



Asymmetric volatility varies in different dry bulk freight rate markets under structure breaks

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HIGHLIGHTS

- Two stages of multiple structural break model and improved A-MF-DFA model are applied to investigate the asymmetric volatility of bulk shipping market.
- Asymmetric properties vary in different vessel sizes of bulk ships.
- The switching points detected by improved A-MF-DFA gather around the structural breaking points.
- Combination of two methods could detect the unobvious switching points.

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ABSTRACT

The past decade has experienced the historical boom and recession in the dry bulk shipping market, which is extremely volatile and more complex than ever before. The asymmetric correlations analysis within the shipping market can provide an understanding of the asymmetric features of risk, which would be helpful for portfolio diversification and risk management. This paper investigates the asymmetric volatility characteristics in dry bulk freight market during the 2008 world financial crisis, which may impose significant impacts on the mechanism of market volatility. First, we apply multiple structural change model to detect the breaking points. Then an improved A-MF-DFA (Asymmetric Multifractal Detrended Fluctuation Analysis) model is applied to capture the asymmetric volatility of the dry bulk shipping market brought by the financial crisis. The empirical results suggest that the financial shocks on the market have a different magnitude of influence on volatility of different vessel types, and the breaking point positions also varies. The positions and scales of the switching points (SPs) of the fluctuation trend detected from A-MF-DFA method also suggest highly asymmetric characteristics in the indices. These findings supply new perspectives for investors in understanding the underlying market risks, crisis effects on bulk shipping market and detailed volatility characters for specific vessel types.

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1. Introduction

The international dry bulk shipping market, one of the most practicable and cost-effective means of large volume cargo transportation is the major component of shipping market, which derives from the world trade market [1–4]. The world

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dry bulk market is characterized as a highly risky and volatile market because of the uncertainty caused by factors such as world trade volume and pattern, the global economy and inter-government policies [5,6]. Unlike world container shipping market, the dry bulk market with highly competitive and fierce freight rate volatility is hardly predictable, while has brought various opportunities and risks for market players to gain and lose [7–9]. The Baltic Dry Index (BDI) reached its historical top at 11771 in May 2008, and nearly all the market participants could make profits during that boom [10]. However, beyond most operators' expectations again, the bulk market turned to decrease suddenly in late 2008 below 1000 within less than 6 months [11]. Since then, the world dry bulk shipping market has been struggling in the downturn. Many ship owners had to abandon their vessels to survive. The BDI, which stands for the freight rate level in the dry bulk shipping market, could best reflect the market volatility characteristics, and has always been the hot research topic in shipping finance and risk management. Thus, it is crucial to investigate the inherent volatile characteristics in the dry bulk market, especially when the market experienced its great booms and recessions in the last 10 years.

The 2008 world financial crisis also resulted in a structure break in the bulk shipping market [12,13], but in the long-term time series, there may exist more than one change. Both the statistics and econometrics literature contain a vast amount of work on issues related to structural change [5,14,15], most of which specifically designed for the case of a single change [16]. The problem of multiple structural changes has received an increasing attention [17]. A structural break appears in time series when an unexpected shift happens in the macroeconomic background. This may lead to huge forecasting errors and unreliability of the model in general [18]. Perron [19] analyzed the American economy history and concluded that sudden financial and economic crisis may induce sudden impulse to the economy, which may generate fake unit root by the traditional ADF (Augmented Dickey–Fuller) test. Then he introduced the structural change points to the literature to explain financial time series changing during crisis. Bai and Perron, Bai and Perron [20,21] illustrated the procedures for modeling with multiple structural changes, which is applied in various empirical applications [22–25]. We apply this method to investigate the multiple changes in time series of bulk shipping market and divide the research periods scientifically into boom and recession under financial crisis.

Financial markets may react asymmetrically to news [26,27]. Asymmetric volatility studies attracts special attention in recent years [28,29]. This is mainly because asymmetric characteristic acts as a key feature in analyzing long-range correlation, switching points, fat-tailed distribution and many other data properties. The research on the asymmetric features of risk are widely applied to enhance the portfolio in terms of diversification and risk management [29]. The two trends of stock market, namely bullish and bearish markets should be treated differently in analyzing the multifractal scaling behavior. However, studies focusing on measuring the asymmetric multifractality are quite limited, especially for the shipping market. DFA method [30] and its extensions of MF-DFA [31], MF-DCCA [32,33] among others [34,35] are effective in detrending high order fluctuations and detecting long-term power-law correlations within a time series via Hurst exponent or generalized Hurst exponent. These DFA based methods are widely applied in physics, finance and many other interdisciplinary fields for its robustness and high reliability [36,37]. For the asymmetric characteristics, A-DFA (Asymmetric Detrended Fluctuation Analysis) method is proposed [38] by introducing two new indices to analyze the positive and negative fluctuation trends separately. For further detecting the asymmetric multifractality of the dry bulk market, A-MF-DFA method [39] is constructed to analyze the asymmetric characteristics within the Chinese stock market. New volatility mechanism may have derived from the world dry bulk market in the post-2008 world financial crisis period, which really interests us. This paper aims to fill the gap in the literature and to do a thorough investigation into the dry bulk freight market to seek the distinct volatility nature during the great market boom and great recession within the past decade.

This study proposes a two-stage research methodology. First, we use the Bai and Perron's multiple structural change model to detect the precise structural breaking points in the dry bulk freight market. By dividing the research periods into boom and recession under financial crisis, then we apply the improved A-MF-DFA model to investigate the asymmetric volatility effects on the freight rate market by the financial crisis. The two-stage research could detect the unobvious switching points neglected by only one method. In addition, the switching points from A-MF-DFA gather around the breaking points from structural change model implying the validity of both methods.

The rest of the paper is organized as follows. Section 2 lists processed data and their statistical features. Section 3 introduces the methodology applied in this paper. Section 4 represents the empirical results. Section 5 makes conclusions.

2. Data description

In the past decade, the world dry bulk shipping market has seen a dramatic development with vicissitudes. The BDI stood at 11771 on its historical record in May 2008 but suddenly shrank more than 90% to be less than 1000 in December 2008. The market condition is so unique and fluctuant that no past experience could compare. We divide the dry bulk market into 3 sectors by vessel sizes, namely Supramax sector, Capesize sector and Panamax sector. Different sized vessels are involved in different commodity trades and shipping routes in the world, and have their unique transportation and risk characteristics. We choose BCI (Baltic Capesize Index), BPI (Baltic Panamax Index) and BSI (Baltic Supramax Index) from the Clarksons to analyze the volatility mechanisms in the 3 sectors to seek the dry bulk shipping market internal rule.

The sample daily data of BSI, BPI and BCI are from 07/01/2005 to 02/26/2015 with 2412 observations as shown in Fig. 1. The data properties displace in Table 1. The raw data processed by log first order difference is by Eq. (1).

$$V_t = \ln I_t - \ln I_{t-1} \quad (1)$$

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