



Contents lists available at ScienceDirect

Energy Economics

journal homepage: [www.elsevier.com/locate/eneco](http://www.elsevier.com/locate/eneco)

# How do OPEC news and structural breaks impact returns and volatility in crude oil markets? Further evidence from a long memory process

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## ARTICLE INFO

### Article history:

Received 13 May 2013

Received in revised form 25 September 2013

Accepted 10 November 2013

Available online xxx

### JEL classification:

G14

G15

### Keywords:

Crude oil prices

OPEC announcements

Volatility

Structural breaks

Long memory

## ABSTRACT

Since its formation, OPEC through its conference decisions has been a major player in the world oil markets. The purpose of this paper is to examine the impacts of OPEC's different news announcements on the conditional expectations and volatility of crude oil markets in the presence of long memory and structural changes. To do so, we first discern OPEC's oil production behavior in response to its "cut", "maintain", and "increase" decisions. Then by applying the ARMA–GARCH class models to the two global benchmarks WTI and Brent over the period May 1987 through December 2012, we find strong evidence of long memory. The empirical evidence also shows that OPEC's announcements especially the "cut" and the "maintain" decisions have a significant effect on both returns and volatility of the crude oil markets, particularly that of the WTI. Moreover, we explore the possibility of structural breaks in the crude oil prices and detect five (six) breakpoints for the WTI (Brent) oil markets. The presence of structural breaks reduces the persistence of volatility. Accounting for OPEC's scheduled news announcements in the presence of structural changes reduces the degree of volatility persistence and enhances the understanding of this volatility in the oil markets. These results have several implications for policy makers, oil traders and other participants in the crude oil markets.

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## 1. Introduction

Oil is an exceptionally important commodity as it has the most influential impact on the world economy particularly in terms of causing recessions, compared to the other commodities (i.e., Elder and Serletis, 2010; Hamilton, 1983, 2009a,b,c, 2013, among others). It is indispensable for the industrial, transportation and agricultural sectors, whether used as a feedstock in production or a surface fuel in consumption. In September 1960, five key oil producers namely Iran, Iraq, Kuwait, Saudi Arabia and Venezuela, created the Organization of Petroleum Exporting Countries (OPEC). OPEC aims at promoting the interests of key oil-producing countries. "In accordance with its Statute, the mission of OPEC is to coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital for those investing in the petroleum industry."<sup>2</sup>

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<sup>1</sup> The third author (S.-M. Yoon) is grateful for the support received from the National Research Foundation of Korea in a grant funded by the Korean Government (NRF-2011-330-B00044).

<sup>2</sup> OPEC's website.

This oil organization has played a very significant role in shaping oil prices since it produces about 40% of the world's oil production. In its management of the oil markets, it not only meets twice a year on prescheduled dates for ordinary conferences but it also calls for extraordinary conferences with short notice on unscheduled dates if the markets warrant that. OPEC undertakes a central position as partial monopolist in the crude oil markets. Stabilizing oil prices is not an easy task for OPEC because the interests of member countries with large resources and small populations are different from those of countries with small resources and larger populations (see, Horn, 2004). To make decisions, OPEC should know certain key facts including its needs for revenues, its own and the competitors' reserves and the elasticities of oil demand and supply. Due to this role as an oil market manager, OPEC thus contributes through announcements and actions to equilibrate the crude oil markets.

Nevertheless, the behavior of OPEC is one of the most sought-after topics in energy economics (Pindyck, 1978; Salant, 1976). OPEC's news announcements have bearing on the expectations and volatility of the crude oil markets. The announcements come out in the form of "cut", "maintain", and "increase" decisions regarding changes in oil production levels. Therefore, these different decisions may have asymmetric effects on the oil returns and volatility, leading to different expectations in the markets and prompting different investment, speculative and hedging strategies.

While OPEC decisions are important for understanding and analyzing the stability (or lack thereof) of oil markets and also crucial for volatility modeling, it is worth noting that these markets are characterized by long-range dependence and structural breaks which also should be accounted for in volatility modeling. More precisely, ignoring structural changes when investigating long memory process may beget to overestimation of volatility persistence, among other statistical properties (see Aggarwal et al., 1999; Arouri et al., 2012a; Arouri et al., 2012b; Ewing and Malik, 2013; Kang et al., 2009, 2011; Lamoureux and Lastrapes, 1990; Lastrapes, 1989).

Arouri et al. (2012a) argue that while persistence in volatility models deals with exponential decays in the autocorrelation of conditional variance, the long memory in volatility processes requires models that accommodate volatility persistence over long horizons. In addition, a presence of unaccounted for structural breaks may reduce the persistence of volatility and hinder the prediction process. Several criticisms are addressed against the long memory models because the presence of this property in the data may be due to the presence of structural breaks or regime switches (Kang et al., 2011). Choi and Zivot (2007), Diebold and Inoue (2001) and Granger and Hyung (2004) argue that structural breaks can severely affect the results of the long memory tests and may generate a spurious long memory process in the series. Hence, the structural change model is more suitable for analyzing volatility than the simple long memory model because structural breaks imply a significant time-variation in unconditional volatility, whereas the LM model requires constant unconditional volatility.

