Transportation Research Part E 118 (2018) 376–391

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Volatility forecasting across tanker freight rates: The role of oil price shocks☆

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ARTICLE INFO

JEL classification:
G11
G12
G13
G14
G20
G24

Keywords:
Volatility forecasts
Tanker freight rates
Oil price shocks
GARCH-X models

ABSTRACT

This paper examines whether the inclusion of oil price shocks of different origin as exogenous variables in a wide set of GARCH-X models improves the accuracy of their volatility forecasts for spot and 1-year time-charter tanker freight rates. Kilian's (2009) oil price shocks of different origin enter GARCH-X models which, among other stylized facts of the tanker freight rates examined, take into account the presence of asymmetric and long-memory effects. The results reveal that the inclusion of aggregate oil demand and oil-specific (precautionary) demand shocks improves significantly the accuracy of the volatility forecasts drawn.

1. Introduction

Seaborne transportation is the leading form of transporting goods worldwide, carrying more than 80% of global trade in terms of volume (UNCTAD, 2017). Out of all seaborne transported commodities, oil and oil products are among the most important in terms of trading value according to a 2016 report by Clarksons, which states that the value of oil transported through sea during the year 2015 was approximately equal to $717bn.[1,2] Tanker freight rates, being the cost of transportation through sea for oil and oil products, have

☆ The authors would like to thank David McMillan for his helpful comments.

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[1] https://clarksonsresearch.wordpress.com/2016/07/22/just-how-big-is-an-economy-without-borders/.

[2] According to the statistical review of world energy (British Petroleum, 2015), world's dependence on energy commodities remains large as the percentages of global energy consumption among all sources of energy is the following: crude oil and oil products (32.6%), coal (30%), natural gas (23.7%), hydroelectric energy (6.8%), nuclear energy (4.4%) and renewables (2.5%). The importance of petroleum-based commodities for the global economy and economic development has been highlighted as early as in Hamilton (1983). Furthermore, oil price shocks have been shown to affect the U.S. stock market (Kilian and Park, 2009).

https://doi.org/10.1016/j.tre.2018.08.012
Received 26 August 2017; Received in revised form 5 July 2018; Accepted 28 August 2018
1366-5545/

been shown to exhibit pronounced volatilities over time (Kavussanos, 1996a; Drobetz et al., 2012; Tsouknidis, 2016).[3] The demand for tanker ships is largely a derived demand for their cargo of oil, which in turn is determined by the international seaborne trade in oil and oil products (Stopford, 2009). In this way, oil price stylized characteristics, such as the excess volatility and cyclicality are expected to be reflected to some extent into tanker freight rates. Thus, given the dependence of the global economy on crude oil and oil products and the pronounced fluctuations of oil price reflected in tanker freight rates, forecasting tanker freight volatility is of paramount importance to several participants in the oil and shipping markets, such as oil producers, traders, refineries, distributors as well as tanker owners and banks financing such investments.[4]

Several studies have been devoted on modeling and forecasting volatility in tanker freight markets (Chen and Wang, 2004; Adland and Cullinane, 2006; Alizadeh and Nomikos, 2011; Drobetz et al., 2012), while related literature has included oil price as an exogenous variable in a GARCH-X setting (Kavussanos, 1996a; Drobetz et al., 2012). This literature developed primarily as a response to the importance of the tanker freight market for the transportation of the world's main energy source being oil and oil products and the unique stylized facts of tanker freight rates which are inherited to some extent from the stylized facts of oil price. Specifically, early research by Kavussanos (1996a,b) estimates a set of GARCH models to establish that (i) freight rates and second-hand vessel prices are time-varying, (ii) the volatility of larger vessel's prices is higher than the one of smaller vessels and (iii) using oil price as an exogenous variable significantly improves forecasts of tanker volatility. In another study, Chen and Wang (2004) document an asymmetric (larger) effect in freight rates' volatility in response to negative changes in freight rates when compared to positive ones. Alizadeh and Nomikos (2011) reveal that freight rate volatility is related to the term structure of the freight market and this relationship is asymmetric, as volatility is higher when the freight market is in backwardation and lower when in contango.[5] Drobetz et al. (2012) examine the dynamics of time-varying volatility in both dry bulk and tanker freight markets, using a GARCH model with exogenous variables (GARCH-X) and an EGARCH model. The authors show that macroeconomic factors provide additional explanatory power when included in the conditional variance equation of these models. The authors document the lack of asymmetry effects in the dry bulk freight market, but their pronounced presence in the tanker freight market. Overall, the results of Kavussanos (1996a) and Drobetz et al. (2012) suggest that the inclusion of oil, as well as other macroeconomic variables (i.e. GDP growth, stock market return, interest rate yields), can improve the forecasting power of volatility models. In a related study, Tsouknidis (2016) provides evidence of large time-varying volatility spillovers within and between the dry bulk and tanker sub-segments; which are far larger during and after the period of the global financial crisis.[6]

