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# The impact of terminal handling charges on overall shipping charges: an empirical study

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## Abstract

Before the introduction of terminal handling charges (THCs), traditional freight rates included both ocean freight charges and terminal charges at ports. Since the introduction of THCs in 1991, the freight rate has become a “port-to-port” charge that covers only the sea leg, while the on-shore costs of using the container terminals are charged separately as THCs. Although both THCs and freight rates are collectively set by conferences, in this study we argue that the former are easier to enforce because they are invariant to other attributes such as haulage distance, inland transport services and types of commodity being shipped. This argument is consistent with the empirical findings from this study that suggest the separation of ocean freight rates from terminal charges has increased the overall shipping charges. In addition, we find that THCs affect the Hong Kong container handling industry by lowering its throughput.

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## 1. Introduction

The ocean liner shipping industry is organized into about 300 shipping conferences primarily on the basis of trade routes. These conferences are essentially price-setting cartels that benefit

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from different levels of exemption from the anti-trust laws of national governments.<sup>1</sup> As legal cartels, they publish their agreed prices openly, and even have some enforcement mechanisms in the US before the passing of the Ocean Shipping Reform Act of 1998.<sup>2</sup> Nevertheless, the incentive for some cartel members to deviate from the collectively set shipping rates is never completely eliminated. For example, most of the trade nowadays takes place through confidential service contracts and conference price setting are generally not followed by conference liners.<sup>3</sup> Thus, from the cartel's point of view, it would be useful to identify specific pricing tools that are more effective than others in implementing cartel prices.

Many of the empirical studies in past literature are focused on the determination of freight rates in the shipping market. For instance, Heaver (1973) and Jansson and Shneerson (1987) find a significant relationship between freight rates and factors such as commodity stowage and commodity unit values. The pricing behaviour of shipping conferences has been investigated in some papers, such as Bryan (1974) and Fox (1992). Bryan examines the possibility of price discrimination within a single route, and Fox estimates a simultaneous equations oligopoly model of the regulated international ocean liner shipping industry.

The introduction of 'terminal handling charges' (THCs) in 1991 by shipping cartels provides a new dimension for empirical research. This study has two major objectives. First, we test the hypothesis that dividing the traditional freight rate into two components—a 'port-to-port' charge and THCs would enable the shipping lines to increase the overall shipping charges. Second, we examine the impacts of THCs on the container handling industry of Hong Kong.

The rest of this article is organized as follows. The next section briefly summarizes the perceived conflict of interests between Hong Kong's shippers, shipping lines, and terminal operators. This is then followed by another section testing empirically the hypothesis that THCs increase the sum of shipping charges. The fourth section examines the impacts of THCs on the port of Hong Kong. Finally, conclusions are drawn in the last section.

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<sup>1</sup> For studies on the origin and practices of the conferences, see Deakin and Seward (1973), Jansson and Shneerson (1987), and Sletmo and Williams (1981). Sjoström (1989) argues that the conferences' setting of prices and quotas was a response to the non-existence of a competitive equilibrium rather than as a means of extracting monopoly profit. However, the cartel view is still alive and well (see Clyde and Reitzes, 1998; Fox, 1994; Yong, 1996; Lu and Marlow, 1999).

<sup>2</sup> According to Clyde and Reitzes (1998, p. 293), the Federal Maritime Commission of the US is "charged with monitoring and enforcing the published rates. When the FMC detects secret discounting from published rates by either a conference or independent carrier, it punishes those parties involved by assessing fines". In addition to this kind of external enforcement mechanism, the shipping conferences also police their members with a neutral body formed by the conferences or an outsider employed by the conferences (see Jansson and Shneerson, 1987, p. 41). Penalty schemes were widely used to prosecute conference liners which deviated from the conference rates (see Jankowski, 1989). For instance, the penalty clause adopted by the FEFC in the 1930s says, "any infringement or deliberate breach of conference regulations or conference tariffs shall be subject to a fine. In order to secure payment members are required to give an undertaking to guarantee payment of any fine up to £2500" (see Deakin and Seward, 1973).

<sup>3</sup> See for example, 'Maritime Commission Seeks Comments on China's Shipping Decree (FMC concerned over restrictions on US shipping companies)', in *South China Morning Post*, March 20, 2002, v3; 'Cargo Volumes Show Increase' in *South China Morning Post*, March 26, 2002, BIZ9.

