



# Investors' behavior and dynamics of ship prices: A heterogeneous agent model



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## ABSTRACT

Distinguishing investors into speculators and operators, and classifying the former group into momentum and contrarian investors, we develop a heterogeneous agent model (HAM) to examine the dynamics of price of second-hand dry bulk ships. The results suggest that momentum strategies based on short-term measures of earnings perform significantly better than the contrarian or passive (buy-and-hold) strategies. The HAM seems to capture the dynamics of vessel prices and the investors' behavior in the market for ships very well. Finally, an increase in participation of momentum investors tends to increase price volatility, whereas higher demand from contrarian investors seems to lower price variability.

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## 1. Introduction

The competitive and capital intensive shipping industry is characterized by cyclical fluctuations, high volatility and periods of extraordinary returns (Stopford, 2009). This combination makes investment in ships very attractive for both regular investors and speculators. The latter are grouped usually under the term “asset-players” looking to benefit from ship value volatility. Asset-players – or any newer types of investors – have not, however, eclipsed the mainstay of shipowners who concentrate on generating income from ship operations and freight services and known as “operators”. The interaction of the trading behavior of shipping investors with the characteristics of shipping industry results in complex dynamics of highly volatile and unpredictable asset (ship) values.

The inherent lags in capacity adjustment, through newbuildings, and response of supply of shipping fleet to expected demand for freight services have often resulted in very high levels of freight and asset prices, while delays in permanent capacity retirement have led to excess supply and depressed freight market and ship prices. Kalouptsidi (2014) shows that the time lags in shipbuilding and their lengthening in periods of high investment activity lead to temporary sharp freight recoveries and hikes, along with steep increases in vessel values and price volatility. Conversely, the recovery of the markets for sea transportation and for ships is hindered by shipping's operational flexibility; i.e. slow steaming or temporary capacity retirement of tonnage in the form of the lay-up of vessels during market downturns. Such possibilities allow to exercise a “wait-and-see” strategy and delay the clearing of the excess capacity which could come about otherwise through scrapping. In addition, dynamics of international trade, technological advances leading to operational efficiency, new regulation or environmental issues may exacerbate the fluctuation of asset values.

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Throughout the post-war era banks often assumed most of the financing of vessel orders which still continued to add to the growth of the world fleet despite the economic and shipping environment of late as discussed in [Puscaciu et al. \(2015\)](#). In recent decades – before and after the financial crisis – tax incentives, public listings and, lately, the involvement of funds and private equity have extended the range of potential investors in shipping.<sup>1</sup> These may include now: (i) Traditional shipping investors and ship-owners, (ii) Large individual investors from other sectors, (iii) Small investors placing savings in individual shares or in investment schemes (tax-related or not) and shipping bonds, and, finally, (iv) institutional investors, hedge funds and private equity firms.

Investors in the market for ships follow different investment strategies and timing tactics for investment and divestment depending on their experiences, beliefs, and expectations regarding future ship prices. For instance, a group of investors may follow the trend in asset prices and base their investment strategy on market momentum; others may believe more in the inherent cyclicity of shipping and follow a countercyclical investment strategy ([Thanopoulou, 1996](#)) alternatively termed as “contrarian”. The latter strategy involves investing when the market has declined and – in the view of contrarian investors – reached the bottom, exiting when asset prices have recovered enough to justify a reasonable return. Such a group of investors may eventually use market fundamentals – in the form of expected freight market conditions – as the basis of their investment strategy: They would invest in ships when market prices are below fundamental values (e.g. discounted present value of expected earnings) and exit when vessel prices are above fundamental values. The diversity in terms of beliefs and actions of shipping investors, combined with shipbuilding delays and resistance to retirement, can have significant impact on asset values and market dynamics such as cyclicity, volatility, and long-term trends.

The diversity in terms of beliefs and actions of shipping investors, combined with shipbuilding delays and resistance to retirement, can have significant impact on asset values and market dynamics such as cyclicity, volatility, and long-term trends. Therefore, the aim of this paper is to develop a model to explain short-term dynamics of ship prices based on heterogeneous investor behaviors and explore their impact on ship values. In this respect, firstly we classify participants in the market for dry bulk ships according to their investment strategies into momentum and contrarian (i.e. countercyclical) investors and examine the performance of each of these investment strategies against the passive, or “buy-and-hold” strategy; secondly, we define an equilibrium model for short term changes in second-hand ship prices based on the heterogeneous agent model (HAM). The HAM specification allows for defining and incorporating demand functions for different types of investors depending on their respective expectations. Finally, we investigate the impact of investor participation on volatility of ship values. The estimation results reveal significant evidence supporting the existence of an impact of agents with heterogeneous investment behavior and of the proportion of participation of each type of investor on the dynamics of ship values.

This paper makes a number of contributions to the existing literature on shipping investment and asset pricing. First, by evaluating the performance of different investment strategies on dry bulk ships, we highlight the significance of adapting different investment policies by ship owners and operators. Second, to the best of the authors’ knowledge, this is the first study to recognize investors’ heterogeneous beliefs and behaviors, and incorporate such information on the formation of asset values in the market for ships. Considering that we study the market for ships, our study also contributes to the literature by investigating the theory of heterogeneous agent behavior in a market for real assets. Third, by applying the HAM to different sub-sectors of dry bulk tonnage we compare the extent of differences in the role of investors’ heterogeneity across size-specific segments of the dry bulk market. This is a most competitive sector of the shipping industry and its high volatility does not elude investors either positively or negatively as indicated by distinctly different beta volatilities between main shipping segments, calculated by [Drobetz et al. \(2016\)](#).

The paper is structured as follows: After the introduction, Section 2 presents the review of literature on shipping investment theory, investment timing and investor expectations. The structure of the HAM model and the methodology are discussed in Section 3. The dataset used for empirical analysis is presented in Section 4. Section 5 reports the empirical results and discusses findings, while the final section concludes.

## 2. Review of literature

### 2.1. Markets for ships: The traditional models

Traditional studies in the shipping economic literature attempt to model ship prices such as [Beenstock and Vergottis \(1989\)](#), [Strandenæs \(1984\)](#), [Hawdon \(1978\)](#) and [Haralambides et al. \(2004\)](#), [Gkochari \(2015\)](#), and [Rau and Spinler \(2016\)](#), among others. All these studies are based on the assumptions that ships are capital assets and reward the investors with operational revenue as well as capital gains or losses. In addition, they assume rational expectations in price formation in the sense that investors are rational profit-maximizing agents who use all the available information to their advantage for timing their investment, divestment as well as for arbitraging any inefficiency in the market. Consequently, the market for ships is assumed to be efficient.

<sup>1</sup> As tax and investment incentives for shipping investment are today limited compared to the past ([Gardner et al., 1996](#)), and as the persisting ones have more relation to investment in containers and specialized shipping (outside the dry bulk market), the model has been constructed in its simpler form. However, this does not make the model or the market for ships less complex.

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