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Oil price and financial markets: Multivariate dynamic frequency analysis

Anna Creti [a], Zied Ftiti [b,c,*], Khaled Guesmi [d]

[a] Université Paris Dauphine PSL-LEDa and Ecole Polytechnique-CECO, France
[b] EDC Business School, OCRE Lab, Paris-France. 70 galerie des Damiers - Paris La Défense 1 92415 Courbevoie cedex, Paris, France
[c] University of Tunis, High Institute of Management, GEF-2A Lab, Tunisia
[d] IPAG Business School, IPAG Lab and Economix, Paris West University Nanterre La Defense, France

HIGHLIGHTS

- A new time-varying measure for the stock markets and oil price relationship in different horizons.
- We propose a new empirical methodology: multivariate frequency approach.
- We propose a comparison between oil importing and exporting countries.
- We show that oil is not always countercyclical with respect to stock markets.
- When high oil prices originate from supply shocks, oil is countercyclical with stock markets.

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ABSTRACT

The aim of this paper is to study the degree of interdependence between oil price and stock market index into two groups of countries: oil-importers and oil-exporters. To this end, we propose a new empirical methodology allowing a time-varying dynamic correlation measure between the stock market index and the oil price series. We use the frequency approach proposed by Priestley and Tong (1973), that is the evolutionary co-spectral analysis. This method allows us to distinguish between short-run and medium-run dependence. In order to complete our study by analysing long-run dependence, we use the cointegration procedure developed by Engle and Granger (1987). We find that interdependence between the oil price and the stock market is stronger in exporters' markets than in the importers' ones.

1. Introduction

Energy markets have been recently marked by considerable price movements. In particular, from 2001 to 2010, record high prices for oil were accompanied by important volatility and sudden decreases. The main oil price peaks are observed between 2007 and 2008. Another peak is observed in June 2009, when prices increased by more than 60% over the January 2009 prices. All of these changes were linked to aggregate demand-side oil price shocks. The first shocks occurred during the Asian economic crisis, while the second occurred in 2000 when interest rates decreased significantly, consequently causing a bust in the housing market and the construction industries. The third shock, which occurred in 2006/2007, was the result of the rising demand for oil from China. Finally, the fourth demand-side oil price shock took place during the global financial crisis of 2008 (see Tables A1 and A2 in Appendix A).

These price movements have a certain impact on the economy, as several studies have documented (Barsky and Kilian, 2004; Hamilton, 2012). More specifically, we are interested in the relationship between oil and one of the main indicators of economic activity, that is the stock market index. Theoretically, there are several transmission channels that explain this link. First, given the price of a share being equal to its discounted future cash flow, rising oil prices can increase the interest rate to limit inflationary pressure, tighten the cost of doing business, put pressure on output prices and thus decrease profits (Jones et al., 2004; Kilian and Park, 2009). High interest rates also make bond investments more attractive than stock investments (Chittedi, 2012). Financialisation of oil markets and intensive oil trading can also amplify the transmission of oil price shocks to the real economy (Creti et al., 2013). All of these effects generally trigger a negative relationship between oil and stock markets, which

* Corresponding author at: EDC Business School, OCRE Lab, Finance, 70 galerie des Damiers, Paris La Défense 1, 92415 Paris, Courbevoie cedex, France
E-mail addresses: anna.creti@dauphine.fr (A. Creti), zied.ftiti@isg.rnu.tn (Z. Ftiti), khaled.guesmi@ipag.fr (K. Guesmi).

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parallels the relationship between high oil prices and macroeconomic indicators (Hamilton, 1996 and 2005).

While there is a sizeable empirical literature on oil and stock markets, less is known about this relationship in the context of oil-importing versus oil-exporting countries (Filis et al., 2011). Most of the studies focus on oil-importing countries, such as the U.S. However, specific effects on different sets of countries are worth investigating. For instance, an increase of oil prices negatively influences the economy of importing countries. When oil prices rise, the importing countries can experience strong negative consequences and an economic recession (Federer, 1996). On the contrary, an increase in oil prices influences positively the economies of the oil-exporting countries. Nevertheless, a decrease in the price of oil exhibits a negative relationship with the economic growth of oil producers and can generate political and social instability (Yang et al., 2002).

As the roots of the link between oil and stock markets are of a different nature, it is interesting to explore whether the co-movements between oil and stock price emerge in a given time frame, either in the short or in the long term. Additionally these effects are all the most interesting when studied in different economic and geographical clusters, that is oil-exporting and oil-importing countries. We do believe that the finer time frame description together with the distinction of the economies that depend on oil or export it is a novel and interesting description of the relationship between oil and the stock market. To this end, we also add to the previous literature on the methodological side, as we use a frequency approach, the evolutionary co-spectral analysis as defined by Priestley and Tong (1973).

