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Dynamic patterns of dry bulk freight spot rates through the lens of a time-varying coefficient model

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ABSTRACT

To overcome high volatile fluctuations, shipping agents should understand the dynamics of freight rates, which will enhance the management efficiency of their revenues and market risks. In the literature, most vector auto-regression (VAR) and vector error correction (VECM) models of dry bulk freight markets assume that the coefficients are time-invariant. However, the relationships measured by the coefficients could change over time, e.g., due to changing market sentiments. Therefore, this study seeks a time-varying coefficient-error correction model (TVC-ECM) with backwardation degree "coefficient driver," to unveil some hidden dynamic patterns. In advance, the presumption, that there are two distinct shocks, such as transitory and permanent ones, is suggested based on some recursive VAR model. Then, two empirical findings are derived. First, in the daily cases, the values of time-varying coefficients of the past spot and forward freight agreement (FFA) rates in the prediction equation increase when the market deviates more from the long-run equilibrium. Second, incorporating the information such as backwardation or contango into the traditional adjustment speed coefficient in the VECM framework marginally improves forecasting performance.

1. Introduction

As well-recognized in the industry and academia, bulk shipping markets, including dry and wet bulk (tanker) shipping, have demonstrated incredibly volatile fluctuations. Therefore, some attempts have been made to hedge the market risks in these highly volatile price fluctuations. In particular, the Baltic International Freight Futures Exchange (BIFFEX) contracts were introduced in May 1985. However, these contracts functioned poorly for hedging purposes, primarily due to basis risks (Kavussanos and Visvikis, 2003). As a tailor-made alternative to hedging, forward freight agreements (FFAs) have emerged as over-the-counter (OTC) derivatives contracts since 1992.

Similar to other forward contracts, the FFA rate also functions as an indicator for future spot movements. According to the "unbiasedness hypothesis," the FFA rate can be an unbiased forecast of realized spot prices. Particularly, the Baltic Forward Assessments (BFAs) provided by the Baltic Exchange are the most representative, and are used for mark-to-market clearing. According to Edwards and Ma (1992), these forward prices reflect the market's current expectations regarding the future level of spot prices. Therefore, this information assimilation can enable a price discovery function of FFA prices. Many extant studies have tested this price discovery function of FFA rates using the vector error correction model (VECM) (e.g., Kavussanos et al., 2004). Furthermore, the change rates of spot and FFA rates, which are typically measured by the natural-log differences, are analyzed by various time-series models, including VAR, VECM, etc. (Kavussanos and Nomikos, 2003; Kavussanos and Visvikis, 2004; Batchelor et al., 2007; Yin et al., 2017).

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Despite the successes of these empirical studies in depicting important economic patterns, such as the price discovery function, lead-lag relationship, overshooting phenomenon, etc., their time-invariant models could be generalized into the time-varying coefficient models. In other words, a time-invariant model with fixed coefficients is special among the possibly time-variant general models. If the variation of a time-varying coefficient is minimal or stable, then the empirical results of a fixed coefficients' model could be accepted. However, we cannot know the dynamic pattern of the coefficients in advance. For example, Keynes (1930) noted that the positions of hedgers and speculators could imply some biases of futures prices in spot price discovery; moreover, Alizadeh et al. (2015) demonstrated that liquidity measures, such as bid-ask spreads, could influence the freight futures prices. Therefore, it could be recommended to use a time-varying coefficient model that incorporates the relevant market information. Considering this background, this study proposes a time-varying coefficient-error correction model (TVC-ECM) with backwardation degree "coefficient driver," to unveil some hidden dynamic patterns.

This paper is organized in six sections: Section 2 presents a review of the relevant literature; Section 3 illustrates the used dataset, the study presumption, and the empirical model; Section 4 provides the empirical results and their interpretations; Section 5 discusses their implications; finally, Section 6 concludes the study by suggesting future research topics.

