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The Nationality Effect of Price Discrimination in the Container Shipping Market and Its Implications for Development Economics: Treating Hanjin Shipping's Collapse as a Natural Experiment

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Abstract

Purpose – International trade leads to the international division of labor, improving the efficiency of the global economic system. Transport costs are a more serious barrier to international trade than customs tariffs. An increase in competition in the transport sector may thus lead to a reduction in transport costs. However, if a carrier's nationality significantly influences transport costs, simply adding more competing carriers of different nationalities would be ineffective. Therefore, it is necessary to establish national or regional carriers to influence competition and reduce transport costs. This study investigates this "nationality effect" by treating Hanjin Shipping's collapse as a natural experiment.

Design/methodology – The theoretical basis of this study is the 3rd-degree price discrimination in container shipping market. By using the monthly data of container freight rates of Korea, China and Japan, this study shows the so-called Korea Premiums, which are the empirical counterparts of nationality effect in Korea container shipping market. For this empirical investigation, the structural model with state-space form is used and the dummy models are also estimated. In addition, because China has been also affected by the Hanjin's collapse, the China premiums are considered too.

Findings – Compared with Japan's case, it is shown that there had been the so-called Korea premiums since the collapse of Hanjin Shipping. These results are robust from both the state-space model and dummy models. The time pattern of Korea premiums was consistent with the market evolution, especially the pattern of substitutability in container shipping markets. In addition, this paper shows the magnitude of Korea premiums.

Originality/value – The argument of this study that the nationality effect can be interpreted as an extended concept of the home market effect is original, which is expected to evoke future research efforts. Further, the discussion on the shipping industrial policy from both horizontal and vertical aspects will provide the relevant policy makers with solid information, especially for the policy coordination in a global scale.

Keywords: Development economics, Hanjin Shipping, Industrial policy, International transport, Nationality effect of price discrimination
JEL Classifications: C22, O25, R48

1. Introduction

In 1776, Adam Smith stated that "the extent of labor division must always be limited by the extent of the market." Because the development of an economic system depends on the extent of the division of labor, growing the market size has become the core subject of economics, especially development economics. For example, Yang (2003) and Cheng and Yang (2004)

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showed an alternative framework to mainstream neoclassical economics for understanding the importance of the division of labor and related market size. Water transportation is a crucial system that links separate economies, which is why Adam Smith emphasized the importance of shipping services by saying "As by means of water carriage, a more expensive market is opened to every sort of industry than what land carriage alone can afford it." According to Stiglitz (2013, 13), "one of the core state functions is shaping infrastructure and supply chain logistics to ensure that the output of emerging manufacturing industries can move cheaply and quickly between countries and from production centers to markets" (hereafter Stiglitz's hypothesis).

However, the question is whether a significant part of these logistics services should be provided by national transportation companies. The pros of a perfect market mechanism insist that the market will provide these services at the same market price. For example, it was reported that the financial authorities of Korean government insisted that, due to the over-capacity in container shipping market, there would be no problems in transporting container shipping cargoes (Yun Min-Hyun, 2019). But, the cons state that because there exists discriminatory marketing behavior in the container shipping market, there will be significant differences in price and service quality. Further, if there existed this "nationality effect" from the discrimination of global container shipping market, then the government could implement container shipping industrial policy. In addition, the measurement of the nationality effect, i.e., the national premiums in this article, could help to determine the size of government support. So, this study aims to test this nationality effect in the container shipping market based on Stiglitz's hypothesis.

The term "nationality" is not used in this study in a social or patriotic sense, but in an economic sense. International trade literature shows that countries with higher demand for certain goods and services possess an international surplus in those industries. This is described as the "home market effect," which means that this type of economy is more likely to have competitive national companies in those industries. However, when one such company exits the market (e.g., owing to market competition), what are the consequences for the economy of the country? The nationality effect addresses this question. We investigate whether—since the exiting company had a significant market share—the resulting reduction in competition causes the remaining companies to increase their margins by exercising their newfound market power.

Further, the nationality effect was one of the most controversial topics during the restructuring of Korea's shipping industry in 2016 (Yun Min-Hyun, 2019). The economic contributions of Hanjin Shipping (e.g., revenue and value added) were easily observable and the sizes of these contributions could be calculated by analyzing its financial reports. However, unobservable benefits—supposedly from the nationality effect—needed to be estimated (see Table 1). Hence, the empirical analysis in this study may assist policymakers in evaluating the unobservable benefits of national shipping companies. For example, the argument for the nationality effect can be used as a rationale for the government support for another Korean

Table 1. Observable and Unobservable Economic Benefits of Hanjin Shipping

Observable Benefits	**Size**
Revenue	$7 billion
Value added	$0.7 billion
Unobservable Benefits	
Reduction in freight cost	To be estimated

Source: Author.

container carrier, HMM, which policy is seriously discussed in the global container shipping market and international organization. So, the quantitative analysis of nationality effect will help to identify the objective benefits of national shipping companies and thus discuss the appropriate policy tools for this pecuniary externality from shipping companies.

The sudden collapse of Hanjin Shipping in 2016 can be used as a natural experiment to test the nationality effect. Hanjin Shipping filed for bankruptcy protection in August 2016 and its services subsequently stopped. At that time, it was the largest shipping company in Korea and the seventh largest globally, with a carrying capacity of 610,000 TEUs (twenty foot equivalent units), meaning that Hanjin could carry 610,000 containers simultaneously. Its in-transit container cargo had an estimated value of $14 billion. In addition, owing to the arresting of Hanjin's ships in many countries (Li and Dong, 2020), the disruptions of its shipping services became worse. For these reasons, this event is thought to have influenced the overall condition of related markets significantly, which makes the natural experiment possible (See Wooldridge, 2016. It is notable that the results when using a difference-in-difference method, which is a typical estimation tool for natural experiment, are similar to those of this study). In particular, it may have influenced market performance such as container shipping freight rates.