## 2. Structure of container handling industry in Hong Kong

THCs are fees charged by shipping lines and paid by shippers (i.e., manufacturers, importers, exporters, retailers, etc.) for moving containers between container terminals (or the ‘shore’) and ships. Before the introduction of THCs, the traditional freight rates for both F.O.B. (free on board) and C.I.F. (Cost, Insurance, and Freight) terms of trading included both ocean freight charges and terminal charges at ports. Since the introduction of THCs in 1991, freight rates have become a ‘port-to-port’ charge that covers the sea leg and a miscellany of other services the carrier provides to the shipper in today’s global logistics environment, while the on-shore costs of using the container terminals are charged separately as two THCs, one at the port of origin and another at the port of destination. THCs should not have any effect on the overall shipping charge if they are purely a device to recover the costs of using container terminals.

There are four key rate-setting cartels on the Hong Kong trade routes, namely, Far Eastern Freight Conference (FEFC), Intra-Asia Discussion Agreement (IADA), Asia North America Eastbound Rate Agreement (ANERA), and Transpacific Westbound Rate Agreement (TWRA). THCs were first introduced to Hong Kong (and to other major ports at the same time) by FEFC in 1990, and the other conferences followed suit in 1991. These cartels have had different degrees of success in getting the shipping lines to abide by the collectively set rates. Like any other cartelized industry, the avoidance of cheating by member firms is not easy due to the significant excess capacity in the shipping industry. But the situation may have been exacerbated by the provision of related, multi-faceted services directly by the shipping lines, or via sub-contractors.

The ocean liner conferences explained that THCs were adopted to recover the costs of container handling at terminals. By separating shore-side charges from ocean freight rates, THCs were intended to provide a greater degree of transparency in shipping charges to shippers. In addition, by making THCs a separate cost item, they were used as a device to prevent “irrational” price cutting or “excessive” competition among shipping lines and their sales representatives.<sup>4</sup> As shown in the next section, shipping lines have improved their profits since the introduction of THCs.

The shippers in Hong Kong, however, have expressed disappointment that THCs have been increasing at an average rate of over 10% per annum since their introduction (see Appendix A). As a consequence, the THCs in Hong Kong are the highest in the world (see Appendix B). While the THCs rose sharply, the ocean freight rates fell due to competition within each conference, competition between conferences and independent operators, and over-capacity in the shipping industry. However, the Hong Kong shippers claim that they were unable to benefit from the falling ocean freight rates because they usually exported their goods on F.O.B. trading terms. Moreover, they say it was difficult to pass the high THCs on to their overseas customers because they faced keen competition from suppliers in other parts of the world, especially in Southeast Asia.

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<sup>4</sup> See Cheng and Wong (1997, p. 45) and “High THCs in Hong Kong see eroding competitive edge of exporters”, *South China Morning Post*, September 29, 1999, p. 1. For instance, the latter article says “FEFC had informed the council (the Hong Kong Shippers’ Council), which had opposed the implementation of THC since 1990, that THC was calculated on the basis of cost recovery and that its separation from ocean freight would provide greater transparency for shippers”.

Against this background, shippers in Hong Kong have accused the shipping lines of using THCs as a monopoly-pricing tool to squeeze as much profit from them as possible. The shipping lines do not deny that the unit cost to the shippers has gone up along with the rising THCs, but explain that the rapid increase in THCs in recent years was largely due to the fact that while at the beginning THCs were used to recover only a small fraction of terminal tariffs (paid by shipping lines to container terminal operators), this fraction went up over time. They put the blame for high THCs in Hong Kong on the high terminal tariffs charged by the Hong Kong terminal operators. They argue that their pricing policy reflected only market demand and cost conditions, and had nothing to do with the extraction of monopoly profits.<sup>5</sup> Unfortunately, those claims and counter-claims cannot be directly validated or refuted by an analysis of the relevant data because both terminal tariffs and shipping lines' operating costs are considered commercially sensitive.

THCs are now standard among conference and non-conference ocean liners.<sup>6</sup> The available data on THCs show that they were increasing rapidly, unlike freight rates that were fluctuating according to supply and demand. An interesting question is whether the separation of traditional 'one-and-for-all' freight rates into THCs and ocean freight charges (or 'port-to-port' freight rates) increases their sum total. If the answer to this question is yes, then the shipping lines are able to raise the overall shipping charges by sending THCs to a higher level. Cheng et al. (1999) develop a two-stage game-theoretical model to address this question. In the first-stage, a shipping cartel sets a THC, which is adhered to all shipping lines. In the second-stage, they compete against one another in the market, and cheat on the conference set port-to-port freight rates by incurring some cheating costs. They find that an appropriate level of THCs can help the shipping lines make higher profits. Moreover, if there are adjustment costs in price increases, then THCs will rise over time to an optimal level. During the adjustment period, each shipping line's profit will continue to rise, whereas the shippers' profits will continue to decline. In general, an increase in THCs is absorbed partly by the shippers and partly by their foreign buyers; the shippers absorb 100% of the THCs only if they face an infinitely elastic demand curve.

