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Determinants of Ship-Management Revenues: The Case of CYPRUS

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Abstract: We explore, for the first time in the literature, how the revenues of the ship-management companies respond to macroeconomic exogenous shocks. Using data for ship-management companies in Cyprus, we find evidence that a demand shock has the largest impact on revenues, exhibiting an almost one-for-one relationship. If the demand shock is permanent, we observe a ceteris paribus permanent effect on revenues. Similarly, this occurs irrespective of the final effect that demand has on the relevant freight rate, proxied via the Baltic dry and tanker (dirty and clean) indices. The BDI and the BDTI indices have smaller effect on revenues, standing at approximately 0.05% for every 1% shock, while the clean tanker index does not have an effect, most likely due to their fleet composition. In accordance with the literature, we find that a shock in the price of Brent oil increases revenues. Our results bear importance not only for ship-management companies per se, but also for countries that are ship-management hubs.

Keywords: shipping; ship-management; freight rates; Bayesian VAR

JEL Classification: G11; G12; G13; G20

1. Introduction

Shipping is the most important mode of transportation. According the most recent statistics, approximately 85% of the world's trade is transported, at some point, by water [1]. Thus, it comes without surprise that the industry as a whole has been, recently, under the spotlight the academic, [2], investor [3], and policymaker communities [4].

As demand for seaborne trade has increased significantly in the current decades [5], investment in vessels attracts ambitious investors [6]. However, investing in the maritime sector carries a high degree of risk, given that the industry is characterized by a derived demand [7–10] and the macro-economic environment as a whole plays a significant role in the cycle of the specific market. Economic factors like GDP [11], interest rates [12], stock markets [13,14], and even exogenous socioeconomic shocks have a huge effect on the shipping market [15,16].

In what is perhaps one of the biggest differences in the maritime sector, Stopford [5], in his seminal work, claims that the shipping cycles last half as much as the normal business cycles suggesting that market conditions can change much more rapidly than in other sectors. In addition, the magnitude of shipping cycles is one of the main factors that many investors enter the market in

the first place. There have been various examples of shipping investors who, in a few years' time, have become enormously successful [17].

The opportunity for high profits does matter for investors. While the average return of shipping investments is relative low when compared to other sectors, their standard deviation of the annual return appears to be much higher, as suggested by the higher magnitude of the cycles [5]. This means that even though investors would be better off investing in the stock or bond market over the long run, shipping investors could potentially outperform if they time their investments to the shipping cycle. Naturally, while some investors aim to buy vessels at low prices and sell them in high [18], this is a rather risky investment and, as most of the researchers suggest, hard to achieve [19]. In fact, many scholars have characterized such investors as "unicorns" given that, on average, the shipping industry does not produce high returns for its investors over the long-run [5].

Nevertheless, the possibility for a "buy low sell high" scenario gives rise to another play, given that these investors still have assets that can produce a significant amount of income until their sale. Given that most use a high level of gearing in their investments, they can potentially boost their average returns, while at the same time benefit even more during the peak periods [20]. However, most of them are not interested in managing the vessels themselves, and hence they sub-contract such operations to ship-management companies [21]. In such a scenario, the vessels would produce a rather stable income for their owners, along with some upside potential. As such, the vicissitudes of the shipping cycle would affect them much less.

As such, it is evident how ship-management has become of crucial importance for the industry as a whole. As evidenced by their number, which has tripled the over the past few years [21], their services add much value for the investors that do not wish to operate their vessels in a daily basis but want their vessels to be hired until the time they sell it.

In the current paper, we examine for the first time in the bibliography the macroeconomic determinants of ship-management company revenues. Using a unique dataset for one of the leading ship-management hubs in the world, Cyprus, our results show that a demand shock has the largest impact on revenues, exhibiting an almost one-for-one relationship. This occurs irrespective of the final effect that demand has on the relevant freight rate, proxied via the Baltic dry and tanker (dirty and clean) indices. The BDI and the BDTI indices have smaller effect on revenues while the clean tanker index does not have an effect, most likely due to the ship-management companies' fleet composition. In accordance with the literature, we find that a shock in the price of Brent oil increases revenues. Our results bear significant implications for the broader shipping community as they provide evidence of the importance that the ship-management and its reliance on global macroeconomic conditions.

Following this introduction, the remainder of this paper is organized as follows: section 2 provides a review of the literature on the issue, section 3 describes the methodology and the data used, section 4 discusses the empirical results obtained, and section 5 concludes on the findings.

