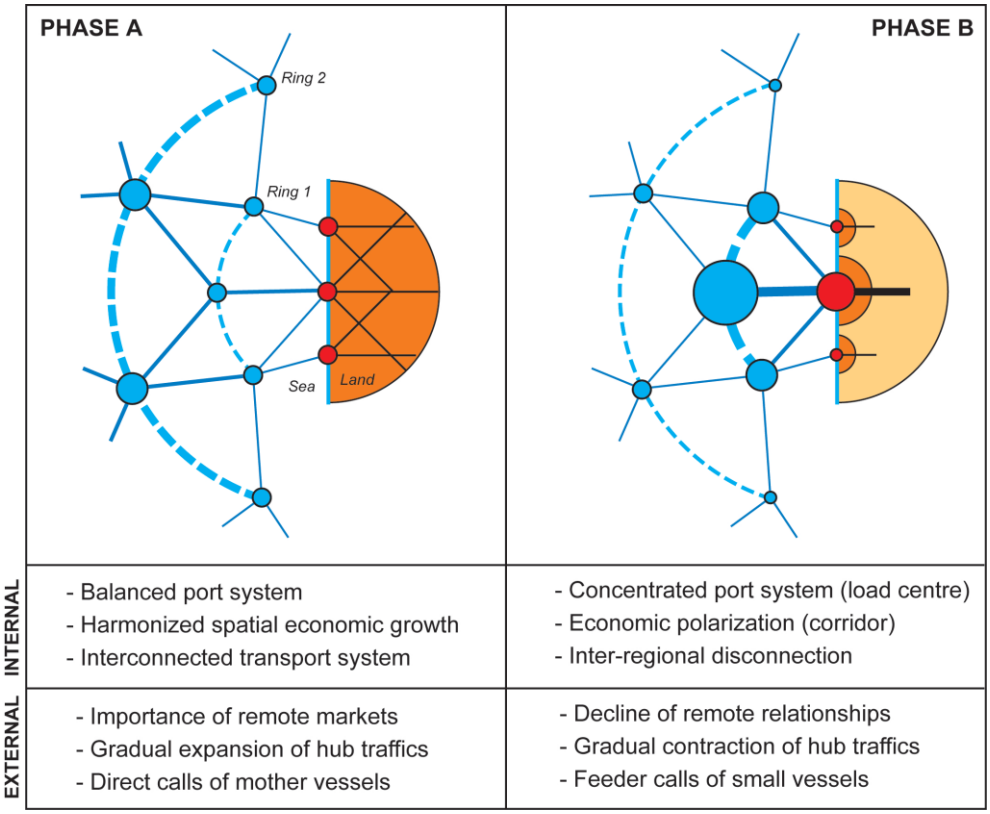
| Type of indicator | Indicator | Calculation method |
|---|---|---|
| **Concentration** | External port concentration (1) | Maximum value of DWT percentages among directly connected port (%) |
| | External port concentration (2) | Maximum value of TEU percentages among directly connected port (%) |
| **Connectivity** | Global connectivity (1) | Total number of ports connected to North Korea worldwide |
| | Global connectivity (2) | Total number of calls worldwide |
| | External connectivity | Total number of directly connected ports |
| | Internal connectivity | Total number of calls at North Korean ports |
| **Performance** | Average ship size | Total DWT divided by the number of ships calling at North Korean ports |
| | Share of small vessels | Percentage of vessels under 4,500 DWT among total vessels (%) |
| | Average age of North Korean ships | Average difference between year of building and year of shipping |
| | Share of North Korean ships | Percentage of ships under North Korean flag among total vessels (%) |

Source: authors

Container capacities refer to the number of available container slots on the ships. It is separated from total deadweight tonnage because external concentration is more likely to happen in the container business than in other shipping sectors. The size of ships is selected because it is widely accepted by port specialists as a direct indicator of both local performance (port modernisation) and global trend (trade importance). Thus, it can be used as well to highlight the lack of investment in port facilities and the decreasing trade. Also, the relative importance of North Korean ships in overall shipping can be used as an indicator for the involvement of foreign ships in North Korea's international trade.

As showed in Figure 5, the first maritime ring (Ring 1) concerns the immediate ports of calls before and after North Korean ports, while the second maritime ring (Ring 2) concerns any port connected to North Korea worldwide. Such distinction allows comparing two dimensions of spatial change.

**Figure 5: Spatial model of theoretical external hub development**




Source: authors

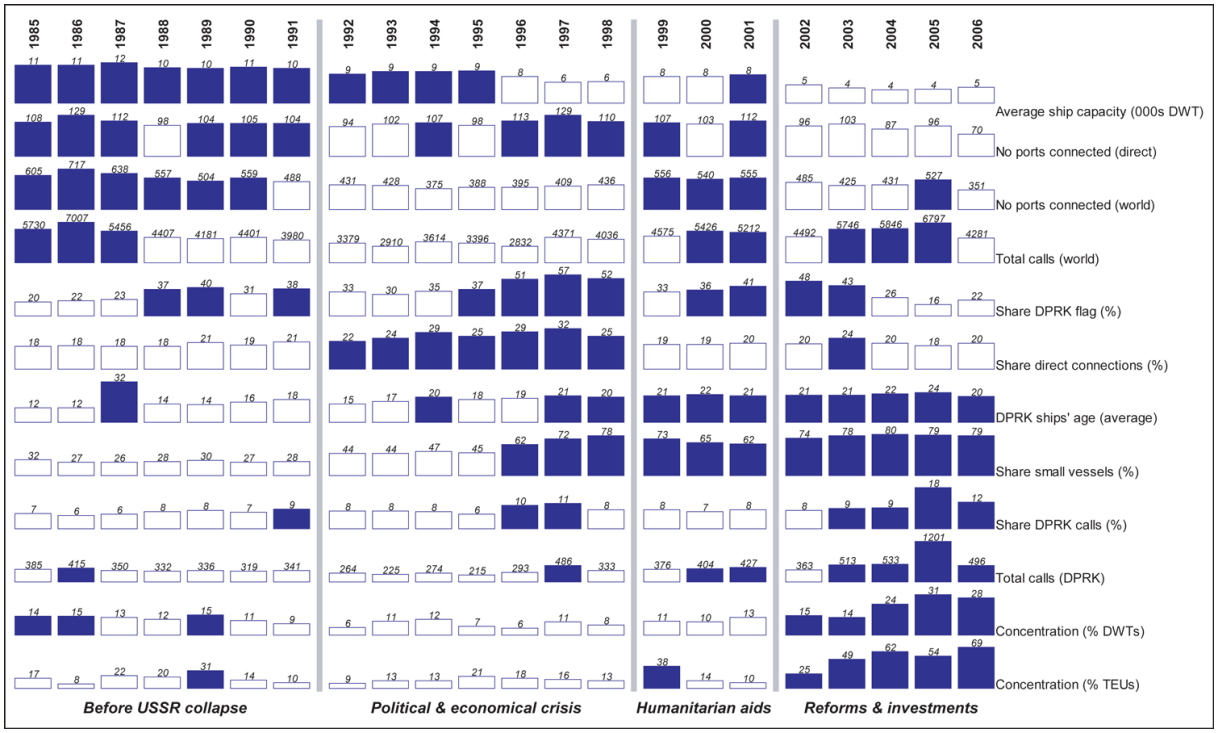
The different concentration degrees within those rings may indicate the changing trade patterns but also the evolving behaviour of shipping companies willing to access North Korean ports. The more a shipping company is willing to connect directly distant ports to North Korea, the more North Korea is embedded in globalisation, and vice-versa. Figure 5 also shows a hypothetical phenomenon from Phase A, with long distance calls serving remote markets (Ring 2), and internal balance of the port system, to Phase B, with dominant short distance calls, internal port concentration and transport system dereliction.

