

Choice Factors of Transshipment Port in Northeast Asia

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Abstract : In order to attract more transshipment cargoes, Busan Port Authority (BPA) has, since 2003, adopted the volume incentive policy by which more than US\$ 10 million annually have been paid back to shipping lines that were called at the port. However, having been a transshipment port for the Northeast region of China, the port of Busan has come under threat from bold Chinese port development projects, notably Shanghai, as northern Chinese regional ports place more emphasis on building facilities capable of handling growing trade volumes. Undoubtedly this would lead to a decline in transshipment container traffic moved via Busan. The purpose of this paper is to identify some core factors that have been affecting the increase of transshipment cargoes of Busan and further to recommend BPA an improved incentive scheme with which more T/S cargoes can be attracted into the port of Busan. To clarify the reason why T/S cargoes have increased in the port of Busan, several steps are made as follows: The first step is to make a quantitative model for explaining the development of T/S cargoes during the last decade. The second step is to define the dependent and the independent variables for multiple regressions after testing variable significance. For this, data collection and the accuracy of validation have been done by the direct interview with the experienced staffs in shipping companies of both domestic and foreign country. After validating the model with collected data, the final step is to find variables which are explaining the model mostly. In conclusion, 2 variables were clearly identified as core factors that explain well the development of T/S cargoes in the port of Busan: 'Mohring effect' and total cost. It is strongly recommended, by an empirical study, that an incentive scheme be changed to a way which more feeder vessels rather than mother vessels can reduce their direct costs to call in the port of Busan.

Key words : Northeast Asia, Transshipment Port, Choice of Transshipment Port, Incentive, Busan Port Authority

1. Introduction

To be hub port by increasing transshipment cargo in the Northeast Asia area is the vital issue of Busan port in order to revitalize Korean economy and to overcome the problem of under utilization of container terminal facility. The port of Busan, Shanghai and Ningbo in Northeast Asia ports has been the competitive relation in terms of transshipment attraction. In the context of competition, Busan port authority has carried out the volume incentive policy to increase the transshipment cargo since the year of 2003, of which the payment is more than US\$ 10 million annually.

The aim of the paper is to select the independent factors for the purpose of clarifying why the transshipment increase happened in Busan port. In order to gain the research objective, several steps are designed. First step is to select quantitative model for explaining real phenomena about transshipment cargo share. Second step is to define dependent and independent variables for multiple regressions after the test of variable significance. On this step, data collection and the accuracy validation has been done by direct interview with the experienced staffs in shipping company in domestic and foreign country. As the port of

Busan has three kinds transshipment flow from China, Japan and Southeast, the paper has to handle individual case separately. Third step is to validate the model using collected data, in order to reveal which variables explain the model in a good fit.

2. Literature review

Hiroshi Ohashi (2005) studied the choice problem of air cargo transshipment airport in Northeast Asia. Based on a unique data set of 760 air cargo transshipment routings to/from the Northeast Asian region in 2000, this paper applies an aggregate form of a multi nominal logit model to identify the critical factors influencing air cargo transshipment route choice decisions. The analysis focuses on the trade-off between monetary cost and time cost while considering other variables relevant for choice of transshipment airport. The estimation method considers the presence of unobserved attributes, and corrects for resulting endogeneity via a two-stage least-squares estimation using instrumental variables. The empirical results show that choice of the air cargo transshipment hub is more sensitive

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to time cost than the monetary costs such as landing fees and line-haul price.

Veldman and Bückmann (2003) analyzed earlier with respect to container port competition in Northwest Europe. They estimated demand functions for both the continental and the overseas hinterland of the West European major container ports and assessed the demand function for a port expansion project for the port of Rotterdam.

Veldman et al. (2005) estimated demand functions for a project to improve the accessibility of the Port of Antwerp by deepening the Scheldt River and thereby reducing waiting times for the tide and the ability to accommodate bigger ships. In both publications the parameters of a Logit Model were estimated with regression analysis and the demand function could be derived by systematically changing cost and assessing the resulting market shares.

Veldman et al. (2008) studied to search significant factors for understanding the competitive position of transshipments ports and port choice elasticities in the market of the Mediterranean. Statistical tests are applied using a 10-year time series of aggregate transshipment flows between 15 transshipment ports and 9 feeder regions. Tests of Logit Models with regression analysis show that variables such as feeder costs, mainline port access costs and Mohring effects are statistically significant.