2. Literature Review

The literature concerning the ship-management companies is rather limited and mainly focuses on managerial aspects. The first study on the matter was by Sletmo [22], who looked into the fact that traditional shipping powers (like the Great Britain or Greece) have been losing part of their national tonnage due to the early stages of the globalization of the maritime industry. Since Sletmo's [22] research, ship-management companies had increased drastically. The reasons for this phenomenon relate to the oil industry majors (e.g. Exxon, Mobil, Shell, BP), who took advantage of the availability of tax-breaks on ship investment and made capital investments by purchasing vessels during the 1960s, as well as the low freight rates and the devalued sale and purchase market of the early 1970s.

It was not until 2006, that researchers (Panayides and Gray [21]) looked into the industry again. Their seminal research focused on the marketing perspective of the ship-management companies at the time. More precisely, in their research they conclude that ship management companies that build long-term client relationships will ensure client retention, reduce transaction costs, and achieve differentiation and competitiveness. In other micro-level studies of ship-management companies

Mitroussi [23,24], provides evidence that ship-owners more often than not outsource the crewing and the technical management of their vessels to ship-management companies. Moreover, ship-owners who employed such services were doing so primarily for flexibility and to relieve themselves from economic pressures, as offered to them by management enterprises. In her follow-up research, Mitroussi [24] focuses on the importance of shipping economic sustainability under the new environmental legislation, and how ship-managers can ameliorate the problems that could possible arise for the ship-owners.

As ship-management companies increased, the literature has looked into the strategies that some companies follow. In particular, high performance companies seem to be achieving economies of scale, differentiation (in particular through a wider range of services offered) and market-focus and competitor-analysis [25], while the investment in their human capital is of prime importance [26,27].

Finally, some of the latest research is focusing both on the environmental and the digitalization fronts when it comes to ship-management companies. Poulsen et al. [28] where the first to look in the energy efficiency that third party ship-management companies are implementing. Their findings suggest that, ship-managers are generally indifferent in putting into effect energy efficient strategies if the ship-owners do not push them to such a direction. When it comes to digitalization, Timimi [29] provide evidence that ship-management companies are not providing enough resources for this new era in the maritime industry.

Overall, while the bibliography has given some evidence on how the ship-management companies operate, no research is available on the macroeconomic factors that can potentially affect them. In this research, we shed light in the above matter, as we estimate, for the first time in the literature, how the shipping markets (namely the dry bulk, dirty tanker, and clean tanker segments) affect the revenues of these companies. Such information is of prime importance not only for the companies but also for the countries that rely on the industry. In the next section, we offer the data and the methods used for the estimation.

3. Data and Methods

Consider a Vector Auto-Regression (VAR) model in which $y_{i,t}$ denotes a matrix with *i* variables relevant to the ship management. The VAR representation is

$$\Delta y_t = \alpha + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \boldsymbol{\Sigma}) \tag{1}$$

where y_t is a vector of endogenous variables, Δ is the first difference operator, *j* is the appropriate lag length and ε_t denotes the vector of serially and mutually uncorrelated structural innovations, with variance-covariance matrix $\boldsymbol{\Sigma}$. β_j are the appropriate coefficients related with lag *j* of the vector of dependent variables.

In particular, vector y_t, in addition to ship-management revenues, also includes the main macroeconomic variables, i.e. oil prices and the stock market capitalization index, both of which are expected to have a positive effect on ship-management revenues. In particular, oil prices usually tend to have a positive impact on freight rates [30–32] as these represent the main vessels expenses, and are usually passed on to the end-client. In this context, we expect oil prices to have a positive effect on ship-management revenue as well. Similarly, stock market changes tend to have a positive impact on freight rates [33,34], as they proxy for the prevailing macroeconomic environment. Given that shipping is a derived demand system, the better the macroeconomic situation, the more demand for transportation there will be, and hence freight rates will rise. We note here that if the revenue structure is fixed and does not vary over the shipping cycle, then the change in these variables may not have an effect on them.

In addition, to the variables mentioned above, we also include the Baltic Dry Index (BDI), the Baltic Dirty Tanker Index (BDTI) and the Baltic Clean Tanker Index (BCTI) which are employed to capture the behaviour of freight rates, i.e., the equilibrium price as per standard theory [5]. The adoption of these particular indices is justified by the fact that they represent the vast majority of ocean cargo transported, and are the underlying assets of shipping freight option contracts [35].