Thus, Figure 5 hypothesizes a correlation between internal and external factors shaping economic development and maritime systems. A developing country would be able to invest in the modernization of its own transport system in order to avoid concentration and congestion internally and externally. This allows more direct calls at multiple ports. Otherwise, only one main load centre will continue to grow at the expense of other isolated port hinterlands[5]. Consequently, this main load centre will also face technical limitations and become dependent on one main and close external hub.

[5] see Lee, Song and Ducruet, 2007 for a synthesis of port evolutionary models

The evolution of all indicators is compared in Figure 6 with reference to four important periods in the country's evolution. Some new indicators have been calculated in order to relate different phenomenon at different scales, such as the percentage of North Korean calls in total calls, and the percentage of capacities at the directly connected maritime ring in the world total.

**Figure 6: Indicators of North Korean maritime connectivity and performance, 1985-2006**




Source: authors, calculated from Lloyd's Marine Intelligence Unit

*N.B. Bold color indicates values higher than the row's average*

- *Four periods*: from the trends observed, four periods can be distinguished. They all correspond to important political and economical changes in North Korea's evolution, such as before USSR collapse (1985-1991), during the crisis (1992-1998), humanitarian aids (1999-2001), and the economic reforms / North-South improvements (2002-2006);
- *Performance and connectivity*: the most striking declining indicators are those of performance (average ship capacity) and global connectivity (total ports connected through Ring 1 and Ring 2), while the growth of other performance indicators (average ship age, share of small vessels, share of North Korean ships) also indicate a decline of North Korea's position in the world system. Long distance calls and services are gradually replaced by short-sea movements based on small shipments. However, some other indicators show the regain of performance and connectivity during the last period (2002-2006), with noticeable increase of total calls and decrease of the relative importance of North Korean ships. Thus, it

may be interpreted that in the recent years, North Korea has managed overcoming some constraints by attracting more shipping lines in a context of increased foreign investments. This is better reflected in the growing share of Ring 1 (direct connections) during the period of crisis (1992-1998), as an effect of global foreland contraction, but this share has gone back to pre-1991 values since 1999 due to increased internationalization. In the end, such evolution indicates a close relationship between geopolitical change and maritime change, resulting in increased isolation;

- *Port concentration*: external concentration within Ring 1 is a very recent trend affecting North Korean ports. While it has been quite stable along the period, except from some important values in the late 1980s, probably due to the importance of Singapore and Hong Kong in North Korea's connections, this concentration suddenly increases since 2002. Although the relation between this trend and the aforementioned loss of performance / connectivity is not demonstrated fully, there is much evidence about the interrelation between the different trends. Another aspect that is in line with former cases of hub development worldwide, is the stronger concentration of container traffics (TEUs) compared to total traffics (DWT). Thus, shipping lines handling containers are more likely to concentrate on one main hub – here between 50 and 70% of traffics – their services;
- *Overall trend*: we see in Figure 6 a process of hub development through external port concentration and internal port limitations. This process is also explained by the restart of extensive port activity in a country which is not able to invest in modern facilities. Although trade amounts grow rapidly, shipping lines are forced to tranship the cargo from a pivotal port – or transit hub port – to a smaller vessel before calling at a North Korean port. In the end, results demonstrate to what extent recent changes in North Korean economic policy such as reforms, foreign investment, and cooperation projects have positively affected maritime activities. Over a short period of time, this activity has restarted although it still lacks of technical standards. Thus, it demonstrates that the extension of a country's maritime connections in a globalized environment depends on industrial dynamism and port service quality, rather than transport costs. Global contraction and local constraints are thus combined to explain the unprecedented trend of port concentration within neighbouring ports.

### 2.2 Regional distribution of traffics

As a first step understanding the evolution of North Korea's maritime linkages, Table 2 provides an overview of the summation of vessel capacities by port region. At first glance, we

observe the growing share of Asia in the total capacity, from 62% in 1985 to 92% in 1986. Of course, this number is inflated because most ships calling at North Korean ports from and to other areas have also to call to other Asian ports. However, it is a good indicator of the isolation of the country over time. The most distant Asian port region, Middle East & Red Sea, has strongly reduced, but other areas have been quite stable while Northeast Asia. The closest area (Russian Far-East, Japan, China, South Korea, and Taiwan), has increased its share twofold along the period, from 38% to 72%. It is interesting to see that until 1988, the share of Asia and of Northeast Asia were reducing, probably illustrating the continued international expansion of trade, although on fragile grounds. Thus, the dramatic decline starting from 1989 clearly depicts the geopolitical change in North Korea's political and economical relations. Also, the sharp increase of Asia's share between 2005 and 2006 confirms to what extent maritime linkages directly react to political issues, here the nuclear test.

Some port regions have declined more rapidly than others. For example, the Black Sea and Scandinavia & Baltic port regions were key trading areas of the USSR until its collapse in 1991 (e.g. wheat trade). The original weight of Central America and North Africa is better explained by their strategic position for global shipping, with the Suez and Panama canals, while their decline illustrates the loosening of long-distance trades with outlying areas, notably Northwest Europe (from 4.8% to 0.7%). Also, it highlights the economic decline and/or political change in brother countries such as Angola, Cuba, Nicaragua, Libya, and Algeria, which have enjoyed privileged relationships at that period. The revival of traffics in most areas during the period of humanitarian aids (1998-2002) is better illustrated in areas such as North America Gulf Coast (oil, grains), West Mediterranean (e.g. Gibraltar), and the aforementioned pivotal regions.

This global snapshot of the geographical distribution of flows only answers one part of the original questions. Some regions have been more or less trading with North Korea over time, and others have remained transit regions through which most of the world's ships pass. A more detailed look at the distribution by port of call would better answer the specific trend of change in the nature and extension of North Korea's external maritime connections, and to verify the gradual building of a hub-and-spoke network around North Korea within Northeast Asia.