Also Lirn et al. (2003, 2004) and Ng (2006) have analyzed the decision factors for transshipment port and have revealed that the cost of a shipping company, route accessibility, and time are important decision factors. Meanwhile, the domestic researches on deciding a transshipment port are as follows: a study of inducement strategies of transshipment cargo (Bae, 1999; Jeong and Gwak, 2002; Park and Kim, 2003), a study of transshipment port decision based on ISM and AHP technique from the viewpoint of a global container shipping company (Baek, 2007), and a study of selection attribution for transshipment port from the viewpoint of a shipping company at home and abroad (Park and Seong, 2008).

However, these previous studies are mainly focusing on the inducement strategies for transshipment cargo or are suggesting the selection attribution for transshipment port as well as the method to select key attributes. But these previous studies have shown that according to the questionnaire respondents (such as a shipping company, cargo owner, importer and exporter, forwarder), their study results are different. In this respect, it means lack of consistency and validity. Moreover, these preceding studies have a limitation

in the sense that they are trying to find decision factors only by way of questionnaire, not performing an analysis based on actual data.

Therefore, different from those preceding studies, this study has analyzed 10-year actual data for comparison analysis. That is, by using logit regression model and the regression model of Veldman (2008), this study has performed a quantitative analysis in order to suggest selection factors for transshipment port, so that it can be a more practical research.

Comparison of the results earlier Veldman's research concerning the Northwest European market shows that the outcomes correspond rather well in terms of the resulting choice or demand elasticity. This paper shows that the use of Logit Models with respect to transshipment port choice leads to useful findings for port planning. This research in combination with earlier research by one of the authors for transshipment port choice in Northwest Europe is a step forward in the field of transshipment port choice.

3. Analysis of transshipment

3.1 Calling pattern in northeast asia

Recently, a shipping company changed calling pattern from traditional pattern(Figure 1) to Chinese pattern which means the ports in China becomes hub port. Before the year of 2000, a shipping company shows typical calling pattern from Singapore, Hong Kong, Kaohsiung, Busan, Yokohama, Tokyo and Seattle sequentially. Under this pattern, a shipping company had to decide a transshipment port between Busan or one of Japanese port in Northeast Asia region.

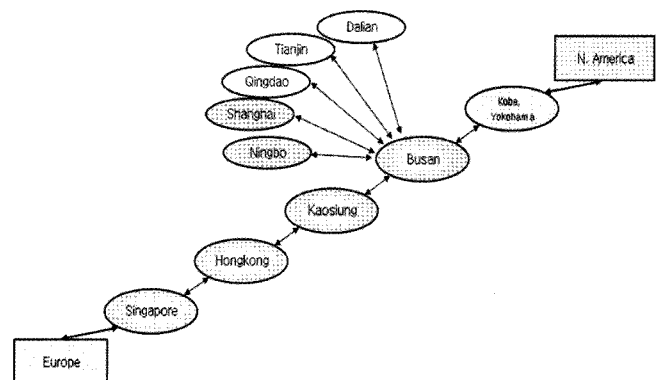


Fig. 1 Traditional route to north america and transshipment ports

After the year of 2000, the calling pattern of the year of 2007 is reformed due to China effect. According to Drewry

report(Drewry 2006), in case of USA bound, the frequency of calling at Chinese ports such as Hong Kong, Shanghai, Yantian have increased in comparison with the year of 2000(Figure 3 and 4). Furthermore, owing to Chinese volume, direct route TP5(ETE) from Shanghai, Ningbo to Los Angelous is opened by Maersk Line and it takes 28 days for one round trip(Figure 5).

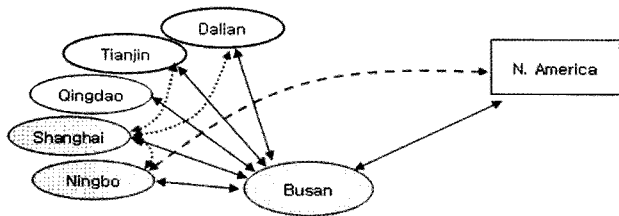


Fig. 2 Current route to north america and transshipment ports

coastal cargo for transshipment. The volume of transshipment is higher than OSC survey report.

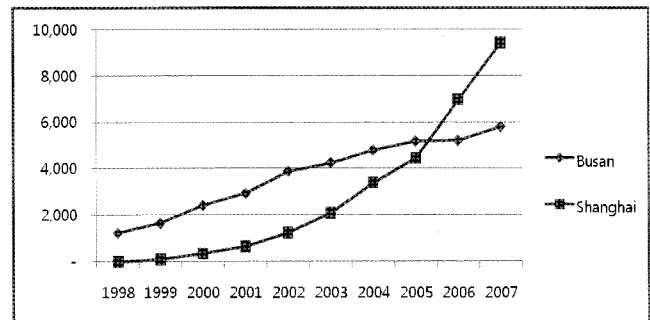


Fig. 5 Transshipment trend in Busan and Shanghai Source: SIPG internal report, and PORT-MIS, 2008