The intuition is that the traditional one-and-for-all freight rates set by conferences are not easy to enforce. Individual shipping lines may find ways to cheat (i.e., discount from the publicly announced rates) subject to the costs of cheating (i.e., the costs of effecting discounts without openly deviating from the conference rates). Cheating is possible because shipping services have multiple attributes and shipping lines provide vertically related services (e.g. transport of cargoes from terminals to destination). Unlike freight rates, THCs are charged on a per unit basis that is invariant to other attributes such as haulage distance, inland transport services and types of commodity being shipped.<sup>7</sup> Although it is not required to file THCs with FMC in the US, THC is a simple price for a simple service, and is thus more difficult to cheat (by offering secret discounts

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<sup>5</sup> Arguments from both sides can be found in: "Asian shippers hit terminal charges", *Journal of Commerce*, October 13, 1998, p. 1B; "Ocean carrier surcharges abusive, say North American, European, Asian shippers", *Journal of Commerce*, September 22, 1998, p. 12A; "Asean shippers to call for government checks on surcharges", *Business Times (Singapore)*, October 13, 1997, p. 1.; "Council presses for single rate; Lines urged to end surcharges", *South China Morning Post*, April 12, 1996, p. 1.

<sup>6</sup> See "Council presses for single rate; Lines urged to end surcharges", *South China Morning Post*, April 12, 1996, p. 1.

<sup>7</sup> As indicated by Jansson and Shneerson (1987), price discrimination by charging an individual freight rate to each shipper of a particular commodity was common. Price discrimination, however, is beyond the scope of this study.

to shippers). By separating THCs from port-to-port freight rates, discounting can only be effected via the latter, for instance, via through bills. The larger are the THCs, the bigger the discount in the port-to-port freight rate that would be needed to achieve the same degree of discounting in the price of shipping. However, when marginal cheating costs are a rising function of the magnitude of cheating, the optimal amount of price discount goes down as THCs rise. As a result, the sum of unit shipping charges goes up, the shipping lines' profits rise, and the shippers' profits decline. As pointed out above, the shippers' loss in profits is due to an increase in the sum total of THCs and ocean freight charges.

### 3. Impacts of THC on shipping charge

Terminal tariffs are fees charged to the shipping lines by container terminal operators for moving containers between the shore and ships. As mentioned in the previous section, shipping lines have blamed their high THCs on high terminal tariffs. It would be interesting to know what their relationship is. Terminal tariffs are well-guarded commercial secrets, and shipping lines are not allowed to release them.<sup>8</sup> According to a pricing scheme issued by a terminal operator in Hong Kong to a shipping line, the annual increase in terminal tariffs was approximately 85% of the 12-month moving average of the Hong Kong Consumer price index B [CPI(B)] measured in September of each year, which will be called 'CPI-adjusted tariffs' below. The annual percentage changes in THCs and the CPI-adjusted tariffs are compared in Fig. 1.

From the figure, it is clear that THCs increased at a much higher rate than the CPI-adjusted tariff. This relationship is consistent with the claim that THCs were an increasing function of tariffs over time, i.e., THCs were a very small fraction of the tariffs at the beginning, but has been increasing over time to recover a larger fraction of the rising tariffs. Nevertheless, shippers argue that the increase in THCs was unrelated to the actual increases in cost and call for an open book investigation.<sup>9</sup>

In defence, shipping lines claim that a direct one-to-one comparison between THCs and terminal tariffs is unfair. First, besides the basic terminal tariffs charged for the loading and unloading of containers, there are also many other terminal charges that are indivisible by nature and cannot be unambiguously attributed to any unit of container handled or to individual shippers. These indivisible charges include dockage charges that vary with ship sizes, additional internal movement charges, overtime charges, hiring of equipment (e.g. forklift truck and weighbridge), and electricity supply. Second, apart from the direct costs of handling containers at container terminals, there are

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<sup>8</sup> The cost data (including terminal tariffs) are business secrets due to agreements between shipping lines and terminal operators (for details, see "High THCs in Hong Kong seen eroding competitive edge of exporters; Council seeks uniformity on handling fees", *South China Morning Post*, September 29, 1999, p. 1).

