Journal of Navigation and Port Research International Edition
Vol.32, No.9 pp. 729~736, 2008 (ISSN-1598-5725)

Forecasting Model for Korean Ships' Detention in Port State Control

Gil-Soo Kim · *Gil-Young Kong*†

*, † *College of Maritime Science, National Korea Maritime University, Pusan 606-791, Korea*

Abstract : *Very often has it happened that Korean flag ships were detained due to the defect of the ship itself at the port they are entering into by the system of Port State Control(PSC). It does matter because the high detention ratio of Korean ships causes to increase the survey ratio of Korean ships by PSC countries, which increases overall operating costs of Korean shipping companies. Therefore Korean government should take tougher action on the detention of Korean ships. The study uses 946 inspections to formulate the model of identifying PSC-weak ships by logistic regression analysis.*

Key words : *Port state control, Detention, Deficiencies, Logistic regression model*

1. Introduction

The present regime of port state control (PSC) is originated from a memorandum of understanding signed in the Hague between eight North Sea states in 1978 that "laid down a general surveillance procedure aimed at verifying that a number of requirements derived from various international agreements were met and that conditions on board ships were not hazardous to safety or health" (Kasoulides, 1993). The subsequent serious maritime accidents such as the Amoco Cadiz oil spill led to a new memorandum of understanding signed in 1982 in Paris(Özcayir, 2001).

Seven important conventions in the international maritime regulatory framework for enhancing safety serve as the bases of the of PSC regime. These are the International Convention for the Safety of Life at Sea (SOLAS), International Convention for the Prevention of Pollution from Ships (MARPOL), International Convention on Load Lines (LOADLINES), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), Convention on the International Regulations for Preventing Collisions at Sea (COLREG), International Convention on Tonnage Measurement of Ships (TONNAGE), Merchant Shipping (Minimum Standards) Convention (ILO 147).

This was in reaction to the belief that many flag states are not willing to perform their duties of ensuring that ships flying their flag comply fully with international safety standards.

Many cases were reported that Korean flag ships were detained when they called foreign ports due to critical defect of PSC(Port State Control) check lists. Port state control is executed to remove the possible causes of ocean accidents by controlling the operation of sub-standard ships. Final responsibility for the ships lies to the flag state. If the detention ratio of Korean flag ships is high, then international credit on Korean shipping service quality would be decreased. And also regional PSC MOU (Memorandum of Understanding) evaluates the status of PSC detections to rank the flag state of the ships. Counterplan for the reinforcement of PSC and case study on the Korean shipping companies have been reported for the past years(Choi et al., 2003; Min et al., 2003).

The detention ratio of Korean flag ships has been decreasing very rapidly, but needs to be improved. If Korean flag ships' detention ratio goes up, then other Korean flag ships' on-board check will be increased and this makes Korean flag ships' expense go up.

This study identifies PSC weak ships by scientific method before collecting the status of Korean flag ships' PSC quality. High risk ships will be drawn out by its characteristics such as ship's age, ship type after analysing the causes of Korean flag ships' detention.

The methodology adopted in this study is Logistic Regression Analysis which makes it possible to evaluate the possibility of detention in case of Korean ships.

The remainder of the paper is organized as follows. In the next section, we briefly review the literature on the PSC system's development. We then describe the data in Section 3 and in Section 4 the model of the detention identification is investigated. In Section 5, we apply the logistic regression method to identify detention-weak ships. Finally, Section 6 presents some conclusions.

* Gil-Soo Kim, gilsoo@hhu.ac.kr, 051)410-4242
† Corresponding Author : Gil-Young Kong, kong@hhu.ac.kr, 051)410-4273

2. Literature review

Literature is available on the issues of why PSC inspections should be implemented and how they should be implemented. There is, however, a lack of statistical analysis on the matters of PSC systems.

Kasoulides (1993) stresses how flag state enforcement has diminished the proliferation of open registries and why coastal States have reacted by asserting their rights by port state control. Özçayir (2001) reviews various issues such as the role of the ISM Code, the function of classification societies, and the implications of the Erika incident in shaping practices in European PSC today, along with the practice of PSC in different regions or jurisdictions.

