Dynamic spillover effects across petroleum spot and futures volatilities, trading volume and open interest

Georgios Magkonis, Dimitris A. Tsouknidis

Abstract

This paper examines the existence of dynamic spillover effects across petroleum based commodities and among spot-futures volatilities, trading volume and open interest. Realized volatilities of spot-futures markets are used as inputs to estimate a VAR model following Diebold and Yilmaz (2014, 2015) and distinguish dynamic spillovers in total and net effects. Results reveal the existence of large and time-varying spillovers among the spot-futures volatilities and across petroleum-based commodities when examined pairwise. In addition, speculative pressures, as reflected by futures trading volume, and hedging pressures, as reflected by open interest, are shown to transmit large and persistent spillovers to the spot and futures volatilities of crude oil and heating oil-gasoline markets, respectively.

Keywords:
Dynamic spillovers
Spot and futures markets
Petroleum markets
Trading volume
Open interest

1. Introduction

The interest on cross-asset interdependencies in general and within the energy commodities market in particular has been stimulated during and after the period of the global financial crisis (Alizadeh & Tamvakis, 2016; Barunik, Kočenda, & Vácha, 2015; Mensi, Hammoudeh, Nguyen & Yoon, 2014; Sadorsky, 2012). Apart from the historically remarkable and growing dependence of global industrial production on energy commodities, the interest on this specific asset class has been pronounced after 2000s also because of the substantial increase of their price volatility.1,2 This excess volatility has been linked with tight oil production from shale formations and the increasing trend in commodity prices, which is often linked to the upward trend in crude oil, was followed by a sharp decline when the global financial crisis hit during 2007–2009 (Cevik & Sedik, 2011); a repeating pattern of large fluctuations also during the Eurozone debt crisis (2010–2013).4 Such notable price movements are often attributed to transaction costs, information asymmetries, supply-demand imbalances and other market microstructure issues which create information spillover relationships among commodities markets. The aforementioned reasons highlight the importance of modelling spillovers of information across energy commodities and among volatilities and trading characteristics for several market participants.

This paper provides novel empirical evidence on two distinct but interrelated research questions, stemming from two underlying research hypotheses. The first issue examined is the evolution, severity and direction of volatility spillovers between the spot and futures markets examined across petroleum-based commodities. This is motivated by recent empirical evidence (see, for instance, Antonakakis, Floros, & Kizys, 2015) documenting large co-movements across asset classes.
which have led investors to rebalance their portfolios towards safer investments, increase their diversification through investing in different asset classes and hedge their positions in the spot market with opposite positions in the futures market. The related to the issue futures literature examines the relation between spot and futures markets and is dominated by the price discovery hypothesis (Chan, 1992; Ghosh, 1993) and the volatility spillover hypothesis (Tao & Green, 2012).

The second issue examined in this paper is the evolution, severity and direction of spillovers among spot and futures price volatility, trading volume and open interest for each individual petroleum-based commodity. This research question stems from the Mixture of Distributions Hypothesis (MDH) suggested in Clark (1973) and the Sequential Information Flow (SIF) developed in Copeland (1976). The MDH approach assumes that price changes and trading volume follow a joint probability distribution. Specifically, trading volume has been widely used as a measure for the rate of informational arrival. In contrast, the SIF approach assumes that information is released sequentially in the market, i.e. informed traders acquire the information first with the rest of the market following to eventually restore equilibrium. Open interest is considered as a proxy for the dispersion of investors’ beliefs (Bessebbinder, Chan, & Seguin, 1996) and as a proxy for the demand of futures contracts as hedging instruments (Aguenaou, Gwilym, & Rhodes, 2011). Open interest has been shown to contain information about future economic activity which is different than the one contained in futures prices (Hong & Yogo, 2012).

Prior empirical studies have focused on the aforementioned hypotheses across futures markets but do not examine their validity over time for the important class of energy futures markets. Specifically, prior studies on the issue do not investigate the existence, severity and direction of dynamic spillovers across petroleum-based commodities and across spot-futures volatilities, trading volume and open interest (Alizadeh & Tamvakis, 2016; Chevalier & Sève, 2012; Foster, 1995; Moosa & Silvapulle, 2000). To the best of our knowledge, this paper is the first to investigate this issue by providing novel evidence regarding the existence of dynamic (time-varying) spillovers among spot-futures volatilities when petroleum-based commodities are examined pairwise; and among spot-futures volatilities, futures trading volume and open interest when petroleum-based commodities are examined individually. The examined futures contracts are traded on the New York Mercantile Exchange (NYMEX) and include: West Texas Intermediate (WTI) crude oil (CL), New York harbor heating oil (HO) and Reformulated Blendstock for Oxygen Blending (RB08) gasoline (XB). These futures contracts are included in the empirical analysis of this paper as they exhibit the highest trading volume and account for the vast majority of trades among all energy futures contracts traded in NYMEX (Alizadeh & Tamvakis, 2016).

Prior relevant studies on the research question of this paper include Baruník et al. (2015) who investigate dynamic volatility spillovers across futures markets of petroleum-based commodities. The authors reveal that after 2008 volatility spillovers increased substantially across petroleum-based commodities and exhibit asymmetric effects (positive or negative). However, the authors do not examine both spot-futures volatilities and trading activity measures, such as trading volume and open interest. Furthermore, Baruník and Krehlik (2016) extend the Diebold and Yilmaz (DY) (2009, 2012, 2014) estimation framework and provide empirical evidence highlighting the importance of the proper measurement of dynamics across time and frequencies by emphasizing the important role of cross-sectional correlation in the connectedness origins. In another study, Alizadeh and Tamvakis (2016) investigate spillovers between returns and volatilities of energy futures contracts of different maturities and their corresponding trading volumes. The authors show that the state of the market (contango or backwordation) has an effect on the relationship between futures price volatility and changes of trading volume; making the relationship stronger when the market is in backwordation.

6 This paper focuses on the existence of economic spillovers in the volatilities rather than in the returns of the spot-futures markets of petroleum-based commodities. This is due to the fact that volatilities appear to be more useful in assessing interdependencies since they are well-approximated as Gaussian rather than returns (for details on this, see, Diebold & Yilmaz, 2015).
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