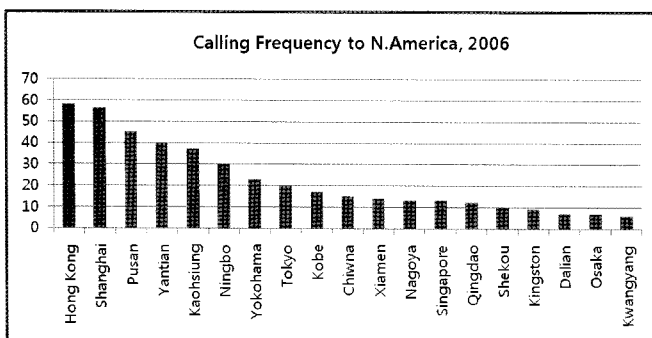


Fig. 3 Calling frequency for USA bound Source: Drewry(2006), compiled by authors

4. The port choice model of transshipment cargo

4.1 Selection factors for transshipment port

Prior to suggesting port choice model, the factors are to be selected from experts who are responsible to design the shipping liner route. The 15 items to be surveyed are collected from the published papers. The collected items are questioned for measuring importance degree with 5 scores from senior managers of major container shipping liners. The way of collecting questionnaire has been performed by direct interview with a responsible person in a shipping company, or visiting or through explanation of the purpose in front of a group of responsible officers in shipping companies. The questionnaires are sent to 30 container shipping liners including both domestic and foreign companies. The response rate is 90% of planned responses. The result of the analysis of the answer of the questionnaire reveals that the most important factor is cargo handling capacity such as handling moves per ship per hour. Second important factor is terminal handling charge. The sequence of priority is listed in table 1. Among these factors, qualitative service factors such as container handling capability, berth facility capability, feeder frequency, feeder network, free time, overtime storage fee etc., can be represented as proxy variable.

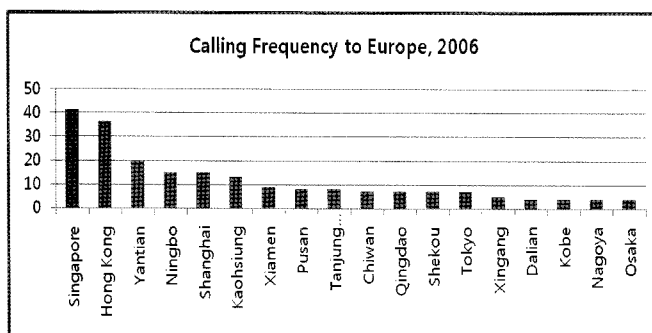


Fig. 4 Calling frequency for Europe Source: Drewry(2006), compiled by authors

In comparison, recent competition relationship has been changed due to the rapid progress of Chinese ports caused by lower cost and local container volume. For reference, transshipment trend from the year of 1998 to the year of 2007 in Busan and Shanghai indicate why the market of transshipment for analysis is focused on port of Shanghai and Busan. The transshipment cargo of Shanghai includes

This study has selected the following factors for transshipment port: cargo volume at the local ports, incentive amount, deviation expenses of a mother ship, total expenses of a mother ship and feeders, and total cargo volume as a service substitution based on the previous studies (Lim et al. 2003, 2004), (Ng, 2006), (Baek, 2007), (Park and Seong, 2008)).

Table 1 Score of transshipment port deciding factors

Item	Response	Mean	SD
Cargo Handling Capability	17	4.294	0.686
THC	17	4.176	0.809
Berth Facility	17	4.059	0.748
Feeder Frequency	16	4.000	0.632
Main Route Location	16	4.000	0.632
CY Facility	17	3.941	0.748
Feeder Network	17	3.941	0.966
Cargo Volume	15	3.933	0.961
Free Time	17	3.706	0.985
Port Dues	17	3.471	1.007
Overtime Storage Fee	17	3.412	0.87
Incentive	17	3.294	0.92
CIQ Service	17	3.294	0.985
Providing Berthing Priority	16	2.938	0.929
Bunker Supply, Ship Repair Service	17	2.824	1.074

4.2 Model Specification

The empirical analysis is based on the selection model of the above-mentioned Hiroshi Ohashi (2005) and Veldman (2008).

The probability that a shipping company in region (r) select transshipment port (p) can be expressed as:

$$P_p^r = \frac{e^{U_p^r}}{\sum_{P=1}^P e^{U_p^r}}, \quad (P=1, 2, \dots, P) \quad (1)$$

U is the "utility" attached to transshipment port (p) by shipping liner in region (r) and p the index of the transshipment port in a total of P ports.

