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# Oil prices and financial stress: A volatility spillover analysis

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## HIGHLIGHTS

- Volatility spillover between oil prices and financial stress index is examined.
- Analysis is conducted for sub-periods: pre-crisis, in-crisis, and post-crisis
- Oil prices spill on financial stress before the crisis, but spillover reversed after the crisis.
- Volatility transmission pattern has similar dynamics before and after the crisis.
- Implications for investors and policy makers are discussed.

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## ABSTRACT

This paper examines whether there is a volatility transmission between oil prices and financial stress by means of the volatility spillover test. We employ WTI crude oil prices and Cleveland financial stress index for the period 1991–2014 and divide the sample into pre-crisis, in-crisis, and post-crisis periods due to the downward trend in oil price in 2008. The volatility model estimations indicate that oil prices and financial stress index are dominated by long-run volatility. The volatility spillover causality test supports evidence on risk transfer from oil prices to financial stress before the crisis and from financial stress to oil prices after the crisis. The impulse response analysis shows that the volatility transmission pattern has similar dynamics before and after the crisis and is characterized by higher and long-lived effects during the crisis. Our results have implications for both policy makers and investors, and for future work.



## 1. Introduction

It is well established in the literature that oil price shocks have detrimental effect on economic activity in developed and developing countries (i.e. Hamilton, 2011 for US; Cunado and de Gracia, 2003 for 15 European countries; Cunado and de Gracia, 2005 for 6 Asian countries), especially for oil-importers. The evidence on the other hand is not clear-cut for oil exporters (Jimenez-Rodriguez and Sanchez, 2005 for UK and Norway). Although the impact of oil shocks on the macro-economy seems to have weakened through time, Kilian (2008) argues that this is partly due to increased demand for industrial output, which offsets the negative impact of an increase in oil price. Rafiq et al. (2009) argue that the negative impact of an increase in oil price is usually found to be higher than the positive impact of a fall in oil prices. It is argued that monetary policy alone cannot account for this asymmetry (see Balke et al., 2002). Transaction costs and financial stress are among the factors that lead to the asymmetric effect. The asymmetric impact of oil shocks on stock returns is also well documented. Aloui et al. (2012), for example, find asymmetric impact of oil shocks on 25 emerging market returns. Park and Ratti (2008) find similar results for US and 13 European economies. They also argue that oil-importers are affected more than oil-exporters.

The dynamic link between oil prices and financial stress can exist through two channels: their impact on economic activity and on investor behavior. A rise in oil prices depresses economic activity, may put pressure on credit markets, and negatively affect

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stock markets and the banking system. In times of high financial stress, economic activity slows down, leading to low energy demand and declining oil prices. Investors see oil markets as alternative investment areas to financial markets. As investors adjust their portfolios with respect to oil price shocks, this will have repercussions on financial asset prices. On the other hand, increased financial stress will also cause investors to change their portfolios and this will have an impact on oil markets. Financial stress also influences economic activity through the bank lending channel via decreasing the amount of available credits and through financial leverage via changes in creditworthiness of borrowing businesses. Even though the linkage between financial stress and economic activity is well-studied (see Illing and Liu, 2006, for a review), the inter-temporal relationship between oil price and financial stress index is not yet well explored.

There are several studies that focus on the equity and commodity market co-movements during crises. A strand of this literature questions the role of speculative component in commodity prices. Killian and Murphy (2014) find evidence on the role of speculative demand on oil shocks in 1979, 1986, and 1990. However, the recent oil price hike during 2003–2008 is due to market fundamentals and not speculation. Büyükşahin and Harris (2011) also support this result. On the other hand, using trader-position level data for non-public traders, Büyükşahin and Robe (2014) show that the association between stock and investable commodity indexes is driven by hedge fund activity, but not other types of traders. They report that during financial turmoil the role of hedge fund activity is weakened. Interestingly TED spread they employ as financial stress signal leads to lower correlation between commodity and equity markets even though hedge fund activity increases. A similar result has also been reported by Büyükşahin et al. (2010), such that during extreme return periods spillovers between commodity and equity markets do not rise significantly. Illing and Liu (2006) point out that the spikes observed in the components of the financial stress index coincide with oil shocks, but to the extent of our knowledge there are no studies that formally test the link between oil price and financial stress index.