A significant difference between the freight rates of Korea and other countries could indicate that the nationality effect did exist, which has important implications for global economic development. As transport costs are a more significant barrier to international trade than customs tariffs, increased competition in the transport sector could reduce such costs. (The forms of competition among shipping liners can be classified into 1) the cost leadership, 2) service differentiation and innovation and 3) hybrid. Lam and Wong, 2018) However, if the nationality effect is significant, it is necessary to establish additional national or regional carriers, since simply adding more foreign competing carriers would be ineffective. This study favors the former policy recommendation, which has more relevance to developing economies with higher freight costs than to developed countries (For additional information on the freight cost burden of developing countries, see Asturias and Petty (2013), Hummels, Lugovskyy and Skiba (2009) and Kleinert and Spies (2011)).

The remainder of this paper is divided into five sections. Section 2 reviews the existing literature and this study's contribution, while Section 3 presents the empirical model and explains the dataset. Section 4 provides the empirical results and their interpretations and Section 5 discusses policy implications. Section 6 concludes.

2. Literature Review

Haralambides (2004, 11) comprehensively addressed the price determinants and price stability in the container shipping market from an industrial economics viewpoint. Regarding price discrimination, he explained the principle of companies "charging what the traffic can bear." He specifically noted that such discrimination is neither uncommon nor unique to shipping, given that arbitrage is not possible and that buyers are geographically separated. However, with the introduction of containers and freight all kinds (FAK) as well as individual and confidential service contracts, most price discrimination of this kind has disappeared. Sjostrom (1992) discussed whether shipping conferences practice economic price discrimination and demonstrated the shortcomings in the literature regarding the test methods for price discrimination. Most of the previous literature has tested price discrimination by regressing the freight rate on product value—which is the demand-side variable—and a set of cost variables. A positive coefficient of product value in these tests is interpreted as evidence

of price discrimination. However, these estimation results could be biased, as some costs could correlate with values not included in the regression.

Francois and Wooton (2001) presumed that shipping cost margins are far more significant than tariff barriers in many countries in terms of the relative costs to trade. For similar results, see Clark, Dollar and Micco (2004) and Hummels (2001). From this point of view, they illustrated the benefits of increased competition using their proposed model and its simulation, one of which is the weakening of shipping conferences' influence. They went on to state that if the number of shipping companies increases—and the market share of each shipping company therefore decreases—these companies perceive market demand as more elastic and consequently behave more competitively. Contrastingly, if the number of companies were to decrease, the industry would become more concentrated, giving remaining companies the opportunity to exercise their increased power because of an increased market share. Fink, Mattoo and Neagu (2002) investigated whether transport costs are exogenously determined by technological developments or influenced by policy. They claimed that a need exists not only for the further liberalization of government policy, but also for reinforced international disciplines on restrictive business practices such as cargo reservation schemes, shipping conferences, and restrictions on port and auxiliary services. The authors proposed two policies: (i) end the exemption of collusive agreements in the maritime sector through national competition law and (ii) give foreign consumers the right to challenge shipping lines' anticompetitive practices in the national courts of the countries of origin of these shipping lines.

Hummels, Lugovskyy and Skiba (2009) emphasized the relevant treatment of transport costs in the economic literature in the sense that the transportation service and costs are endogenous elements to the relevant international trade and amenable to cost reduction through concerted policy action. They used this background to examine the economic effects of market power in the shipping market and adopted panel estimation models to demonstrate that price-discriminating carriers apply higher markups to goods with high prices, high tariffs, and low absolute import demand elasticity. However, as Sjostrom (1992) mentioned, one should be cautious when considering the relationship between the markup and price of goods, as a range of shipping service quality options are available to shippers. Faster ships, direct routing, and more careful handling are options available at a premium rate and are more likely to be chosen for the transportation of high-quality goods. Therefore, the marginal cost can be related to the price of goods. Sjostrom suggested a test strategy to avoid this identification problem. If a positive relationship is discovered between tariffs and shipping prices, we can attribute this to market power and not to variations in marginal shipping costs, since the tariff does not influence the above-marginal cost relating to service quality. Therefore, tariffs have a direct increasing effect on the prices of foreign goods due to taxing and an indirect effect by inducing higher shipping prices, while both decrease trade flows. Particularly relevant from a policy perspective, this study showed that market power somewhat explains the higher ad valorem shipping prices faced by developing countries. As an example, non-OECD exporters paid an average of 41% more than OECD exporters when shipping into the United States and an average of 40% more when shipping into Latin America.

Kleinert and Spies (2011) claimed that circular causality exists between transport prices and trade levels in that there is a virtuous circle of lower transport costs and higher trade. This argument was implicitly introduced by the observation that China trades high volumes with the United States and the European Union at modest transport prices compared with many African economies trading rather moderate trade volumes at high transport prices despite their more favorable geographic location. Specifically, the authors stated that increased cross-

border transactions not only stem from transport cost reductions, but also boost investments in the international trade infrastructure, which leads to further cost reductions.

Bertho, Borchert and Mattoo (2014) followed Fink, Mattoo and Neagu's (2002) observation that such policies as cargo reservation schemes affect shipping prices to demonstrate that government trade barriers in mode 3 (foreign investment restrictions on the shipping sector) have a significant effect in terms of increasing maritime transport costs and thus decreasing seaborne trade flow. De Oliveira (2014) investigated the determinants of freight rates in six European countries and 47 partners. Notably, this study—similar to the works of Limao and Venables (2001) and Wilmsmeier and Hoffmann (2008)—used the freight rate of a homogeneous unit (container) as the dependent variable. Inter alia, this study indicated that the level of competition between transport companies affects the freight rate.

Recently, there have been two notable research papers on the case of Hanjin Shipping's sudden collapse. One is Song Dong-Wook et al. (2019). By reviewing available literature, they suggested various external and internal factors for the Hanjin Shipping's bankruptcy in both the outside and inside perspectives. Also, they provided a holistic interpretation of Hanjin Shipping's case based on an interpretive structural modeling. Particularly, they stressed that Korea's public policy viewing shipping as a public goods did not necessarily remain effective over the years to come. The other is Shin Sung-Ho et al. (2019). Based on the duration analysis of charter contract managements of ten major containership chartering operators, they showed that one major cause of Hanjin Shipping's collapse was the miscalculation of chartering risk. Also, they pointed out that the resignation of top management having long chartering experience and the lack of effective governance such as the over-regulation from the Korean government were all the primary causes of Hanjin Shipping's bankruptcy. However, this present study differs from the former two papers in a sense that it addresses not the causes but the economic consequences of Hanjin Shipping's case.

