



Efficiency analysis of major cruise lines



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HIGHLIGHTS

- This study measured the efficiency of the top three cruise lines
- Network DEA and bootstrapped-truncated regression were used
- They were efficient at the operating stage, but varied at the non-operating stage
- Cruise lines attempting high capacity expansion were relatively inefficient
- Neglected hedging policy over financial risks also contributed to the inefficiency

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ABSTRACT

Three major cruise lines account for 82% of the total market share. Their financial statements show different results between the operating incomes and net incomes over time. To examine the major causes of the differences, this study measured the efficiency of the top three cruise lines to develop a network DEA model to analyze the cruise operations at two stages, namely operating and non-operating stages. In addition, the determinants of the efficiencies were examined using a bootstrapped-truncated regression model. Overall, cruise lines were efficient at the operating stage, but varied widely in the efficiency of the non-operating stage. Cruise lines attempting high capacity expansion were relatively inefficient because of the heavy interest payments arising from the high debt-to-capital ratio. Moreover, the neglected hedging policy regarding the financial risks also contributed to the inefficiency.

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1. Introduction

Cruise tourism has witnessed substantial growth in the tourism market over the last few decades. From 1980 to 2014, the annual growth rate of cruise passengers was 7.2% (FCCA, 2015), where 22.1 million passengers enjoyed cruise travel in 2014 alone. The future of the industry is also encouraging. According to Cruise Market Watch, the number of passengers are projected to grow to 25 million in 2019 with an average growth rate of 4.5%. Although cruise tourism comprises only a fraction of the total tourism industry, whose total revenue amounted to \$ 40 billion in 2015, the per capita expenditure of cruise passengers is more than double the amount of general tourists; in 2014, each passenger paid nearly \$ 1797 to cruise lines for their service while other general tourists spent \$ 830 (UNWTO, 2015). The substantial spending of cruise passengers, together with

the high growth rates indicate that the cruise industry has great market potential. Therefore, policy makers and researchers have paid close attention to the economic impacts of cruise tourism at the national or regional level (Braun, Xander, & White, 2002; Dwyer, Douglas, Livaic, 2004; Chang, Park, Liu, & Roh, 2016b; Dwyer & Forsyth, 1998).

Cruise Market Watch reports several key statistics that characterize the cruise industry. For one thing, the industry is dominated by three major cruise lines. Carnival Corporation & plc (CCL) is the leader in the global market. In 2015, it carried 48.1% of passengers and collected 42.4% of revenue in the industry. Royal Caribbean Ltd. (RCL) and Norwegian Cruise Line (NCL) come next with the passenger and revenue share being 23.1% and 22.1%, and 10.4% and 12.4%, respectively. The oligopolistic market structure is rooted from two factors: the enormous fixed costs required in cruise line operation and the high entry barrier (Papatheodorou, 2006). First, potential entrants should purchase cruise ships to operate, which costs almost a billion dollars per ship. To recover the fixed costs, entrants need to build a substantial customer base. Second, it is not easy for new comers to establish a passenger base due to brand-

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awareness and reputation effects, meaning that cruise passengers tend to prefer well-established cruise lines to reduce their risk of travel involving high expenditure.

Provided promising market conditions and a strong entry barrier, the major cruise lines are supposed to enjoy substantial market power and collect massive profits. On the other hand, this is not always true when looking into the performance of the lines. Table 1 presents a snapshot of financial statements of the major cruise lines. All three lines have performed well in generating their revenues, but showed different outcomes in making their net incomes. Together with implementing a well-planned operation, cruise companies need to leverage their profits through appropriate financial strategies. A failure in financial strategies, e.g., hedging and capital investment, can decrease the final returns substantially even when sales and physical operation are successful. The variations in their performance in the table may have been affected by divergent business strategies in operation and financial management. Therefore, an interesting research question arises; if cruise lines are efficient in both operational and financial management, and if not, which part caused the inefficiency?

Despite the importance of assessing the performance, tourism researchers have not focused on the operational or financial performance of cruise lines. Other than cruise lines, a variety of tourism units have been analyzed in the tourism literature to determine if their operation was efficient, e.g., hotels (Barros, 2005; Hwang & Chang, 2003), resorts (Goncalves, 2013), and travel agencies (Fuentes, 2011). These studies applied a widely used method, the data envelopment analysis (DEA) proposed by Charnes, Cooper, and Rhodes (1978) (henceforth, CCR model). DEA is a programming-based method to gauge the performance of organizational units in relation to their peers. The main advantage of DEA is that it does not require a production function and can handle multiple inputs and outputs. This attractive feature has made DEA pervasive among researchers.

