A COMPARATIVE STUDY OF PORT CONCENTRATION IN THE CONTAINER PORT SYSTEMS OF JAPAN, CHINA AND KOREA

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1. Introduction

The concentration of port traffic into a limited number of container ports has been observed and well documented in many literatures. Since 1990s, the concentration tendency of port system has been reinforced by the concept of hub-and-spoke shipping network resulted from the increasing vessel size and strategic alliances of shipping liners. Meanwhile, the competition of the container ports has intensified into the regional level vying for hub status in the region. Concentrated investment was injected to major ports by port authorities or terminal operators for the expansion of the capacity and upgrading of the facilities to accommodate the latest generation vessels, in an attempt to become the regional hub ports.

In the battle for regional hub in the northeast Asia region, Japanese ports are seems to be in an inferior position. It is often said that the international competitiveness of Japanese port is too low, based on the fact that Japanese port is loosing its leading position in world port league and the mother vessels have been starting to abandon Japanese port resulting in the transshipment of the container cargo at neighboring ports. It is claimed that the low competitiveness of Japanese ports is resulted from the fact that Japanese port is too de-concentrated to consolidate the container traffic providing enough volume for the call of the trunk line vessel. From that fact that Japan has five major ports of medium size and a large number of small local container ports, while the neighboring country China and Korea both have dominating mega-ports such as Shanghai and Busan, it seems to be a reasonable judgment that the container port system in Japan is too de-concentrated. However, since the geographical scale and economic scale of these countries are very different, it is difficult to compare the concentration degree of container port system in different country. Therefore, a new comparable index for measuring the degree of concentration is proposed in this paper and applied to the port systems in Japan, China and Korea; moreover, the influence of the port development strategy on port concentration of the country concerned was discussed.

2. Methodology: Geo-Economic Concentration index (GECI)

The Geo-Economic Concentration index (GECI) is developed based on the traditional Herfindahl-Hirschman index (HHI). HHI is defined as the sum of the squared market share of firms in a market expressed as:

$$HHI = \sum s_i^2$$

where s_i is the market share of the *i-th* firm.

In HHI, since market share is the only determinant to measure concentration, the definition of the entire market is extremely important. However, the result of the HHI is very sensitive to the definition of the relevant market. This is because the HHI has been derived to be an appropriate concentration measure based on a restrictive assumption the all firms are in the same market, producing a homogenous product and engaging in full competition. In container port market, ports in the different spatial location may not in the same market, and the competition among them may also vary greatly depending on the level of their overlapping hinterland.

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*Keywords: container port system, concentration index, port development strategy

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The concept of GECI is to introduce a weigh function which is expressed by the distance between two ports to indicate the degree of overlapping hinterland of the two ports, in other words, to what extend the two ports share the same market. By normalizing the distance between ports in different country by the means of incorporating the individual characteristics of each country, such as geographic scale and economical scale, the index can be standardized and use for comparing the degree of concentration of container port system in different country. Figure 1 shows the concept of the GECI.

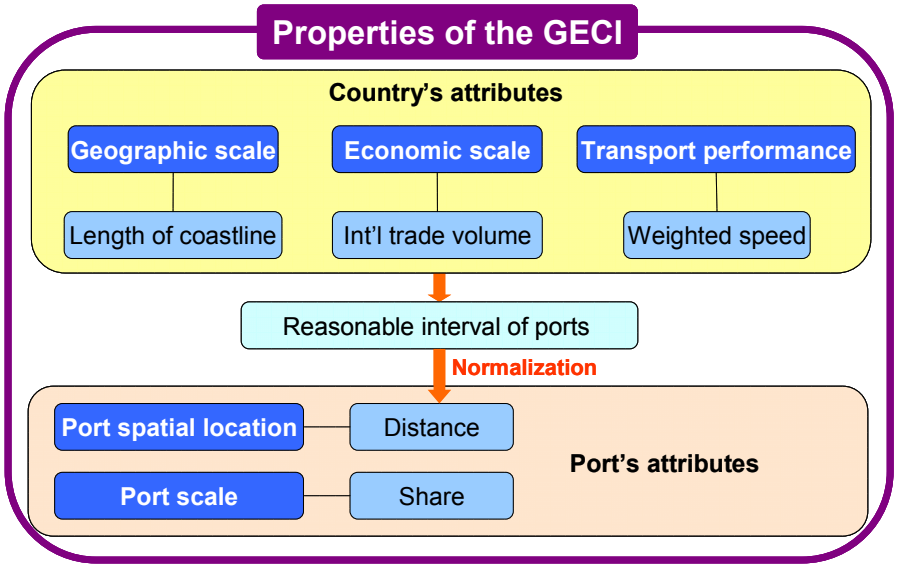

Figure 1: The properties of the Geo-Economic Concentration index (GECI)