Our study contributes to the literature in three ways. First—to the best of our knowledge—it is the first attempt to identify shipping carriers' price-discriminating behaviors in specific countries by using time-series analysis. Few studies have addressed the effect of national carriers such as Hanjin Shipping operating in Korea. For example, the literature considers the number of carriers to be a channel through which market power would decrease with price discrimination. Therefore, the national carrier's role is neutral in this reduction in market power because it simply adds to the number of carriers without a differentiated impact on the freight rate. In particular, this simple addition of carriers to export-import transportation has been advocated by most of the shipping advanced countries. In contrast to this argument, this study demonstrates that in reality nationality is significant in an economic sense, at least in the case of Hanjin Shipping in Korea. So, it is recommended to promote some national or regional shipping companies, especially in industrial or developing countries.

Second, the nationality effect in the shipping market is more deeply interpreted in an economic sense. Asturias and Petty (2013) and Kleinert and Spies (2011) indicated that the transportation sector is endogenous to international trade. Therefore, this study addresses the nationality effect in the shipping market, especially as the extended concept of home market effects, which is expected to trigger further research in other industrial areas.

Third, if we accept the nationality effect, we should consider policy responses. As stated before, a simple increase in the number of carriers would be ineffective and more vigorous policy actions are required. This study clearly illustrates the need for shipping industrial policies in both a horizontal and a vertical context. However, these policies could change the characteristics of strategic trade, which could lead to retaliation. We therefore propose a global governance strategy for the shipping industry. This proposal has important implication especially for the crisis period of COVID-19, because many shipping countries have adopted

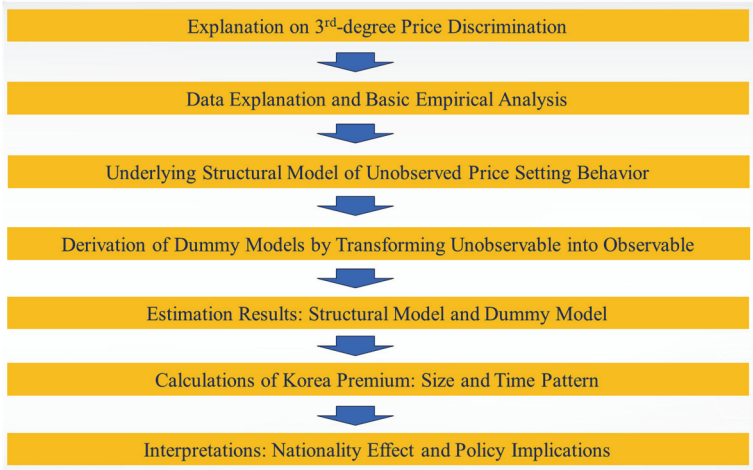
and will continue government support policies.

In summary, the economic interpretation of the nationality effect from the perspective of an extended home market effect and its implications for new policies are a synthesis to explain the determinants of transport costs in international trade from the aspects of optimal investment in technology and policy-related transport margins.

3. Empirical Model and Data

Fig. 1 presents a flow chart of the empirical analyses of this study and their interpretations.

Fig. 1. Flow Chart of Empirical Analyses and their Interpretations



3.1. Theory of Price Discrimination

Total revenue R is price multiplied by quantity:

$$R = P(Q) \times Q. \tag{1}$$

Therefore, marginal revenue—which is the change in revenue from selling an additional unit—is calculated as follows:

$$MR = \frac{\partial R}{\partial Q} = P(Q) + Q \times \frac{\partial P(Q)}{\partial Q} = P(Q) \times \left(1 + \frac{Q}{P(Q)} \times \frac{\partial P(Q)}{\partial Q}\right) = P \times \left(1 + \frac{1}{\varepsilon}\right), \tag{2}$$

where $\varepsilon = \frac{dQ/Q}{dP/P}$.

To maximize the company's profit, marginal revenue must equal marginal cost:

$$MR = MC. \tag{3}$$

Thus,

$$MC = P \times \left(1 + \frac{1}{\varepsilon}\right) \Longrightarrow \frac{P-MC}{P} = -\frac{1}{\epsilon}. \quad (4)$$

The left-hand term $\frac{P-MC}{P}$ is the price/cost margin or markup known as the Lerner index of market power (Lerner, 1934). A company in this situation can determine its prices based on demand elasticity. As Varian (1992) explained by referring to Pigou (1920), three forms of price discrimination exist: first-degree price discrimination or perfect price dis-crimination, second-degree price discrimination, and third-degree price discrimination. In third-degree price discrimination—which is the most common form—the seller charges consumers from different groups different unit prices.

Suppose there are two groups of customers with differing aggregate demand curves and a company can determine to which group a customer belongs. If resale between the two groups is prevented or limited (no resale condition) and if the company knows each group's aggregate demand curve (identification condition), then it would be profitable to set different prices for the two groups. Considering the container shipping market, the geographical segmentation of its customers (shippers) satisfies the identification condition and the non-storability of a shipping service satisfies the no resale condition.

For simplicity, we assume that the company (or a group of companies such as a cartel) determine the two prices by setting separate output levels. The company's optimization problem is then presented as

$$\max_{Q_1,Q_2} \pi = [P_1(Q_1) - m] \times Q_1 + [P_2(Q_2) - m] \times Q_2,$$

where m is the assumed constant marginal cost.

To maximize the company's profit,

$$MR_1 = P_1 \times \left(1 + \frac{1}{\epsilon_1}\right) = m, \text{ and } MR_2 = P_2 \times \left(1 + \frac{1}{\epsilon_2}\right) = m.$$

Therefore,

$$P_1 \times \left(1 + \frac{1}{\epsilon_1}\right) = P_2 \times \left(1 + \frac{1}{\epsilon_2}\right) \Longrightarrow \frac{P_1}{P_2} = \frac{1 + 1/\epsilon_2}{1 + 1/\epsilon_1} = \frac{1 - 1/|\epsilon_2|}{1 - 1/|\epsilon_1|}. \quad (5)$$

A decrease in $|\varepsilon_1|$ will thus increase p_1/p_2. Thus, when the value of p_2 is given, p_1 increases.