Considering Veldman's model (2008) and the factors to be surveyed, the utility function is modified as:

$$U_p^r = \alpha_1 CT_{pr} + \alpha_2 CI_{pr} + \alpha_3 CD_{pr} + \alpha_4 L_{pr} + \alpha_5 M_{pr} \quad (2)$$

where CT_{pr} is the sum of feeder cost CF_{pr} and mother ship access cost CM_{pr} . The feeder transport cost CF is incurred between transshipment port and feeder port (p,r) in r region; CM is the mainline access cost to transshipment port; CI is the incentive between transshipment port and competition port (p, p'r); CD_{pr} is deviation cost between transshipment hub port and feeder port. L_{pr} represents the attraction of a port given its volume of local cargoes. M_{pr} represents the total handling throughput of a port including local and transshipment cargo. This is a part of Mohring-effects (Mohring, H., 1972) and expressed as a function of the level of port throughput. As feeder calling frequencies increase, wait times of cargo decrease, demand

increases, and transit frequencies can increase again. This effect can be used as substitution variable of port service. The Greek symbols $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and α_5 are the coefficients of the utility function.

By taking for each region (r) the ratio of the market share of transshipment port (p) and of an arbitrarily chosen basic port (p*), it follows from (1):

$$\left(\frac{P_p^r}{P_{p'}^r} \right) = \frac{e^{U_p^r}}{e^{U_{p'}^r}} = e^{U_p^r - U_{p'}^r} \quad (3)$$

Combination of equations (2) and (3) and taking of logarithms leads to:

$$\begin{aligned} \ln \left(\frac{P_p^r}{P_{p'}^r} \right) = & \alpha_1 (CT_{pr} - CT_{p'r}) + \alpha_2 (CI_p - CI_{p'}) \\ & + \alpha_3 (CD_p - CD_{p'}) + \alpha_4 (L_p - L_{p'}) \\ & + \alpha_5 (M_p - M_{p'}) \end{aligned} \quad (4)$$

4.3 Variable Description

Dependent Variable

$\ln \left(\frac{P_p^r}{P_{p'}^r} \right)$ is the share of transshipment in the port of Busan among total transshipment in the region.

Independent variables

Selecting independent variables is dependent on research outputs on the topic. Researchers insist that deciding transshipment port is influenced by cost, location, service factors like productivity and incentive system etc.

- $CT_{pr} - CT_{p'r}$ is the total cost difference between the port of Busan and Shanghai port for moving containers from origin to destination in Northeast region This cost is composed of operation cost, running cost and logistics cost.

- $CI_{pr} - CI_{p'}$ is the incentive difference between the port of Busan and the port of Shanghai, where THC of deepsea volume is discounted with some percentage or where compensation for the growth of transshipment compared with a previous year throughput. is paid to shipping company.

- $CD_{pr} - CD_{p'}$ means the difference of deviation cost from main line route to the port of Busan or the port of Shanghai. In Northeast Asia, Traditionally, main trunk route towards USA is established via Singapore, Hon Kong, Kaosung, Busan and Yokohama to Los Angeles (Fig. 1).

- $L_p - L_{p'}$ can be obtained by the ratio of local cargo of Busan and the region. This is proxy variable representing

attraction effect.

• $M_{pr} - M_{p'}$ can be obtained by the ratio of total handling cargo of Busan and the region. This is proxy variable representing mohring effect.

The used variable for regression analysis is named as Y , X_1 , X_2 , X_3 and X_4 as follows.

5. Data for input variable

5.1 Value of dependent variable

There is a controversial issue concerning the scope of region. The criteria of research scope are trade direction such as USA or Europe bound. The other criteria are drawn from the relationship between the feeder sub region and competition transshipment port. In this study, the potential hinterland of Busan port covers four major ports in the region. In the quantitative model research, Northeast Asia region and North America trade will be examined together. In the context, the mother value of dependent variable is defined transshipment containers in the Northern China ports such as the port of Dalian, the port of Tianjin, the port of Qingdao including the port of Shanghai and Busan port. The numerator of dependent variable is transshipment container in the port of Busan for 10 years.

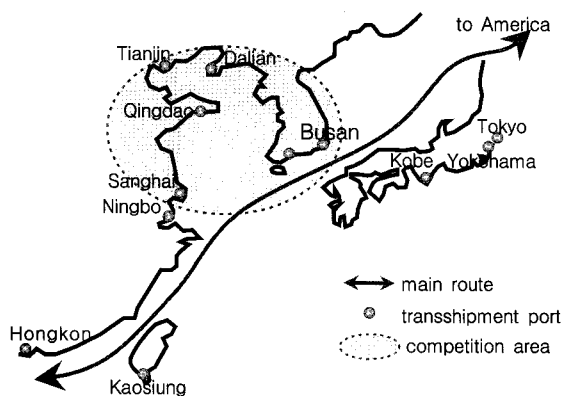


Fig. 8 Scope of research

In the ship operation, different types of cost are occurred on supply chain steps. Ship cost is composed of voyage cost and running cost. Ship voyage cost is composed of fueling cost and port dues.

