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GAME THEORY ANALYSIS IN INDONESIA'S SHIPPING INDUSTRY: CASE STUDY AGREEMENT BETWEEN PT. X AND PT. Y

Heru Susanto

Politeknik Pelayaran Surabaya, JL. Gunung Anyar Boulevard No. 1, Surabaya, Indonesia,
ORCID 0000-0001-7060-1408
e-mail: susantoheru329@gmail.com

Abstract: Nowadays, the container shipping industry in Indonesia has a tendency to oligopoly, even in one shipping route. Two big shipping liners in Indonesia, PT. X and PT. Y, have been dominating sales on the Surabaya-Banjarmasin route. The aim of this study is to know how the liners behave in an oligopoly, making decisions that are profitable for both parties. The agreement on challenge, competition, and cooperation between PT. X and PT. Y in serving shipping services is the main focus in this study. The methodology used is a game theory approach to show the possible strategies in rates and supply competition. The result shows that the agreement between PT. X and PT. Y consisted of price decision and supply quantity. The price decision is rated at a lower price of USD 300/TEU where P = MC which has no incentive. While the agreement on supply quantity is 26.000 TEUs in total. Moreover, the cooperative agreement between the shipping liners is a joint allience which not depend on each capacity ratio.

Keywords: container, shipping industry, oligopoly, game theory.

1. INTRODUCTION

Indonesia is a large and beautiful archipelago where approximately 85% of economic activities depend on maritime transport. This circumstance derives from the industrial and trading estate centralized on Java. Hence, the shipping industry is the primary backbone. The number of total seaborne cargoes reached 436,555,000 tons and was served by 17,838 unit vessels (71,915,789 DWT) in 2013 [Kementrian Perhubungan 2013]. Indonesia's first container shipping company, MV Gloria Express, was introduced and operated by PT Gesuri Lloyd in the 1970s [Nurwana 2013]. Container shipping dominates all routes, with a throughput of 13,527,065 TEUs in 2013, and tends to increase by 35.05% per annum [Kementrian Perhubungan 2013].

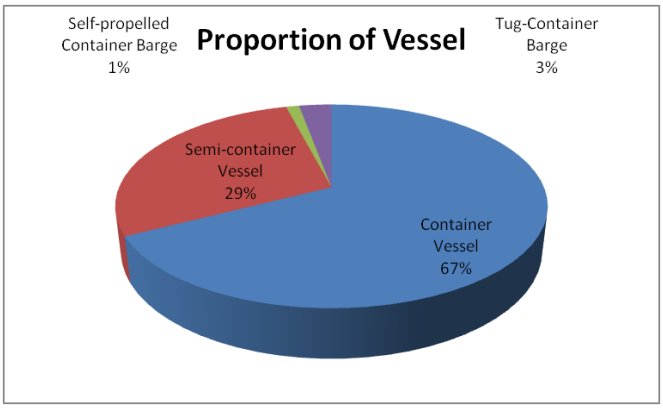

Fig. 1. Proportion of vessels [Kementrian Perhubungan 2013]

The number of container vessels that serve domestic shipping is 172 unit vessels [Pratidinatri 2014]. These include not only container vessels, but also semi-container vessels and barges, self-propelled barges and tug-barges. For infrastructure, four main big ports play an important role, including: Belawan Port Medan, Tanjung Priok Port Jakarta, Tanjung Perak Port Surabaya, and Soekarno-Hatta Port Makassar.

Fig. 2. Domestic container ports in Indonesia [Pratidinatri 2014]

Legends:

Huge
Big
Medium
Small
Tiny

Since a cabotage policy was implemented in Indonesia, 3,513 domestic shipping companies compete to fulfill the demand of inter-island transportation [Kementrian Perhubungan 2013]. However, the domestic market structure tends towards oligopoly. Now, several big companies (oligopolists), namely PT Meratus Line, PT Samudera Indonesia, PT Tanto Intim Line, PT Salam Pasifik Indonesia Line, and PT Pelayaran Tempuran Mas, dominate the domestic container shipping business in Indonesia. The market structure in every route still shows a dominance of the big companies. However, one big company does not have all of the routes. For example, Y just serves the route based on Jakarta (Jakarta-Pontianak, Jakarta-Banjarmasin, Jakarta-Balikpapan, Jakarta-Makassar, Jakarta-Batam and Jakarta-Padang), and based on Surabaya (Surabaya-Banjarmasin, Surabaya-Makassar, Surabaya-Samarinda, Surabaya-Semarang, Surabaya-Balikpapan).