3.2. Data

The sample countries for this study are Korea, China, and Japan. Japan is the country of reference, since it was the least influenced by the collapse of Hanjin Shipping because of its large national carrying capacity relative to its cargo volume (see below Table 4). We consider four sample shipping routes: East Asia to the United States' west coast (EA-WC), East Asia to the United States' east coast (EA-EC), East Asia to northern Europe (EA-EU), and East Asia to the Mediterranean (EA-MED). The sample period is from September 2012 to August 2020. The basic breakpoint is September 2016, which is the official date of Hanjin's collapse. Similar to previous studies including De Oliveira (2014), Limao and Venables (2001) and Wilmsmeier and Hoffmann (2008), this study uses the freight rate for a homogeneous container (TEU or FEU, forty foot equivalent) as the freight price variable.

Data sources include the Rate Discount & Consulting Service (RADIS) for Korea, Shanghai Export Containerized Freight Index (SCFI) for China, and Drewry Index for Japan, which are all FAK rates. The FAK freight rate is applicable to all types of goods and is therefore not

restricted to a particular commodity. Shipping companies quote FAK rates to forwarder consolidators such as the NVOCC, which fill shipping containers with the different cargoes received from different shippers, different consignees, or both. While the consolidator may charge its clients on a commodity-specific basis, it pays the shipping carriers a predetermined FAK rate. The RADIS rate is published on a monthly basis by the Korea Shippers' Council and is calculated as a market average of the spot export container freight rates from 22 logistics companies. It is the freight price including the ocean rate and various surcharges. The SCFI for China is a comprehensive index reflecting the spot rates of 13 individual shipping routes. It is similar to a FAK rate that includes the ocean rate and various surcharges and is published weekly. Drewry's container freight rates for Japan are based on the averages of the representative rates paid by freight forwarders to shipping carriers. The sources for these rates are 28 freight forwarders located in Europe, the Middle East, North America, South America, and Asia. The rate benchmarks represent the spot market rates for a container paid by forwarders to shipping carriers for a month or week. Table 2 summarizes the dataset used in our calculations.

Table 2. Explanation of the Data

-	**Explanation**
Sample Countries	Korea, China, Japan
Sample Routes	East Asia–West Coast of the United States (EA-WC). Unit: $/FEU East Asia–East Coast of the United States (EA-EC). Unit: $/FEU East Asia–Northern Europe (EA-EU). Unit: $/TEU East Asia–Mediterranean (EA-MED). Unit: $/TEU
Data Sources	Korea: RADIS China: SCFI Japan: Drewry
Sample Period	September 2012 to August 2020

Source: Author.

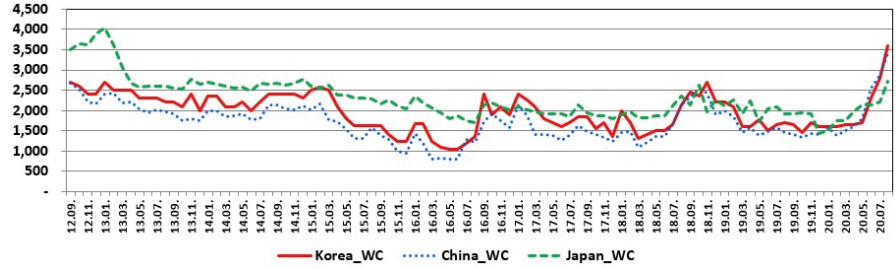
3.3. Empirical Model

3.3.1. Basic Empirical Analysis for the Underlying Model

Fig. 2 illustrates the trends in freight rates for the EA-WC route. While the freight rates co-move, the graph seems to indicate four sub-periods: September 2012 to March 2015, April 2015 to August 2016, September 2016 to May 2020, and June 2020 to August 2020.

Fig. 2. Trends of Freight Rates for EA-WC

(Unit: $/FEU)



Sources: Drewry (2020), KITA (2020) and SSE (2020).

However, our study considers two subsamples before/after the date of the Hanjin's collapse. Period 1 is from September 2012 to August 2016 and Period 2 is from September to August 2020. Incidentally, the sample lengths of these two subsamples are the same as 4 years, i.e., 48 months.

Korean shippers experienced increased freight rates due to Hanjin Shipping's collapse. However, this freight rate increase can be assessed by comparing selected reference rates. Table 3 illustrates the change patterns of freight rates compared with those in China and Japan.

Table 3. Change Patterns of the Freight Rates for Each Country

(Unit: $/FEU (WC, EC), $/TEU (EU, MED))

		Korea	China	Japan
EA-WC	09_12 to 08_16	2,032	1,749	2,587
	09_16 to 08_20	1,885	1,689	2,002
	Change	-147	-60	-585
	Change rate	-7%	-3%	-23%
EA-EC	09_12 to 08_16	3,558	3,142	4,374
	09_16 to 08_20	2,934	2,696	3,179
	Change	-624	-446	-1,195
	Change rate	-18%	-14%	-27%
EA-EU	09_12 to 08_16	1,400	915	1,756
	09_16 to 08_20	1,220	833	1,409
	Change	-180	-82	-348
	Change rate	-13%	-9%	`-20%
EA-MED	09_12 to 08_16	1,602	1,009	1,652
	09_16 to 08_20	1,469	828	1,329
	Change	-133	-181	-322
	Change rate	-8%	-18%	-20%

Source: Author's calculation Using Drewry (2020), KITA (2020) and SSE (2020).

After the Hanjin's collapse, all the three countries have experienced the reduction of freight rates on average. This reduction of freight costs has been due to the scale effects of large container ships. However, the freight rate decreases of Korea and China seem to be smaller than that of Japan. These differences in freight rate decreases can be explained by the relative strengths of the countries' national shipping capacities. As Table 4 indicates, Japan's national container shipping capacity was five times larger than that of Korea and 11 times larger than that of China. Therefore, when shipping companies remaining after the collapse of Hanjin charged higher freight rates, shippers in Japan could choose an alternative service provider from among their national carriers, whereas shippers in Korea and China had a relatively small set of alternative service providers from which to choose. Hence, the demand elasticity of prices in the Japanese market was larger than those in Korea and China.

