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Volatility spillovers between oil prices and stock sector returns: Implications for portfolio management

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A B S T R A C T

In this article we take a recent generalized VAR-GARCH approach to examine the extent of volatility transmission between oil and stock markets in Europe and the United States at the sector-level. The empirical model is advantageous in that it typically allows simultaneous shock transmission in the conditional returns and volatilities. Insofar as volatility transmission across oil and stock sector markets is a crucial element for portfolio designs and risk management, we also analyze the optimal weights and hedge ratios for oil-stock portfolio holdings with respect to the results. Our findings point to the existence of significant volatility spillover between oil and sector stock returns. However, the spillover is usually unidirectional from oil markets to stock markets in Europe, but bidirectional in the United States. Our back-testing procedures, finally, suggest that taking the cross-market volatility spillovers estimated from the VAR-GARCH models often leads to diversification benefits and hedging effectiveness better than those of commonly used multivariate volatility models such as the CCC-GARCH of Bollerslev (1990), the diagonal BEKK-GARCH of Engle and Kroner (1995) and the DCC-GARCH of Engle (2002).

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1. Introduction

It is common in theory that stock prices are equal to the sum of discounted values of expected future cash flows at different investment horizons. Market participants must therefore identify the factors

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affecting these discounted cash flows to support their decision making. In view of the crucial role of oil in the global economy and its spectacular price fluctuations in recent years, it is naturally opportune to ask questions about the impact of the price of oil on stock prices. Research in the energy finance literature has documented several channels through which oil shocks are transmitted to stock markets, but the most important one may be the financial link between oil prices, corporate cash flows, and the discount rate used in stock-valuation models. We can see easily that the latter two factors depend on economic conditions (changes in the consumer price index, interest rates, industrial production costs, economic growth rates, investor and consumer confidence, and so on) that are significantly influenced by changes in the price of oil (Jones and Kaul, 1996; Sadorsky, 1999; Park and Ratti, 2008; Apergis and Miller, 2009). It is thus obvious that a change in oil prices of either sign (positive or negative) may move stock prices.

Although understanding the causal relationships between oil price changes on stock markets is crucial for energy policy planning, portfolio diversification and energy risk management, and other such issues, it is only recently that these relationships have been examined[1] Moreover, the focus was essentially on broad market indices (national and/or regional stock market indices). One of the earliest pieces, done by Kling (1985), studies oil shocks and US stock market behavior, and shows that stock market returns are negatively associated with the rise of crude oil prices. Jones and Kaul (1996) use a standard present value model to examine the response of four developed stock markets (Canada, Japan, the United Kingdom, and the United States) to oil shocks and find that changes in stock returns can be partially accounted for by the effect of oil price movements on current and future cash flows. Subsequent studies including, for example, those by Huang et al. (1996), Sadorsky (1999), Park and Ratti (2008), and Apergis and Miller (2009) rely on such methods as vector autoregressive models, international multifactor asset pricing models, cointegration tests, and vector error-correction models and reach similar conclusions. As to emerging stock markets, several papers have shown that changes in the price of oil have significant effects on stock returns over both the short and the long-term (Papapetrou, 2001; Basher and Sadorsky, 2006; Narayan and Narayan, 2010). But it must be emphasized that both the magnitude and sign of the effects differ from one market to another, depending on whether the market is more dependent on petroleum-related products or less so.

Some studies have examined the extent of oil price impacts on stock prices from a sector-by-sector perspective. For instance, Sadorsky (2001) and Boyer and Filion (2007) show that the stock returns of Canadian *Oil & Gas* companies are positively related to oil price increases. El-Sharif et al. (2005) obtain similar findings for *Oil & Gas* returns in the United Kingdom, whereas non-*Oil & Gas* sectors are weakly linked to oil price changes. Nandha and Faff (2008) study the short-term relationship between oil prices and thirty-five global industries covered by Datastream International and show that the rise of oil prices has a negative impact on all industries but not *Oil & Gas*. The work of Nandha and Brooks (2009) focuses on the reaction of the transport sector to oil prices in thirty-eight countries around the world and shows that oil prices do play a role in determining the transport sector returns in developed countries. For the Asian and Latin American countries in their sample, however, there appears to be no such evidence. In a more recent attempt, Arouri and Nguyen (2010) shift attention to short-term links between oil and stock prices in the aggregate as well as sector-by-sector in Europe. Their findings, obtained through various econometric techniques, suggest that the sensitivity of sector stock returns to oil price changes differs greatly from one sector of activity to another. More interestingly, their out-of-sample analysis shows that there are substantial diversification benefits to adding the oil asset to a diversified portfolio of stocks, as doing so significantly improves the portfolio's risk-return characteristics. This finding is consistent with those of several other papers, for which using futures contracts on traded commodities as part of existing portfolios of stocks improves overall returns (Satyanarayan and Varangis, 1996; Geman and Kharoubi, 2008).

As we can see, almost all of the abovementioned papers look at price spillover in oil and stock markets, whereas little has been done on possible volatility spillover. Using different specifications of

[1] Most earlier contributions to the understanding of oil effects focus on the links between oil price changes and real economic variables (Hamilton, 1983, 2003; Hutchison, 1993; Amano and van Norden, 1998; Kilian, 2008) following the major oil price events of the 1970s. Most of these studies find that oil price shocks significantly affect economic activity in both developed and emerging economies.

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