<sup>9</sup> Mr. Nivatvongs (President of the Federation of Asean Shippers Councils) said in an article in *Journal of Commerce*, October 13, 1998, p. 1B, that terminal handling charges were a severe burden on shippers because of lack of transparency and because they were increased in some markets where there was no corresponding increase in terminal tariffs. Mr. Nivatvongs further pointed out in *Business Times (Singapore)*, October 13, 1997, p. 1, that the scale of increases in the THC levels contradicted the figures provided by terminal operators in that the increased costs are well below THC increases imposed on shippers.

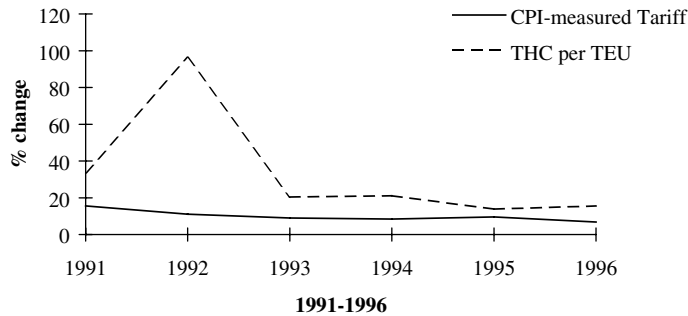


Fig. 1. Comparison of terminal tariffs and THCs (Sources: CPI from *Hong Kong Statistical Year Book*; Hong Kong terminal tariffs from shipping companies; THC from the Hong Kong Shippers' Council).

also many other indirect expenses, such as general and administrative expenses including employees' salaries/benefits, rental of premises, trucking, maintenance, and depot/off-dock expenses.<sup>10</sup> In the past 10 years, while the trucking costs have had a marginal increase, the general and administrative expenses have nearly doubled and become the second biggest cost item (the biggest item is terminal tariffs). However, if the shipping lines are really interested in the transparency of their operating costs, the above complications do not seem to be insurmountable.

The profit index of terminals is compared with that of shipping lines in Fig. 2.

In Fig. 2, liner profits are given by the average profits of five leading conference shipping lines operating in Hong Kong, and terminal profits are the average profits of the two largest container terminal operators in Hong Kong (total market share = 85%). For the purpose of comparison, the data are transformed into indices with 1991 as the base year. Preliminary inspection of the figure suggests that terminal operators' profits were increasing steadily with conference throughput over the past 10 years. In contrast, shipping line profits were declining prior to the full adoption of THCs in 1991 even through the cargo volume was increasing. This negative relationship between cargo volume and liner profits before 1991 was largely due to the fierce competition that resulted in high volume growth at the expense of profit margins. After the adoption of THCs in 1991, however, the profits of shipping lines started to grow in line with that of terminal operators.

The relationship between shipping lines' revenue ( $R$ ), ocean freight charges, THCs, and throughput volume ( $Q$ ) is

$$R = P \times Q, \quad (1)$$

$$P = \begin{cases} P_1 & \text{before 1991,} \\ P_2 & \text{in/after 1991,} \end{cases}$$

where  $P_1$  = once-and-for-all freight rates per unit and  $P_2$  = ocean freight charges + THCs per unit.<sup>11</sup> In order to test the hypothesis that separating ocean freight charges from THCs can increase their sum total, the following regression equation is constructed.

<sup>10</sup> Depot and off-dock places are used for storing the containers temporarily outside the container terminal.

<sup>11</sup> In practice, shipping companies charge different composite cost elements separately incurred in the movement of containers, e.g., bunker surcharges and peak season surcharges. The 'once-and-for-all' freight rate defined here refers to the sum of sea-leg and terminal handling charges before their separation in 1991.

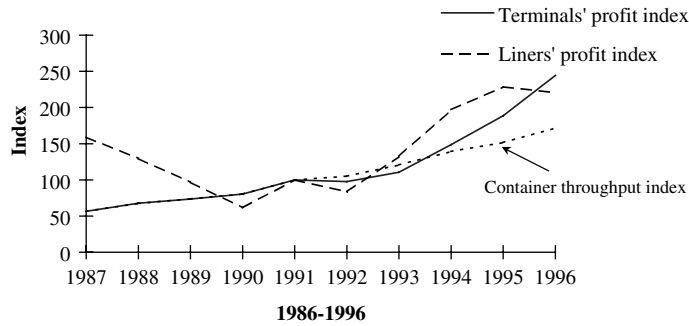


Fig. 2. Comparison of profit indices (1991 = 100) (Sources: Terminal profits from the annual reports of MTL and HIT; Liner profits from the annual reports of five conference lines operating in Hong Kong; Container throughput from *Hong Kong Shipping Statistics*).