Table 4. Comparison of National Carrying Capacity Relative to Cargo Volume

-	**Container Cargo Volume (2016) (mil. TEU): *S***	**Carrying Capacity (2017) (1,000 TEU): *C***	**(*C*×100)/*S***
Korea	26	434	1.7
China	220	1,736	0.8
Japan	16	1,442	9.0

Source: Alphaliner (2017) and Clarksons Research (2017).

3.3.2. Underlying Structural Model of Unobserved Price-Setting Behavior

The basic price-setting behavioral model before the Hanjin collapse is presented as follows:

$$w_t = \phi \times w_{t-1} + \varepsilon_t, \text{where } 0 < \phi < 1 \quad (6)$$

$$lny_{k,t} = \alpha_k \times w_t + e_{k,t} \quad (7)$$

$$lny_{c,t} = \alpha_c \times w_t + e_{c,t} \quad (8)$$

$$lny_{j,t} = \alpha_j \times w_t + e_{j,t} \quad (9)$$

where w is the logarithmic global price, y_k is the Korean price, y_c is the Chinese price, and y_j is the Japanese price.

Additionally, $\varepsilon_t \sim i.i.d.N(o, \sigma_\varepsilon^2)$, $e_{i,t} \sim i.i.d.(0, \sigma_i^2)$, ε_t, and $e_{i,t}$ are mutually independent of one another.

This model presumes that an unobserved global freight rate exists, which is expressed by w_t. This price follows an autoregressive process.

In this model, for example, the price ratio of Korea relative to Japan is as follows:

$$\frac{E[y_{k,t}]}{E[y_{j,t}]} = \frac{E[\exp(\alpha_k \times w_t + e_{k,t})]}{E[\exp(\alpha_j \times w_t + e_{j,t})]}. \quad (10)$$

The theoretical price ratio for Equation (5) equals the ratio of expected values for Equation (10). We normalize the model and assume

$$\alpha_j = 1. \quad (11)$$

After the Hanjin collapse, the price-setting model becomes

$$w_t = \phi \times w_{t-1} + \varepsilon_t \quad (6)$$

$$lny_{k,t} = (\alpha_k + KP_j) \times w_t + e_{k,t} \quad (7\text{-a})$$

$$lny_{c,t} = (\alpha_c + CP_j) \times w_t + e_{c,t} \quad (8\text{-a})$$

$$lny_{j,t} = 1 \times w_t + e_{j,t} \quad (9\text{-a})$$

This model assumes a Korea premium— KP_j—relative to Japan and a China premium— CP_j—relative to Japan. Specifically, we can rewrite the above as the following state-space model. Kim Chang-Jin and Nelson (1999) explained this state-space model and its estimation more in detail.

For i = k (Korea) or c (China),

[Measurement Equation]

$y_t = \mathrm{H}\beta_t$

where $y_t \equiv [lny_{it} \quad lny_{jt}]'$,

$$\mathrm{H} \equiv \begin{cases} \begin{bmatrix} \alpha_i & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} if\ t < t_0 \\ \begin{bmatrix} (\alpha_i + P_j) & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} if\ t \geq t_0 \end{cases},$$

$\beta_t \equiv [w_t \quad e_{i,t} \quad e_{j,t}]'$.

[Transition Equation]

$$\beta_t = F\beta_t + E_t,$$

where $\mathrm{F} \equiv \begin{bmatrix} \phi & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$, and $E_t \equiv \begin{bmatrix} \varepsilon_t \\ e_{i,t} \\ e_{j,t} \end{bmatrix} \sim i.i.d.N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\varepsilon^2 & 0 & 0 \\ 0 & \sigma_{ei}^2 & 0 \\ 0 & 0 & \sigma_{ej}^2 \end{bmatrix} \right)$.

3.3.3. Empirical Models Based on the Observed Variables

Instead of using structural equations with unobserved variables, we derive regression equations with the observed variables using the following dummy model.

The premiums of KP_j^D and CP_j^D can be measured by comparing the prices of pairwise countries. In summary,

$$lny_{k,t} = \left(\gamma_{k,j} + KP_j^D\right) lny_{j,t} + v_{kj,t} \tag{16}$$

$$lny_{c,t} = \left(\gamma_{c,j} + CP_j^D\right) lny_{j,t} + v_{cj,t} \tag{17}$$

These equations assume that the premiums vary across the sample countries. Regarding Korea, the null hypothesis H_0 is that $KP_j^D = 0$. If this null hypotheses is rejected, we can measure the relative price increases after the collapse of Hanjin.

Based on the point estimation of $\gamma_{k,j}$ and $\gamma_{c,j}$, the Korea and China premiums can be calculated as follows:

$$KP_{j,t} = y_{k,t} - \exp\left[\gamma_{k,j} \times lny_{j,t}\right], \tag{19}$$

$$CP_{j,t} = y_{c,t} - \exp\left[\gamma_{c,\mathrm{j}} \times lny_{j,t}\right]. \tag{20}$$

4. Empirical Results

4.1. Estimation Results of the State-Space Model

Table 5 and Table 6 illustrate the estimation results of the state-space model. As implied by the high correlations in the related freight rates, α_k and α_c are close to unity and statistically significant. For the dummy coefficients of the premiums relative to Japan (KP_j and CP_j), all the cases except China-Japan Med's case show that the premiums have been statistically significant. We can therefore conclude that there were additional freight costs in Korea and China relative to Japan.