5.2 Mother ship dimension for cost estimation

In the paper, mother ship's dimension is assumed to be 51,836 Gross Tonnage, 22,101 Net Tonnage, 61,153DWT,

4,400TEU Capacity, and navigation speed is 22 knots, draft is 13.6 meters, unloading moves are 600TEU (120TEU, 240FEU), loading moves are 600TEU(120TEU, 240FEU), total handling moves are 720 boxes which are assumed full containers, berthing time is 24 hours and handling time is 12 hours, the ratio of local cargo and transshipment is 62.6 vs 37.4 and bunker C consumption is 27 ton per day and bunker A is 2.5 per day.

Table 2 Mother vessel's specification for quantitative model

Gross Tonnage	51,836GT
Net Tonnage :	22,101NT
DWT	61,153DWT
Draft	13.6 meters
TEU Capacity :	4,400TEU
Unloading containers	600TEU (120TEU, 240FEU)
Loading containers	600TEU (120TEU, 240FEU)
Total handling containers (Assumed full containers)	720BOX
Ratio of local and transshipment	62.6:37.4
Berthing time	24 hours
Handling times	12 hours
Bunker C Consumption	27 ton per day
Bunker A Consumption	2-3 ton per day

5.3 Feeder ship dimension for cost estimation

In the paper, feeder ship's dimension is assumed to be 6,764 Gross Tonnage, 3,954 Net Tonnage, 9,981 DWT, 576 TEU Capacity, and navigation speed is 13.5 knots, draft is 7.9 meters, unloading moves are 225TEU (75TEU, 75FEU), loading moves are 225TEU(75TEU, 75FEU), total handling moves are 300 boxes which are assumed full containers, berthing time is 24 hours and handling time is 10 hours, the ratio of local cargo and transshipment is 62.6 vs 37 and bunker C consumption is 19 ton per day and bunker A is 2 per day.

Table 3 Feeder specification for quantitative model

Gross Tonnage	6,764 GT
Net Tonnage :	3,958 NT
DWT	9,981DWT
Draft	7.9 meters
TEU Capacity :	576TEU
Unloading containers	225 TEU (75TEU, 75FEU)
Loading containers	225 TEU (75TEU, 75FEU)
Total handling containers (Assumed full containers)	300 BOX
Ratio of local and transshipment	62.6:37.
Berthing time	8 hours
Handling times	5 hours
Bunker C Consumption	19 ton per day
Bunker A Consumption	2 ton per day

5.4 Ship voyage cost

Variable cost includes expenses related to a specific voyage. Port cost and logistics cost such as THC, lashing, shuttling, tally cost and cargo wharfage, fuel consumption cost, are included into voyage cost category.

5.5 Port dues

When a mother ship calls at a port, she has to pay for various kind of charge to Port Authority, Terminal Operator, pilot, tug company and related company for providing port service.

The charge comparison of the port of Busan and the port of Shanghai is as follows;

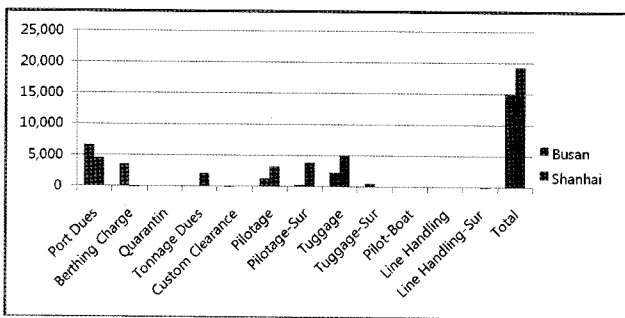


Fig. 9 Port dues of Busan and Shanghai port, unit US\$
Source: Hanjin Shipping and Sinokor

5.6 Fuel cost for mother vessel access

Fuel consumption cost for transportation is calculated by distance from origin to destination and daily bunker consumption. In calculating fuel consumption, the distance difference of two cases is considered from Hongkong to Shanghai or from Hongkong to Busan. Tracking historic data for 10 years, RIM data is used as bunker C and A price.