This study examines whether there is information transmission between world oil prices and financial stress index. Considering the leading role of the US financial system all over the world, the FSI for US is taken as representative of the global financial stress.[2] To the extent of our knowledge, this study is the first to explicitly examine spillovers between financial stress and world oil markets by employing the volatility spillover test. To explore the risk transmission, we benefit from the recent developments in time series analysis and use the volatility spillover test of Hafner and Herwartz (2006). We also conduct Toda and Yamamoto (1995) mean causality test and derive the generalized impulse response functions to compare how world oil prices and the FSI respond to short-run temporary shocks. The data set includes daily observations from September 25, 1991 to January 02, 2014 and is divided into three sub-periods due to the downward trend in oil prices in 2008: the pre-oil crisis, the oil crisis, and the post oil crisis (pre-crisis, crisis, and post-crisis hereafter) periods. The key findings of this study are that (i) oil prices and the financial stress index are dominated by long-run volatility, (ii) there is a volatility transfer from oil prices (financial stress) to financial stress (oil prices) before (after) the crisis, (iii) there is causal linkage from oil prices to financial stress after the crisis and from financial stress to oil prices in the crisis, and finally (iv) the volatility transmission pattern has similar dynamics before and after the crisis and is characterized by higher and long-lived effects during the crisis.

The rest of the paper is organized as follows: The literature review, data description, and causality in variance test is outlined in methodology section (Section 2). In Section 3, we present the descriptive statistics and time series properties of data and interpret the empirical results. Section 4 is devoted to discussion and implications, followed by Section 5 on the concluding remarks.

## 2. Methodology

### 2.1. Literature review

The financial stress index literature is a rapidly developing one. Existing studies either focus on only constructing a financial stress index (FSI) for a country (i.e. Illing and Liu, 2006) or both on constructing and evaluating the link between financial stress and economic activity to examine how well FSI identifies known periods of financial distress (Cevik et al., 2013; Cardarelli et al., 2011; Chau and Deesomsak, 2014; Mallick and Sousa, 2013). There are also a few studies that consider financial stress transmission among countries (Balakrishnan et al., 2009; Park and Mercado Jr., 2014).

Since FSI is a relatively new concept, the literature on impacts of oil prices on macroeconomic and financial variables is a lot broader than the FSI literature. Here we mention only a few recent studies related to the oil price-financial stress literature.[3] Cunado and de Gracia (2014) examine the link between stock market returns in 12 oil importing European countries and oil prices. They find that in most of these markets returns respond significantly negatively to oil shocks. This negative relationship is confirmed for South Africa by Gupta and Modise (2013). Recognizing that mean spillovers between oil and financial markets may not be covering the entire story, some studies (i.e. Jouini, 2013; Soytas and Oran, 2011) also consider risk transfers. Their findings imply that volatility spillover is another dimension through which financial and oil markets interact. Morana (2013) utilizes a rather comprehensive macro and financial dataset for 31 countries to examine dynamic interaction between oil price and macro-finance variables. The results suggest a large contribution of financial shocks to oil price increases during 2000s while macroeconomic shocks were the main drivers earlier. This result may be largely due to financialization of oil markets. The recent crisis in 2008 is attributed to a macro-finance episode, where macro-shocks carry the burden with financial shocks contributing marginally. The study by Chen et al. (2014) is probably the only article in the literature that examines the link between FSI and oil prices. Using Kansas City FSI, global oil production, global real economic activity, and real oil prices, they find that FSI shocks trigger a significant negative response in real oil prices. Then they consider the impacts of oil, aggregate demand, oil-specific demand, and financial shocks on industrial production, consumer price index, and stock prices in France, Germany, USA, UK, and Japan. Using Killian's (2009) method to distinguish between structural shocks and employing quarterly data for the 1993–2012 period, they show that financial markets play an important role in assessing the impact of oil price shocks on economic activity. Although, they suggest a link between FSI and oil prices, their study does not explicitly consider mean and volatility spillover between FSI and oil prices.

It seems that this newly emerging literature does not yet cover transmissions between FSI and non-financial markets, including oil markets. Financial stress may be contagious and if it is

[2] Dovern and van Roye (2014) show that FSI shock in US transmits rapidly internationally with a persistent negative impact on economic activity. However, a negative shock in US aggregate demand has limited global spillover to financial stress.

[3] See Gupta and Modise (2013) for a critical review of the literature.

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