Table 5. Estimation Results of the State-Space Model: Korea and Japan

-	EA-WC		EA-EC		EA-EU		EA-MED	
	Estimate	s.e.	Estimate	s.e.	Estimate	s.e.	Estimate	s.e.
α_k	0.966***	0.003	0.974***	0.002	0.966***	0.004	0.991***	0.004
KP_j	0.023***	0.004	0.016***	0.003	0.013***	0.006	0.019***	0.006
ϕ	1.000***	0.001	0.999***	0.001	0.999***	0.000	0.999***	0.000
σ_ε^2	0.004	0.001	0.003	0.001	0.001	0.000	0.001	0.000
σ_{ek}^2	0.023	0.004	0.014	0.003	0.051	0.007	0.038	0.005
σ_{ej}^2	0.002	0.001	0.003	0.001	0.000	0.000	0.001	0.000

Notes: 1. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

2. Values of less than 1/1000 are excluded.

3. The values of ϕ are close to unity, which is similar with that of Munim and Schramm (2016).

Table 6. Estimation Results of the State-Space Model: China and Japan

-	EA-WC		EA-EC		EA-EU		EA-MED	
	Estimate	**s.e.**	**Estimate**	**s.e.**	**Estimate**	**s.e.**	**Estimate**	**s.e.**
α_c	0.947 ***	0.003	0.957 ***	0.003	1.071 ***	0.004	0.924 ***	0.005
CP_j	0.029 ***	0.005	0.022 ***	0.004	0.018 ***	0.006	0.008	0.008
ϕ	1.000 ***	0.001	0.999 ***	0.001	1.000 ***	0.000	0.999 ***	0.001
σ_ε^2	0.004	0.001	0.003	0.001	0.001	0.000	0.002	0.001
σ_{ek}^2	0.031	0.005	0.021	0.003	0.041	0.009	0.077	0.011
σ_{ej}^2	0.002	0.001	0.003	0.001	0.000	0.000	0.001	0.000

Notes: 1. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.
2. Values of less than 1/1000 are excluded.
3. The values of ϕ are close to unity, which is similar with that of Munim and Schramm (2016).

4.2. Breakpoint Tests

First, Table 7 indicates that we can reject the null hypothesis H_0 that no Korea premium exists relative to Japan on all the four routes. In addition, we can also reject the additional null hypothesis that no China premium exists relative to Japan on all the routes except on the China-Med route. However, the dummy coefficient on the China-Med route is positive.

Table 7. Dummy Tests of Breakpoints for Korea-Japan and China-Japan

		WC	EC	EU	MED
	Regression Equation: $\boldsymbol{lny_{k,t} = (\gamma_{k,c} + KP_j^D) lny_{j,t} + v_{kj,t}}$				
Korea	KP_j^D's estimate	0.023 ***	0.015 ***	0.013 **	0.021 ***
	KP_j^D's t-value	5.359	4.597	2.069	3.531
	KP_j^D's p-value	0.000	0.000	0.041	0.001
	Regression Equation: $\boldsymbol{lny_{c,t} = (\gamma_{c,j} + CP_j^D) lny_{j,t} + v_{cj,t}}$				
China	CP_j^D's estimate	0.028 ***	0.021 ***	0.023 ***	0.009
	CP_j^D's t-value	5.553	5.214	2.935	1.089
	CP_j^D's p-value	0.000	0.000	0.004	0.279

Notes: 1. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.
2. Values of less than 1/1000 are excluded.

4.3. Korea and China Premium Measures

Table 8 shows the Korea and China premiums per cargo unit (FEU or TEU), highlighting that Korea and China premiums relative to Japan have been significant. Specifically, Korea premiums per one container box have been at least $100 relative to Japan.

Table 8. Korea and China Premiums Using a Dummy Method

-	EA-WC	EA-EC	EA-EU	EA-MED
Korea and Japan	$lny_{k,t} = (\gamma_{k,j} + KP_j^D) lny_{j,t} + v_{kj,t}$			
	322	359	120	213
China and Japan	$lny_{c,t} = (\gamma_{c,j} + CP_j^D) lny_{j,t} + v_{cj,t}$			
	351	440	134	58

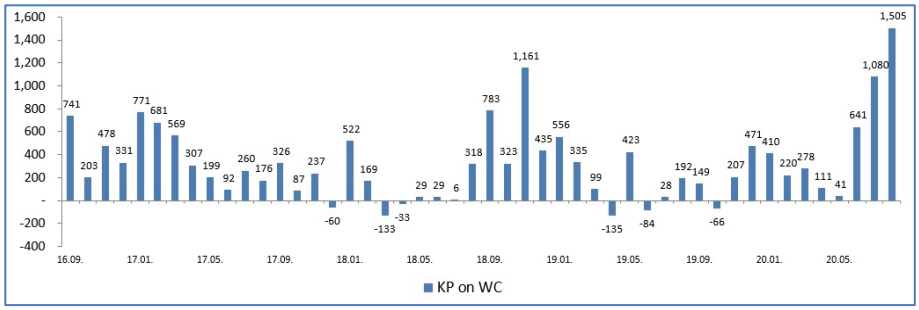
Source: Author's calculation.

4.4. Time Pattern of Korea Premiums

Fig. 3 shows the time pattern of Korea premiums relative to those of Japan on the EA-WC route. A new Korean carrier, SM Line, started its service on this route in April 2017. This new service provided an alternative for Korean shippers, increasing substitutability. This change also increased the demand elasticity of prices. The third-degree price discrimination formula implies that carriers should decrease their freight rates for this route. In addition, since June 2020, there has been a surge in container cargo demand given the shortage of container fleet capacity, which has made freight rate jumps. Further, this trend has tightened the slot availability in this route, which resulted in decreasing the demand elasticity of prices in Korea container shipping market. These two typical market changes are reflected in the dynamics of the Korea premiums illustrated in this figure.

Fig. 3. Time Pattern of Korea Premiums Relative to that of Japan on the EA-WC route (Dummy Method) (From Sep. 2016 to Aug. 2020)

(Unit: $/FEU)



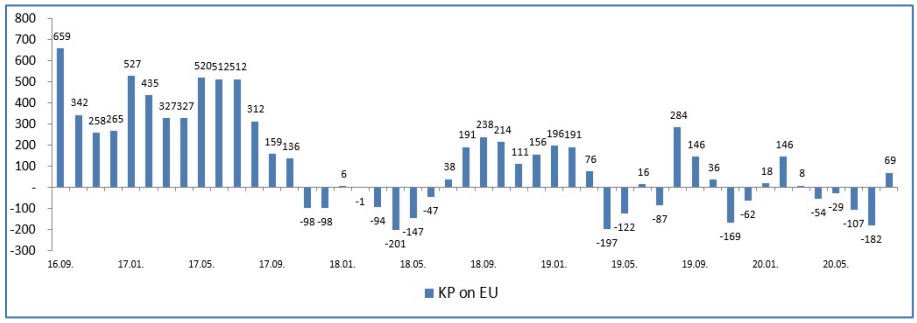
Source: Author's calculations.