Following the same derivation of HHI, the GECI can be defined as:

$$GECI = \sum \frac{s_i^2}{\sum w_{ij} s_j}$$

where s_i , s_j are the shares of the *i-th* and the *j-th* port respectively. w_{ij} is defined as the weight of port *j* for port *i*, which indicates the degree of sharing the same market of the two ports, and expressed as an exponential function of the distance between port *i* and port *j*:

$$w_{ij} = \exp\left(-k \cdot \frac{r_{ij}}{D_{norm}}\right) = \exp\left(-k' \cdot r_{ij}\right)$$

Where $k' = k/D_{norm}$; k is a constant and D_{norm} is a distance normalization factor, which is defined as the economically reasonable interval of ports in each country. By minimizing the unit transportation cost of container cargo including land transportation cost and terminal operation cost, D_{norm} can be described as:

$$D_{norm} \propto \left(\frac{L_C \rho}{T}\right)^{1/2}$$

Where L_c is the length of the coastline, T is total international trade volume, p is the land transport performance which is described as:

$$\rho = \sum_i LS_i \cdot V_i = \sum_i \frac{L_i}{L_t} V_i = \left(\sum_i L_i V_i\right) / L_t$$

Where L_i is the length of the road of the *i-th* level, V_i is the speed of the road of the *i-th* level, L_t is the total length of the road in the country. Therefore,

$$\frac{k_1'}{k_0'} = \left(\frac{T_1}{T_0}\frac{L_0}{L_1}\frac{\rho_0}{\rho_1}\right)^{1/2}$$

By employing the above equation, we can obtain the value of k' for each country if the value of a reference country k_0' is available. Hereinbefore, T_0, L_0 and P_0 are the length of the coastline, the international trade volume, and land transport performance, respectively of a reference country (Japan is used as a reference country in this study); and T_1, L_1 and P_1 are the length of the coastline, the international trade volume, and land transport performance, respectively of the country concerned.

3. Application results and discussion

(1) Port concentration of Japan, China, and Korea from 1975 to 2007

The degree of concentration of container port systems in Japan, China and Korea from 1975 to 2007 (for China, 1980-2007) is examined by the developed index described above. The data used in the study covers a large percentage of the total throughput in each country. For example, the data of 2005 include 34 containers ports in Japan with total throughput coverage of 98%, 26 containers ports in China with total throughput coverage of 91% and 8 containers ports in Korea with throughput coverage of more than 99%. The referenced parameter k_0' is obtained by using the OD data from *Survey report of international container cargo flow in 2003* of Japan. The application results are shown in Figure 2.

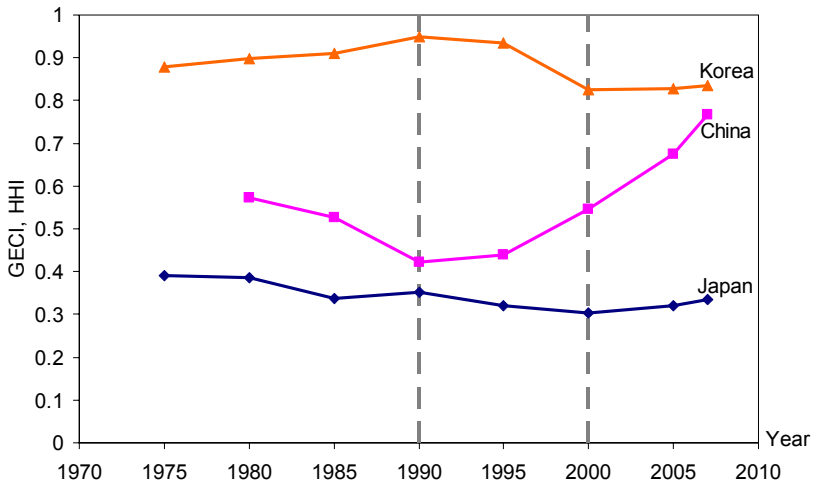

Figure 2: Concentration degree of container port system in Japan, China and Korea from 1975 to 2007

