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# Financing green ships through export credit schemes

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ABSTRACT

In response to the significant emission reduction potential of ocean transport, researchers and industry stakeholders have come up with green solutions for addressing the industry's environmental challenges. The variety of technical measures and the even wider range of their potential combinations call for generalized financing approaches to support technological driven environmental progress. This article is one of the first to present a financing model based on export credit schemes (ECS) that could be applied to retrofits of existing ships and green new build ships alike. A market evidence analysis followed by an event study based on 20 ECS loans and stock returns over an approximately 5 years period is carried out in the context of the cruise industry to introduce ECS concepts to the area of transportation research and to develop empirically grounded model assumptions. A scenario-simulation based model application using an empirical sample of bond spread curves from the leisure and transport industry indicates that the potential capital structure benefit is highest for the retrofit case. The importance of a constant dialogue between technical and financial decision-makers is emphasized, as ECS are linked to technical decisions such as selection of shipyards and manufacturers.

## 1. Introduction

The increasing interest in environmentally friendly or green ship technology can to a large extent be ascribed to regulatory forces that oblige ship owners to reduce emission from green house gases (GHG) as well as air pollution such as sulfur limits introduced by the International Maritime Organization (IMO) in Annex IV of the International Convention for the Prevention of Pollution from Ships (MARPOL). Furthermore, the adaption of clean and environmentally sound technology contributes to the United Nations Agenda for Sustainable Development (United Nations, 2015) by addressing Goal 9 "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation" as well as Goal 14 "Conserve and sustainably use the oceans, seas and marine sources for sustainable development". Green ship technology in academic literature can broadly be classified as technical or operational measures (Bouman et al., 2017; Aronietis et al., 2014; Krikke, 2015; Wang et al., 2010; Eide et al., 2009; Buhaug et al., 2009) while the focus of this work is on financial solutions for technical measures. Examples include firstly switching the main energy source of the ship to more efficient fuel alternatives such as liquefied natural gas (Schinas and Butler, 2016), photovoltaic systems (Kobougias et al., 2013), wind propulsion (Li et al., 2015), fuel cells (Tse et al., 2011) or batteries (Dedes et al., 2012). These alternatives play already a role in some context, locally, as shown by the first case of a marine vessel entirely operated on batteries (Skjong et al., 2015). Secondly, upgrades of the ship's main components such as improvement of main engine configurations, installation of ballast water treatment systems (Donner, 2010; Balaji et al., 2014) or upgrading auxiliary systems with waste heat recovery systems (Singh

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and Pedersen, 2016). Thirdly, technology for reduction of NOx such as selective catalytic reduction systems (Choi et al., 2015) or exhaust gas recirculation systems (Verschaeren et al., 2014) as well as measures for SOx reduction through installation of scrubbers (Ülpre and Eames, 2014). Implementation of new technology can be realized either via upgrading (retrofitting) existing ships or by specifying new builds based on green technology.

In any case, significant upfront investments are required from the industry to adopt new green technology (Bazari and Longva, 2011). This comes at a time when many banks have reduced their ship finance activities in the aftermath of the global financial crisis of 2008. Since then, the 10 major lending institutions alone have reduced their ship finance portfolios by approximately USD 50 billion (Devabhaktuni and Kennedy, 2012), triggering capital constraints for shipping companies and creating financial barriers for the implementation of energy efficiency measures such as access to and cost of capital (Wang et al., 2010; Maddox Consulting, 2012; Rehmatulla et al., 2013). At the same time, the purchase price of more environmentally friendly ships is expected to be higher as compared to conventional vessels (DNV GL, 2014), adding to the challenge of overcoming financial barriers.