The evolutionary co-spectral analysis does not impose pre-treatment of the data (as is the case with volatility analysis, for instance, which requires stationarity, or cointegration techniques, applied only to time series data integrated of order one). In particular, the evolutionary co-spectral analysis provides a robust frequency representation of non-stationary processes, as it is the case for our data sample. Second, the analysis we use does not have an "end-point problem". In other words, no future information is used, implied or required as in band-pass or trend projection methods. Finally, the frequency analysis endogenously delivers whether the variables under investigation present short-, medium- or long-term interdependence. The monthly frequency of our data prevents us from obtaining long-term dependence through the spectral approach, which allows the study of short-term (10 months in our study) and medium-term dependence (3 years and one quarter).[1] For this reason, we complement our study by using the cointegration approach that looks at longer terms phenomena.

Our results partially contradicts, on one side, studies that only document a negative relationship between oil prices and stock market returns and, on the other, those that argue that this relationship holds regardless of the country oil import dependency. We clearly show changes in co-movements between oil prices and stock markets and repercussions in the economy that differ when consider oil-exporting or oil-importing countries respectively. Overall, our analysis reveals two main findings. Oil price shocks in periods of world turmoil or during fluctuations of the global business cycle (downturn or expansion) have a significant impact on the relationship between oil and stock market prices, both in oil-importing and oil-exporting countries. In exporting countries, our analysis unveils higher and multiple peaks that coincide with important events, such as the oil price crisis that occurred in 2008. In the case of importing countries, the pattern of interaction is clearly smoothed compared to exporting countries. All other oil price shocks originating from OPEC's production cuts, hurricanes, etc. do not have a significant impact on the coherence between oil and stock markets in importing countries. In any case, though the interdependency between oil and stock markets is not very strong in the 10-month horizon, it is more clearly apparent in the medium-term (3 years and one quarter). According to the cointegration analysis, we show that the long-term relationship is significant for all studied importing countries and non-significant for some cases of exporting countries. Loosely speaking, the long-term and medium-term relationships display similar patterns.

The paper is organised as follows. Section 2 summarises the literature and compares our approach to existing studies. Section 3 presents the empirical methodology and the data. Section 4 details our results, and Section 5 concludes the paper.

2. Literature review

The relationship between oil price and real economic activity has been widely investigated. Hamilton (1983) concludes that positive oil price shocks are a substantial cause for the economic recession in the US. Following this work, oil price dynamics motivated many studies, among them the ones focusing on the links between oil and stock prices. Most papers devoted to oil-importing countries indicate a negative relationship between oil prices and stock market activities. One of the first papers to exhibit this relationship is Sadorsky (1999), who shows that oil price shocks have symmetric effects on the economy, with positive shocks having a greater impact on stock markets and economic activity than negative oil price shocks. Since this seminal paper, other studies have either confirmed this finding (such as Basher et al., 2010; Chen, 2009; Elder and Serletis, 2010; Jones and Kaul, 1996; Kilian and Park 2009; Masih et al., 2011; Wei, 2003) or noted that the impact of oil prices on stock markets is weakly significant (Aspergis and Miller, 2009; Miller and Ratti, 2009). In the following, we detail some of the empirical models with respect to this topic.

Hammoudeh et al. (2004) examines the long-term interaction between five gulf cooperation countries' (Bahrain, Kuwait, Oman, Saudi Arabia, and UAE, henceforth referred to as GCC) stock markets and three global factors (oil spot price indices, US 3-month Treasury bill rate, and S&P index). They apply cointegration tests and a vector error correction model to weekly data from February 1994 to December 2004. The authors find that oil price movements do not have direct effects on any GCC stock markets, while the latter counts for less than 4% of the variations in oil prices after a 20-week period.

Using a multi-factor approach, Syed and Sadorsky (2006) study the impact of oil price changes on the emerging stock market. They argue that oil price risk impacts stock price returns. Narayan and Narayan (2012) use the EGARCH method to model daily data of crude oil prices and conclude that shocks influence constantly and asymmetrically the volatility over the long term. Asymmetric effects indicate that positive shocks affect the price of oil differently than do negative shocks. Chiou and Lee (2009) examine the asymmetric effects of WTI daily oil prices on S&P 500 stock returns. Using the autoregressive conditional jump intensity model with expected, unexpected and negative unexpected oil price fluctuations, they find that high fluctuations in oil prices have asymmetric unexpected effects on stock returns. Malik and

[1] The frequency approach allows for the study of 7 frequencies: $(\pi/20)$, $(4\pi/20)$, $(7\pi/20)$, $(\pi 10/20)$, $(13\pi/20)$, $(16\pi/20)$, and $(\pi 19/20)$. The shift from the frequency domain to the time domain occurs through the following formula: $(2\pi/\lambda)$, where λ is the frequency. The smaller frequency gives us information about the bigger time span relationship. In other terms, the frequency $(\pi/20)$ corresponds to $(2\pi/(\pi/20))$ months=3 years and one quarter, whereas $(10\pi/20)$ refers to a 10-month time frame. With monthly data, we cannot go beyond the 3 year and one quarter limit.

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