$$R_{it} = \alpha + \beta t + \lambda P_1 Q_{it} + (1 - \lambda) P_2 Q_{it}, \tag{2}$$

where

$$\lambda = \begin{cases} 1 & \text{for } t < 1991, \\ 0 & \text{for } t \geq 1991. \end{cases}$$

In Eq. (2), subscripts *i* and *t* stand for firm *i* and time *t*, and  $\lambda$  is a dummy variable defining a structural change after the shipping lines started to charge THCs in 1991.  $P_1$  and  $P_2$  are coefficients describing the relationship between revenues and throughput. Since  $R_{it}$  can be generated from different trade routes, the estimates of  $P_1$  and  $P_2$  could be interpreted as the average shipping charges per container across these routes. Eq. (2) explicitly assumes that these average charges are equal across shipping lines due to intense competition. We expect  $P_2 > P_1$  under the major hypothesis. In other words, the separation of the traditional freight rates into THCs and port-to-port freight rates would result in a net increase in overall shipping charges. The constant  $\alpha$  and time trend  $\beta t$  are intended to capture the effects of non-shipping activities on revenues.<sup>12</sup>

The sample covers 20 leading shipping lines in terms of cargo volume in 1997.<sup>13</sup> The sampling period runs from 1987 to 1996. Data of  $Q_{it}$  (in TEU) are taken from the *Containerization Yearbook*. Data of  $R_{it}$  are from various sources: Standard & Poor's *Compustat*, Thomson Financial

<sup>12</sup> A concern raised by the referee is about the consideration of the state of the prevailing container shipping freight market in the empirical analysis. For instance, changes in the competitiveness of the shipping market, the composition of service bundles offered by shipping lines, average ship size, and the importance of different trade routes over time would definitely affect the revenue-throughput relationship as stated by Eq. (2). Since we have neither reliable data nor a strong prior on the underlying mechanism, the impact of such changes over time can easily be captured within our empirical framework by including a time trend (*t*).

<sup>13</sup> They are Maersk, Evergreen, P&O Nedlloyd, Sea-Land, COSCO, Hanjin, NOL/APL, Mediterranean shipping, NYK/TSK, MOL, HMM, Zim, Yang Ming, CMA-CGM, OOCL, CP Ships, K-Line, Hapag-Lloyd, Cho Yang, and SCL. The world market share of these companies was 51% in 1997. We use the list of top 20 in 1997 to take into account the impact of merges/acquisitions on the ranking. Some of the amalgamated companies listed here did not exist for the whole sampling period from 1987–1996. For those periods prior to the amalgamation, the sum of the pre-amalgamated companies' throughputs is used.

*Datastream*, FT-Extel Financial Company Research, and data provided by the shipping lines. Revenues of non-US firms are converted to US dollar denomination with the aid of the Pacific Exchange Rate Service of the University of British Columbia. The panel data set is unbalanced because observations of some firms in the 1980s are missing. The number of observations available for regression is 163. Although there are a large number of shipping lines operating in the world market, most of the leading shipping lines have formed alliances or consortia to formulate common market strategies as well as to pool resources. Therefore, data from these 20 leading shipping lines in the sample should be sufficient to represent the entire industry. The results of the estimation are reported in Table 1.

In Table 1, the estimated coefficients for all the major variables are positive and statistically significant. The Durbin–Watson statistic, which is close to 2, lends support to our model specifications. The goodness-of-fit as indicated by the adjusted  $R^2$  is satisfactory. As expected, the estimate of  $P_1$  is smaller than that of  $P_2$ . To confirm the existence of a structural change in shipping charges in 1991, a Wald Test of the following hypothesis is conducted.

$$H_0: P_1 = P_2,$$

$$H_a: P_1 \neq P_2.$$

The result is reported in the last row of Table 1, which concludes that  $H_0$  is rejected at 1% level of significant. This finding supports the hypothesis that separating the traditional ‘once-and-for-all’ freight rates into THCs and port-to-port freight rates increases the total shipping charges. Judging from the face values of the estimated coefficients, the average shipping charges per TEU were \$2043 (traditional freight rate) and \$2197 (THCs + port-to-port freight rate) before and after the introduction of THCs, respectively. In other words, the introduction of THCs has resulted in a 7% increase in total shipping charges.

Table 1  
Structure test on the relationship between shipping line revenues and throughput volume (dependent variable =  $R_{it}$ )

Independent variable [Name of coefficient]	Estimated coefficient
Constant	4.860e+08
$[\alpha]$	(2.192)
$t$	7.488e+07
$[\beta]$	(4.269)
$Q_{it}$	2043.385
$[P_1]$	(5.209)
$Q_{it}$	2197.021
$[P_2]$	(4.968)
Adj. $R^2$	0.869
$F$	105.873
Durbin–Watson	2.041
Wald Test of $H_0: P_1 = P_2$	78.750

Note: Values in parentheses are  $t$ -statistics.

