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Investment into container shipping capacity: A real options approach in oligopolistic competition

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ABSTRACT

We develop a container industry-specific real options investment model in oligopolistic competition taking into account endogenous price function, fuel-efficient investment, endogenous lead times, and endogenous price formation in the second-hand vessel market. We assess how optimal capacity is influenced by competitive intensity, number of players, volatility, fuel-efficiency, lead time, and cost. Moreover, we investigate optimal investment policies. We find that strategic action increases firm value and that it is worthwhile to consider alliances. Additionally, players in the market should consider retrofitting old vessels for fuel economy in economic downturns and using new, fuel-efficient vessels for capacity expansion in market upswings.

1. Introduction

"Rough seas ahead for container shipping industry" was the title of a CNBC news item that aired in April 2015. It seems the container shipping industry was indeed facing historical challenges. Several players were facing bankruptcy and struggled to make money with transportation services (Barnato, 2016). One year later, however, the situation has even further deteriorated: the Shanghai Containerized Freight Index (SCFI) has hit his all-time low since introduction in 2009 (414 USD/TEU in March 2016) while capacity in the market has continued to rise (SSE, 2016).

Facing challenges to this large extent, players in the industry need to draw more attention to their capacity investments. They should assess the viability of strategic investment, assess optimal capacity and how it is influenced and finally design optimal investment policies over time. The intention of this research is to shed light on these issues and show how - by consideration of a real options investment model in oligopolistic competition - investment policy can be improved.

1.1. Challenges of the shipping industry

The shipping industry is a challenging environment, because players are exposed to market cycles, the high capital intensity of investments, supply–demand imbalances and market concentration.

The ocean freight market has experienced market cycles since the start of modern sea trade; in the past decades, however, these cycles have varied significantly in terms of length and amplitude (Stopford, 2010). Investments into freight vessel capacity are capital-intensive and have a long-term horizon of 20–30 years. These investments are usually undertaken by shipowners with the backing of long-term charter contracts. For example, the Vicente Pinzon (4800 TEU) was recently

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put into service by Alianca de Navegacao (part of the Oetker group among Hamburg-Süd and others). It had originally been ordered by Ship Finance International (SFI) for 57.5 million USD, backed by a seven year charter contract with Hamburg Süd (26,250 USD per day). After delivery delays, however, SFI walked away from the contract and Hamburg-Süd assumed direct ownership of the vessel (Alphaliner, 2014d).

An analysis of time charter rates, new orders as well as idle fleet in the container shipping sector (Fig. 1) shows that strong ordering during time charter rate hikes has – repeatedly – led to high capacity delivery in low rate environments. As of September 2014, idle capacity for container ships has dropped to 1.3% of total fleet (vs. 3.9% in September 2013). However, with the start of the winter period, more empty sailings are expected to occur and the amount of idle capacity is expected to increase (Alphaliner, 2014b).

It can be argued that under- and over-supply situations occur frequently in shipping markets due to non-optimal investment timing. For example, the boom years from 2001 to 2008, when daily earnings increased strongly, led to supply demand imbalances in the 2009 recession (Syriopoulos, 2010). One reason for non-optimal investment timing is shortcomings in current methods to evaluate sea freight capacity investments; for example, current Discounted Cash Flow (DCF) methodologies do not capture flexibility in investment timing. Non-optimal investment timing and sizing has resulted in strong growth in the capacity market (Bendall, 2010). At the end of 2013, there were 5115 container vessels (+4.9% p.a. since 1999) with an average capacity of 3349 TEU (+5.0% p.a. since 1999) (Clarksons, 2013c).

In contrast to the bulk shipping market, which is characterized by perfect competition (Pirrong, 1992), container shipping is much more concentrated: the top 10 operators control more than 60% of worldwide TEU capacity (Alphaliner, 2014e). Hence, the actions of single companies do matter in terms of price and market share. Moreover, price adjustments (up and down) are not always in line with supply–demand fundamentals; at the same time, the price elasticity of long-distance container shipping demand is very low since no substitutes are available at a comparable cost.

1.2. Investment decisions in shipping

Investment decisions in shipping are driven by a number of factors. On the one hand, the true intrinsic value of a project – based on time charter or freight rate earnings and lifetime of a ship, along with potential embedded real options – is relevant and drives decisions. On the other hand, factors such as fuel efficiency, network considerations, sources of funding, regulation, vessel sizes, and asset prices also play an important role.

First, new generations of ships offer substantial fuel savings of up to 30% which mostly benefit the carriers. Hence, substantial operational cost advantages allow carriers to replace ships earlier and to gain a competitive advantage from operating newer ships. Second, carriers serve customers in networks. For example, the CMA CGM "French Asia Line 16" runs from Kaohsiung via Shanghai, Tanjung Pelepas, and other ports to Hamburg. The 13,800 TEU ships sail on a published weekly schedule and need 57 days for a round trip. The 10 vessels associated with the string are operated by CMA CGM's strategic partner Evergreen (CMA-CGM, 2014). This means that a minimum number of ships needs to be deployed to serve a network string; it also means that, in case of vessel sharing agreements or alliance membership, investment decisions need to be aligned with strategic partners. Third, since the financial crisis and bankruptcies of shipping funds, sources of financing have changed. KG funding (closed-end shipping funds in Germany) is almost nonexistent and large shipping banks are reducing exposure; this makes financing vessel purchases more difficult and forces ship buyers to rely more on equity and debt capital markets as well as private equity investment. Fourth, substantial regulatory changes are expected: ballast water, air pollution, and overall CO_2 targets are expected to change in the decades to come, calling for retrofitting and new investment. Fifth, in terms of vessel sizes, the Panama canal expansion, the building of the Nicaragua canal and increased port sizes around the world are changing size requirements. This will favor investment into larger ships, while Panamax ships (4000–5099 TEU, about 20% of total capacity) will be increasingly scrapped. Currently, one of the largest container ship designs is the Maersk Triple E class with a capacity of 18,340 TEU. These very large ships are optimized for slow steaming and provide significant fuel efficiency savings – when fully utilized. They are deployed on Asia–Europe routes since the volumes are sufficient and their size still allows them to cross the Suez Canal. Finally, new and second-hand vessel prices are currently at historic lows and drive vessel purchases contrary to supply–demand fundamentals (expert interviews conducted in 2013 and 2014, Alphaliner (2013b, 2014e) and Clarksons (2013a)).

1.3. Research questions

The objective of this paper is to develop a real options investment model in oligopolistic competition to evaluate investment decisions in shipping. The research questions that guide this research are:

- Under what conditions is strategic behavior in the container shipping industry beneficial?
- What is the optimal capacity in an oligopolistic shipping market and how is it influenced by factors such as competitive intensity, number of competitors, freight rate volatility, fuel efficiency, lead time, and variable cost?
- What are optimal policies for undertaking investments in the container shipping industry over time?

The structure of the paper is as follows. Section 2 reviews existing real options literature on maritime investment and oligopoly models and details the contribution of this research. Section 3 introduces a continuous-time model and shows gen-