**Table 2: Regional distribution of North Korea's maritime connections, 1985-2006 (Unit: % DWT)**

| Port region | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Asia, of which:** | **62.6** | **58.1** | **61.9** | **57.7** | **65.7** | **64.7** | **73.2** | **82.2** | **76.3** | **79.6** | **82.9** | **76.4** | **83.2** | **72.6** | **65.2** | **72.8** | **72.2** | **82.9** | **83.7** | **80.4** | **71.9** | **92.6** |
| Northeast Asia | 37.6 | 34.3 | 33.8 | 31.9 | 33.9 | 33.2 | 44.7 | 55.9 | 52.6 | 55.0 | 58.7 | 45.6 | 60.4 | 44.3 | 39.8 | 51.4 | 42.9 | 62.4 | 59.4 | 64.0 | 51.4 | 70.8 |
| Southeast Asia | 11.5 | 11.4 | 11.5 | 13.7 | 16.6 | 17.7 | 14.2 | 14.4 | 12.9 | 13.3 | 12.8 | 18.4 | 10.5 | 15.4 | 15.7 | 12.1 | 18.8 | 11.2 | 11.9 | 10.5 | 9.8 | 12.8 |
| North Korea | 5.7 | 4.7 | 5.4 | 6.0 | 6.6 | 5.7 | 6.5 | 6.5 | 5.6 | 6.5 | 5.2 | 7.3 | 7.5 | 6.2 | 5.3 | 5.6 | 6.4 | 5.4 | 5.5 | 4.7 | 5.7 | 5.4 |
| Indian Subcontinent | 2.8 | 3.3 | 3.7 | 3.2 | 6.2 | 4.8 | 4.1 | 4.2 | 4.4 | 3.3 | 5.5 | 4.2 | 4.1 | 3.5 | 2.9 | 1.6 | 2.9 | 2.2 | 3.8 | 0.8 | 2.6 | 3.0 |
| Middle East & Red Sea | 5.2 | 4.3 | 7.4 | 2.9 | 2.4 | 3.3 | 3.7 | 1.2 | 0.9 | 1.5 | 0.7 | 1.0 | 0.7 | 3.2 | 1.5 | 2.0 | 1.4 | 1.7 | 3.1 | 0.5 | 2.5 | 0.6 |
| **Europe, of which:** | **18.8** | **18.8** | **18.4** | **20.1** | **16.6** | **14.1** | **10.6** | **6.2** | **6.3** | **6.0** | **5.1** | **8.4** | **7.7** | **11.4** | **11.2** | **5.8** | **12.5** | **6.1** | **6.5** | **8.9** | **9.8** | **2.9** |
| Black Sea | 6.8 | 8.3 | 5.7 | 7.5 | 8.9 | 6.5 | 3.0 | 1.0 | 1.0 | 1.0 | 2.2 | 3.6 | 2.3 | 0.4 | 1.2 | 0.9 | 1.7 | 1.3 | 1.2 | 2.4 | 2.0 | 0.2 |
| West Mediterranean & Iberian Peninsula | 2.8 | 3.5 | 3.6 | 3.6 | 1.8 | 2.4 | 2.9 | 1.3 | 2.3 | 3.2 | 0.9 | 2.3 | 3.0 | 5.6 | 5.3 | 2.6 | 4.5 | 2.2 | 2.4 | 3.1 | 3.0 | 0.2 |
| Northwest Europe | 4.8 | 2.5 | 3.4 | 4.0 | 2.7 | 2.5 | 1.7 | 1.7 | 1.5 | 0.9 | 1.0 | 1.0 | 0.4 | 1.9 | 1.4 | 0.7 | 2.2 | 1.0 | 0.9 | 0.7 | 1.3 | 0.7 |
| Scandinavia & Baltic | 1.7 | 2.1 | 2.3 | 2.8 | 0.9 | 1.0 | 1.2 | 0.4 | 0.5 | 0.2 | 0.1 | 0.4 | 0.4 | 1.7 | 0.9 | 0.4 | 1.8 | 0.2 | 1.2 | 0.6 | 0.5 | 1.6 |
| British Isles | 1.2 | 0.8 | 1.7 | 1.0 | 0.7 | 0.6 | 1.1 | 1.4 | 0.4 | 0.3 | 0.8 | 0.4 | 0.2 | 0.3 | 1.8 | 0.5 | 1.7 | 1.0 | 0.9 | 1.7 | 2.5 | 0.2 |
| East Mediterranean | 1.4 | 1.6 | 1.6 | 1.0 | 1.6 | 1.2 | 0.7 | 0.5 | 0.6 | 0.4 | 0.1 | 0.6 | 1.4 | 1.4 | 0.6 | 0.6 | 0.5 | 0.4 | 0.1 | 0.5 | 0.5 | 0.0 |
| **Africa, of which:** | **9.1** | **9.3** | **7.9** | **9.0** | **8.5** | **7.6** | **4.5** | **3.6** | **4.6** | **6.1** | **2.2** | **4.6** | **3.0** | **4.1** | **5.0** | **4.2** | **3.9** | **2.3** | **3.7** | **3.6** | **2.9** | **1.2** |
| North Africa | 6.0 | 6.8 | 5.6 | 7.4 | 6.5 | 6.3 | 3.2 | 1.9 | 2.0 | 5.3 | 1.5 | 2.3 | 1.5 | 3.3 | 2.2 | 0.9 | 2.0 | 1.2 | 1.4 | 1.6 | 1.7 | 0.0 |
| West Africa | 2.3 | 1.6 | 1.2 | 1.0 | 0.8 | 0.8 | 0.5 | 0.5 | 1.7 | 0.0 | 0.2 | 0.7 | 0.2 | 0.3 | 1.0 | 0.7 | 0.5 | 0.4 | 1.1 | 0.9 | 0.1 | 0.4 |
| Southern Africa | 0.3 | 0.3 | 0.9 | 0.3 | 0.7 | 0.4 | 0.6 | 1.1 | 0.6 | 0.7 | 0.5 | 1.4 | 0.8 | 0.3 | 1.3 | 2.0 | 1.1 | 0.5 | 0.4 | 0.7 | 0.8 | 0.1 |
| East Africa & Indian Ocean | 0.5 | 0.6 | 0.3 | 0.3 | 0.4 | 0.1 | 0.2 | 0.1 | 0.3 | 0.1 | 0.0 | 0.2 | 0.5 | 0.3 | 0.5 | 0.6 | 0.3 | 0.3 | 0.7 | 0.3 | 0.2 | 0.6 |
| **North America, of which:** | **2.6** | **6.9** | **3.7** | **6.8** | **2.8** | **5.8** | **6.0** | **3.6** | **3.8** | **3.1** | **5.4** | **3.0** | **3.3** | **5.4** | **8.5** | **9.5** | **6.2** | **4.9** | **0.6** | **2.9** | **3.8** | **0.2** |
| North America West Coast | 1.8 | 2.4 | 1.5 | 3.6 | 1.3 | 3.7 | 4.2 | 2.7 | 2.4 | 1.1 | 4.7 | 2.0 | 0.8 | 0.8 | 2.2 | 3.9 | 3.3 | 3.2 | 0.5 | 2.0 | 1.8 | 0.2 |
| North America Gulf Coast | 0.4 | 2.4 | 1.1 | 1.2 | 1.0 | 1.3 | 1.2 | 0.6 | 1.1 | 1.5 | 0.2 | 0.7 | 1.6 | 3.7 | 4.6 | 3.7 | 1.7 | 1.1 | 0.2 | 0.2 | 1.1 | 0.0 |
| North America East Coast | 0.4 | 2.2 | 1.1 | 2.0 | 0.5 | 0.8 | 0.5 | 0.3 | 0.3 | 0.6 | 0.5 | 0.3 | 0.9 | 0.9 | 1.7 | 2.0 | 1.3 | 0.6 | 0.0 | 0.8 | 0.8 | 0.0 |
| **Latin America, of which:** | **2.8** | **4.0** | **3.0** | **2.5** | **1.5** | **2.3** | **1.2** | **0.8** | **1.9** | **0.7** | **0.5** | **0.7** | **0.5** | **1.7** | **4.0** | **2.0** | **2.3** | **1.0** | **0.4** | **1.3** | **1.7** | **0.1** |
| Central America | 2.5 | 2.3 | 1.6 | 2.1 | 1.2 | 2.1 | 1.2 | 0.8 | 1.5 | 1.3 | 0.6 | 1.1 | 0.7 | 2.4 | 3.1 | 1.9 | 1.2 | 1.0 | 0.5 | 1.3 | 1.6 | 0.0 |
| South America East Coast | 0.3 | 0.4 | 0.8 | 0.2 | 0.5 | 0.7 | 0.6 | 1.0 | 1.6 | 0.4 | 0.4 | 0.5 | 0.6 | 0.8 | 2.1 | 0.2 | 0.7 | 0.3 | 0.5 | 1.4 | 1.2 | 0.3 |
| Caribbean | 0.8 | 1.2 | 0.6 | 0.9 | 0.5 | 0.6 | 0.2 | 0.3 | 0.1 | 0.0 | 0.2 | 0.0 | 0.1 | 0.5 | 0.9 | 0.5 | 0.9 | 0.9 | 0.0 | 0.7 | 0.1 | 0.0 |
| South America West Coast | 0.1 | 0.1 | 0.6 | 1.1 | 0.5 | 0.4 | 0.0 | 0.0 | 2.1 | 0.0 | 0.2 | 0.7 | 0.1 | 1.5 | 0.2 | 0.7 | 0.6 | 0.3 | 0.1 | 0.0 | 0.2 | 0.0 |
| South America North Coast | 0.1 | 0.2 | 0.4 | 0.1 | 0.2 | 0.0 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 1.2 | 0.4 | 0.7 | 0.5 | 0.0 | 0.0 | 0.1 | 0.0 |
| **Oceania & Pacific, of which:** | **3.1** | **2.7** | **4.1** | **1.9** | **3.5** | **3.8** | **3.4** | **2.1** | **3.7** | **3.4** | **3.0** | **5.3** | **1.3** | **1.0** | **2.7** | **3.9** | **1.0** | **0.8** | **4.4** | **0.8** | **8.4** | **2.7** |
| Oceania | 2.5 | 2.4 | 3.7 | 1.7 | 3.3 | 3.6 | 3.3 | 1.8 | 3.6 | 3.4 | 2.6 | 5.3 | 1.3 | 0.9 | 2.6 | 3.5 | 0.9 | 0.7 | 3.6 | 0.7 | 8.2 | 2.7 |
| Pacific | 0.6 | 0.3 | 0.4 | 0.3 | 0.1 | 0.2 | 0.1 | 0.3 | 0.2 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.1 | 0.5 | 0.1 | 0.2 | 0.7 | 0.1 | 0.2 | 0.0 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |

Source: authors, calculated from Lloyd's Marine Intelligence Unit

## 3. THE EMERGENCE OF SOUTH KOREA AS NORTH KOREA'S MAIN TRANSIT HUB

### 3.1 Measuring connexity at ports connected with North Korea

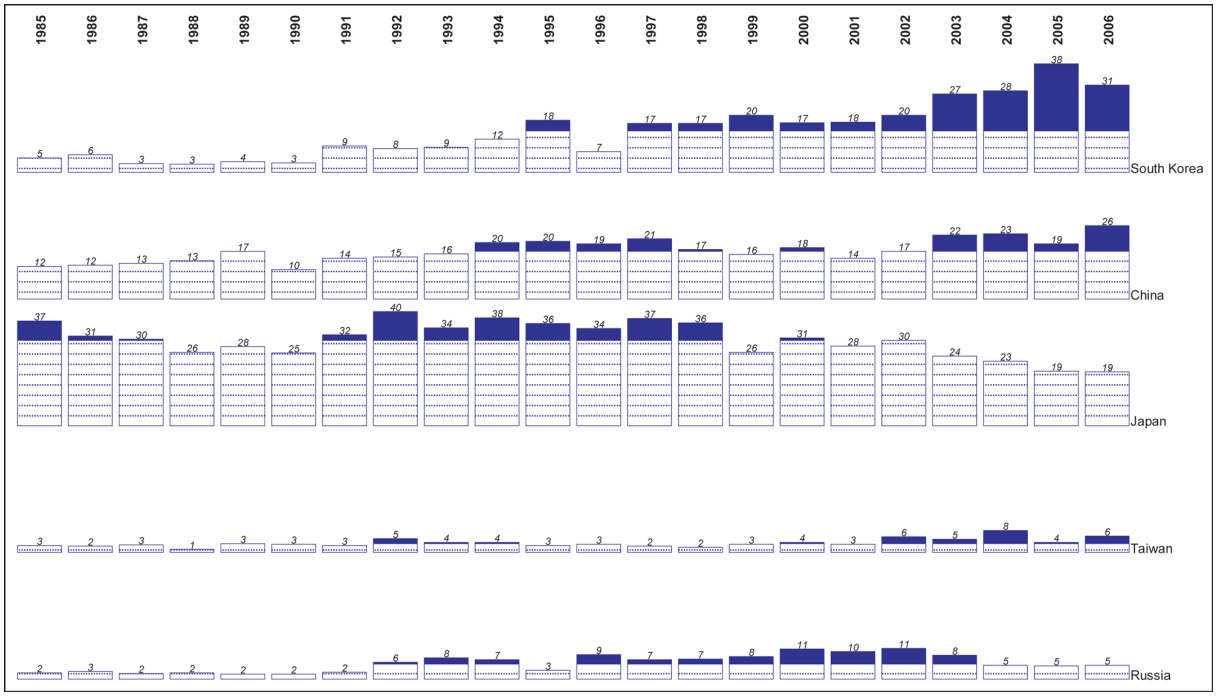
Although a large part of the existing literature points at the emergence of port hubs within port regions, there is no recognized methodology for studying such trend. Thus, this paper proposes a simple approach based on the number of calls by port. This index can be associated to the wider group of connectivity indexes, because it sums on a yearly basis all ship movements realized within the North Korean-related worldwide maritime network. In so doing, the indicator summarizes embedded dynamics of great complexity, since various ships, companies, with various destinations and origins are included in this final number.