This study has three primary objectives. The first objective is to investigate the presence of dual long memory in crude oil market series. The second is to analyze the informational content of OPEC's announcements in terms of their impacts on the behavior of the WTI and Brent prices. More precisely, this objective aims to explore the asymmetric effects of OPEC decisions on the long memory of the oil markets. To achieve this goal, we intend to distinguish between the different kinds of production decisions taken by OPEC whether expressed as "cut" decisions, "maintain" decisions, or "hike" decisions and to examine their effects on the changing persistence of the crude oil markets. The third objective is to investigate the relevance of incorporating structural changes in volatility modeling to obtain accurate levels of volatility persistence. For this purpose, we use the Bai and Perron (2003) test to detect the possibility of structural breaks in the crude oil markets. To the best of our knowledge, this is the first study which investigates the linkages among OPEC decisions, structural breaks and long memory in modeling the conditional expectations and volatilities of the two global crude oil benchmarks (U.S. West Texas Intermediate and Europe's Brent).

The remainder of this paper is organized as follows. Section 2 reviews the recent empirical studies in the literature. Section 3 discusses the econometric method used in the paper. Section 4 presents the data and the statistical properties for both the WTI and Brent return series. The empirical results and implications are discussed in Section 5. Finally, we provide concluding remarks in Section 6.

## 2. Literature review

In the last few years, researchers have focused on the effect of global macroeconomic news announcements on the conditional volatility of financial and commodity markets (e.g., Demirel and Kutan, 2010; Jiang et al., 2012; Marshall et al., 2012; Rangel, 2011), particularly on the crude oil markets (Schmidbauer and Röscher, 2012). The analysis of OPEC's news announcements provides useful information for those concerned with the crude oil markets including investors, traders, speculators, and government agencies as these announcements have substantial effects on the world's oil prices and economic performance (Hanabusa, 2012). Since the second Gulf war, the crude oil prices have varied dramatically over time due to changes in economic and geopolitical factors and to the presence of disequilibrium between the supply

and demand for oil. Moreover, the OPEC conferences may increase instability of crude oil markets. In this term, an extensive body of the theoretical and empirical literature examines the behavior of OPEC (see, for example, Aguiar-Conraria and Wen, 2012; Brémond et al., 2012; Cairns and Calfucura, 2012; Deaves and Krinsky, 1992; Horan et al., 2004; Lin and Tamvakis, 2010; Wirl and Kujundzic, 2004). For example, Draper (1984) examines the impact of OPEC's announcements on different futures maturities in the heating oil market and finds significant differences in pre- and post-announcement's average weekly returns for regularly scheduled meetings. In a recent study on the effect of the OPEC meetings on oil prices, Demirel and Kutan (2010) use the event study method to evaluate the informational efficiency of the crude oil spot and futures markets with respect to the OPEC and U.S. Strategic Petroleum Reserve (SPR) announcements between 1983 and 2008. Regarding the OPEC announcements, they find an asymmetry in that only OPEC's production cut announcements yield a statistically significant impact, with the effect diminishing for longer maturities. The authors also show that the persistence of returns following the OPEC production cut announcements creates substantial excess returns to investors who take long positions on the day following the end of OPEC's conferences. In the case of the SPR announcements, Demirel and Kutan (2010) show that the U.S. government's use of this program initiates a short-run market reaction following the announcement date. Furthermore, the crude oil market reacts efficiently to the SPR announcements providing support for the use of the strategic reserves as a tool to stabilize the oil market. Lin and Tamvakis (2010) investigate the differential effects of OPEC announcements on major international crude oil prices including key benchmarks and several other heavy and light grades, using the event study approach. Those authors find differentiation in the magnitude and significance of the responses of the different oil grade prices to OPEC's quota decisions under different price bands.

More recently, Schmidbauer and Röscher (2012) examine the impact of OPEC announcements on the expectations and volatility of daily oil price changes and find evidence of a post-announcement effect on the expectations, which is negative in the case of the cut decisions and positive in case of the increase or no change decisions. The authors also find that there is a positive pre-announcement effect on volatility, which is strongest in the case of the cut decisions. In another work, Hanabusa (2012) investigates the influence of the 107th OPEC ordinary meeting on oil prices and economic activities. To analyze the shift of the volatility of oil prices, this author applies the Exponential Generalized Autoregressive Conditionally Heteroskedasticity (EGARCH) model and finds that the level and volatility of oil prices increase after the meeting. However, those authors do not account for long memory in the analysis of OPEC announcements.

On the other hand, the topic of long memory (LM) and stylized facts in financial markets have been documented in numerous studies but only a few of these studies focus on the crude oil return series and OPEC announcements. The new classes of the fractionally integrated family GARCH let us capture the long memory properties and examine the effect of OPEC decisions on persistence in both the WTI and Brent markets. Since the meeting decisions of OPEC affect the world's crude oil price, it is important to investigate and discuss the effects of these meetings. Recent empirical works examine the presence of structural breaks in crude oil markets, using the Bai and Perron (2003) test. Liao and Suen (2006) find significant changes in the global oil market over the period 1986–2004, supporting the evidence of a significant structural change taking place on November 12, 1999 which came after the oil glut caused by the 1997 Asian crisis. According to Liao and Suen (2006), the average WTI price was US\$ 19.02 per barrel before the structural change and US\$ 30.90 per barrel after the change. Moreover, they find two structural breaks for the price volatility, while the price is rather stable in the middle period. Arouri et al. (2010) investigate the dynamic behavior of crude-oil prices in four countries of the Gulf Cooperation Council (GCC) for the period February 1997 to January 2010 and find supporting evidence of short-term predictability in the oil-price

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