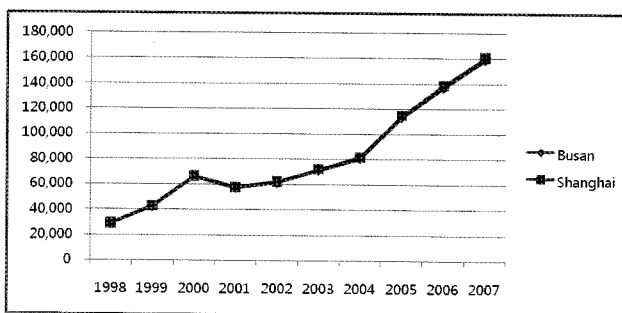


Fig. 10 Fuel cost for navigation
Source: RIM data

5.7 Port logistics cost

Within scope of port logistics cost, THC, lashing cost, shuttle cost, wharfage, tally cost are included in the category. Even though Port Authority used to announce THC tariff, most of terminal operators have private contract with a

shipping company about real tariff according to promised volume. In case of Shanghai port, if a shipping company pays THC, the other cost such as lashing fee, storage charge in CY, shuttle fee in same terminal are included in THC. In comparison, the port of Busan charges the elements of port disbursements separately. On this reason, it is not fair to list difference of individual cost one by one.

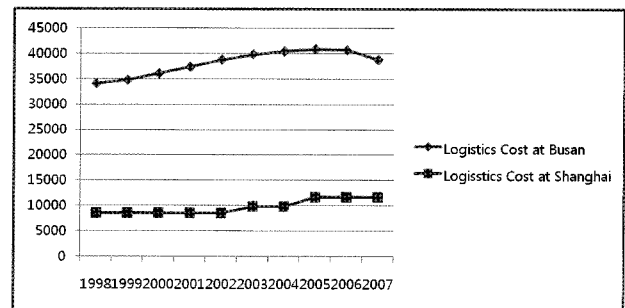


Fig. 11 Port logistics cost of transshipment in Busan and Shanghai
Source: By Authors' Interview with PA and Hanjin Shipping

5.8 Ship running cost

Running cost consists of capital and operating expenses according to period of voyage. Capital cost is a fixed item, i.e. the purchase price of the ship, whether acquired a newbuilding or on the second market. Deposit, repayment of loan principal and interest are part of capital cost. Within the overall ship cost, it is operation cost category where ship owner has the greatest influence over the choices made out. The core operating cost elements are manning costs, insurance costs, repair cost, the cost of stores and supplies, and management and administration. (Drewry, Ship Operating Cost, 2006) As this cost depends on market price, it is not easy task to track for 10 years. On this point, Drewery suggested ship cost and charter type relationship as proxy value of running cost. Based on the relationship, daily time charter rate is used for calculating running cost from origin to transshipment port including capital cost and operating cost.

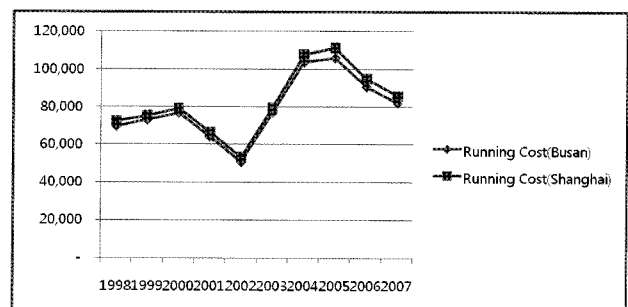


Fig. 12 Running cost of Mother vessel and feeder of Busan and Shanghai
Source: Drewry, Annual Container Market Review and Forecast 2006

5.9 Sum of ship cost

Ship costs including fueling cost, running cost and port charges from origin to destination is summed for comparison between Busan port and Shanghai port.

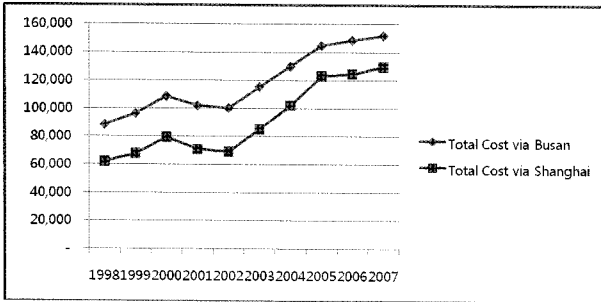


Fig. 13 Total cost of transshipment via Busan and Shanghai

5.10 Data for measuring port attraction

Port attraction is defined the ratio of captive cargo of Busan port by total captive cargo in the region. Busan's captive container is obtained from PORT-MIS, the regional data is from OSC report (OSC, Container Port Strategy, 2006).