Fig. 4 shows the time pattern of Korea premiums relative to those of Japan on the EA-EU route. As well known in the market, the alliance system reformed in April 2017, which led HMM—a Korean carrier—to withdraw its ships from the EA-EU route and purchase shipping space from 2M (Maersk and MSC). This change decreased HMM's market power. Hence, since April 2017, carriers have enjoyed more market power to set higher freight rates, notably on the EA-EU route, as illustrated in this figure.

In summary, the time pattern depicted in this article shows well the development of the relevant container shipping markets. In particular, the Korea premiums reflect the changes of substitutability of container shipping service in the considered routes. However, the Korea premiums seem to have disappeared in Korea-EU routes on average but remained in the Korea-US routes.

Fig. 4. Time Pattern of Korea Premiums Relative to that of Japan on the EA-EU route (Dummy Method) (From Sep. 2016 to Aug. 2020)

(Unit: $/TEU)



Source: Author's calculations.

5. Discussion and Policy Implications

The nationality effect we address in this study can be interpreted using the perspectives of Linder's (1961) hypothesis and the home market effect in international trade theory (Krugman 1980/1995). Linder's observation states that countries tend to export goods for which they have high domestic demand rather than exporting based on conventional supply-based comparative advantage. Specifically, we compare this demand-side hypo-thesis with Heckscher–Ohlin's supply-side theory. Furthermore, Linder's theory has developed into Krugman's theory of home market effects, which hypothesizes that—based on the assumptions of increasing returns to scale and the existence of transport costs—a country with more consumers of an industry's goods will run a surplus in that industry, characterized by economies of scale.

Similarly, since Korea and China have developed into large trading countries, leading to a remarkable increase in demand for shipping services, it has become necessary to establish national shipping carriers, primarily through large investments in expensive ships (Asturias and Petty, 2013). This investment was well documented by the shipping industry in Korea and China (see Korea Shipowners' Association, 2007). Previously, the home market effect was clear. However, the nationality effect arose after large shipping companies with scale economies—possessing improved shipping technology—exited their respective shipping markets. Since the exiting shipping company had a significant market share, the resulting reduction in competition compelled the remaining oligopolistic shipping carriers to increase their shipping margins. This explanation is directly related to the observation that small and developing countries suffer more from the high transport costs caused by price discrimination in the container shipping market, as stated by Asturias and Petty (2013), Hummels, Lugovskyy and Skiba (2009) and Kleinert and Spies (2011).

The analysis in this study reveals that because of the existence of price discrimination and a substitutability change, some pecuniary effects have arisen at the national level. Hence, the nationality effect makes it necessary to implement specific policy for shipping industries in open economies, including Korea. Logically, one aim of this policy should be to decrease freight rates and improve service quality. Table 9 summarizes the economic size, export level, and fleet size of selected countries, showing that most large, open economies (except for the United States) have the corresponding shipping power.

Table 9. Size and Ranks of GDP, Exports, and Fleet (2016)

(Unit: billion US dollars for GDP and Exports, million DWT for Fleet)

	GDP		-	Exports		Fleet	
Country	**Rank**	**Size**	**Country**	**Rank**	**Size**	**Rank**	**Size**
US	1	18036	China	1	2275	3	165
China	2	11158	US	2	1505	8	67
Japan	3	4383	Germany	3	1329	4	112
Germany	4	3363	Japan	4	625	2	223
Korea	11	1377	Korea	6	527	7	80

Sources: ISL (2017), World Bank (2017) and WTO (2017).

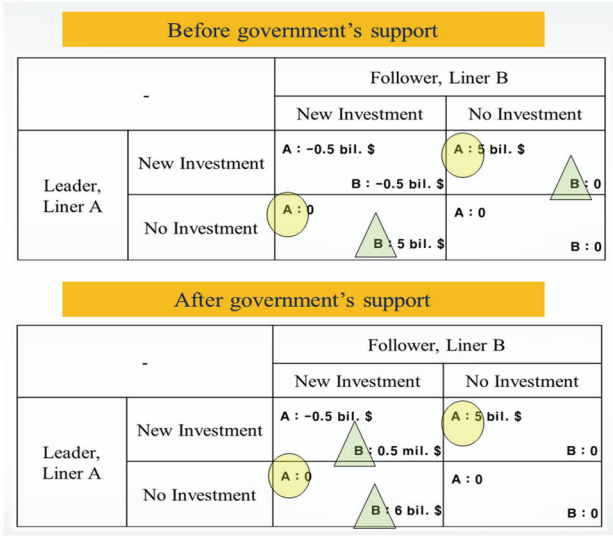
This interpretation of national carriers can also be applied to small and medium-sized trading countries that have insufficient shipping companies. Previous studies emphasized that the liberalization of restrictions on foreign investment in the shipping industry could reduce freight costs. However, our study argues that if there is no significant national counterpart that can function as a substantial competitor, foreign shipping companies may act as a colluding cartel, leading to continued and persistent price discrimination in these small and medium-sized countries. Therefore, national carriers can play a role in substantially reducing international transport costs beyond simply adding to the number of competing carriers. Further, this argument might be applied to the container terminals and port industry. That is, the promotion of national port companies would enhance the efficiency of international logistics market.

Moreover, regarding the need for an industrial policy for the shipping industry, some important issues have arisen in developed countries. One example is a government-related financial institute in China promising approximately $26 billion to support its national carrier, COSCO. Similarly, Germany's central and regional governments have also provided their national carrier, Hapag-Lloyd, with the financial support of approximately $2.4 billion. Taiwan's government announced that it would provide financial support of approximately $2 billion to its national carrier, Yang Ming. Lastly, the Korean government plans to support its national shipping industry by implementing new policies including financial assistance.