The common aspect of all of the 1,720 related ports is that they each have been connected to North Korean ports – directly or indirectly – at least once between 1985 and 2006. As mentioned earlier, there must be a rational selection of places by the shipping lines, according to the specific trading networks within which North Korea has been embedded over time, and also due to shipping costs for reaching North Korea itself. The number of calls will differentiate ports according to their degree of connectivity with North Korea's trade flows, either for transit or for trade itself. The difficulty distinguishing transit calls from trade calls is not specific to this dataset, since most port studies are aware of the difficulty analysing transhipment rates in port traffics. Therefore, the number of calls can be employed as a surrogate for the geographical extension of North Korean maritime linkages and, beyond, for revealing which ports are more connected than others. Although one single call may hide a wide range of realities in terms of vessel type and vessel size, the sum of yearly calls still illustrates a degree of regularity in shipping movements. Also, it has the advantage of not being influenced by exceptional values stemming from the gap between conveyed ship capacities, such as between a containership of 200,000 DWT and a general cargo ship of 20,000 DWT that would distort the results based on total or average capacity values.

When calculating the percentage of neighboring countries in overall connexity (Figure 7), it appears that closest transit ports have played a varying role over time. Japan, a major trading partner, has lost its dominance only since 2003 due to the decrease of commercial relations and the banning of North Korean ships from its ports. Until then, Japan has concentrated between 25% and 40% of all maritime connections of North Korea, notably in the period of isolation (1992-1998). Although trades with China and Russia are dominantly landward, their shares of maritime connections have also increased in recent years, but those

of Russia have suddenly decreased since 2004. Notably, Dalian serves as a transit hub for Nampo traffics to and from Europe Thus, traffics have been redistributed to South Korea, which has now become the leading external hub, while it had concentrated only 3% to 12% of North Korea's external connections until 1997.

**Figure 7: Connexity shares at North Korea's neighbouring ports by country, 1985-2006 (% calls)**




Source: authors, based on Lloyd's Marine Intelligence Unit

## 3.2 Factors of traffic growth at South Korean ports

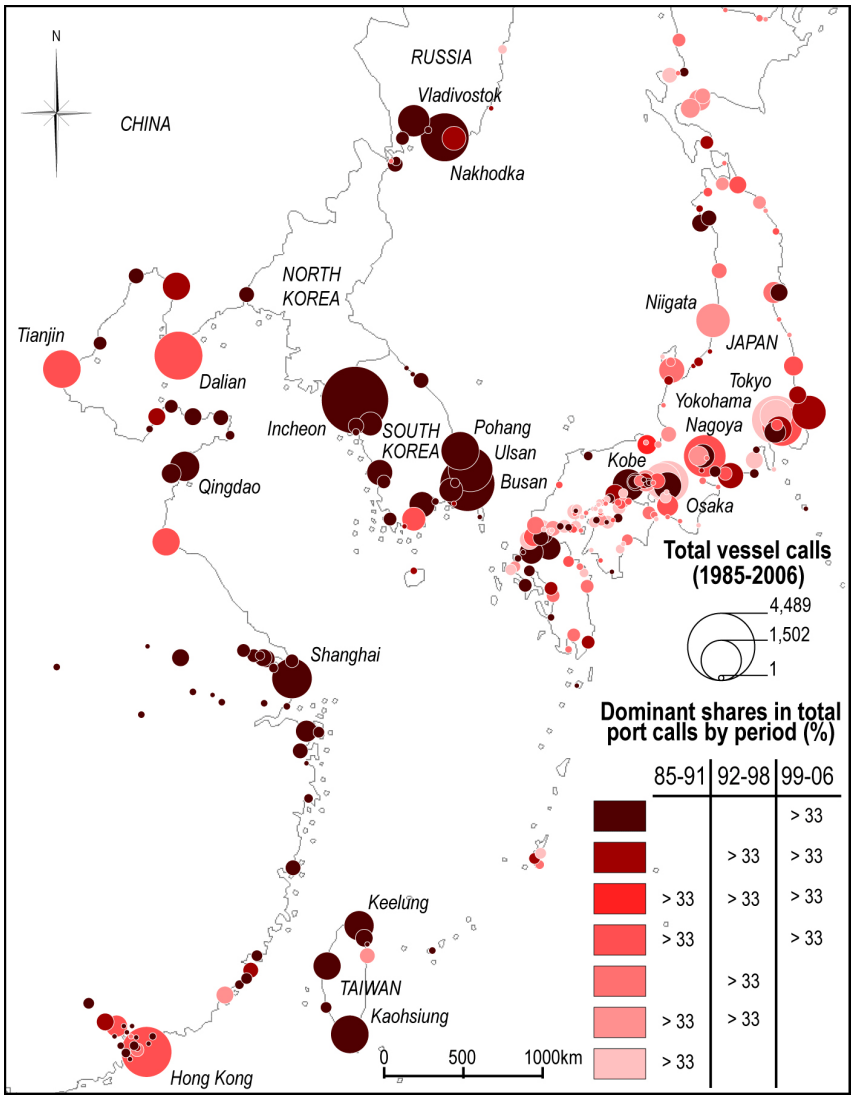
Several explanations can be given to the rise of South Korea as the leading hub:

- The importance of humanitarian support, accounting for 25 to 60% of inter-Korean trade, due to the fact that South Korea is willing to avoid a sudden collapse of the North's economy that would have in turn irremediable consequences on its own economy;
- The continuous growth of inter-Korean trade that is realized 90% through maritime transport due to the blockage at the demilitarized zone (DMZ) between the two Koreas;
- The successful economic cooperation projects following the inter-Korean summit that have required important shipments of raw materials and manufactured goods to build and start, notably, the Gaeseong Industrial Park;

- Institutional arrangements such as the inter-Korean maritime agreement (2004) focusing on the opening of new sea routes and inter-port cooperation, resulting in the agreement between Incheon and Nampo (2005) for regular ferry and container services;
- The advantageous situation of South Korea as a pivotal hub allowing optimizing the servicing of both east and west coasts of the peninsula, in a context of maritime network reorganization of interested shipping lines in Northeast Asia.

As a result, Incheon is the most favorably located to serve the Nampo-Pyongyang industrial corridor (Roussin and Ducruet, 2007) where most recent investments have occurred (Figure 8).

**Figure 8: Connexity index at Northeast Asian ports connected to North Korea, 1985-2006**




Source: authors, based on Lloyd's Marine Intelligence Unit

Also, Incheon is more directly accessible for small vessels willing to access North Korea, confirming its role as a hub of the Yellow Sea (Ducruet, 2007). Another explanation lies in the balance of trade, because North Korea imports more than it exports. Thus, the dominant hub is also the hub that is responsible for most imports from North, i.e. South Korea. It may be the case that export flows have a different spatial pattern, for example through North Korean ships using preferably Chinese or Russian hubs.