Cuttler (1995) examines PSC in terms of ship-sourced pollution prevention and calls upon states to focus greater attention on the potential benefits of developing a pro-active framework, which is PSC (Cuttler, 1995, p. 199). Hare (1997) offers one of the first contributions on the effectiveness of PSC in showing how the proliferation of regional MoUs has significantly reduced substandard ships. McDorman (2000) examines also how regional PSC agreements and harmonized inspection procedures have contributed towards levelling the playing field among different ports. Owen (1996) gives a detailed description of the practice of PSC in the Paris MoU and discusses the limitations inherent in the PSC regime connected with the fact that the port state has no direct influence over the design and construction of ships that are being inspected. Knapp et. al(2007) reviewed 183,819 port state control inspections of 6 years' period to formulate the model of the probability of casualty. And they also tried to find out the effects of various ship safety inspections. Cariou et al.(2007) used 4,080 observations from the Swedish Maritime Administration to test how vessel's characteristics influence the length of time between two port state control inspections along with the number of deficiencies detected during PSC.

3. The Present Detention Ratio of Korean flag ships

3.1 The Detention of Korean flag ships by region(country)

The portion of Korean flag ships detained in Japan is 44.4% of all detained Korean ships, while that of China is 27.9% as shown in Table 1. The reason why detention ratio is so high in those countries is that the middle or small size ships are more likely to enter the ports of the countries and those ships are inclined to be managed less effectively by their management companies due to their size.

Table 1 Korean ships' detention by region

(unit: ship)

region (country) \ year		2001	2002	2003	2004	2005	sum	ratio(%)	
Asia Pacific	Japan	26	3	5	2	0	36	44.4	36.7
	China	2	0	0	0	0	2	2.5	2.5
	Russia	2	1	0	0	0	3	3.7	3.1
	Hong Kong	5	3	7	0	0	15	18.5	15.3
	Austr ailia	3	6	2	0	5	16	19.8	16.3
	others	3	4	2	0	0	9	11.1	9.2
	sum	41	17	16	2	5	81	100.0	82.6
USA		4	1	0	0	0	5		5.1
Europe		3	0	2	1	2	8		8.2
Indian Ocean		0	0	1	1	2	4		4.1
sum		48	18	19	4	9	98		100.0

3.2 The Detention of Korean flag ships

Some 7,000 ships out of 40,870 registered Korean flag ships were inspected and 382 ships were found to have faults during 2000 to 2005. 138 Korean flag ships were given detention code.

3.3 The Detention of Korean flag ships by ship's age

The analysis of detention ratio by ship's age is shown in Table 3. It reveals that the older the ships the greater the detention ratio. Ships with the age of 20-25 have shown the highest detention ratio of 44.2% in Table 4.

Table 2 PSC deficiency recorded(Year 2000~2005)

year	registered Korean flag ships (A)	ships of deficiency (B)	deficiency ratio (B/A)	ships of detention (C)	detention ratio (C/A)
2000	6,494	74	0.0114	44	0.0067
2001	6,586	56	0.0085	45	0.0068
2002	6,792	57	0.0084	15	0.0022
2003	6,881	57	0.0083	20	0.0029
2004	6,998	54	0.0077	4	0.0006
2005	7,119	84	0.0118	10	0.0014
sum	40,870	382	0.0561	138	0.0206

Table 3 PSC detention by ships' age(Year 2000~2005)

	under 5 years	5-10 years	10-15 years	15-20 years	20-25 years	over 25 years
ratio of detained ships(%)*	0.0	2.9	8.0	23.2	44.2	21.7
ratio of Korean flag ships(%)**	8.3	18.3	19.6	15.2	14.4	24.3

* ratio of detained ships(%): detained ship's by age/ total detained ships

** ratio of registered Korean flag ships(%): registered Korean flag ships by age/total registered Korean flag ships

Table 4 PSC detention ratio by ships' age (Year 2000~2005)

ages	2000 detention ratio	2001 detention ratio	2002 detention ratio	2003 detention ratio	2004 detention ratio	2005 detention ratio
5year under	0	0	0	0	0	0
5-10year under	0	0.0022	0	0.0008	0	0
10-15 year under	0.0052	0.0015	0	0	0	0.0020
15-20 year under	0.0034	0.0158	0.0090	0.0047	0.0008	0
20-25 year under	0.0169	0.0203	0.0048	0.0110	0.0021	0.0055
25year over	0.0142	0.0050	0.0006	0.0017	0.0005	0

3.4 The detention of Korean flag ships by ship type

The detention of Korean flag ships by ship type is shown in Table 5. The detention ratio of cargo ship(bulk ships, general cargo ships and container ships) proves to be the highest of 74.7%, and that of dangerous cargo ship is the second highest with the ratio of 14.5%.