Shi et al. (2013) investigate the relationship between tanker freight rates and oil price shocks of different origin as introduced by Kilian (2009), who is the first to reveal that the origin of an oil-price shock determines its effect on the global economy and the stock market (Kilian and Park, 2009).[7] Specifically, the authors adopt and extend Kilian's framework by investigating the effect of different oil price shocks on the Baltic Dirty Tankers Index (BDTI). The authors show that crude oil supply shocks have significant effects on the BDTI index, whereas the impact of crude oil demand shocks are not as significant. Overall, their results reveal that the effects of oil price shocks on tanker freight rates are weak. In related studies, Chen et al. (2017) and Zhou (2012) examine the cross-correlations between the West Texas International crude oil (WTI) and Baltic Exchange Dirty Tanker Index (BDTI) by employing the Multifractal Detrended Cross-Correlation Analysis (MF-DCCA). The authors show that the degree of short-term cross-correlation is higher than that in the long term and that the strength of multifractality after financial crisis is larger than that before. However, using an aggregate tanker freight rates index, such as the BDTI, misses differences (fixed effects) arising from different freight contracts, i.e. spot vs. time-charter rates, and of vessel sizes in the tanker segment, i.e. VLCC, Suexmax, Aframax, Medium Range Product Tankers (MR), examined.

Despite the plethora of studies on modeling and forecasting volatility of tanker freight rates, the extant literature misses completely the growing empirical evidence supporting that the origin of oil price shock determines its effect to the global economy, the financial markets and the shipping sector (Kilian, 2009; Kilian and Park, 2009; Lambertides et al., 2017; Shi et al., 2013). Filling this gap in the literature, this paper is the first to investigate if oil price shocks of different origin can improve volatility forecasts drawn from a wide set of popular GARCH models for tanker freight rates across freight contracts (spot and 1-year time charter contracts) and vessel sizes (VLCC, Suezmax, Aframax, MR).

[3] For an overview on shipping finance, see Alexandridis et al. (2018); and for ways to manage risks in the shipping freight rate market using shipping derivatives, see Kavussanos and Visvikis (2006). Shipping derivatives have been shown to: lead their corresponding spot markets (Kavussanos and Visvikis, 2004); exhibit economic spillovers among shipping sub-segments (Kavussanos et al., 2014; Alexandridis et al., 2017) and carry liquidity premia (Alizadeh et al., 2015).

[4] The frequent episodes of extreme volatility in oil prices can be documented by data from the U.S. Department of Energy, where oil prices tumbled from 106.2 $/barrel in June 2014 to 26.55 $/barrel in January 2016.

[5] Backwardation is the state of the market when the futures price is below the expected future spot price, i.e. in favor of traders being "net long" in their positions. Contango refers to the opposite case.

[6] Another strand of the literature aims on forecasting spot and forward prices of freight markets. For example, Cullinane (1992) and Cullinane et al. (1992) provide evidence on the ability of univariate ARIMA models to forecast spot freight rates. Kavussanos and Nomikos (2003) report that vector equilibrium correction models (VECM) produce accurate forecasts for spot freight prices but not for futures freight prices. Batchelor et al. (2007) find that (i) VECM models produce the best in-sample fit, (ii) forward rates can be helpful on forecasting future spot rates, and (iii) ARIMA and VAR models perform better than VECM models on forecasting forward rates. Furthermore, trading and liquidity characteristics, such as the volume of trading and open interest have been shown to improve forecasts for freight forward agreements (FFA's) (Alizadeh, 2013) and oil futures contracts (Magkonis and Tsouknidis, 2017).

[7] The oil price shocks have been shown to affect stock returns mainly through shocks on stock order flow imbalances (Lambertides et al., 2017).