The DEA models used in tourism papers assumed predominantly that the inputs were converted to outputs via a single production process. On the other hand, this may misrepresent many cases including cruise line operation. For example, cruise lines initially attempt to induce as many passengers as possible to generate ticket and ancillary revenues. This process is followed by profit generation, which is related to the cruise lines' efforts to maximize the net income out of their revenue. In this case, at least two stages of the production process are involved in cruise line

operation, i.e. operational and financial. Therefore, traditional DEA models with a single process used in existing works of the tourism literature are inadequate to analyze the operational procedures. Rather, it can be modelled more properly by the network DEA, which originated from Färe and Grosskopf (1996). Network DEA models are advantageous when evaluating a multi-level production process. Yu and Lee (2009) and Hsieh and Lin (2010)'s application of a network DEA model to the hotel industry showed that the model has potential merits in evaluating the tourism units by enabling a sophisticated depiction of its operation.

In this backdrop, this paper assessed the efficiency of major cruise lines. By applying a network DEA model, this study examined the cruise lines' efficiency at two stages. The first one is the "operational" stage, where cruise lines collect ticket and other miscellaneous revenues from their labor and capital expenses. The operating income earned at this stage flows into the "non-operational" stage, where the cruise lines obtain profits. The latter stage is closely related to the financial strategy of cruise lines because profits can be increased or decreased depending on the firms hedging and investment practices.

This paper contributes to tourism literature in two ways. First, the efficiency of major cruise lines was measured in a network structure. To this end, the network data envelopment analysis (DEA) model by Tone and Tsutsui (2009) was constructed. Second, this study examined the factors that determine the efficiency of cruise lines using a bootstrapped-truncated regression model in Simar and Wilson (2007). The tourism industry is affected by macro-economic factors, such as economic crises (Papatheodorou, Rosselló, Xiao, 2010), epidemics (Cooper, 2006) and global income (Jang, Bai, Hong, & O'Leary, 2004), as well as the tourism units financial strategy (Wie, 2005). Therefore, this study examined if these factors affect the efficiency of the lines using the bootstrapped-truncated regression model.

The remainder of this paper is organized as follows. Section 2 covers the theoretical background of cruise tourism and reviews the relevant papers that performed efficiency analysis in the tourism literature along with the developments of network DEA models in the theoretical DEA literature. Section 3 illustrates the network structure of cruise line operation and its mathematical formulation and specifies the estimation model that determines the efficiency. The data source, data handling, and results are presented in Section 4, and Section 5 concludes the paper.

2. Literature review

2.1. Theoretical background

Wild and Dearing (2000) defines cruise tourism as "any maritime based tour by fare paying guests onboard a vessel whose primary purpose is the carriage of passengers." As the definition suggests, cruise tourism encompasses leisure, transportation and logistics, and maritime businesses. Owing to the applied and integrated nature of the cruise industry, theoretical development and empirical research have been scant, and in-depth research for the cruise industry is growing only in recent years. Researchers examined the cruise industry mainly from three divergent angles: cruise line operation, passenger analysis, and economic effects.

Studies on cruise line operation analyzed the nature of cruise lines and their suitable management strategy. Weaver (2005) made a deep look into the cruise operation from "McDonaldization" perspective. He argued that essential indicators of McDonaldization were observed in the cruise industry, which are efficiency, calculability, predictability, and irrationality of rationality. However, he contended that inherent risk in cruise operation, e.g., safety and weather condition, and service differentiation within a ship or

Table 1
Summary of the financial statements of major cruise lines.

Cruise line	Year	Revenue	Net income	Ratio
Carnival	2009	\$13,460,000.00	\$1,790,000.00	13%
	2010	\$14,469,000.00	\$1,978,000.00	14%
	2011	\$15,793,000.00	\$1,912,000.00	12%
	2012	\$15,382,000.00	\$1,298,000.00	8%
	2013	\$15,456,000.00	\$1,078,000.00	7%
	2014	\$15,884,000.00	\$1,236,000.00	8%
Norwegian	2009	\$1,855,204.00	\$66,952.00	4%
	2010	\$2,012,128.00	\$22,986.00	1%
	2011	\$2,219,324.00	\$126,859.00	6%
	2012	\$2,276,246.00	\$168,556.00	7%
	2013	\$2,570,294.00	\$102,886.00	4%
	2014	\$3,125,881.00	\$342,601.00	11%
Royal Caribbean	2009	\$5,889,826.00	\$152,485.00	3%
	2010	\$6,752,504.00	\$515,653.00	8%
	2011	\$7,537,263.00	\$607,421.00	8%
	2012	\$7,688,024.00	\$18,287.00	0%
	2013	\$7,959,894.00	\$473,692.00	6%
	2014	\$8,073,855.00	\$764,146.00	9%

Unit: \$ thousand.

Source: Annual reports of cruise lines

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