From the application result, we can observe the following facts:

a) First, in terms of the overall level of concentration, Korea is in a high level of concentration for a long time period though a de-concentration tendency can be observed from 1990 to 2000. In contrast, Japan is in a low level of concentration with some minor fluctuations. However, as for China, thought the overall level of concentration is between that of Japan and Korea, since 2000, the concentration degree has increased dramatically and stays in a high level.

b) Second, taking a look at the changing trend of concentration in the time series, we can divide the evolution into three stages with two turning points of the year 1990 and 2000. Japan shows a moderate de-concentration tendency in the first stage (1975-1990) and the second stage (1990-2000). In the third stage (2000-2007), a slight concentration tendency can be observed. In the first stage (1980-1990), China shows an obvious de-concentration trend; however, in the second stage (1990-2000), it turned into a strong concentration trend and further accelerated in the third stage (2000-2007). As for Korea, in the first stage (1980-1990) the concentration degree is strengthened steadily, and then became decreasing in the second stage (1990-2000); however, a returning concentration pattern is observed in the third stage (2000-2007).

c) Third, considering the range of fluctuation, the concentration degree of Japan varies between 0.30 and 0.39, comparing to the variation between 0.42 to 0.76 of China and between 0.83 to 0.95 of Korea. The variation of the concentration degree in Japan is very limited, representing an immovable system, while China has the largest fluctuation, representing a very flexible system.

(2) Port development strategy and port concentration

Since port facility is a basic infrastructure of vital importance for facilitating the national economic development, the port concentration reflects the government's strategy on the concentrated development or balanced development of port system. Moreover, the concentration of port system is also influenced by the institutional framework of the port governance structure and the social structure of the countries.

Japan has been observed a low degree of concentration in its container port system from the very beginning of containerization. The nation's adoption of a balanced development policy as the basic principle for national development is identified as an important reason that influences on the port concentration. Though since the middle of 1990s, there has growing arguments on the declining international competitiveness of Japanese ports, and the government therefore reviewed the concept of super-hub port as a strategic redirection from the balanced development to "selection and concentration", the concentration trend after 2000 is very marginal and the degree of concentration is still relative in a very low level. The social structure on which the national policy-making is decided through adjustment in accordance with the intentions of the various stakeholders, particularly the involvement of the local autonomous bodies in the process of policy-making, determines that the concentration of the investment and resource is not likely to be happened. Consequently, it indicates that structural change of the basic policy from balanced development to concentrated development can not be achieved easily.

In contrast, Korea has been constantly adopting the concentrated development strategy in terms of container port development. The essential reason lies in the centralized port governance system for a long established time in which national government decides everything for the purpose of fulfilling the national interest to the upmost. Though the strategy of two-port System with the development of Gwangyang port is claimed to be a gesture to show the contribution to balanced national land development from container port development, however, the actual reason is that Busan has already reached its limitation for further development. In addition, the development of Gwangyang is also targeting on the transshipment container cargo and positioning as a logistics hub in Northeast Asia. Thought the essential principle of concentrated development has remained unchanged, the development plans in each period have shown the different measures in archiving the objective of ensuring the hub status in Northeast Asia with respect to changing environment and the strategy of the neighboring countries. The shifting from the development of Gwangyang port to the development of Busan New port provides the good evident. The flexibility in the policy changing is ensured by its social structure of top-down policy-making.

As for China, under the background of the economic reform from the planned economy to market economy, continuous institutional reform was carried out in the port governance system. The decentralization of administrative rights to the local port authority and the participation of the private sector in container development lead to the dramatic concentration driven by the market power. Moreover, the national governments policy incentives for the development of a few specific ports for the purpose of positioning hub status in the regional competition have further contribution to the concentration tendency after 2000.

4. Conclusion

This paper proposed a new index name Geo-economic concentration index (GECI) to measure the degree of concentration of container port system in different countries. The application results of Japan, China and Korea from 1975 to 2007 confirmed that Japan has a relatively de-concentrated port system comparing with China and Korea. The concentration of the port system is greatly influenced by the government's port development strategy and port governance and social structure.

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