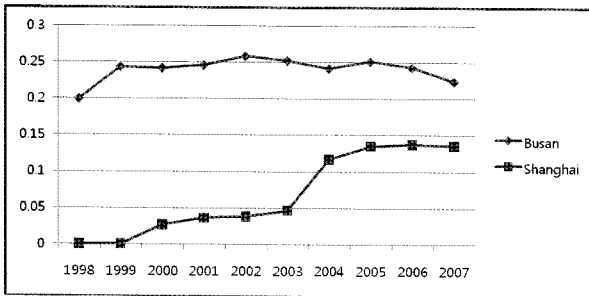


Fig. 14 The ratio of local cargo of Busan and Shanghai on region

5.11 Data measuring mohring effect

Mohring effect is defined the ratio of total cargo of Busan port by total cargo in the region(OSC, Container Port Strategy, 2006).

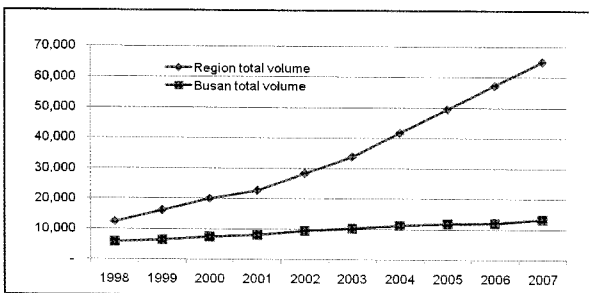


Fig. 15 Mohring effect

5.12 Deviation cost

Due to recent change of route pattern, defining deviation is

complex and variable. The mainline deviation distance is measured as the extra distance needed to call at a transshipment port compared to the distance of the shortest navigation course between the Hong Kong, Shanghai, Yokohama and Hong Kong, Busan to Yokohama. The remaining distance to North America is not considered because of same distance to USA.

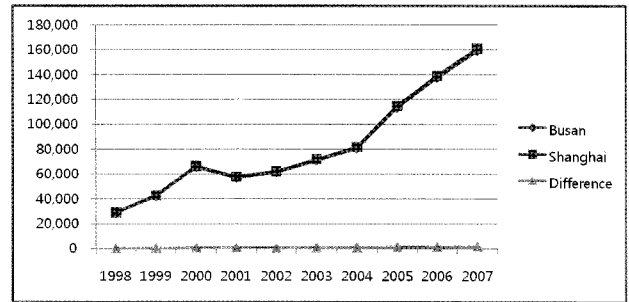


Fig. 16 Deviation cost of Busan and Shanghai

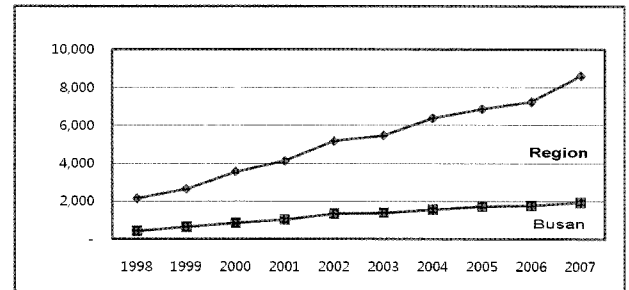


Fig. 17 Transshipment of Busan to China and Northeast Region Source: Port MIS and OSC Report (2006)

6. The result of model test

The multiple regression model is tested with 10 years data. The authors selected one observation per year, therefore the number of data is 10. The reason for selecting only 10 data is due to the anomaly prevention of the result of statistical test. If we increase the number of observation by quarterly or monthly, the result of analysis shows the anomaly, i.e. the significant probability of most of independent variables is under 5 %.

Table 4 Variable definition of model

Variable	Definition	Unit
Dependent Variable(y)	Ratio of Transshipment of Busan with Region Transshipment	Ratio
Independent Variable X1	Ratio of Local Container of Busan with Region Local Container	Ratio
X2	Difference of Incentive Payment of Transshipment	US \$
X3	Difference of Mother Vessel Deviation Cost of Transshipment	US \$
X4	Total Transshipment Cost of Mother and Feeder	US \$
X5	Ratio of Total Handling Container of Busan with Regional Total Handling Container	Ratio

6.1 Step 1 model test

The regression model has been tested in 2 steps. In the beginning, 5 variables are selected as independent variables as Veldman's Model (Veldman 2008). The result shows that X1(mohring effect) and X4(total cost) are accepted, and X2(deviation cost) and X3(incentive payment) is rejected under 5% significance level. As the adjusted R square is 0.986, this means the model shows high explanation of phenomena.

R	R ²	Adjusted R ²	Standard Error	Durbin-Watson
0.998	0.996	0.996	0.00386	0.449

As the result of ANOVA, the regression model has effective meaning because significant probability is less than 5%.