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Finally, we also use the interest rate in our estimation, for the first time in the literature, in order to account for the potential spillovers from monetary policy and financing conditions. As is well known, capital costs can account for a large part of the total expenses for a vessel, and hence an increase in the financing cost can have important implications for shipping companies. Most importantly, higher policy rates suggest that the overall conditions in an economy are tighter, meaning that demand should be lower. As such, and according to standard economic theory, the interest rate is expected to have a negative effect on revenues. In our model, we proxy the global policy rates via the US Effective Federal Funds Rate (EFFR), given that the US is the largest importer in the world [1].

Moving to the particularities of our estimation, as it is widely known, sample size is essential in this formulation since estimations of β_j can be inaccurate when the time-series dimension is small [36]. This is important given that the data range for our estimation is constrained: while freight indices are available starting from 2000, the ship management revenues data from the Central Bank of Cyprus survey are only available from 2009 onwards. Subsequently, the application of Bayesian methods, as presented by Litterman [37], are used to address this issue. In particular, and as previously introduced in the shipping literature [38], we using a non-informative Normal-inverse Wishart prior to allow us to obtain more robust results. The use of this prior is also popular in the economics literature [36,39].

To avoid the use the imposition a Kronecker structure on the prior distribution, which creates a dependence between the variance of the residual term and the variance of the VAR coefficients for each equation, [40], we use an Independent Normal-Wishart (INW) prior with unknown $\boldsymbol{\Sigma}$ and an arbitrary variance-covariance matrix, Ω_0. Hence, the prior distribution is specified such that, $\beta \sim N(\beta_0, \Omega_0)$. While any structure can be adopted for β_0 and Ω_0, the former is typically defined as the usual Minnesota β_0 vector, with ones in the first lag of each endogenous variable and zero for further lags and cross-variable lag coefficients [40]. Similarly, Ω_0 also takes the form of the Minnessota covariance matrix. Given these conditional distributions, it is possible to use the Gibbs sampler to obtain random draws from the unconditional posterior distributions of the parameters of interest.

With regards to data sources, data for Brent crude oil prices and the Wilshire 5000 total market full cap index, as well for the US Effective Federal Funds Rate (EFFR) are collected from Federal Reserve Economic Database (FRED). Data for the freight indices were obtained from Clarksons Shipping Intelligence, while the ship management revenues data are gathered from the Ship Management Survey, conducted by the Statistics Department of the Central Bank of Cyprus (CBC) and concentrates primarily on transactions between resident ship management companies and ship owning/ shipping related entities.[1] Our data range from 2009q1 to 2022q2 (full data availability of the survey).

Before we proceed with the estimation, it is useful to illustrate the path of the main variable of interest. Figure 1 shows the path of ship-management revenues in the country. As the path shows, revenues have been increasing over time, evidenced from the dashed trend line. Excluding the pandemic period, revenues have almost doubled since 2009, while they have fully recovered to their pre-Covid levels by 2022q2. To illustrate how important these revenues are for the country, we note that they have averaged at around 4.6% of Cyprus' GDP.

With regards to the estimation, we note that one lag was used, as this resulted in the lowest log-likelihood value. The BVAR abides with good statistical practices as no roots lie outside the unit circle. To account for the one-off drop during the pandemic, a dummy variable taking the value of 1 over the 2020q1-2020q4 period and zero otherwise to account for the one-off Covid-19 pandemic era. Results from our estimation can be found in the following section.

[1] While data from the CBC Ship Management Survey only exist at a semi-annual basis, we have interpolated them via a cubic spline to match the quarterly frequency of the rest of the data.

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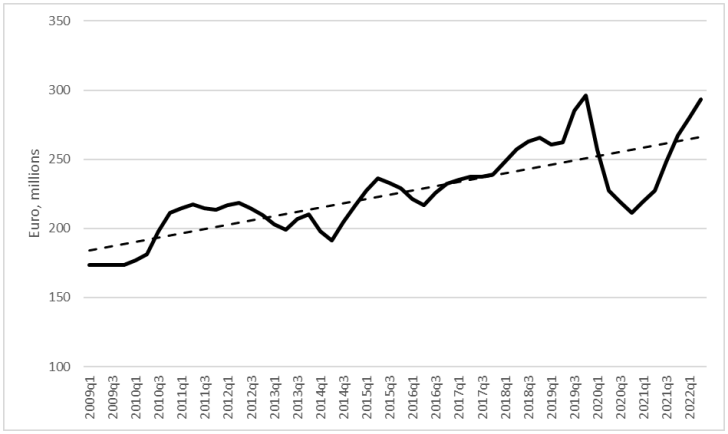

Figure 1. Ship-management Revenue in Cyprus.