In response to these barriers, academia and industry stakeholders have started to explore alternative financing sources for fostering the implementation of green technology (SSI, 2013; Stulgis et al., 2014). Still, existing approaches focus on retrofits of old vessels while little has been done to explore financing models, which can analogously be applied to the significant area of new build ships with more than 66 million of new gross tons that entered the merchant fleet only in 2016 (UNCTAD, 2018). In a recent survey of 162 studies in the area of shipping finance and investments (Alexandridis et al., 2018), Export credit has been identified as an important alternative source of shipping finance which is expected to become even more relevant in light of the increased regulatory environment, at the same time representing an area where further research is needed. The key contribution of this work is to address both gaps by developing a financing model for green ships that works for retrofits and new buildings alike based on concepts of ECS financing. Given the novel and under-researched nature of ECS financing in transportation literature, this article at first presents a detailed introduction on the ECS framework and lending policies supported by a market evidence analysis of the cruise industry in Section 2. Findings are subsequently tested based on an empirical event study of 20 ECS loans and cruise stock returns during an approximately 5 years period in Section 3. Due to the industry's long history of ECS financing in the context of funding high investment volumes, the cruise market is well suited for studying ECS and their implications on capital structure in order to develop a framework for financing green ships in general. Based on the findings from the cruise industry, a sourcing-based export finance model (SBEFM), which combines guarantees from the Export Credit Agencies (ExCrA) of countries that are benefitting from the innovative engineering technology of green ships at the macroeconomic level is applied and tested in Section 4 using a scenario-simulation based on a sample of bond spread curves from the leisure and transport industry to reveal capital structure sensitivities and limitations. Section 4.2 discusses the results, while Section 5 concludes and examines areas for further research.

## 2. Export credit schemes

### 2.1. The international cruise industry

The international cruise market is characterized by strong growth during the last years. According to industry figures, passenger capacity increased from 17.8 million passengers in 2009 to 26.7 million in 2017, representing a 50% absolute growth in only 10 years. The forecast for 2018 expects passenger capacity to increase further to 28 million passengers (CLIA, 2018). The world fleet only comprises of approximately 449 ships as per 2017 (CLIA, 2018) and the market is transparent with around 77.9% of the market share in terms of passenger capacity being owned by three major publicly listed companies (Cruise Industry News, 2016): Carnival Corporation & plc. (CCL), Royal Caribbean Cruises Ltd. (RCCL) and Norwegian Cruise Line Holdings Ltd. (NCL), therefore providing for a reliable database. In recent years there have been first attempts to build large cruise vessels at Asian ship yards such as in Japan (Mitsubishi Heavy industries, 2016) or intentions for building potential future ships in China (Fincantieri, 2016), however with more than 90% of the cruise ship orderbook, the majority of vessels is built at European ship yards. The three large shipyard groups in Europe are Meyer Werft (Germany and Finland), Fincantieri (Italy) and STX-France (France). In 2017 the orderbook of 43 cruise ships placed at Meyer Werft and Fincantieri amounts to approximately USD 32 billion, resulting in an average building price of approximately USD 744 million per vessel while STX-France had firm orders, letters of intent and options adding up to around USD 11 billion (Corbett, 2017). At the same time, the cruise industry faces high pressure to increase the industry's environmental performance given the relatively higher consumption of electrical power, hot water and steam of cruise ships compared to other vessel types (Geneidy et al., 2018) while recent research has emphasized that the cruise industry has an opportunity for environmental leadership compared to other maritime segments (Carr and Corbett, 2017). In summary, due to the high degree of technological sophistication combined with significant investment volumes, the challenges of financing cruise ships show parallels to the case of financing green ships in general, making the cruise market well suited for drawing generalized conclusions for financing green ships across maritime industries through ECS.

### 2.2. Lending policies and market evidence

ExCrA are agencies that provide support to national exporters competing for overseas sales in, broadly, two ways: either in the form of direct credits to foreign buyers or by providing a guarantee or insurance for the benefit of lenders financing the export. This insurance or guarantee creates financial collateral, which provides lenders with additional comfort to finance the project (Fleisig and Hill, 1984). The literature shows that ExCrA play a central role in global trade and investment flows (Stephens, 1999), particularly in the context of investments into developing countries (Kuhn et al., 1995). In general, ExCrA support is particularly important in the