Another possible analysis of hub dependence is to calculate for every North Korean port the share of its connections with immediately connected ports and countries. Table 3 shows the results for the three main periods, retaining only the five highest shares and the main trading partners within Northeast Asia, with three main trends:

- *The South Korean hub*: South Korean ports have realized the highest shares for some North Korean ports, as for Incheon for Haeju (84% inbound and 87% outbound) and Nampo (10% inbound and 13% outbound); Ulsan for Heungnam (23.5% inbound and 25% outbound) and Songjin (31% outbound). Although other South Korean ports have increased their shares rapidly, they remain secondary connections for other North Korean ports.
- *The permanency of long-distance calls*: the sustained importance of Singapore as the main external hub of some North Korean ports such as Cheongjin (9% inbound) and Songjin (12% inbound), together with Kaohsiung (Taiwan), Richards Bay (South Africa), Bangkok and Laem Chabang (Thailand) shows that some port cities have maintained some international trade efficiently. The North Korean ports for which distant ports are still directly connected for substantial shares are usually large cities, gateways to large and isolated hinterlands (Nampo-Pyongyang, Cheongjin, Heungnam-Hamheung), or locate close to cooperation projects (e.g. KEDO project and Songjin) (Ducruet, Gelezeau and Roussin, 2007). The relation between hinterland evolution and port traffic appears in Table 3, with a divide between East and West in terms of urban and port growth;
- *The regional specializations of maritime linkages*: for other North Korean ports, the proximity is the main factor explaining the distribution of traffics, such as in the East between Rajin and Russian ports, between Wonsan and Japanese ports (e.g. ferry link with Niigata). Also among South Korean hubs, we see an effect of maritime façade

with strong connections among closely located ports, such as between Nampo, Haeju, and Incheon in the West, and between Heungnam, Cheongjin, Wonsan, and Busan, Ulsan, and Onsan in the East. Although the share of Japan has decreased dramatically, Japanese traffics are still dominant for Cheongjin, Wonsan, and Nampo.

**Table 3: Port and urban evolution in North Korea**

| | Urban population (000s) | | | Port traffics (Totals) | | |
|---|---|---|---|---|---|---|
| | 1983 (a) | 1993 (b) | 2002 (c) | 1985-1991 (a) | 1992-1998 (b) | 1999-2005 (c) |
| Cheongjin | 754 | 520 | 674 | 4,611,125 | 1,991,722 | 2,149,775 |
| Hamheung-Heungnam | 775 | 701 | 821 | 4,397,516 | 917,715 | 2,012,611 |
| Haeju | 213 | 195 | 265 | 230,992 | 450,178 | 865,869 |
| Nampo-Pyongyang | 2,880 | 3,307 | 3,833 | 8,478,900 | 6,842,432 | 7,836,534 |
| Wonsan | 350 | 300 | 347 | 4,938,751 | 1,561,443 | 866,728 |
| Rajin-Seonbong | 70 | 120 | 150 | 913,798 | 836,943 | 357,837 |
| | Urban growth (%) | | | Port traffics change (%) | | |
| | (a) to (b) | (b) to (c) | (a) to (c) | (a) to (b) | (b) to (c) | (a) to (c) |
| Cheongjin | -31.0 | 29.6 | -10.6 | -56.8 | 7.9 | -53.4 |
| Hamheung-Heungnam | -9.5 | 17.1 | 5.9 | -79.1 | 119.3 | -54.2 |
| Haeju | -8.5 | 35.9 | 24.4 | 94.9 | 92.3 | 274.8 |
| Nampo-Pyongyang | 14.8 | 15.9 | 33.1 | -19.3 | 14.5 | -7.6 |
| Wonsan | -14.3 | 15.7 | -0.9 | -68.4 | -44.5 | -82.5 |
| Rajin-Seonbong | 71.4 | 25.0 | 114.3 | -8.4 | -57.2 | -60.8 |

Source: authors, calculated from various sources

### 3.3 Implications for North Korea's port and regional development

This research has highlighted for the first time regional dynamics in which North Korean ports are embedded. Of course, ports are not isolated from their local and regional environments, i.e. hinterlands. Therefore, port dynamics in North Korea must be closely related to internal changes in terms of regional evolutions of the economy. Such dynamics may be interpreted as follows:

- Internal concentration: the trend of *external* port concentration that is one key element of the emergence of a hub serving a given area is accompanied in North Korea by the parallel trend of *internal* port concentration. Thus, although it is not well connected through land transport, the North Korean port system is undergoing a major spatial change with the westward shift of traffics favoring Nampo, the port gateway of Pyongyang. Therefore, the concentration on Incheon hub is also in some way reflecting the concentration on Nampo. This indicates to what extent internal and external factors are tied together;

- Industrial dynamics: a corollary of the previous trend of internal port concentration is the uneven industrial evolution within the country. Although major hinterlands such as Nampo-Pyongyang, Heungnam-Hamheung, and Cheongjin show a similar trend of sustained long-distance flows due to stronger industrial base than smaller cities, one can except that most seaborne trade occurs at Nampo, while Eastern cities have a higher percentage of humanitarian aids in their traffics. As mentioned elsewhere, most industrial and port facilities in the eastern part of the country, including also Wonsan, have deteriorated more rapidly than in the western part, due to several factors such as geopolitical change (loss of Russian and Japanese trades), peripheral location, and lack of energy and investments;
- Logistics and accessibility: one other important factor to explain how diversely North Korean ports are responding to change is the logistic cost and the overall accessibility. Recent data provided by forwarders in North Korea, combined with data from NGOs all show the rapid increase of transport costs from Pyongyang to other cities of the east coast. In North Korea, most investments in road infrastructure have been made in the western area, resulting in poor accessibility to the east. Such divide is reinforced by natural factors such as land elevation and climate. This also can explain why Nampo is the only port that has been modernized in recent years. Also, it explains why most foreign investments (i.e. China and Europe) outside free-zones have occurred along the Nampo-Pyongyang industrial corridor in recent years (Roussin and Ducruet, 2007).

We can discuss further the implications for future development of such trends with the following developmental issues:

- Regional disconnection: there is a risk that the economic space of the North Korean territory is more and more restrained to the core region of Nampo-Pyongyang. In this respect, the lack of transport policy – and the financial, technical means to implement it – cannot allow the different parts of the country to remain connected and form one single spatial system. We have in North Korea the emergence of several sub-systems having their own resources for economic development. For instance, not only the South Korean free-zones (Gaeseong, Mt. Geumgang) and the Chinese free-zones (Raseon, Sinuiju) are too far from each other to be interconnected, but also they are not well connected with the core region of Pyongyang-Nampo, except for Sinuiju.