4. Estimation Results

Figure 1 shows the impulse response functions following the estimation of our Bayesian VAR model. As suggested in the literature, a shock in oil prices has the expected beneficial effects on stocks and the BDI index, while, as Michail & Melas [15] also find, higher oil prices tend to have a negative effect on BDTI and BCTI on account of the higher value of the cargo and the negative repercussions this will have on costs. As expected, revenues have a positive reaction to an oil price shock, suggesting that higher oil prices can potentially imply more demand, and most importantly, that ship-management revenues are not static and fluctuate depending on the level of the freight rates.

Stock prices, as a proxy for the global macroeconomic environment, pose the largest source of change for ship management revenues. In particular a 1% change in stock prices implies a 0.6% increase in ship management revenues, in contrast to around 0.1% following a 1% increase in oil prices. On the other hand, the change in BDI, BDTI, and BCTI is more evident in the longer-run, given that only after 4-5 quarters do freight rates cause an increase in the indices. Given the expected delays in the shipping market before a shock is fully integrated [41], this result is not out of the ordinary.

An interesting point for the researcher deals with the delay and freight rate absorption of the stock market shock and how it moves on to affect ship management revenues. A potential answer to that question lies in the anticipation and sentiment effects, which, as Melas and Michail note [42], have a strong impact on prices. As such, with higher sentiment about the future path of world economy, ship management companies likely see this as an opportunity to expand their profit margins and thus request higher fees. While this is one potential explanation, we note that other factors, such as built-in terms in contracts, may also play a role.

As expected, the BDI and BDTI freight rates have a positive effect on revenues. However, this is not the case for BCTI, something that is perhaps attributed to the types of vessels under management. Of the two, the BDI has the largest impact on ship management revenues, standing at around 0.04% per 1% shock. The BDTI effect is lower at around 0.03%. Both results support the view that higher freight rates positively affect revenues, as was expected.

As a general conclusion from Figure 1, it appears that the demand side has a strong effect on ship management revenues, with stock prices, used as a proxy for global macroeconomic conditions, having the largest impact on them. As suggested, this implies a sentiment effect, meaning that as stock prices rise, expectations of higher future gains makes agents discount them to the present and raise ship management fees.

Moving to Figure 2, the main conclusions remain the same, however, when we add interest rates, their effect on freight rates and ship management revenues does not appear to be significant. This result is adding value to the already existing bibliography since previous papers have found that shipping company are mitigating any potential interest rate risks through hedging strategies [31]. Naturally, while interest rates do not appear to have a direct effect, they can have an indirect impact via their influence on the stock market as the recent developments over 2022 have demonstrated [43].