Suppose the total shipping charge ( $P$ ) is set collectively by shipping conferences, the relationship between the throughput ( $q$ ) and the profit of a particular shipping line ( $\pi$ ) can be established as follows:

$$\pi = P \cdot q - TC(q), \quad (3)$$

where  $TC$  is the total cost with  $TC'(q) > 0$ . The optimal level of  $q$  that maximizes  $\pi$  should satisfy the following first and second order conditions

$$P = TC'(q), \quad (4)$$

$$TC''(q) > 0, \quad (5)$$

which state that marginal revenue should equal marginal cost at the optimal choice of  $q$ . Other things being equal, Eqs. (4) and (5) imply that the increase in  $P$  from  $P_1$  to  $P_2$  in 1991 has led to an increase in both  $q$  and  $\pi$ .

#### 4. Impact of THC on the port of Hong Kong

Hong Kong and Singapore are the world's two busiest container ports. In 2001, Hong Kong and Singapore handled 17.826 and 15.571 million TEUs (twenty feet equivalent units), respectively. Both ports were far ahead of the third busiest container port, Kaohsiung, which handled 7.541 million TEUs in the same year. Although many Hong Kong manufacturers have moved their production facilities to South China to take advantage of the latter's cheap labor and land, they continue to export their goods through Hong Kong's port because, until recently, there were no container ports in South China that are viable substitutes for the container port in Hong Kong. As about 80% this manufacturing output is for export and the manufacturing sector is highly dependent on the import of raw materials, increases in THCs will have significant impacts on the manufacturers operating in the South China region.

With data of THCs, container throughput, and trade figures, the share of THC expenditures in the value of trade can be calculated for different product categories. Raw materials are low-value-added goods, so the share of THC expenditures in their total value of trade is much higher than that of high value-added final products. For example, in the textile and garment manufacturing industry, the THC expenditures are about 0.2–0.5% of total manufacturing costs. The same figures are about 1.3–1.8% for imports of raw plastic materials, and 4–5% for recycled plastic materials. The burden of THCs borne by Hong Kong's shippers depends on the extent to which they are able to pass the high shipping costs onto their overseas customers. The above figures only provide an upper bound of this burden if the shippers are unable to pass any of the higher shipping costs to their customers. As Hong Kong is a small city economy, its survival and prosperity are heavily dependent on external trade, which accounts for a large part of its gross domestic product. Therefore, any inefficiency in operating its port will ultimately undermine the foundation of its economy.<sup>14</sup>

<sup>14</sup> Hong Kong's external trade to GDP ratio continued to go up from 1986 to 1996. The external trade to GDP ratio during 1986–1990 was 2.055 on average and it increased to 2.429 during 1991–1996.

To study the impact of THCs on the port of Hong Kong, we establish a structural break in 1991 for the relationship between container throughput and its key determinants as follows:

$$HKVOL_t = \alpha_1 + \mu t + \varphi SEASON + \beta_1 HKGDP_t + \gamma_1 CHNTRD_t + (\alpha_2 - \alpha_1)D1 + (\beta_2 - \beta_1)D2 + (\gamma_2 - \gamma_1)D3 + \eta_t, \quad (6)$$

where

$$D1 = \begin{cases} 0 & 1986-1990, \\ 1 & 1991-1996, \end{cases} \quad D2 = \begin{cases} 0 & 1986-1990, \\ HKGDP_t & 1991-1996, \end{cases} \quad D3 = \begin{cases} 0 & 1986-1990, \\ CHNTRD_t & 1991-1996. \end{cases}$$

The test for a structural change occurring in 1991 is equivalent to a Wald Test for the following hypothesis:

$$H_0: \text{the coefficients of } D1, D2, D3 = 0$$

against

$$H_1: \text{the coefficients of } D1, D2, D3 \neq 0.$$

In Eq. (6),  $HKVOL_t$  is the log of Hong Kong's total containerized cargoes (in 1000 TEUs) handled by its container terminals in Kwai Chung at time  $t$ .  $HKGDP_t$  is the log of Hong Kong's GDP measured in constant 1990 million US dollars.  $CHNTRD_t$  is the log of the total value of imports and exports of the People's Republic of China measured in constant 1990 million US dollars, which is included because about 80% of Hong Kong's container throughput was generated by re-export to/from the Mainland China. Data of these variables are taken from *Hong Kong Shipping*