3.5 The detention of Korean flag ships by tonnage

The detention ration of Korean flag ships by tonnage is shown in Table 6. It reveals that the ships over 10,000 tons show higher risk of detention.

Table 5 PSC detention by ships' type(Year 2000~2005)

ship type	2000	2001	2002	2003	2004	2005	sum	ratio(%)
cargo ships	32	34	13	14	2	8	103	74.7
dangerous cargo ships	6	8	1	3	1	1	20	14.5
passenger ships	1	0	0	0	0	0	1	0.7
others	5	3	1	3	1	1	14	10.1
sum	44	45	15	20	4	10	138	100.0

Table 6 PSC detention ration by ships' Tonnage (Year 2000~2005)

tonnage(G/T)	2000 detention ratio	2001 detention ratio	2002 detention ratio	2003 detention ratio	2004 detention ratio	2005 detention ratio
under 500 tons	0.0002	0.0003	0	0.0001	0.0001	0
under 1,000 tons	0.0101	0.0116	0	0.0040	0	0
under 5,000 tons	0.0703	0.0494	0.0148	0.0169	0.0035	0.0016
under 10,000 tons	0.0571	0.1190	0.0208	0.0200	0	0.0126
over 10,000 tons	0.0702	0.1271	0.0560	0.0630	0.0068	0.0331

3.6 The detention of Korean flag ships by defect

The detention of Korean flag ships by defect is shown in Table 7 and 8. The primary reason for detention(391 events) is found to be deficiency in facilities(73%) and the second cause is a defect in the safety management system(35%).

Table 7 The number of PSC detention by deficiency items(Year 2000~2005)

deficiency type	deficiency in facility	operation procedure(ISM) and documents	qualification of crew	others
detention ratio(%)	73	9	3	15

3.7 The detention of second-hand ships

The detention of second-hand ships is shown in Table 9. It shows that 12% of the ships that imported from other countries are detained.

Table 8 PSC detention by deficiency items(Year 2000~2005)

reason of detention	the number of detention
life-saving facility	64
fire-fighting and safety facility	76
hull structure	58
loadline	40
navigation equipment	39
oil pollution facility	24
ISM-related	26
SOLAS-related	13
propulsion and auxiliary machine	14
radio equipment	12
documents	6
others	19
sum	391

Table 9 PSC detention by second-hand ship (Year 2000~2005) (unit : ship)

		2001	2002	2003	2004	2005	sum
imported number of second-hand ships(A)		28	30	29	47	51	185
total detention(B)		48	18	19	4	9	98
detention of imported ships(C)		11	4	4	1	2	22
ratio(%)	C/B	22.9	22.2	21.1	25.0	22.2	22.4
	C/A	39.3	13.3	13.8	2.1	3.9	11.9

4. Binary Logit Model

4.1 The model of the probability of detention

Binary logistic regression can be applied to the estimated probability (*P*) of a ship having a detention. The dependent variable (*y*) in this case is "detention" or "no detention". The binary logistic model in its end result provides the necessary coefficients (β) in order to compute the "estimated probabilities of detention" given a certain combination of dependent variables (*X*) which can be classification society, ship owner, ship's age or the type of the ship.

In binary logistic regression, a latent variable $y*$ gets mapped onto a binominal variable *y* which can be 1 (detained) or 0 (not detained) and is expressed as a function (*F*) of the error term (ε). If $y^* \geqslant 0$ then y=1 and if $y^* < 0$, then y=0. Intuitively, the model can be derived as follows:

$$P(y_i = 1 \mid X_i) = P(y_i^* \geq 0 \mid X_i) = P(\epsilon_i > X_i\beta) = F(X_i\beta)$$

Binary Logit Model is a possibility model, which is used for the case that dependent variable is binary, and the binary variable is statistically mutually exclusive event. It means that there are only 2 selections in which event A is selected or not, i.e mutually exclusive. For example, the possession of a house or the usage of PDA asks us to select just one case.

To estimate the coefficients, quasi-maximum likelihood (QML) is used as method of estimation in order to give some allowance for a possible misspecification of the assumed underlying distribution function. For the final models, logit and probit models are compared to see if there are any significant differences and logit models are used for the visualization part.