However, this last free-zone is the only zone to have not succeeded in enticing foreign investments, due to politics and lacks of trade agreements. It can also be the case that such inter-regional disconnection is a planned policy of North Korea. This is reflected in the spatial distribution of the highway network, which has a political rather than economic rationale, since it does connect at the borders. Thus, the trend of external port concentration, coupled with sustained regional seaborne links of proximity, may reflect the will of North Korean officials to limit the circulation of goods within the country, preferring a multi-polar rather than an integrated territory as a defense strategy. In the eventuality of a military invasion, land-based troops would not be able to reach Pyongyang easily;

- Further internationalization: in order to become better inserted within the global economy, North Korea has no option but to improve the way its ports are embedded within transport and logistics chains. However, the abovementioned limiting factors showed the trend of declining port capacity and increased external hub dependence. Although Nampo is a key element in the internationalization of Pyongyang core economic region, as hinted in the recent strategy of the Egyptian firm Orascom (cement) using Nampo as an export gateway, this port remains limited by the West sea Barrage, resulting in low nautical accessibility. In the near future, in the context of growing trade and foreign investments in this area, North Korean officials will face a lack of capacity and technical standards, as it was felt in Indonesian ports at early 1980s. Thus, the issue is to what extent would a foreign terminal operator or a shipping line invest in stevedoring facilities in Nampo? One can imagine that Hutchinson Whampoa, a Hong Kong terminal operator which has experience in upgrading Shenzhen ports, Port of Singapore Authority (PSA), or Dubai Ports World (DPW) would probably be interested in such prospects for development. However, although North Korea has started its reform process, it does not yet open the door to multinational corporations of this size, notwithstanding the related Chinese or Arabic capitalistic culture of such organizations. Perhaps in North Korea, upgrading ports may require other methods, such as coupling foreign public investments with the resources of NGOs, so as to maintain the subtle equilibrium between sustained ideology and economic development necessity.

## Conclusion

This paper has demonstrated the economic factors and spatial mechanisms giving birth to hub dependence in the case of a constrained economy. Although such process is not specific to North Korea and has been verified elsewhere, such as the growth of hub ports stemming from technical limitations and rising handling costs in traditional port cities, it has been analyzed using an original methodology based on vessel movements. Not only the geographical pattern of those movements helps understanding the changing trades and behavior of shipping lines at various scales, but also the characteristics of the ships highlight internal factors such as port infrastructure dereliction resulting in decreasing average capacity. The shift from long-distance to short-sea shipping is thus measured precisely through the evolution of maritime connexity at main transit ports. However, hub dependence may greatly vary among ports of a single country, as it has been demonstrated with the varying roles of Russia, Japan, China, and South Korea in connecting North Korea with the outside world.

Such methodology can be applied elsewhere in order to provide a comparative analysis, not only in constrained economies but also in developing and advanced economies, as a means to evaluate the impact of port planning on foreland extension. Notably, countries and ports that are willing to measure their hub dependence (e.g. Le Havre, viz. Antwerp and Rotterdam) may benefit from such research agenda.