Table 2  
Structure test on Hong Kong's container throughput (dependent variable =  $HKVOL_t$ )

Independent variable [Name of coefficient]	Estimated coefficient
Constant	-5.131**
$[\alpha_1]$	(-7.37)
$HKGDP_t$	0.499**
$[\beta_1]$	(2.67)
$CHNTRD_t$	0.169*
$[\gamma_1]$	(1.55)
$D1$	0.535*
$[\alpha_2 - \alpha_1]$	(1.36)
$D2$	-0.318
$[\beta_2 - \beta_1]$	(-1.23)
$D3$	-0.452**
$[\gamma_2 - \gamma_1]$	(-2.63)
Adj. $R^2$	0.856
$F$	10.490
Wald Test of $H_0: D1, D2, D3 = 0$	4.502**

Note: Values in parentheses are  $t$ -statistics.

\* Significant at the 10% level.

\*\* Significant at the 5% level.

*Statistics, Hong Kong Annual Digest of Statistics and Direction of Trade Statistics* (published by IMF). All variables are log-transformed such that their coefficients can be interpreted as elasticity of demand. The sampling period runs from 1986 to 1996 quarterly. The number of observations is 44. In addition to these major variables, seasonal dummies (*SEASON*) are also included to account for seasonal fluctuations. The results of estimating Eq. (6) by the ordinary least squares method are summarized in Table 2.

The results of estimation clearly reject the null hypothesis that there are no changes in the coefficients of the explanatory variables in 1991. The Wald Test statistic reported in the last row of Table 2 rejects  $H_0$  that  $D1 = D2 = D3 = 0$ . If we assess the significance of each structural variable individually, the estimated coefficients in Table 2 suggest that  $D1$  is significant at 10% level,  $D2$  is insignificant and  $D3$  is significant at 5% level. In particular, while the positive coefficient for  $D1$  indicates an upward shift in the intercept, the negative coefficient for  $D3$  implies a drop in elasticity of demand for container handling services with respect to  $CHNTRD_t$  after 1990. The expected negative impact of THCs on the Hong Kong throughput is consistent with the negative coefficient of  $D3$ , but not with the positive coefficient of  $D1$ . The larger intercept ( $D1 > 0$ ) could be attributed to the commencement of two new container terminals, CT No. 6 and 7, in 1991 that have added an additional 1.65 million TEUs handling capacity to the Hong Kong port. The lower elasticity of demand for container handling services ( $D3 < 0$ ) with respect to  $CHNTRD_t$  could be due to the introduction of THCs or the emergence of competition from the South China ports. However, the former is supposed to be more important than the latter because even though the South China ports do represent a potential threat to the competitiveness of the Hong Kong Port due to their lower terminal tariffs, during our sample period they were too small in terms of container throughput.<sup>15</sup> Shenzhen, Hong Kong's only competitor in South China, handled 0.12 million TEUs in 1993 and 0.59 million TEUs in 1996, in comparison with Hong Kong's 9.2 million TEUs in 1993 and 13.46 million TEUs in 1996. Given the above results, the introduction of THCs could be the major cause of the structural decrease in Hong Kong's container throughput in 1991. Of course, we cannot rule out the co-existence of other unfavorable factors undermining the competitiveness of the Hong Kong port, such as the high terminal charges imposed by the Hong Kong terminal operators and the rise of the Shenzhen port (see Fung, 2001).

## 5. Conclusions

In this study, the empirical findings suggest that the introduction of THCs has resulted in an increase in the price of shipping a container and the profits of shipping lines, but at the expense of shippers. In addition, we found that THCs affected the Hong Kong container handling industry by reducing its throughput. The shipping lines' improved profitability can be explained by the introduction of common THCs adhered to the conference liners. The THCs not only helped to recover the high costs of using container terminals, but also alleviated the adverse consequences of competition in freight rates. However, there is a second related explanation, namely that the

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<sup>15</sup> See Cheng and Wong (1997) and Fung (1998) for detailed comparison of the South China port and the Hong Kong port.

improved profitability might reflect a general increase in the market power of shipping lines brought about by merger and acquisition activities and strategic alliances (see Heaver et al., 2000; Sheppard and Seidman, 2001 for detailed discussions). In particular, mergers and acquisitions have been an on-going process that has transformed the structure of the shipping industry. Recent examples include P&O and Nedlloyd's 50–50 merger agreement and NOL's take over of APL in 1997. As a consequence, the number of independent shipping lines in the industry has been decreasing, and the shipping lines' bargaining power in negotiating with container terminal operators and other suppliers of supporting services has increased correspondingly. Statistical analyses conducted in this study support the first explanation (i.e., the use of THCs led to higher profits), but do not rule out the second one (i.e., that higher profits resulted from greater market power). It seems sensible to conclude that the improvement in shipping lines' profitability was the result of a general increase in the shipping lines' market power and the exercise of this power in the form of collectively set THCs.