The reason why this model does not use OLS(ordinary least square) is that the dependent variable is not continuous. Therefore Binary Logit Model supposes that the following relationship exists in order to overcome the weakness of linear regression equations.

$$y^* = \sum_{k=1}^{K} \beta_k \chi_k + \epsilon \tag{1}$$

where ε is E(ε)=0(Symmetric distribution),
CDF(Cumulative Distribution Function)≡F(ε)

- y* Unobservable Response Variable, called Latent Variable
- y* is treated as dummy variable, which is expressed as the following.

$$y = \begin{cases} 1 & \text{if } y^* > 0 \\ 0 & otherwise \end{cases} \tag{2}$$

The following expression is also true from equation (1) and (2).

$$\begin{aligned} Prob(y=1) &= Prob\left(\sum_{k=1}^{K} \beta_k \chi_k + \epsilon > 0\right) \\ &= Prob\left(\epsilon > -\sum_{k=1}^{K} \beta_k \chi_k\right) \\ &= 1 - F\left(-\sum_{k=1}^{K} \beta_k \chi_k\right) \\ &= F\left(\sum_{k=1}^{K} \beta_k \chi_k\right) \end{aligned} \tag{3}$$

From equation (3) the probability of binary selection can be defined as the function F(ε) which is the function of ε's CDF. Therefore continuity can be obtained by the use of the probability function, which otherwise can not be dealt in the ordinary regression equation which arises because of the discontinuity of binary selection.

4.2 Logistic Distribution Function

Binary Logit Model supposes that it follows logistic distribution which is expressed as the following continuous possibility distribution function.

$$\begin{aligned} F(\theta) &= \frac{1}{1+e^{-\theta}} = \frac{1}{1+\frac{1}{e^{\theta}}} \\ &= \frac{e^{\theta}}{e^{\theta}+1} = \frac{e^{\theta}}{1+e^{\theta}} \end{aligned} \tag{4}$$

where, Θ is arbitrary possibility variable

Therefore logistic distribution function is either one of the following two:

$$F(\theta) = \frac{1}{1+e^{\theta}}$$

$$F(\theta) = \frac{e^{\theta}}{1+e^{\theta}}$$

Equation (4) can be depicted as Fig. 1, which shows that arbitrary possibility variable(Θ) is moving from 'minus infinity to 'plus infinity', and the dependent variable (Θ) ranges from 0 to 1.

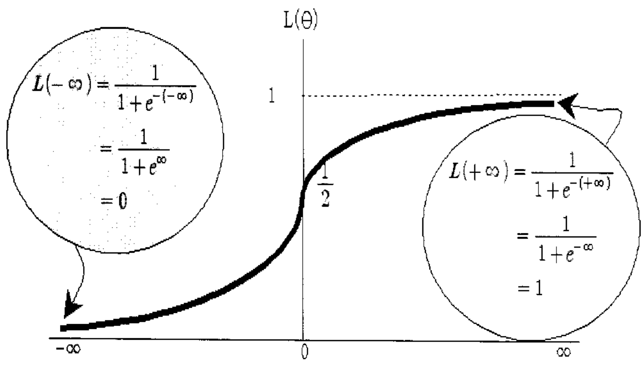

Fig. 1 Logistic Distribution Function

$$Prob(y=1) = F(\theta) = F(\sum_{k=1}^{K}\beta_k \chi_k) \quad (5)$$
$$\theta = \sum_{k=1}^{K}\beta_k \chi_k$$

Equation (7) and (8) is deducted from equation (5), and equation (7) is actually 'odds'.

$$Prob(y=1) = F(\theta) = \frac{e^{\theta}}{1+e^{\theta}} \quad (6)$$

$$\rightarrow e^{\theta} = e^{(\sum_{k=1}^{K}\beta_k \chi_k)} = \frac{P(y=1)}{1-P(y=1)} \quad (7)$$

5. The model of PSC risk forecasting

5.1 Input Data

Each regime maintains their own database and does not share data on inspection information with each other directly. The only public database which does share information is Equasis3 but the data cannot be used for risk profiling or to determine the effect of inspections.

The article uses a combined data set of port state control inspections, detention data and industry inspections to demonstrate that the data can be combined for statistical purpose to calculate the probability of detention. Binary logistic regression is used in the analysis but a twin ship data set is constructed which enables to filter out causal effects of variables such as flag, classification society, age, ship types or ownership of a vessel and concentrates on variables which indicates the quality of an inspection such as detention, which port state control regime inspected the vessel, vetting inspections and deficiencies found during a port state control inspection.

Every PSC inspection generates an inspection report that, inter alia, contains detailed information on the deficiencies noted (including 0 for no deficiency) together with relevant vessel particulars such as the flag of registry, IMO vessel number, vessel type, year built, and date of inspection. In this study, we assume one of the effects of PSC inspections as improving performance at subsequent inspections, manifested by a decrease in terms of the number of deficiencies noted. Conversely, we assume that vessels exhibiting an increase in the number of deficiencies noted at subsequent inspections are indicative of lack of significant effect of the PSC regime.

