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Original Research Paper

An empirical analysis of freight rate and vessel price volatility transmission in global dry bulk shipping market

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ABSTRACT

Global dry bulk shipping market is an important element of global economy and trade. Since newbuilding and secondhand vessels are often traded as assets and the freight rate is the key determinant of vessel price, it is important for shipping market participants to understand the market dynamics and price transmission mechanism over time to make suitable strategic decisions. To address this issue, a multi-variate GARCH model was applied in this paper to explore the volatility spillover effects across the vessel markets (including newbuilding and secondhand vessel markets) and freight market. Specifically, the BEKK parameterization of the multi-variate GARCH model (BEKK GARCH) was proposed to capture the volatility transmission effect from the freight market, newbuilding and secondhand vessel markets in the global dry bulk shipping industry. Empirical results reveal that significant volatility transmission effects exist in each market sector, i.e. capesize, panamax, handymax and handysize. Besides, the market volatility transmission mechanism varies among different vessel types. Moreover, some bilateral effects are found in the dry bulk shipping market, showing that lagged variances could affect the current variance in a counterpart market, regardless of the volatility transmission. A simple ratio is proposed to guide investors optimizing their portfolio allocations. The findings in this paper could provide unique insights for investors to understand the market and hedge their portfolios well.

1. Introduction

As closely related to global economy and international trade, the global dry bulk shipping industry is very volatile (Lun et al., 2006). The past decade has witnessed the great fluctuation of dry bulk shipping freight rates, newbuilding and secondhand dry bulk vessel prices. In the dry bulk market, vessels are also traded as assets by shipowners' investment

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or divestment strategies. Therefore, the time-varying characteristics of freight rates and vessel prices have made it hard for carriers and shipowners to predict market trend and to make operation decisions (Stopford, 1988).

Past research on dry bulk shipping market was mainly focused on freight rate and vessel price modeling, price volatility econometric modeling, etc. However, the research on the relationship among the freight rate volatility, newbuilding and secondhand vessel price volatility has been ignored. Volatility underlies the inherent uncertainty and risk of both freight rate market and vessel market. Within the whole dry bulk shipping market, the volatilities may intersect and interplay in both markets. According to the demand-supply theory, the vessel market was influenced by freight rate market, and the vessel market volatility was believed to be influenced by freight rate market volatility. The volatility transmission effect within the whole dry bulk shipping market is the main issue we try to address in this paper and empirical findings may provide a new perspective on market inherent risk management. This paper aims to fill the gap in the literature by exploring the volatility transmission effects among the freight rate market, newbuilding and secondhand vessel markets. We applied a 2-step research outline to address the problem. First, we will examine whether there exist volatility spillover effects among the 3 markets (freight rate market, newbuilding vessel market, secondhand vessel market). Second, a tri-variate GARCH model will be proposed to detect the volatility transmission directions within the 3 markets, whether the demand (freight rate volatility) leads the supply (newbuilding, secondhand vessel price volatility), or the vessel price volatility takes the lead.

The paper structure is laid out as follows. Section 1 provides the brief background of this research. Section 2 is the literature review. Section 3 gives the data properties. Methodology and empirical results are shown in Section 4. Section 5 lists discussion and model implication. Conclusions are remarked in Section 6.

2. Literature review

There is a considerable amount of literature on the study of freight rate and vessel price volatility. Traditional models such as ARIMA, ADF were applied to study freight rate volatility (Cullinane, 1992; Veenstra and Franses, 1997). However, since Kavussanos (1996a, 1996b) first introduced ARCH (Auto Regressive Conditional Heteroskedasticity) classic models into worldwide shipping market, the research on shipping freight rate and vessel price volatility has gained its popularity. A series of Kavussanos' researches have concluded that the dry bulk freight rates and secondhand vessel prices were time-varying; freight rates for larger vessel sizes showed greater fluctuation effects; freight rates and vessel prices were first order stationary; and derived class of GARCH models had been extensively applied in dry bulk shipping market research (Kavussanos and Alizadeh-M, 2001, 2002; Kavussanos and Visvikis, 2004; Kavussanos and Nomikos, 2000). Tvedt (2003) confirmed the stationarity of shipping freight rates and validated that the freight rate volatility tended to be reduced when transforming US dollar to Japanese Yen. Some other researches paid attention to the leverage effects on dry bulk freight markets, and revealed that the asymmetric impacts between past innovations and current volatility were internal nature and the asymmetric characters were distinct for different vessel sizes and different market conditions (Chen and Wang, 2004; Lu et al., 2008). A further research extended dry bulk freight rate conditional volatility and pointed that macroeconomic factors had important impacts on freight rate volatility (Drobetz et al., 2012).

Besides, a large body of research has been done on newbuilding and secondhand vessel price modeling. Specific econometric models were established to estimate newbuilding and secondhand vessel prices. Newbuilding (secondhand) vessel price and freight rates were confirmed to have the largest impacts on secondhand (newbuilding) vessel price; trading volume and trading activity also affect vessel prices (Adland and Koekebakker, 2007; Alizadeh and Nomikos, 2003; Jiang and Lauridsen, 2012; Lun and Quaddus, 2009; Mulligan, 2008; Syriopoulos and Roumpis, 2006; Tsolakis et al., 2003).

As shown above, extensive econometric models have been proposed in the dry bulk shipping research area. However, little has been done to explore the volatility transmission effects among the freight rate market, newbuilding and secondhand markets. Dai et al. (2014) investigated the price volatility transmission effect on the dry bulk vessel market, but neglected to incorporate the determinant factor-freight rate into the model. As the global dry bulk shipping market experienced a historical boom and recession in the past decade, it is crucial to examine the volatility transmission effect to understand the overall dry bulk shipping market risk well.

However, a lot of researches on volatility transmission across different assets or markets have been done in other financial sectors due to their important roles in portfolio risk management and market stability assessment. Most attention has been paid to the volatility spillovers between international stock markets with GARCH models (Cifarelli and Paladino, 2005; Kim and Rui, 1999; Wang et al., 2002). Other studies have focused on volatility spillovers between spot and futures market, such as stock indices (Booth and So, 2003), interest rates (Craln and Lee, 1995), foreign exchange (Wang and Wang, 2001), and real estate market (Wong et al., 2007).

3. Data property

In this paper, we choose the monthly data of world dry bulk one year time charter rates, newbuilding and secondhand vessel prices from Clarkson Intelligence Network during the period of 2001/12 to 2012/11. The raw data was pre-processed by log first order difference to show the characteristics of volatility. The vessel price volatility and freight rate volatility for all 4 vessel types are shown in Figs. 1–12 (in the figures, the X axis presents the year scale, the Y axis depicts the freight and price volatility, which is non-dimensional). As it can be seen from Fig. 1, the vessel prices are very volatile. The descriptive statistics of all 4 vessel types are listed in Table 1. In Table 1, V_{FC} is capesize freight rate volatility, V_{SC} is secondhand capesize vessel price volatility, V_{NC} is