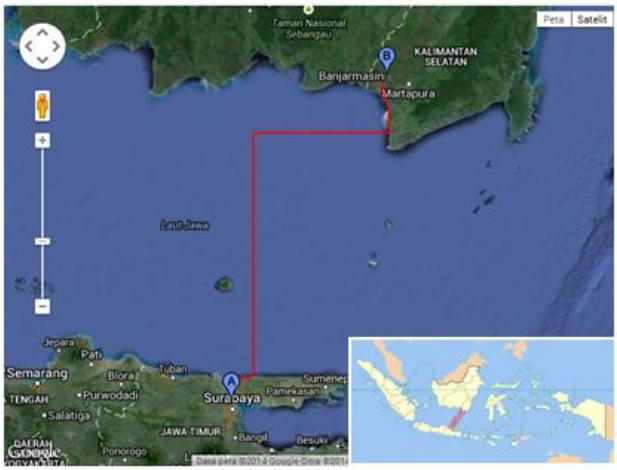

Fig. 3. Surabaya-Banjarmasin route

Source: own study.

This study focuses on one profitable route, Surabaya to Banjarmasin, where throughput of this route is 400 thousand TEUs per annum, including in the 6 biggest ports in Indonesia [Noerhudha 2014]. The freight rate between Surabaya-Banjarmasin lies in the range of 3 to 4.5 million Rupiah per TEU (242-364 USD/TEU). However, two big liners, PT. X and PT. Y, dominate sales. PT. X provides full inter-island container services which are supported by a fleet of 56 vessels and 40,000 box containers for all services. PT. X also offers 9,000 TEUs per month on average. On the other side, PT. Y integrates a shipping company which focuses more on regional container shipping supported with 13 vessels and offers 17,000 TEUs per month on average. In this case, both PT. X and PT. Y would like to obtain a monopoly outcome, even though cooperation is difficult to maintain. One strategy is to lower the rates limitation, which aims to keep a climate

of competition for other liners, especially during peak season when there is a price war.

Moreover, less connectivity between islands and lack of logistics in Indonesia leads to some large gaps in the prices of commodities. Less connectivity means there are fewer shipping lines serving in those routes. Various circumstances cause this, such as lack of a supporting facility in the place of origin and/or destination, and the high cost and risk of low return due to an imbalance between supply and demand of transportation service. Domestic shipping has a higher cost than ocean-going shipping; for instance, the shipping of oranges from South Sulawesi to Jakarta costs twice that from Shanghai to Jakarta [Pratidinatri 2014]. Therefore, the President of Indonesia, Joko Widodo, proposes an idea of implementing the 'Sea Toll' concept. This concept will connect the big islands in Indonesia with the building of 24 deep-sea ports and operating 3,000 TEUs vessel [Setyowati 2014].

Some studies have been made in analysing container competition. Amin, Adrianto, and Sartono [2018] discussed the competition trend between terminal container and behaviour, and shipping lines, including capacity, price, congestion and the loading/unloading level using the game theory approach as the methodology. The study found that a terminal container with a larger capacity is able to reduce the price of shipping due to the increase in demand as it is more likely to have spare capacity and less congestion. Similar to Al-Amin, Adrianto and Sartono, Xiao and Zhiming [2014] also observed in game theory analysis on a two stage scenario of collaboration between a terminal container and shipping lines and competition with another terminal container and shipping lines. The result showed that the cooperation strategy of shipping lines depends on the demand and supply situation of ships. The terminal which collaborated with shipping lines will cause a significant decrease in its charges, but it will have an affect on the limited charge on another terminal. Saeed and Larsen [2010] also used the game theory methodology to analyse the effect of the type of concession contracts on user surplus and profits of terminal operators. They found that an optimal concession contract that is feasible for both terminal user and operation is obtained.