2. Literature review

Alizadeh and Nomikos (2009) provided an excellent comprehensive text regarding the FFA market, and Kavussanos and Visvikis (2016) is a more recent, compact study that summarizes the FFA market's characteristics. Kavussanos and Visvikis (2006) and Glen (2006) have provided a literature survey on freight shipping derivatives and their modeling techniques. Furthermore, Benth and Koekebakker (2016) presented a stochastic model of spot rates that could mimic various FFA curve shapes.

Using daily data observations, Kavussanos and Nomikos (2003) applied a VECM to investigate the relationship between the Panamax spot rates and BIFFEX futures rates, and then forecast these variables. Their main issue was that since spot and futures prices would not be linked by a cost-of-carry relationship due to the shipping market's non-storable nature, futures prices may not contribute to the discovery of new information to the same extent as the markets for storable commodities. The authors evaluated the VECM specifications' forecasting performance with ARIMA, VAR, and random-walk models as benchmarks. According to their results, the VECM is the most superior in forecasting spot rates using spot and futures data; they also demonstrated that futures prices tend to discover new information more rapidly than spot rates due to the limitations of short-selling the underlying spot index, and that the futures prices can be used to generate more accurate forecasts of the spot prices, but not vice-versa.

Using daily data observations, Batchelor et al. (2007) applied various time-series models, including ARIMA, VAR, VECM, and S-VECM (seemingly unrelated regression equation VECM) to investigate the relationship between the Panamax spot rates and FFA rates, and then to forecast these variables. Their one notable observation is as follows: The forward rates are much more difficult to forecast than spot rates; across all routes, the adjusted R^2's for changes in spot rates are higher than those for forward rates, indicating a potentially higher predictability in spot rates than forward rates. However, with respect to adjustment speed and contrary to their expectations, forward rates adjust more strongly than spot rates in three of the four routes. Nonetheless, out-of-sample forecasting with the VECM models indicate that they are not helpful in predicting forward rate behavior, but do help predict spot rates, which is more consistent with market efficiency.

Kavussanos and Visvikis (2004) analyzed the lead-lag relationship in both the returns and volatilities between spot and FFA markets. They used a multivariate VECM-Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, which was applied to the dataset of daily spot and FFA prices. As Kavussanos and Nomikos (2003) noted, based on generalized impulse responses analyses, the following two findings are notable: First, an overshooting, which follows a positive shock in the market, wherein ship owners withhold ships in anticipation of further increases in rate levels, while charterers rush to fix vessels, creating a further shortage and pushing rates beyond their equilibrium, is observed in the spot market. Second, FFA prices respond to new information and reach a long-run equilibrium more rapidly than their corresponding spot prices, which may be explained by the asymmetry in transaction costs between the spot and FFA markets (hereafter "asymmetry between spot and FFA markets"). This asymmetry suggests that it is more difficult to establish a short position in the spot market by hiring vessels than in the FFA market without hiring cost.

Yin et al. (2017) applied the VAR and VECM to show the long-term and mutual, causal relationship between spot and FFA prices. Specifically, the authors used monthly data for the BPI TC and BCI C7 routes, the three closest to maturity quarterly for Panamax, monthly for Capesize, coal trade, iron ore trade, steel index, Panamax fleet, and Capesize fleet. This study differentiated from and contributed to the current literature by incorporating supply and demand variables into the dynamics of spot and FFA rates. Further, the authors separated the adjustment speed coefficient in the two regimes, i.e., when the error correction term is positive and negative. The present study reflects this aspect of handling different regimes.

This study provides the following differentiated contribution. As Dangl and Halling (2012) emphasized, this study attempts to identify some economic forces that cause time-varying predictive relations in dry bulk shipping freight markets, especially through the use of a coefficient driver, to unveil some important hidden dynamic patterns. In particular, this study demonstrates that in the daily cases, the coefficient values increase when the market deviates more from the long-run equilibrium. Then, this study evaluates the forecasting accuracy of the proposed time-varying coefficient models, the reference models, and the typical time-invariant VECMs. Therefore, this study could invoke future research efforts to explain the causes of this time-varying pattern.