These shipping nations' supports for their shipping industry can be explained by strategic trade theory, which is that the government's support in an oligopolistic and game-theoretic situation changes the game's equilibrium. Fig. 5 illustrates the details of the strategic trade policy. The yellow circles indicate the dominant strategies of leading liner A and the green triangles reflect those of follower liner B. The equilibrium before adding the government's support is that liner A earns $5 billion and liner B does not invest, and therefore earns no gain. However, if liner B's government promises its support, the game changes and the resulting equilibrium is that liner A abandons investing and liner B invests and earns $6 billion, including $1 billion in government support. This government support can lead to a vicious cycle of excess competition in the container shipping market.

Until now, our discussion has focused on the horizontal aspect of industrial policy in the shipping industry. As emphasized by Stiglitz (2013, 13) and our own results, the government should implement industrial policy measures to ensure the efficient movement of goods between countries. However, concrete policies to achieve this goal could have an additional vertical nature across economies.

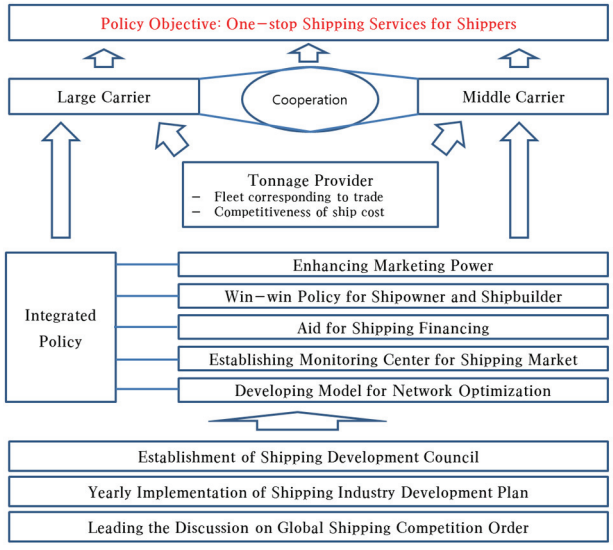
Fig. 5. Shipping as a Strategic Industry



Source: Modified Table 1 of Krugman (1987).

Fig. 6 illustrates an example of vertical shipping industrial policy following recommendations for the Korean shipping industry (Ko Byoung-Wook et al., 2020). The problems and corresponding policy measures were derived from in-depth interviews with industry experts, policymakers, and related financiers.

Fig. 6. Recommendations for Integrated Shipping Industrial Policy in Korea



Source: Ko Byoung-Wook et al. (2020).

6. Conclusions

Many economists agree that governments should create infrastructure and implement effective supply chain logistics to ensure the efficient movement of goods, according to Stiglitz's hypothesis. However, the question of whether a national carrier is necessary to provide these services has been controversial. This study answers this question using the case of Hanjin Shipping's collapse as a natural experiment. According to the empirical results based on time-series analyses (including a state-space model), a significant nationality effect occurred due to price discrimination, with substitutability changes in Korea's and China's container shipping markets, especially relative to that of Japan. This purported nationality effect can be explained from the perspective of an extended home market effect, which first appeared in the economic literature as Linder's hypothesis. Based on this nationality effect, it is necessary for governments to implement shipping industrial policies in open economies. This policy recommendation differs substantially from the existing literature, which emphasizes the importance of enhancing competition—especially in developing countries—and focuses on the number of competing carriers, not on carriers' nationalities. If the assertion about a national carrier is accepted, the policy agenda should next involve ways to implement these policies (Ko Byoung-Wook et al., 2020).

In summary, new policies for the shipping industry are needed both as horizontal industrial policy and vertical industrial policy. Additionally, this study demonstrates that time-series analysis (including a state-space model) is an appropriate method to monitor the behavior of market participants such as container shipping companies that may act collectively as an implicit price cartel.

Several important topics can be addressed by future research. The first involves designing shipping industrial policies for developing countries. Various studies including this one find that competition in the container shipping market should be increased to improve international transport services and reduce freight rates. However, ways to increase competition remain to be determined. One alternative—as suggested by Fink, Mattoo and Neagu (2002)—is to give foreign consumers the right to challenge shipping lines' anticompetitive practices in the national courts of the countries of origin of these shipping lines. Furthermore, establishing a national or regional carrier could be an effective alternative policy, especially for small and medium-sized open and developing economies. However, incumbent carriers and their countries may not prefer the latter alternative in the current concentrated, oligopolistic, and global container shipping market. Joint ventures or similar agreements between developed and developing shipping countries could thus offer strong plausible alternatives.

The second future research topic involves seeking improved global governance for the container shipping market. The European Union abolished shipping conferences' block exemptions under competition law in October 2008, leading to enhanced competition. However, this policy also invoked several large mergers and acquisitions and an increase in strategic alliances, leading the global container shipping industry to become so oligopolistic that the abuse of the resulting market power has become a cause for concern. The abolishment of shipping conferences could be attributed to this unintended outcome. Therefore, this tendency toward concentration should be investigated and discussed, especially for the promotion of sufficient diversity in the container shipping market. Regarding these two topics, discussing the establishment of a World Maritime Committee under the United Nations' UN Conference on Trade and Development or International Maritime Organization would be appropriate. This committee could be expected to be similar to the United States' Federal Maritime Committee in structure and function. The first task of this World

Maritime Committee should be to design and implement harmonious shipping industrial policies and the second task should be to seek alternative global governance.

The third future topic involves empirical research, as this study lacks explanatory power when analyzing the change in container freight rates. For example, researchers can use route-specific variables such as the utilization ratio and micro data such as specific freight rates for a commodity or a shipment. This improvement in the scope of the data would help more rigorously test the nationality hypothesis.

The last, not the least, future research topic is the mechanism of freight rate determination. As an outsider to the actual container shipping markets, the researchers cannot observe the negotiation process between container liners and shippers for determining the freight rates. Owing to this difficulty of assessing the rationality of the determination of freight rate, this study has a limit on evaluating the nationality effect. Therefore, this line of research on the freight rate determination method will contribute to examining the nationality effect in container shipping markets.

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