Therefore, from these brief backgrounds, this study aims to know the agreement between PT. X and Y to address the challenges, competition, and cooperation in providing services using game theory. This study also hoped to bring some understanding of the game theory approach in the analysis of the agreement between PT. X and PT. Y.

2. METHODOLOGY

An oligopoly is a market dominated by few companies. Oligopoly focuses on how firms respond to mutual interdependence of their actions within the market place [Europe Economics 2001]. A distinctive characteristic of oligopolistic markets is

that the companies and players are interrelated, in the sense that the behavior of one player affects the positioning (and in the end the profits) of other players. This interrelationship makes oligopolistic markets suitable for a game theoretic analysis [Gkonis and Psaraftis 2009]. Game theory has become the main tool for analysing oligopoly behaviour since the 1980s [Europe Economics 2001]. Game theory is defined as a methodology of decision making involving multiple parties such as persons, companies or agents [Shi 2011]. Each company will consider its own strategies but its behaviour will be influenced by what it thinks the reaction of its rivals will be [Mankiw and Taylor 2014]. The dilemma of the company will be the choice of cooperation and self-interest. Even oligopolists tend to cooperate and to act like a monopolist, but each oligopolist cares only about its own profit. There are sufficient incentives to make difficulties in maintaining cooperation between oligopolists. Each company has to put themselves in the position of the other companies before deciding on a strategy due to having a payoff matrix that shows the possible outcome of strategies' [Mankiw and Taylor 2014].

In this study the samples are two big shipping liners in Indonesia, called PT. X and PT. Y, which were examined for 8 months. These liners dominate the Surabaya-Banjarmasin route for shipping containers. However, both of these liners compete with each other. There are two models of monopolistic competition in oligopoly, namely the Bertrand and Cournot model. Bertrand's model is used to analyse the competition between companies' strategies based on setting the price instead of the quantity [Mankiw and Taylor 2014]. The Bertrand model examines the interdependence between rivals' decisions in terms of pricing decisions [IOLecture4 2015]. Meanwhile, Cournot's model is used to analyse the quantity or supply capacity within the competition of companies. The total quantity will determine the market price. As in the law of supply and demand that a high level of output results in relatively low price rather than a lower level output [Zeder 2017]. Hence, each company should consider the expected quantity of its competitor to maximise their profits.

3. RESULT AND DISCUSSION

In this case, PT. Y assumes that the rate fixed is given by PT. X and vice versa. PT. X sets rate at USD 350/TEU, and PT. Y has calculated that PT. X's rate is above its MC, hence PT. Y has an incentive to offer USD 320/TEU to capture all of the market even though in the short term it will reduce the profit, but still be profitable. Similar to PT. Y, PT. X also considers the rate, and based on its calculation the rate USD 320/TEU is still above the MC and still profitable, thus PT. X set the rate at USD 300/TEU which is lower than PT. Y. This condition will continue simultaneously until P = MC. For example, if MC is equal to USD 300, the

minimum rate will be USD 300/TEU. This mean that there is no incentive to change their price strategies.

Both of the liners can agree the to determine minimum rate based on Bertrand-Nash Equilibrium, but they still need to consider the other liners that also service the Surabaya-Banjarmasin route. Therefore, it will lead to healthy competition and avoid predatory pricing. On the other hand, the strategies are the space supplied and payoff still maximize the profit of each liners. PT. Y has capacity for 17,000 TEUs per month while PT. X has 9,000 TEU's per month, hence the total capacity available is 26,000 TEUs per month. The proportion of both liners will be 65% for PT. Y and 35% for PT. X. It is given as equilibrium and reaches PT. Y as the leader of shipping liners instead of PT. X with the rate set at USD 320/TEU.