	Sum of Square	Degree of Freedom	Mean Square	F	Significant Probability
Model	.137	5	.127	1,827.373	.000***
Residual	.001	34	.000		
Sum	.137	39			

* p<.1, ** p<.05, *** p<.01

The coefficient of regression model is as follows.

Variable	Non Standard Coefficient		t	Significance Probability	Multicollinearity	
	B	S.E			Tolerance	VIF
A	0.1750000	0.0190	8.9940	0.000		
X1	0.0200000	0.0970	0.2020	0.841	0.0060	175.917
X2	-0.00000214	0.0000	-1.6820	0.102	0.3590	2.7830
X3	0.00000412	0.0000	0.7040	0.486	0.0510	19.6870
X4	-0.0000043	0.0000	-11.4980	0.000***	0.1970	5.0730
X5	0.7830000	0.1180	606440	0.000***	0.0040	247.471

* p<.1, ** p<.05, *** p<.01

6.2 Step 2 model test

According to step 1 test, the model to be tested is modified with deletion of 3 variables which show weak significant probability. The independent variables to be selected are X4(Total Cost) and X5(Mohring Effect). The result of test is that adjusted R square is 0.995. According to ANOVA, significance probability is 0 and this indicate effective model. Furthermore, the fact that correlation indicator, VIF(Variance Inflation Factor), is less than 10 means any dependence does not exist in between independent variables. The coefficient of model is $Y = 0.179291199 - 0.000004782589 X4 + 0.810489669X5$. This expression will be used for sensitivity analysis.

R	R ²	Adjusted R ²	Standard Error	Durbin-Watson
0.998	0.996	0.996	0.00386	.512

	Sum of Square	Degree of Freedom	Mean Square	F	significant probability
Model	0.137	2	0.068	4584.348	0.000***
Residual	0.001	37	0.000		
Sum	0.137	39			

* p<.1, ** p<.05, *** p<.01

Variable	Non Standard Coefficient		t	Significance Probability	Multicollinearity	
	B	S.E			Tolerance	VIF
A	0.17000000	0.0050	36.597	0.000***		
X4	-0.000004503	0.0000	-21.695	0.000***	0.629	1.590
X5	0.82200000	0.0090	87.179	0.000***	0.629	1.590

* p<.1, ** p<.05, *** p<.01

7. Conclusion

The purpose of this study is to decide the selection factors for transshipment port. To this end, this study is based on Logit model of Hiroshi Ohashi (2005) and Veldman (2008), which are being commonly used as a port selection model. Also, taking into consideration the selection factors of the previous studies, this study has produced the following five factors based on the past 10 years' actual data: cargo volume at a local port, incentive amount, deviation expenses of a mother ship, total expenses of a mother ship and feeders, and total cargo volume as a service substitution.

The actual data in this study has been confined to which port between Busan Port and Shanghai Port the feeder cargo in the northern area of China select. The following assumption has been made: the mother ship of 65,000 GRT departs from Hong Kong via Busan or Shanghai to the U.S. West Coast, and the feeder, a 6,700 GRT container feeder ship, sails from Dalian Port to Shanghai or from Dalian Port to Busan.

The actual data used in the model are based on the 10-year data from 1998 to 2007. Some of these data have been posted by related organizations or the others have been collected during our field visit. The collected data have been used by the above-mentioned selection model in order to calculate the difference values between the two rival ports of Shanghai and Busan. The procedure to test the validity of variables has adopted the following three steps.

In the first test, the two variables among the five - "the transshipment cargo expenses difference between the port of Busan and the port of Shanghai in both a mother ship and a feeder" and "the rate of Busan Port's total cargo volume against the regional total cargo volume" - are statistically

significant at the significant level of 0.01. Therefore, the second test has been made for these two variables that are statistically significant, and as a result of the second test these two variables again are statistically significant at the level of 99%. This means that “cost reduction of a mother ship and a feeder ship” and “total cargo increase at the local port” are significant factors for transshipment cargo volume. The third test has been conducted after the mother ship’s expenses and feeder’s expenses have been separated, and the results of this test have revealed that these two are statistically significant at the level of 0,01, and that the feeder’s expenses carry more significance than the mother ship’s expenses. This means that more incentives should be given to the feeders which are suffering financial difficulty.

In conclusion, the previous studies have mainly tried to suggest the significant selection factors for transshipment port from the strategic point of view or by means of questionnaires given to the related experts or decision makers. However, this study has based on the actual data of the past ten years from 1998 to 2007, comparing and analyzing the two competing ports, and consequently trying to improving its validity.

Nevertheless, this study has been confined to two competing ports for analysis and comparison, and also five selection factors alone have been given, which are not enough for all kinds of transshipment ports. The remaining part for further research will be to apply the logit model to other ports in regional area in order to confirm the independent variables have effectiveness.

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