



Time-varying correlation between oil and stock market volatilities: Evidence from oil-importing and oil-exporting countries



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ABSTRACT

This paper investigates the time-varying conditional correlation between oil price and stock market volatility for six major oil-importing and oil-exporting countries. The period of the study runs from January 2000 until December 2014 and a Diag-BEKK model is employed. Our findings report the following regularities. (i) The correlation between the oil and stock market volatilities changes over time fluctuating at both positive and negative values. (ii) Heterogeneous patterns in the time-varying correlations are evident between the oil-importing and oil-exporting countries. (iii) Correlations are responsive to major economic and geopolitical events, such as the early-2000 recession, the 9/11 terrorist attacks and the global financial crisis of 2007–2009. These findings are important for risk management practices, derivative pricing and portfolio rebalancing.

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1. Introduction

Over the last two decades a greater interest has been born to understand the impact of oil prices on the stock market. Some notable and influential studies have identified that there is a negative relationship between the two markets (see, *inter alia*, Jones & Kaul, 1996; Nandha & Faff, 2008; Miller & Ratti, 2009 and Chen, 2009). On the other hand, researchers argue that a positive relationship pertains to oil-exporting countries, while the adverse interaction only applies to oil-importing countries (see, *indicatively*, Bashar, 2006; Mohanty, Nandha, Turkistani, & Alaitani, 2011 and Wang, Wu, & Yang, 2013).

Furthermore, many financial institutions and investors consider the oil market as a profitable alternative destination since it has low correlation with traditional asset classes and positive co-movement with inflation (see, for example, Kat & Oomen, 2007, and Silvennoinen & Thorp, 2013). Some authors put a question mark over these views suggesting that the oil market and the stock market could become highly linked due to the recent financialisation of the oil market, which is a result of

the increased participation and speculation of hedge funds in the oil market (Buyuksahin, Haigh, & Robe, 2010; Silvennoinen & Thorp, 2013; Tang & Xiong, 2012; Buyuksahin & Robe, 2011; Hamilton & Wu, 2012 and Sadorsky, 2014).

Overall, despite the increased interest in the stock-oil relationship, the literature has remained relatively silent about the relationship between the stock and oil market volatilities. It is since the late 80s that Ross (1989) showed that asset price volatility holds important information and thus, volatilities from different markets could affect each other. More recently, Bloom (2009) and Baum, Caglayan, and Talavera (2010) maintain that uncertainty in the oil market generates investment decision delays and, thus, increases stock market volatility. Linking all these studies together, we maintain that stock and oil market volatilities could exercise significant effects to each other.

Even more, the majority of the existing studies investigate the stock-oil relationship in a static environment. However, recent papers provide indisputable evidence that these markets do present dynamic interrelations (see, Bhar & Nikolova, 2010; Choi & Hammoudeh, 2010; Filis, Degiannakis, & Floros, 2011; Filis, Degiannakis, & Kizys, 2014; Antonakakis & Filis, 2013 and Degiannakis, Filis, & Floros, 2013, among others). Therefore, the relationship between stock and oil market

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volatilities could also present heterogeneous behaviour at different time period and thus it should be investigated with a dynamic approach. Thus, the aim of the present study is to investigate the time-varying relationship between stock and oil market volatilities in both oil-importing and oil-exporting countries.

More specifically, the objectives of the present paper are the following: i) to investigate the time-varying conditional correlation between stock and oil market volatilities, ii) to assess if this dynamic correlation is different for oil-importing and oil-exporting countries and iii) to examine changes in the dynamic correlation during major economic and geopolitical events.

To do so we focus on the stock markets of three oil-importing countries (S&P500 index for the US, SSE composite index for China, and Nikkei 225 index for Japan) and oil-exporting countries (OSEAX for Norway, S&P/TSX for Canada and RTS for Russia), employing a Diag-BEKK model. The period of investigation runs from January 2000 until December 2014. Furthermore, oil and stock markets have showed severe boom and busts periods since 2000.

The findings suggest that the correlation between the oil and stock market is indeed time-varying and it assumes both positive and negative values, although the positive values prevail. Furthermore, we notice that there is heterogeneous behaviour between the oil-importing and oil-exporting countries, as for the former group correlations are mainly positive, whereas this is not the case for the latter group. Finally, we show correlations are responsive to major economic and geopolitical events, such as the early-2000 recession, the 9/11 terrorist attacks and the global financial crisis of 2007–2009s.

The results have important implication for risk managers and investors as the correlation of these two asset classes could inform derivative pricing, portfolio rebalancing, as well as, risk management practices.

The rest of the paper is organised as follows. Section 2 provides the review of the literature, whereas Section 3 describes the data used in the study and Section 4 details the methods used. Section 5 analyses the findings and Section 6 concludes the study.

2. Literature review

Many researchers claim that the impact of oil price fluctuation on stock returns is indirect and it is transmitted through macroeconomic variables. More specifically, oil is an important production input. Subsequently, any oil price escalation increases production costs, which, in turn, leads to higher prices and thus lower demand and consumer spending (Hamilton, 1996; Huang, Masulis, & Stoll, 1996; Aroui & Nguyen, 2010). Lower consumption results in a decreased production and eventually decreases employment (Lardic & Mignon, 2006; Davis & Haltiwanger, 2001). Accordingly, corporate earnings and dividends, which are key drivers of equity prices, decrease as well (Sadorsky, 1999; Al-Fayoumi, 2009).