**Table 3: Distribution of cargo flows by main external connections by North Korean port, 1985-2006 (Unit: % DWT)**

| Port | Inbound flows | | | | | | | | | | Outbound flows | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1985-1991 | % | 1992-1998 | % | 1999-2006 | % | Pays | 1985-1991 | 1992-1998 | 1999-2006 | 1985-1991 | % | 1992-1998 | % | 1999-2006 | % | Pays | 1985-1991 | 1992-1998 | 1999-2006 |
| Cheongjin | Singapore | 11.7 | Singapore | 9.6 | Singapore | 8.8 | Japan | 50.4 | 44.9 | 25.8 | Singapore | 10.9 | **Maizuru** | 9.1 | **Maizuru** | 17.4 | Japan | 59.4 | 54.6 | 38.1 |
| | **Yokohama** | 5.3 | **Mutsure** | 6.3 | Busan | 8.8 | China | 14.1 | 21.0 | 7.5 | Hong Kong | 8.4 | Shanghai | 7.3 | Richards Bay | 15.3 | China | 16.3 | 10.6 | 5.0 |
| | **Mutsure** | 5.0 | Hong Kong | 5.7 | Gwangyang | 8.2 | South Korea | 0.8 | 7.7 | 27.2 | **Yokohama** | 5.7 | **Kinuura** | 7.2 | Busan | 14.1 | South Korea | 1.0 | 19.7 | 29.8 |
| | Hong Kong | 4.3 | **Kobe** | 4.6 | Kaohsiung | 8.1 | Russia | 0.3 | 2.0 | 2.5 | **Osaka** | 5.5 | **Mizushima** | 6.3 | Ulsan | 10.1 | Russia | 0.0 | 7.1 | 7.8 |
| | **Otaru** | 3.5 | Dalian | 4.0 | **Maizuru** | 7.0 | Other | 34.5 | 24.4 | 36.9 | **Chiba** | 3.9 | Busan | 5.8 | Mipo | 3.6 | Other | 23.3 | 8.0 | 19.3 |
| Haeju | Dalian | 17.8 | Incheon | 12.1 | Incheon | 84.0 | Japan | 18.7 | 49.2 | 2.7 | Singapore | 24.6 | **Kashima** | 15.1 | Incheon | 86.8 | Japan | 29.6 | 77.7 | 3.7 |
| | **Lianyungang** | 14.2 | **Yokohama** | 6.5 | Busan | 2.4 | China | 50.4 | 21.2 | 2.2 | Lianyungang | 10.5 | **Toyohashi** | 14.1 | Busan | 4.7 | China | 30.3 | 17.2 | 0.2 |
| | **Yokohama** | 8.8 | **Toyohashi** | 5.1 | Gunsan | 2.3 | South Korea | 2.0 | 15.2 | 92.7 | **Fukuyama** | 9.0 | **Himeji** | 7.0 | Ulsan | 2.8 | South Korea | 2.1 | 0.8 | 96.1 |
| | Jeddah | 8.7 | **Hirohata** | 4.8 | Bangkok | 2.0 | Russia | 1.8 | 4.3 | 0.0 | Hong Kong | 7.8 | Qinhuangdao | 6.9 | **Toyohashi** | 1.7 | Russia | 0.0 | 0.0 | 0.0 |
| | Zhanjiang | 6.8 | **Osaka** | 3.5 | Hong Kong | 1.9 | Other | 27.1 | 10.2 | 2.4 | **Kashima** | 6.8 | **Hitachi** | 6.9 | Gunsan | 1.2 | Other | 38.0 | 4.3 | 0.0 |
| Heungnam | Singapore | 21.5 | Singapore | 18.2 | Ulsan | 23.5 | Japan | 33.2 | 33.0 | 11.2 | Singapore | 33.0 | Singapour | 14.6 | Ulsan | 24.9 | Japan | 46.3 | 41.1 | 13.9 |
| | **Mutsure** | 5.5 | Panama Canal | 9.6 | Busan | 10.7 | China | 17.5 | 18.3 | 6.4 | **Fukuyama** | 6.7 | Busan | 14.0 | Busan | 12.7 | China | 10.5 | 10.9 | 8.3 |
| | Dalian | 4.4 | **Niigata** | 5.8 | Singapore | 9.6 | South Korea | 2.9 | 7.8 | 55.5 | **Kisarazu** | 5.3 | **Niigata** | 13.4 | Onsan | 10.7 | South Korea | 1.6 | 19.9 | 60.0 |
| | Suez | 4.2 | Dalian | 5.6 | Incheon | 7.7 | Russia | 1.2 | 3.1 | 3.7 | **Wakayama** | 4.1 | **Hakodate** | 7.4 | Singapore | 6.2 | Russia | 0.5 | 1.0 | 3.3 |
| | Aden | 3.8 | Ko Sichang | 2.8 | Onsan | 6.7 | Other | 45.2 | 37.8 | 23.2 | Dalian | 4.1 | Guangzhou | 5.1 | Incheon | 4.9 | Other | 41.1 | 27.1 | 14.5 |
| Nampo | Singapore | 13.7 | Singapore | 9.1 | Incheon | 9.9 | Japan | 37.2 | 39.1 | 29.5 | Singapore | 12.2 | **Oita** | 11.6 | Incheon | 12.7 | Japan | 43.9 | 51.3 | 33.8 |
| | Dalian | 8.9 | Dalian | 7.8 | Singapore | 8.3 | China | 28.4 | 27.6 | 17.4 | Hong Kong | 7.9 | **Kisarazu** | 7.4 | **Nagoya** | 10.0 | China | 28.6 | 26.0 | 19.9 |
| | Hong Kong | 8.7 | **Nagoya** | 6.2 | **Nagoya** | 8.2 | South Korea | 3.4 | 7.5 | 24.8 | **Oita** | 7.3 | Hong Kong | 6.1 | Busan | 7.5 | South Korea | 4.4 | 7.2 | 30.3 |
| | **Nagoya** | 5.7 | Hong Kong | 5.9 | Busan | 5.4 | Russia | 0.2 | 1.2 | 2.2 | **Nagoya** | 6.5 | Singapore | 5.6 | **Tobata** | 5.8 | Russia | 0.2 | 0.6 | 2.6 |
| | **Yokohama** | 5.1 | **Kisarazu** | 4.1 | Dalian | 5.3 | Other | 30.8 | 24.6 | 26.1 | **Kisarazu** | 5.9 | Dalian | 5.5 | **Kisarazu** | 5.3 | Other | 22.9 | 14.9 | 13.4 |
| Rajin | *Nakhodka* | 15.6 | Singapore | 13.1 | *Nakhodka* | 32.0 | Japan | 54.8 | 40.4 | 43.1 | Shantou | 16.3 | **Tsuruga** | 16.6 | *Nakhodka* | 37.6 | Japan | 61.8 | 69.3 | 32.8 |
| | **Mutsure** | 7.5 | *Vladivostok* | 12.4 | **Tomakomai** | 8.4 | China | 11.4 | 13.3 | 2.3 | **Himeji** | 11.3 | **Hitachi** | 12.5 | **Niigata** | 11.8 | China | 32.8 | 7.7 | 1.5 |
| | Shantou | 6.2 | **Tsuruga** | 8.2 | **Niigata** | 8.2 | South Korea | 2.3 | 6.5 | 4.8 | Dalian | 7.8 | Taichung | 7.1 | *Posyet* | 7.3 | South Korea | 0.0 | 1.2 | 6.1 |
| | **Mizushima** | 4.9 | Hong Kong | 5.3 | Ko Sichang | 6.0 | Russia | 17.7 | 17.3 | 37.1 | **Hachinohe** | 6.4 | **Muroran** | 6.6 | *Zarubino* | 6.6 | Russia | 2.2 | 6.2 | 57.2 |
| | Singapore | 4.1 | **Mutsure** | 4.3 | **Maizuru** | 5.4 | Other | 13.8 | 22.5 | 12.7 | **Okinawa** | 5.9 | **Kanda** | 5.1 | **Tomakomai** | 4.9 | Other | 3.2 | 15.6 | 2.4 |
| Songjin | Singapore | 47.8 | **Osaka** | 42.3 | Singapore | 12.4 | Japan | 11.1 | 50.2 | 15.0 | Gladstone | 47.8 | **Hiroshima** | 42.3 | Ulsan | 31.1 | Japan | 11.1 | 50.2 | 28.4 |
| | Paradip | 41.0 | Panama Canal | 34.1 | Incheon | 6.8 | China | 0.0 | 8.0 | 0.0 | Hong Kong | 41.0 | Alang | 34.1 | Pohang | 6.9 | China | 41.0 | 0.0 | 3.3 |
| | **Osaka** | 11.1 | Shanghai | 8.0 | Kaohsiung | 5.9 | South Korea | 0.0 | 0.0 | 26.9 | **Niihama** | 11.1 | Incheon | 8.0 | Laem Chabang | 5.6 | South Korea | 0.0 | 8.0 | 52.3 |
| | - | - | *Nakhodka* | 7.7 | *Vladivostok* | 5.7 | Russia | 0.0 | 7.7 | 7.8 | - | - | **Kobe** | 7.9 | **Nagoya** | 5.2 | Russia | 0.0 | 7.7 | 9.1 |
| | - | - | **Toyohashi** | 4.0 | Busan | 5.7 | Other | 88.9 | 34.1 | 50.3 | - | - | *Nakhodka* | 7.7 | *Vladivostok* | 4.9 | Other | 47.9 | 34.1 | 6.9 |
| Wonsan | Ulsan | 30.8 | **Niigata** | 41.9 | **Niigata** | 26.6 | Japan | 48.7 | 61.2 | 48.2 | **Niigata** | 26.4 | **Niigata** | 41.0 | **Niigata** | 26.3 | Japan | 61.0 | 66.6 | 55.6 |
| | **Niigata** | 25.0 | Ningbo | 6.1 | Ulsan | 8.6 | China | 2.0 | 16.4 | 2.3 | Ulsan | 17.9 | Bintulu | 6.3 | **Kiire** | 7.9 | China | 1.9 | 3.8 | 3.9 |
| | **Yokohama** | 5.2 | **Kashima** | 5.9 | Busan | 8.1 | South Korea | 36.5 | 6.2 | 23.7 | Busan | 5.9 | Onsan | 5.5 | Ulsan | 7.2 | South Korea | 26.6 | 9.2 | 23.7 |
| | Trincomalee | 5.1 | Qingdao | 4.6 | **Kashima** | 8.0 | Russia | 0.0 | 5.5 | 10.6 | **Osaka** | 5.9 | **Mizushima** | 5.5 | Busan | 6.6 | Russia | 0.1 | 6.4 | 15.3 |
| | **Chiba** | 4.8 | *Nakhodka* | 3.9 | Bangkok | 4.2 | Other | 12.8 | 10.7 | 15.2 | Keelung | 4.4 | *Nakhodka* | 3.7 | *Vladivostok* | 4.2 | Other | 10.4 | 14.0 | 1.5 |

*Related countries:* | **Japan** | China | South Korea | *Russia* |

Source: authors, calculated from Lloyd's Marine Intelligence Unit

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