



Does fuel efficiency pay? Empirical evidence from the drybulk timecharter market revisited



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ABSTRACT

The time charter market for ships represents a classical example of the principal-agent problem, where shipowners can opt to invest in energy efficient ships, yet any savings in fuel expenditures accrue to the charterers. In a competitive and efficient market, ships that have more fuel-efficient designs should, all else equal, obtain a rate premium to reflect the fuel savings. In this paper we investigate empirically the determinants of timecharter rates using a comprehensive panel data set of over 9100 timecharter fixtures for bulk carriers above 40,000 DWT between January 2001 and January 2016. We test for the presence of an energy efficiency premium using four different definitions of efficiency, while controlling for key macro, ship-specific, and contract-specific variables. Our findings suggest that the “market rate” for a standardised vessel dominates in terms of explanatory power, but that vessel age, fuel prices, place of delivery and DWT also are significant determinants across sizes. We show that the earlier findings on the energy efficiency premium in the literature are not robust when expanding the sample in time and vessel size. Using a substantially longer sample across an entire market cycle, we show that only 14–27% of fuel savings are reflected in a higher rate during normal market conditions, while the sign of the relationship flips during market “booms” such that energy inefficient vessels attract a premium. We introduce several explanations as to why there is an apparent market failure and suggest policy measures that could address this issue.

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1. Introduction

Energy efficiency has come to the fore in shipping over the past few years and much has been said on the importance of reduced ship-to-air emissions if the industry is to contribute its share of global emission reductions. As reduced emissions generally go hand in hand with lower fuel consumption and costs, being green is often equivalent to being more profitable, and so this would appear to be one area where shipowners and environmentalists share a common goal. Yet, when theory meets practice, conventions with regards to contractual structure and vessel operation in shipping are often such that the most energy-efficient solutions are not chosen, or that energy efficiency is not rewarded by the market. In the general literature on energy efficiency (see e.g. [Sorrel et al., 2000](#)), these barriers are often categorised into (a) organisational, (b) behavioural and (c) economic factors.

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Barriers to energy-efficient shipping often fall into the “market failure” category (see, e.g. [Rehmatullah et al., 2013](#), or [Acciaro et al., 2013](#), for a detailed account). A well-known example is the split incentives problem under a voyage charter. Here, any reduction in fuel costs (and emissions) from agreeing to reduce the sailing speed would accrue to the shipowner, while the charterer/cargo owner would be left with longer lead times in the supply chain and the associated increase in trade financing costs. Similarly, the added construction costs of a state-of-the-art energy-efficient newbuilding paid by the owner may not be fully recovered if the vessel is then chartered out on a timecharter where fuel savings accrue to the charterer only (a principal-agent problem).

In this paper we examine whether the principal-agent problem in the timecharter market results in a market failure. Specifically, we assess empirically whether there exists a freight rate premium for energy-efficient drybulk ships that is commensurate with fuel savings. This is important from a policy point of view. The presence of a market failure, in the sense that shipowners do not get sufficiently compensated for building energy-efficient ships, will inhibit innovation and slow down the uptake of new fuel-saving technologies. However, it also has a direct impact on the operational strategies of charterers and shipoperators. If there is no premium for fuel-efficient ships in the timecharter market then the optimal chartering strategy is to always pick the most energy-efficient vessel available, sublet it in the spot market on a voyage charter and pocket the fuel savings. Freight rates in the spot market for voyage charters, measured on a \$/tonne basis, will typically cover all voyage costs for the marginal vessel required to perform transportation, though this lower bound is occasionally breached for low-volume (i.e. backhaul) routes in times of severely depressed freight market conditions ([Adland, 2012](#)).

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature, Section 3 presents our chosen panel data variables and regression methodology, Section 4 presents the data and the empirical results and Section 5 contains concluding remarks on policy implications and suggestions for future research.

2. Literature review

The observation that the principal-agent problem can represent a barrier to energy efficiency is well known in the general energy efficiency literature. In this context, the principal-agent problem refers to the observation that the economic benefits of energy conservation do not accrue to the person who is trying to conserve. [Blumstein et al. \(1980\)](#) provide an early taxonomy of energy efficiency barriers and argue that they can be classified as: misplaced incentives, lack of information, regulation, market structure (degree of concentration), availability of financing and custom. Similarly, [Brown \(2001\)](#) articulates the barriers to clean energy usage in the US and argues for the presence of large-scale market failures. The principal-agent problem belongs to the category “misplaced incentives” and has been investigated empirically in several market contexts. For instance, [Graus and Worrel \(2008\)](#) estimate the size and the impact of the principal-agent problem for cars provided as a company perk in the Netherlands and find that company cars have higher total higher energy consumption. [Vernon and Meier \(2012\)](#) consider the impact on the US trucking industry and estimate that up to 91% of total trucking fuel consumption is affected by “usage” principal-agent problem, where the driver does not pay fuel costs and lacks incentive for fuel saving operation. Deep-sea shipping is an extremely interesting empirical case within the broader transportation sector as it is generally more transparent and geographically integrated than land-based transportation. Moreover, market intermediaries (shipbrokers) have a long history of collecting and disseminating data on both market transactions and technical vessel details, resulting in the availability of rich datasets where the division of economic benefits due to energy efficiency can be explicitly estimated.

Within the maritime economics literature, our paper belongs to the stream of research that investigates the microeconomic determinants of freight rates. Typically, freight rate data for individual contracts (fixtures) are here regressed against a chosen set of vessel and route-specific characteristics with a view to establish whether certain effects, such as vessel quality premia, are present in the price data. We note that vessels can be chartered on two main types of contracts: voyage charters and timecharters (TC). Under a voyage charter, the shipowner is paid on a \$/tonne cargo basis and has to pay all costs, including fuel expenses. Under a timecharter, the shipowner gets paid on a \$/day basis for the duration of the hire period, but voyage costs such as fuel expenses are borne by the charterer. The charter type chosen for a vessel at a particular point in time will depend on the policy of the shipowner, the market expectations of owners and charterers, the offers available in the market and the attractiveness of the vessel. Many vessels will operate mainly in the spot market for voyage charters throughout their lifetime. We also note that vessels fixed on a period timecharter often will be re-let in the spot market, and so there is no clear separation between the two sub-markets.

However, the empirical literature treats the voyage charter and timecharter markets separately, with most research focusing on the former. For instance, [Tamvakis \(1995\)](#) tests whether there is a freight rate premium paid to tanker vessels of lower age, vessels with double-hull construction, or vessels trading to the United States, with mixed results. In a follow-up study, [Tamvakis and Thanopoulou \(2000\)](#) investigate the existence of a two-tier spot freight market in the drybulk freight market on the basis of vessel age, and find no significant age premium in the freight rate. In related work, [Strandenæs \(1999\)](#) assesses the potential for a two-tier tanker market to develop based on simulations of a non-linear equilibrium model of the international tanker market. [Alizadeh and Talley \(2011a,b\)](#) broaden the investigation of vessel and contract-specific determinants of tanker and drybulk spot freight rates to include the lead time between the contracting date and loading, as well as macroeconomic proxies representing the market freight rate level and its volatility. [Adland et al. \(2016\)](#) show that there exist substantial fixed effects related to the identity of owners, charterers and owner-charterer matches in the pricing of voyage charters in the tanker and drybulk segments.

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