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### Appendix A. THC for the Hong Kong container port

Effective date	HK\$ per TEU	HK\$ per FEU
<i>Intra Asia Discussion Agreement (IADA)</i>		
August 1, 1991	\$320 (N.A.)	\$480 (N.A.)
January 1, 1992	\$500 (56.25%)	\$750 (56.25%)
July 1, 1992	\$600 (20%)	\$900 (20%)
May 1, 1993	\$800 (33.33%)	\$1200 (33.33%)
August 1, 1993	\$1000 (25%)	\$1500 (25%)
January 1, 1995	\$1200 (20%)	\$1800 (20%)
June 1, 1996	\$1380 (15%)	\$2070 (15%)
<i>Asia North America Eastbound Rate Agreement (ANERA)</i>		
September 1, 1991	\$600 (N.A.)	\$800 (N.A.)
September 1, 1992	\$1125 (87.5%)	\$1500 (87.5%)
January 1, 1994	\$1460 (29.78%)	\$1950 (30%)
January 1, 1995	\$1690 (15.75%)	\$2250 (15.38%)
February 1, 1996	\$1875 (10.95%)	\$2500 (11.11%)
January 1, 1997	\$2065 (10.13%)	\$2750 (10%)

Effective date	HK\$ per TEU	HK\$ per FEU
<i>Far Eastern Freight Conference (FEFC)</i>		
January 1, 1990	\$849 (N.A.)	\$1226 (N.A.)
October 1, 1990	\$942 (10.95%)	\$1331 (8.56%)
May 1, 1991	\$1030 (9.34%)	\$1450 (8.94%)
January 1, 1992	\$1140 (10.68%)	\$1605 (10.69%)
March 1, 1993	\$1250 (9.65%)	\$1760 (9.66%)
March 1, 1994	\$1363 (9.04%)	\$1918 (8.98%)
January 1, 1995	\$1486 (9.02%)	\$2091 (9.02%)
November 15, 1995	\$1686 (13.46%)	\$2491 (19.13%)
February 15, 1997	\$2065 (22.48%)	\$2750 (10.4%)

Data sources: Hong Kong Shippers' Council.

Note: Values in parentheses are growth rates.

### Appendix B. A comparison of terminal handling charges as at February 27, 1997

HK\$	ANERA		TWRA		FEFC		IADA	
	TEU	FEU	TEU	FEU	TEU	FEU	TEU	FEU
Hong Kong	\$2065	\$2750	\$2065	\$2750	\$2065	\$2750	\$1380	\$2070
Taiwan	\$1228	\$1586	\$1228	\$2061	\$1228	\$1586	\$1228	\$1586
Singapore	\$986	\$1463	\$1285	\$1902	\$878	\$1247	\$986	\$1463
South Korea	\$825	\$1122	\$748	\$1012	\$748	\$1012	\$595	\$876
Japan <sup>a</sup>	Free	Free	Free	Free	Free	Free	\$592	\$888
Malaysia	\$914	\$1363	\$1187	\$1772	\$589	\$883	\$914	\$1363
Philippines	\$541	\$734	\$773	\$958	\$502	\$618	\$443	\$590
Indonesia	\$773	\$1198	N.A.	N.A.	N/A	N/A	\$386	\$579
Thailand	\$780	\$1170	\$780	\$1170	N/A	N/A	\$780	\$1170
Germany	N.A.	N.A.	N.A.	N.A.	\$1362	\$1362	N.A.	N.A.
Netherlands	N.A.	N.A.	N.A.	N.A.	\$1231	\$1231	N.A.	N.A.
UK	N.A.	N.A.	N.A.	N.A.	\$869	\$869	N.A.	N.A.

Data sources: Hong Kong Shippers' Council.

ANERA: Asia North America Eastbound Rate Agreement, TWRA: Transpacific Westbound Rate Agreement, FEFC: Far Eastern Freight Conference, IADA: Intra-Asia Discussion Agreement, TEU: Twenty-foot equivalent units, FEU: Forty-foot equivalent units, N.A.: Not applicable, N/A: Not available.

<sup>a</sup>Freights between Japan–North America and Japan–Europe are under different conferences. There are no THCs charged on Japanese exports to North America and Europe. Similar charges imposed by the IADA are known as Empty Container Handling Charge (ECHC).

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