PT. X wants to increase its capacity by adding more vessels to make the same market share, from 9,000 TEUs per month to 17,000 TEUs, but there would be an excess of supply and the rate would fall. Each have the same proportion in the total 34,000 TEUs. We assume the rate will be USD 290/TEU, and it is above the marginal cost. Since MR = MC is maximum profit, PT. Y will make a strategy to reduce their capacity to keep obtaining the maximum profit. The strategy can be observed in Figure 4 below;

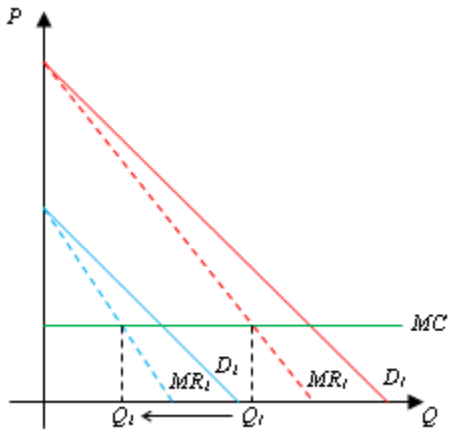

Fig. 4. Y's Strategy

PT. X faces the same problem if PT. Y decides to increase the capacity, thus PT. X will set Q to shift to the left. This simultaneous decision-making, whereby each liner is trying to increase its profit but assuming its rivals will not react over different time periods, eventually leads to an equilibrium position [Mankiw and Taylor 2014]. For each liner, optimal supply of capacity is dependent on the other liner's supply, it is called by the reaction function. The model that we use is the Cournot Model. In the Cournot model, liners simultaneously compete in terms of the capacity suplied to the market [Gkonis and Psaraftis 2009].

Either PT. Y or PT. X face a prisoner's dilemma, that is, on the one hand they want to increase profit through self-interest but on the other hand force them to follow explicit cooperation in supply to gain maximum profit. In the payoff matrix, the situation can be drawn that the Nash-Equilibrium is keeping their capacity in total. The Payoff matrix here showed abcorrelation between the decision on capacity

from each liner and their price decision. To sell their excess capacity, they have to decrease their rates. Hence in the short-run, the rate of the rival will remain the same in the rate USD 290/TEU and the liners still attain optimum profit.

Table 4. Payoff Matrix

Freight Rate (PT. X, PT. Y)		Y	
		Keeping Supply	**Adding Supply**
X	Keeping Supply	320.320	320.290
	Adding Supply	290.320	290.290

Source: own study.

Table 1 above showed that PT. Y is better off keeping the supply whatever PT. X has done. In addition, PT. X is also better off keeping the supply instead of adding service. This game will continue simultaneously long term if PT. Y decides to add their capacity, but the rate will decrease, while PT. X has to make a decision to maintain its competitiveness.

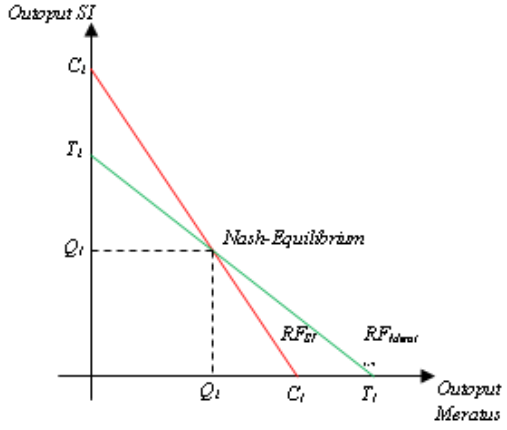

Fig. 5. Reaction function of Y and X

In Figure 5, the Nash-Equilibrium can be observed in the graphic. The RF line is the reaction of the function line, which is the decision of one firm on a particular issue in response to the decisions of its rivals [Mankiw and Taylor 2014]. Each line shows how much supply of each liner is if other liners add their supply. If PT. Y plays as a monopolist, it will offer 26,000 TEUs to the market and vice versa, indicated in C1. In contrast, if PT. X plays dominance as only-one seller, it also offers 26,000 TEUs for its services, indicateda in T1. The line is downward slope as the reaction of its rival's decisions. The equilibrium will be Q1, Q2 where the total capacities both of PT. Y and PT.. X is 26,000 or however much capacity they each offer. Both PT. X and Y aim to keep the freight rate in equilibrium since the maximum profit is on that rate.

Sometimes duopoly can make cooperation. Like a cartel that is able to manage and maintain a collusive arrangement, despite the incentive for individual members to defect [Mankiw and Taylor 2014]. For example, the cartel's agreement in a container-shipping line in a capacity agreement, which each liner has to respect in

the agreement. This agreement aims to keep its market share and to minimize new entrance.