A major body of empirical literature confirms these adverse effects of oil price changes on stock markets (Jones & Kaul, 1996; Ciner, 2001, 2013; Papapetrou, 2001; Driesprong, Jacobsen, & Maat, 2008; Chen, 2009; Miller & Ratti, 2009). However, some researchers endorse the notion that this fact is relevant only for the oil-importing countries; whereas positive impacts of oil price movements on stock markets holds for the oil-exporting countries (Sadorsky, 2001; El-Sharif, Brown, Burton, Nixon, & Russell, 2005; Bashar, 2006; Boyer & Filion, 2007; O'Neill, Penm, & Terrell, 2008; Mohanty et al., 2011; Mohanty & Nandha, 2011; Aroui & Rault, 2012; Filis & Chatziantoniou, 2013; Wang et al., 2013).

On the other hand, some authors provide empirical evidence that oil price changes have little or no effects on stock market returns (Lescaroux & Mignon, 2008; Cong, Wei, Jiao, & Fan, 2008; Apergis & Miller, 2009; Al-Fayoumi, 2009 and Al Janabi, Hatemi-J, & Irandoust, 2010). A plausible explanation of these little or no effects can be found on the fact that economies are able now to battle the economic consequences of oil price changes and thus these effects are not transmitted to the stock market. For example, Filis et al. (2011) state that currently

monetary authorities put emphasis on their inflation stability and thus they prevent any inflationary pressures caused by oil price changes. Hence, they minimize the effects of oil price changes in the economy and thus in the stock market. Moreover, the International Energy Agency (2006), as well as Nordhaus (2007) and Blanchard and Gali (2007) suggest that the recent developments on investment, production, wage policies and renewable resources tend to minimize the consequences of oil price changes on the economies, as a whole and on stock markets, in particular.

However, we should not lose sight of the fact that oil price changes could exercise different effects on stock markets, depending on the nature of the oil changes. Hamilton (2009a, 2009b) shows that oil price changes can be triggered by demand- and supply-side events. He explains that demand-side oil price shocks are triggered by changes in the global aggregate demand (e.g. due to China's industrialisation, global recessions), whereas supply-side oil price shocks are generated due to change in global oil supply (e.g. due to OPEC decisions to cut or increase oil production or due to disruptions in the oil supply due to severe weather conditions). Evidence suggests that demand-side shocks exercise positive impacts to economic activity compared to the negative effects of supply side shocks. Additionally, Kilian (2009) identified a third oil price shock by disentangling the demand-side shock into aggregate demand shocks (which is the same as Hamilton's demand-side shock) and the precautionary oil demand shock, which reflects the uncertainty about the future availability of oil. The later shock is triggered by events such as war conflicts in the Middle East or terrorist attacks. Overall, it is evident that all three oil prices shocks are directly related to major economic and geopolitical events.

Kilian and Park (2009) shows that stock markets respond positively to aggregate demand shocks, whereas a negative response is observed in the case of precautionary demand shocks. Additional empirical evidence suggests that a positive correlation exists between positive aggregate demand shocks and financial or economic returns, whereas the reverse is true for positive precautionary demand and supply-side shocks (Lescaroux & Mignon, 2008; Kilian & Park, 2009; Apergis & Miller, 2009; Filis et al., 2011; Basher, Haug & Sadorsky, 2012; Baumeister & Peersman, 2012; Chen, Hamori, & Kinkyo, 2014). Furthermore, many researchers consolidate the concept that supply-side shocks do not exercise any effect on economic activity or financial markets (Barsky & Kilian, 2004; Kilian, 2008; Hamilton, 2009a, 2009b; Filis et al., 2011; Sadorsky, Basher, & Haug, 2012; and Degiannakis, Filis, & Kizys, 2014).

These past studies focus on stock market returns and oil price returns (or shocks). Nevertheless, the interaction between the oil market and the stock market may potentially occur through their volatilities (Huang et al., 1996). An early study on the effects of oil price volatility on the stock market is this by Sadorsky (1999). His findings reveal that oil price volatility tends to have asymmetric effects on the US stock market returns, showing that the impact of the positive shocks in the oil price volatility exerts a significantly greater impact on US stock returns, compared to the negative shocks. More recently, Park and Ratti (2008) also suggest that oil price volatility contributes negatively to changes in stock returns in the US and in thirteen European countries. However, this finding does not hold true for the Norwegian stock market, which seems to respond positively to increases in oil price volatility, possibly due to the fact that Norway is a major oil exporter. Ratti, Seol, and Yoon (2011) seconds these findings. Furthermore, oil price shocks, and more specifically the aggregate demand shocks also impact stock market volatility, as Degiannakis et al. (2014) show.

Despite the few studies that concentrate on oil market or stock market volatility, there is no evidence on the relationship between the volatilities of the two markets. This study aims to fill this void. Even more, we examine the aforementioned relationship in a time-varying environment. This choice is justified by the fact that an emerging strand in the literature has shown that the relationship between the oil and stock market returns is indeed dynamic (see, Aloui & Jammazi, 2009;

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