This study uses data related to PSC inspections carried out on Korean vessels that called at various ports around the world. Korean PSC statistics were selected because of the comprehensiveness of the data available from the Korean Registry of Shipping that comprises more than 1,435 inspection reports with the possibility of building a sample of 946 observations.

Input data were supplied by Korean Register of Shipping which supplied 1,435 informations on Korean flag ships, whose attributes are as the followings:

- classification number
- IMO number
- ship's name
- gross tonnage
- management company
- ship type
- ship's age
- inspection country(PSC)
- assigned MOU
- detention or not
- inspection date

Table 10 Database for the analysis

No.	Class No	IMO	Ship Name	G/T	Manager	Ship Type		Ins. country	MOU	detention_chk	Ins. date
1	9139697	9005259	CHOYANG WORLD	36627	CHO YANG SHIPPING CO., LTD.	CONTAINER SHIP		USA	USCG	N	20000102
2	8248205	8214798	HONGHAE PUSAN	3873	HONG HAE UNIVERSAL TRADING CO., LTD.	CARGO SHIP		RUSSI	TOKYO	Y	20000117
---	---	---	---	---	---	---		---	---	---	---
1435				(자	료	생					

source: Korean Register, www.krs.co.kr

The number of input data ready for SPSS analysis was 946 as is described in Table 11.

Table 11 Input data in SPSS

Class No	deficiency	ton 5-30	ton 30-100	com-deficiency	gen	bulk	tank	other	age 10	age 10-20	age 30	detention
9449845	1	0	0	9	1	0	0	0	0	1	0	0
8835527	1	0	0	4	1	0	0	0	0	1	0	1
---	---	---		omitted				---	---			

note : deficiency: the number of deficiency
ton5-30 : ship's tonnage of 500 tons to 3,000tons
ton30-100 : 3 thousand to ten thousand
com-deficiency : company deficiency
gen : general cargo ship
bulk : bulk cargo ship
tank : tankers
other : other ship
age10 : less-than-ten-year old ships
age11to20 : ships of ages between 10 to 20
age30 : ships of ages over 20

5.2 The Fitness of the Model

Regression coefficients can be calculated, in the general regression analysis, by OLS(ordinary least square), but Maximum Likelyhood Method is adopted. in case of logistics regression analysis.

The procedure of hypothesis testing is as follows.

- 1st stage : hypothesis establishment
- 2nd stage : Statistical calculation of Maximum Likelyhood ratio
- 3rd stage : decision making
- 4th stage : p- value calculation

5.3 Validation of the Model

1) The Variables inserted in the equation

Various models were tested: i.e. 6 years' data or 3 years' data are tested and the authors found the latter is more reliable. Various sets of variables were tested to find the best fit model.

And finally regression coefficients were found as in Table 12.

Table 12 Coefficients drawn from binary logit

variables	B	S.E.	Wald	degree of freedom	possibility of significance	Exp(B)
deficiency	.482	.363	1.759	1	.185	1.619
ton5-30	-.317	.197	2.594	1	.107	.728
ton30-100	.039	.124	.099	1	.753	1.040
com-deficiency	-.063	.076	.694	1	.405	.939
gen	-3.015	.904	11.116	1	.001	.049
bulk	-1.538	.756	4.135	1	.042	.215
tank	-2.567	.826	9.657	1	.002	.077
other	-1.468	.695	4.464	1	.035	.230
age10	.384	.770	.249	1	.618	1.468
age10to20	-.171	.536	.102	1	.749	.843

note : deficiency: the number of deficiency
ton5-30 : ship's tonnage of 500 tons to 3,000tons
ton30-100 : 3 thousand to ten thousand
com-deficiency : company deficiency
gen : general cargo ship
bulk : bulk cargo ship
tank : tankers
other : other ship
age10 : less-than-ten-year old ships
age11to20 : ships of ages between 10 to 20
age30 : ships of ages over 20

The table summarizes the main findings as follows:

- General cargo vessels seem to show the highest risk. Second in line are tanker ships.
- Age is only significant if it is under 20 years
- Tonnage is also only significant if it is under 3,000 tons.

2) The test result of the model coefficients

The result of the model testing shows that Chi square is 150.627 which means that possibility of significance is 0.000 when the degree of freedom is 10. It means these parameters have significance.