The other form of cooperation between liners is alliance. An alliance is a close, collaborative relationship between two or more firms with the intent of accomplishing mutually compatible goals that would be difficult for each to accomplish alone. The liners agree on the employment and utilization of vessels, including joint vessel route assignment, addition and withdrawal of capacity, and operations over the global system [Song, Panayides and Wang 2001].

As is discussed before about the Sea Toll policy, it is known that Eastern Indonesia is a less-profit route since there is an imbalance in the return with a high cost. The high cost is not only caused by the operational cost of the vessel itself, but also the loading-unloading facility in the destination. Thus, the possibility of PT. Y and PT. X making alliance to overcome the problem or be better off 'self-operating' can be seen through variables related on the decision, such as capacity, cost, revenue, and competitiveness. These variables are drawn in Figure 6 below.

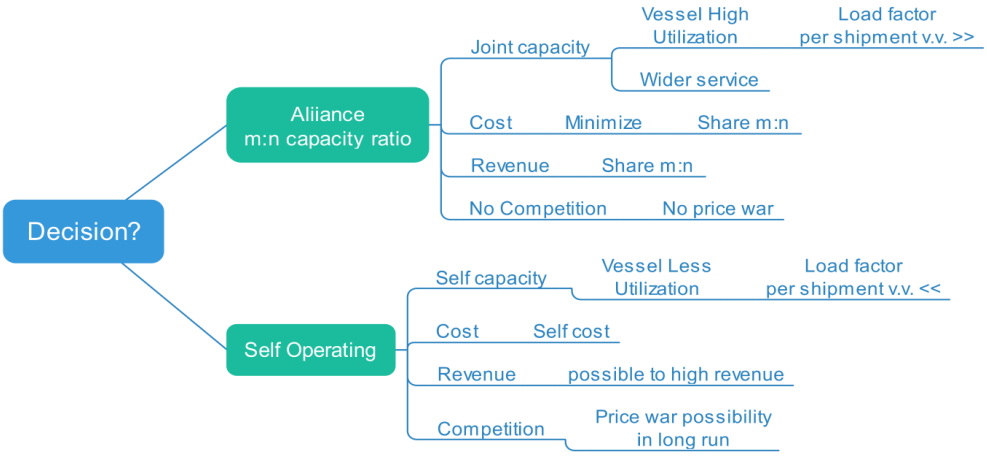

Fig. 6. Mind map of Strategies

Source: own study.

In an alliance, joint capacity will entail high utilization of vessel; it means, whatever the demand, it will be in return (for example Sorong-Surabaya), PT. Y and PT. X could reach a high load factor from a certain supply of capacity. However, it has difficulty the in the Surabaya-Sorong route due to high demand. Revenue and cost between members have to be shared in line with the capacity ratio. In the long run, there is a minimal possibility of competition, if they still maintain agreement in alliance. On the other hand, the 'self-operating' decision is not a bad decision, since the liner can obtain revenue by itself. However, the result will be profit as payoff.

The liner has to consider the capacity ratio [Song, Panayides and Wang 2001]. Sometimes, if there is not a 1:1 capacity ratio, for example 1:3, it affects how much profit the liner can obtain. In the case of PT. Y and PT. X, PT. X has 56 vessels and Y has 13 vessels that are ready to serve. It assumes that all vessels have the same capacity and are ready to serve, and then we get 2.3:7.7 capacity ratio (calculate in proportion of vessel and times by 10. PT. Y profit can be calculated with the equation $\frac{2.3}{2.3+7.7} \times Profit\ in\ possible\ route$. If the profit in alliance is smaller than the profit in 'self-operating', PT. Y is better off deciding for 'self-operating'.

4. CONCLUSION

Discussing agreement between PT. X and Y as oligopolists in Surabaya-Banjarmasin, this study concludes that there are some conditions in competition. The first is the price decision competition which showed the lower rate limitation for USD 300/TEU where P = MC and no incentive within. This price decision has been made with agreement between PT. X and Y. The second is the agreement in supply capacity with the result of 26,000 TEUs of total capacity. The third is the cooperative work between the liners which showed that in serving Eastern Indonesia, they will not depend on the capacity ratio and will be joined as an alliance.

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