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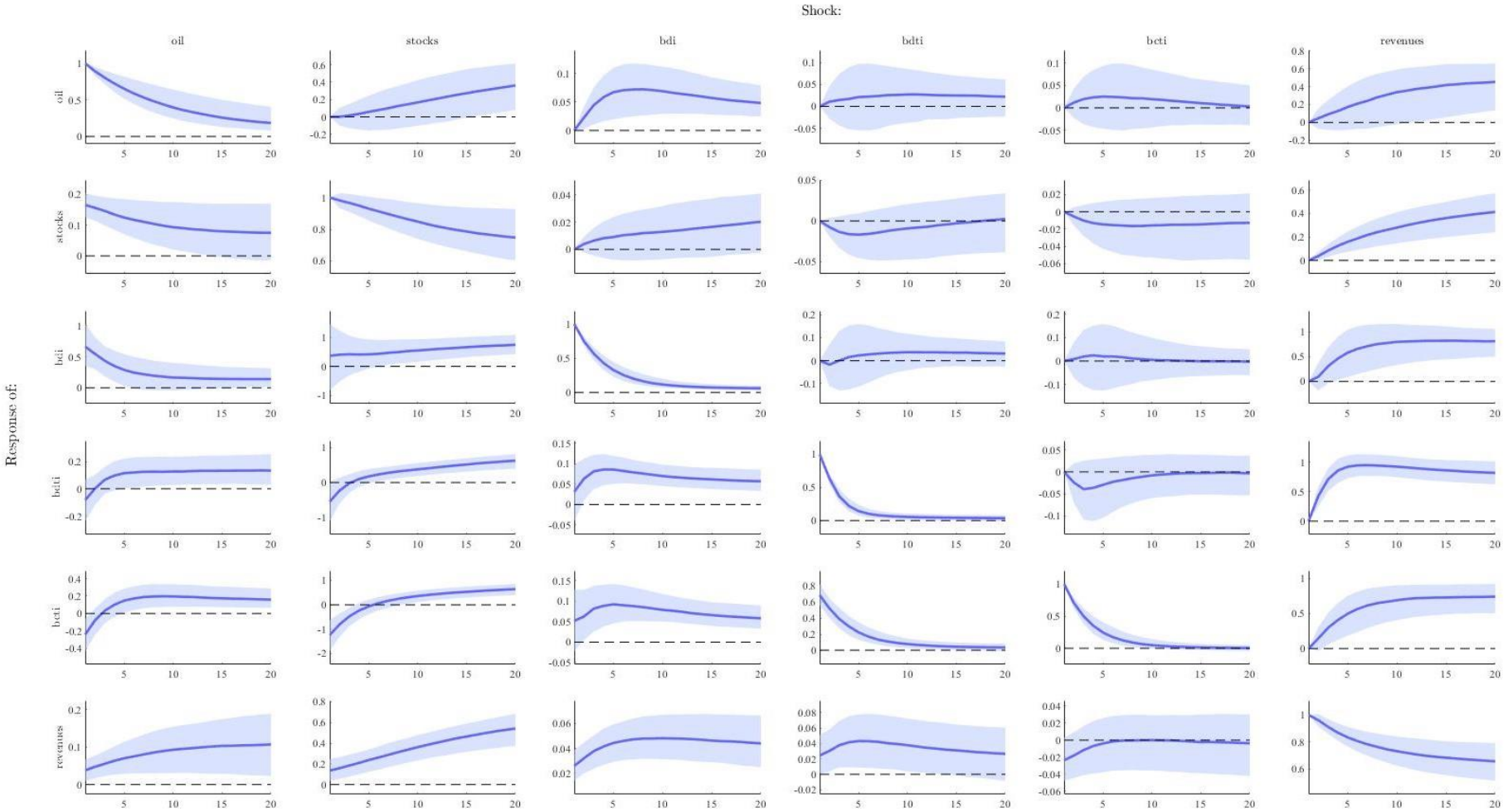

Figure 1. Impulse response functions.

