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Oil and energy sector stock markets: An analysis of implied volatility indexes

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ABSTRACT

The objective of our study is to assess the linkage between global oil and the US energy sector stock markets using their implied volatility indexes available from the Chicago Board of Options Exchange (CBOE). Our empirical analysis also includes the US VIX data in order to control for the effect of global equity market uncertainty. To investigate whether cointegration exists amongst the volatility series used, we consider applying the ARDL bound tests. The findings reveal that there exists a long-run relationship between oil and stock market implied volatility indexes. Besides, employing the Toda–Yamamoto version of Granger causality test indicates short-run "lead-lag" associations between the implied volatilities of international oil and the US energy sector stock markets. The results carry important implications for investors and policymakers.

1. Introduction

Since oil is an important production input for an economy, variations in its price could bring uncertainty to the overall economic growth and development. Vo (2011), for instance, argue that an upsurge in oil price levels leads to higher production costs which affect inflation, consumer confidence and therefore economic growth. Previous studies also document that as oil price is one of the major indicators for an economy, fluctuations in its volatility can have substantial impacts on the stock markets (Noor and Dutta, 2017). An empirical work by Ciner (2013), for example, claims that oil prices tend to impact the stock returns in two ways. First, oil price shocks can cause changes in expected cash flows by their effect on the overall economy. Second, oil price shocks can affect the discount rate used to value equities by changing inflationary expectations. In addition, Bouri (2015) argues that oil price shocks can transmit into equity markets leading to immediate instabilities in financial markets and distant disruptions of economic activities.

Although the literature investigating the oil-stock link is vast,[1] very few studies examine the association between oil and energy sector equity markets. Notable contributions include Henriques and Sadorsky (2008), McSweeney and Worthington (2008), Soytas and Oran (2011), Sadorsky (2012a,b), Kumar et al. (2012), Broadstock et al. (2012), Managi and Okimoto

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[1] Some recent contributions include Martin-Barragan et al. (2015), Balcilar et al. (2017), Batten et al. (2017), Dutta et al. (2017a,b), Mensi et al. (2017), Dupoyet and Shank (2017) amongst others.

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(2013), Wen et al. (2014), Reboredo (2015), Bondia et al. (2016), Dutta (2017) and Reboredo et al. (2017) among others. Henriques and Sadorsky (2008), for instance, document that variations in oil prices, technology stock prices and interest rates have some power in explaining the movements of the stock prices of alternative energy companies. In addition, Soytas and Oran (2011) attempt to study the inter-temporal links between global oil prices, ISE 100 and ISE electricity index returns unadjusted and adjusted for market effects. The authors assess the causality using the Cheung–Ng approach and show that world oil prices Granger cause electricity index and adjusted electricity index returns in variance, but not the aggregate market index returns. While analyzing the impact of oil price changes on renewable energy company risk, Sadorsky (2012b) finds that oil price increases have a positive impact on company risk. The study concludes that when oil price returns are positive and moderate, increases in sales growth can offset the impact of oil price returns and this leads to lower systematic risk. Reboredo (2015) examines the systemic risk and dependence between oil and renewable energy markets using copulas to characterize the dependence structure and to estimate the conditional value-at-risk as a measure of systemic risk. The findings indicate significant time-varying average and symmetric tail dependence between oil returns and several global and sectoral renewable energy stock indices. More recently, Reboredo et al. (2017) explore the co-movement and causality between oil and renewable energy stock prices using continuous and discrete wavelets. The authors show that dependence between oil and renewable energy returns in the short run appears to be weak, but gradually tends to be strengthened towards the long run, mainly for the period 2008–2012.

While the abovementioned articles examine the impact of oil price on the energy sector equity markets using traditional oil and stock price indexes, this paper aims to assess such links using the implied volatility indexes of oil and energy sector stock markets. This investigation is important, since implied volatilities are forward looking measures of volatility and hence can be considered better predictors of future volatility than the historical volatility measures (Liu et al., 2013; Maghyereh et al., 2016; Dutta, 2017; Dutta et al., 2017a). Methodologically, we employ ARDL (auto-regressive distributed lag) bound tests to assess whether the volatility indexes considered move together in the long run. In addition, we consider the application of Toda–Yamamoto version of Granger causality test with a view to investigating the short-run "lead-lag" relations among the volatility series under study.

We contribute to the existing literature at least in two aspects. First, to the best of our knowledge, this is the initial work to assess the linkage between the implied volatility indexes of oil and the US energy sector equity markets. We thus investigate a market's expectations of future uncertainty and changes in these expectations rather than the actually realized price movements. Second, as an important indicator of global stock market uncertainty, the US equity market implied volatility index (VIX) has also been included in our empirical analysis. Employing VIX is vital, since uncertainty could flow from the US VIX to both crude oil and energy sector equity market volatility series. Liu et al. (2013), for example, show that the US VIX acts as a driving force for crude oil volatility index (OVX). In addition, Maghyereh et al. (2016) also document that causality significantly runs from the US VIX to OVX. Hence, we contribute to the uncertainty transmission literature by exploring the association between oil and equity volatilities.

The rest of the paper is organized as follows. Section 2 will describe the data considered in our empirical analysis. Section 3 outlines the ARDL bound test. The findings are discussed in Section 4. Section 5 concludes our work.

2. Data

The aim of this paper is to examine the connection between the US VIX, the US energy sector equity VIX (VXXLE) and crude oil VIX (OVX). Like the US VIX, the other volatility indexes are also introduced by the Chicago board of options exchange (CBOE) to measure the market's expectation of 30-day volatility. Our sample period ranges from 16 March 2011 to 30 June 2017, yielding a total of 338 weekly observations. The starting date of the sample period depends on the availability of the VXXLE data.

Table 1 demonstrates the descriptive statistics of different volatility indexes under investigation. Panel A reports the results for the levels, while Panel B does the same for differenced series. The outcomes of both panels confirm that oil market is more volatile than other markets as supported by the corresponding standard deviations. The results also indicate that all the series show positive skewness. In addition, all the indices have kurtosis higher than 3 implying that each index has a leptokurtic distribution with asymmetric tails. The Jarque-Bera test further evidence that the data do not satisfy the normality assumption.

Next, Table 2 shows the Pearson correlation coefficients between oil and stock markets. These figures exhibit significantly positive contemporaneous correlations between the volatility indexes under study implying that the expected changes in the oil and equity volatilities tend to move in the same direction over the sample period. Such associations confirm the existence of close linkages among these volatility series. Furthermore, the highest correlation is observed between the implied volatility indexes of the US equity markets.

Fig. 1 depicts the implied volatility indexes considered in this study for the whole sample period. The graph shows several major jumps or upward moves in these indices. Interestingly, the hikes seem to be a consequence of either economic or political events. For instance, the first spike occurring during the beginning of 2011 can be attributed to the Libyan war for which the oil price uncertainty increases markedly. The next spike which appears in august 2011 is triggered by the US and European debt default risk. Furthermore, several spikes are also observed in the oil market VIX during the period 2015–2016.

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