Table 13 Significant probability of binary logit model

	Chi square	degree of freedom	possibility of significance
stage	150.627	10	.000
block	150.627	10	.000
model	150.627	10	.000

Table 14 Explanatory coefficients of the binary logit model

stage	-2 Log Likelyhood	R-square (Cox and Snell)	R-square (Nagelkerke)
1	133.563	.520	.694

3) The validity of the model

The testing result of the model coefficients shows that the possibility of significance is 0.000, which means that the goodness of fit is very high. 'Cox and Snell' R^2 is 0..52 which means the explanation of the model is quite high. .Nagelkerke's R^2 was 0.694 which is also high. Therefore we selected this model as a representative model for this analysis.

5.4 The Identification of 'PSC weak ships'

'PSC weak ships' were selected if its odds is higher than 0.2. Table 15 shows the ships with PSC risk higher than 0.2. It totals 60 ships.

Table 15 PSC weak ships(sorted)

NO.	Class No	Ship Name	G/T	Manager	Ship Type	Keel Laid	PSC Risk
1	824XXXX	hidden	12844	hidden	BULK CARRIER 'ESP'	19810907	**0.42688**
2	845XXXX		19757		BULK CARRIER 'ESP'	19840120	**0.38769**
3	805XXXX		5262		CONTAINER SHIP	19781006	**0.37605**
4	855XXXX		18870		BULK CARRIER 'ESP'	19850314	**0.37202**
-	-	-	-	-	omitted	-	-

6. Conclusion

Port state control was adopted to reduce ship accidents and sea pollution by controlling sub-standard ships. The detention ratio of Korean flag ships are decreasing, but needs tougher control to earn international reputation, which play a role in the inspection of Korean ships.

This study tried to identify PSC weak ships by logistic regression method by collecting the data of Korean flag ships. By adopting clustering technique, high risk ships have been identified by using the variables such as ship's age, ship type etc.

'PSC weak ships' were selected if its odds is higher than 0.2. The number of the ships with PSC risk higher than 0.2. is 60 ships. The final conclusion is that the Korean government should concentrate its monitoring effort on the ships identified by this model.

Reference

[1] Australian Maritime Safety Authority : Internet Homepage -http://www.amsa.gov.au

[2] Cariou, P. et al. (2007), "On the effectiveness of port state control inspections. Transportation Research Part E."

[3] Choi, U. er al., : A Study on the counterplan for the reinforcement of Port State Control, Journal of The Korean Society of Maritime Environment & Safety, Vol.9.No.1, July 30, 2003

[4] Cuttler, M. (1995), "Incentives for reducing oil pollution from ships: the case for enhanced port state control." Georgetown International Environmental Law Review 8(1), 175-284.

[5] Hare, J., (1997), "Port state control: strong medicine to cure a sick industry". Georgia Journal of International and Comparative Law 26(3), 571-594.

[6] Kasoulides, G. C., (1993), "Port state control and jurisdiction: evolution of the port state regime: Kluwer Academic Publishers", Dordrecht, Netherlands.

[7] Knapp, S. and Franses, P. H. (2007), "Econometric Analysis on the effect of port state control inspections on the probability of casualty". Marine Policy 31.

[8] Knapp, S. and Franses, P. H. (2007), "Econometric Analysis to differentiate effects of various ship safety inspections". Marine Policy 30.

[9] KR (2001-2005), Port State Control Annual Report.

[10] McDorman, T. L., (2000), "Regional port state control agreements: some issues of international law". Ocean and Coastal Law Journal 5(2), 207-225.

[11] Memorandum of understanding on Port State Control in Asia-Pacific Region, http:// www.tokyo-mou.org.

[12] Min, B. S., Kim, S. K., Kong, G. Y. (2003) "The Analysis of MOUs and their Activities Related to Port State Control, Vol.27,No.3.

[13] MOU (2001-2005), Port State Control Annual Report - Tokyo.

[14] Owen, P. (1996), "Port state control and ship deficiencies". The International Journal of Shipping Law 5(December), 267-274.

[15] Özcayir, Z.O., (2001), "Port state control. LLP, London, UK."

[16] Paris MOU (2001-2005), Port State Control Annual

Report.
[17] The Paris Memorandum of understanding on Port State Control, http://www. parismou.org.
[18] U.S. Coast Guard, http:// www.uscg.mil/hg/g-m/pscweb/index.htm.
[19] USCG (2001-2005), Port State Control Annual Report.

Received 11 September 2008
Revised 23 December 2008
Accepted 24 December 2008