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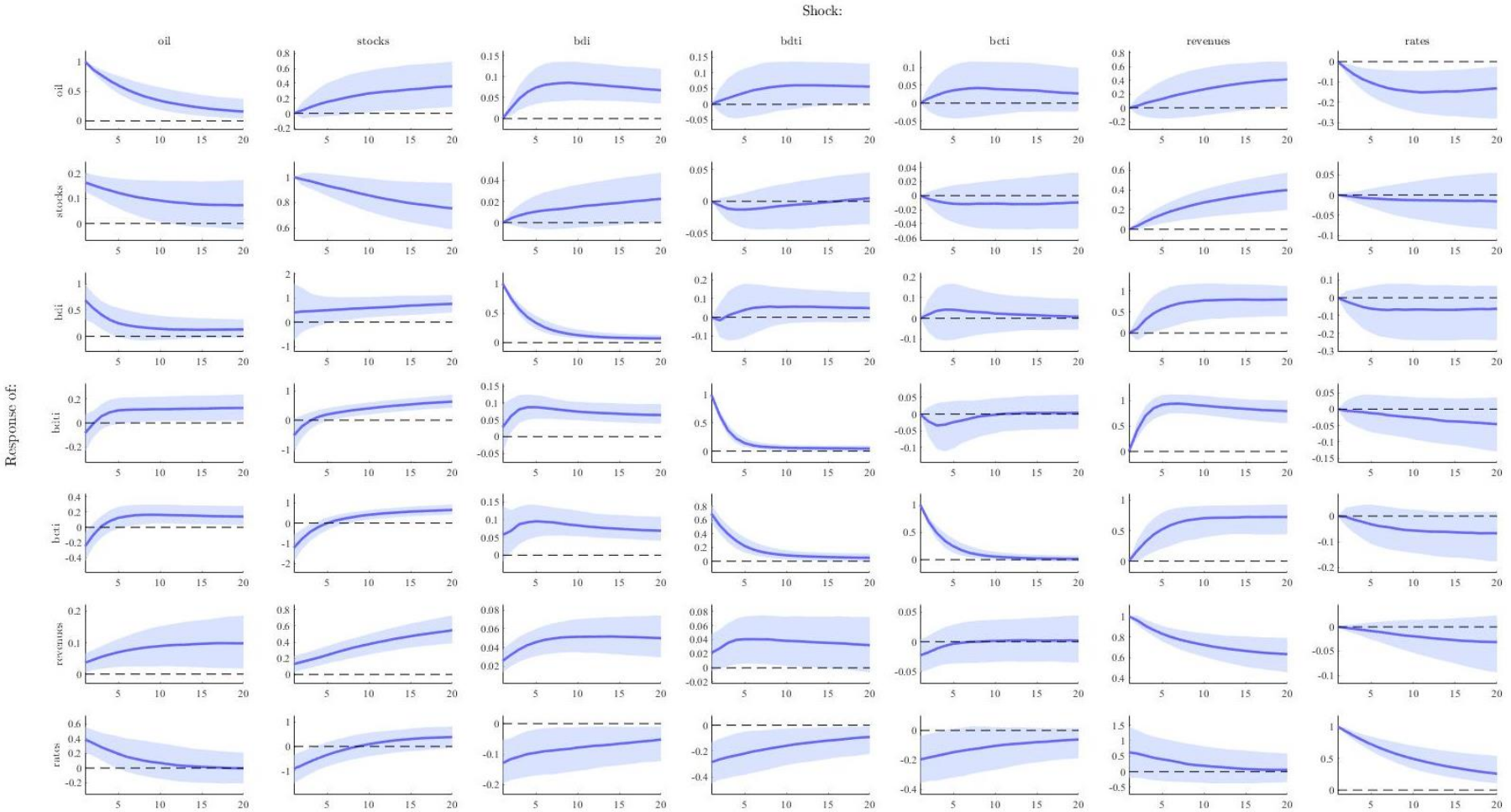

Figure 2. Impulse response functions (with interest rates).

Overall, the results suggest that the main macroeconomic factors do have a strong influence on ship management revenues. This can be important for both the companies as well as the local economies that depend on the well-being of the sector as they tend to be major players in the local labour markets. Furthermore, the implications include the fact that institutions that aim to evaluate the potential impact of adverse effects for forecasting purposes should also be able to properly forecast future ship management revenues given the importance of the sector. This, depending on the situation, can potentially have strong effects on a country's economic forecasts.

5. Conclusions

We shed light in one of the most under-researched fields in the maritime industry, namely on the macroeconomic determinants of ship-management companies. Despite their importance, little research has been conducted on the topic primarily due to the scarcity of the available information. In this paper, using a novel dataset from the Central Bank of Cyprus, we explore the interrelations between the freight rates of the vessels under management, interest rates, the stock market, Brent oil prices, and ship-management revenues.

Our study has multiple findings. Initially, we find that both the dry bulk market and the dirty tanker market have a positive relationship with the revenues of the shipping companies. On the contrary, the clean tanker market does not seem to have an impact on ship-management revenues. Thus, we can assume that the ship-owners of clean tankers do not rely on third management services for their operations given the specific trade between distilled oil and consumers.

Additionally, we find a positive relationship between the stock market and the revenues of shipping companies. This result is especially interesting as it suggests that a general improvement in the macroeconomic outlook does not only affect markets but also boosts demand for transport, perhaps also by improving the overall sentiment in the industry [42]. Finally, we find that when we include interest rates in the estimation, these do not have an important effect on revenues. This can be attributed to the use of hedging strategies by companies.

Given the importance of this sector for many economies, with ship-management revenues accounting for around 4.6% of the Cyprus GDP, changes in them can have a strong effect on a country. As such, the implications of our study include the ability to properly forecast future revenues as well as evaluate the potential impact of adverse effects, such as the recent pandemic or the effect from the interest rate-driven drops in the stock market. This, depending on the situation, can potentially have strong effects on a country's economic performance.

Our research has of course, its limitations, namely that we can only examine the results of the ship-management companies that are located in Cyprus. As such, future work could be addressed for other countries that are have ship-management hubs, which would assist in providing further insights to this important sector.

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