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Long run dynamic volatilities between OPEC and non-OPEC crude oil prices ☆

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HIGHLIGHTS

- We investigate asymmetric-dynamic mechanisms of OPEC and non-OPEC crude oil prices.
- Such dynamics are explored using original ECM within threshold cointegration modeling and CGARCH errors.
- OPEC couldn't drive down (up) crude oil prices with alike speed for all producers.
- Conditional volatility has long memory and shocks on long run component decay slowly.
- The speed-adjustments show evidence for distinct competitive behaviors between OPEC and non-OPEC.

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ABSTRACT

Understanding the long-run dynamics of OPEC and non-OPEC crude oil prices is important in an era of increased financialization of petroleum markets. Utilizing an ECM within a threshold cointegration and CGARCH errors framework, we provide evidence on the cointegrating relationship and estimate how and to what extent the respective prices adjust to eliminate disequilibrium. Our findings suggest that the adjustment process of OPEC prices to the positive discrepancies is slow which implies that OPEC producers do not prefer moderate oil prices; however, the reverse holds for non-OPEC producers. These results reflect distinct competitive behaviors between OPEC and non-OPEC producers.

1. Introduction and literature review

The increasing growth in demand for crude oil from economies such as China, India and the Middle-East has had an impact on the prices of oil, which reached a record level of $145 per barrel in 2008. Changes in the price of oil are increasingly significant and have influenced every economy around the world. The analysis of oil prices has always been of considerable interest to all people. Established in September 1960, the Organization of Petroleum Exporting Countries (OPEC) exercises enormous influence on the world prices of oil due to many factors, particularly its spare oil capacity of roughly 4 million barrels per day in 2014, based on an assumed 85% utilization rate.[1] Additionally, according to the International Energy Agency (IEA), non-OPEC countries had an excess demand of 35.5 million barrels per day in 2013[2]; this gap is satisfied with the oil supplied by the 12 members of OPEC.[3] In 2013, the non-OPEC share of global oil production was approximately 59.8% of the total world production of oil. Due to the non-OPEC excess demand-supply, it is a common belief that non-OPEC producers behave as price takers and that OPEC may play a central role in the world oil market by adjusting its production and setting the prices of oil. However, it remains the case that the dynamics in

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[1] Source: 2014 World Oil Outlook. OPEC, Austria. www.opec.org.
[2] Source: Oil Market Report, Annual Statistical Supplement, IEA. www.oilmarketreport.org.
[3] Filling such a gap requires OPEC members to coordinate their oil production policies through incremental capacities; these reactions help avoid sudden increases in crude oil prices. In addition, if supply outruns demand, over time OPEC will manage the excess capacity to avoid sudden decreases in oil prices. According to Smith [1], the oil demand and supply curves are highly inelastic in the short-run; shifts in the curves can lead to excessive price volatility.

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crude oil markets depend on their different market fundamental situations [2,3]. These dynamics are attributed to their price regimes such as Brent, West Texas Intermediate and OPEC Reference Basket. The oil market itself appears to be in charge of pricing.

There is a vast literature on the price of oil. Gately [4] establishes that the reductions in the world demand for oil following the increase in oil prices in the 1970 s have not been completely reversed by the price cuts of the 1980 s. De Santis [5] explains the volatility of crude oil prices by focusing on the quota regime as a primary characteristic adopted by OPEC agreements. Recently, Nakov and Nuño [6] incorporated the ample spare capacity and the volatile domestic production, as features of Saudi Arabia, into a general equilibrium model where the global oil market is modeled as a dominant producer with a competitive fringe. They find that Saudi Arabia produces a smaller amount of oil than its capacity given the oil price, allowing it to charge a markup over its marginal cost. Lin [7] finds oligopolistic behavior among non-OPEC producers and collusion among OPEC producers during the period 1970–2004. Hamilton [8] investigates the factors responsible for changes in crude oil prices by reviewing the statistical behavior of oil prices and the key features of crude oil supply and demand. He concludes that there is an increasing contribution of scarcity rent to the petroleum price. Li [9] shows that the non-OPEC production Granger-causes world oil prices and that the causation runs from the refiner acquisition cost of imported crude oil to OPEC production. He concludes that it is not appropriate to treat OPEC as a dominant firm. Additionally, Ji and Guo [10], using an event study methodology and an AR-GARCH model, show that the reactions of oil price returns to different OPEC production announcements are inconsistent.

Few of the previous works assume that the adjustment process is asymmetric. Moreover, a number of studies claim that there is an asymmetric relationship between the oil price followed by OPEC and non-OPEC countries [11–15]. Chen et al. [11] document new supportive evidence for asymmetric adjustment in United States retail gasoline prices. The asymmetric transmission is found to occur through the spot markets of crude oil and refinery gas and their future markets. A number of empirical studies have also been performed on price asymmetry for the North American markets, but the findings of these studies are mixed [16,17[4],18] According to Borenstein [19], oil price increases do not reflect a compensation mechanism for the weakness in the US dollar featured in a long-run declining trend of its purchase power. He indicates that, during 2007, the dollar lost approximately 10% against others major currencies whereas the price of crude oil in dollar increased roughly 50%, with oil prices being set based more on the balance of worldwide supply and demand. The existing empirical evidence in favor of (or against) price asymmetries in oil markets is skillfully summarized by Perdiguero-García [15], who conducts a meta-analysis of the related contributions and concludes that the smaller (higher) level of competition in the market displays higher (smaller) degree of price asymmetries. He states that asymmetries are more difficult to detect in analyses that cover a long period of time.

The variability in the crude oil price can be explained by OPEC and non-OPEC crude oil price volatilities and by their oil production variability. Nevertheless, even if financial trader activities are confined to the oil futures market, their speculative trading in spot markets can provoke oil price volatility [1,20,21]. According to Smith [1], the oil market share of financial traders increased between 2004 and 2008; meanwhile, the share of oil producers decreased during that span. Many authors (e.g., [1,22,23]) consider that non-fundamental factors such as speculative activities in the crude oil future markets, financial market risks and geopolitical conflicts may drive the short and long-run volatility of international crude oil prices. Based on fundamental factors, Wu and Zhang [23] question the effects from October 2005 to November 2013 of China's real crude oil net imports[5] and real monthly Brent oil spot price changes. They find that, in the short- and long-run, China's crude oil net imports do not significantly affect Brent price changes. However, using variance decomposition, they show that China's crude oil net imports contribute to Brent price volatility approximately 10%, that is, less than the US dollar exchange rate. Zhang and Wei [22] empirically analyze the asymmetric and dynamic impacts of various risk factors from January 1997 to July 2007 based on the weekly average returns in the US, UK, and Japan stock markets on the weekly US WTI futures oil price changes. They use the time-varying Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) to develop a dynamic factor model.[6] They find that the three stock market risks have significant time-varying effects and can exert asymmetric linear and non-linear shocks to the crude oil market in their up and down conditions and that the dynamic risk of the US stock market on the oil market has the largest volatility compared to the British and Japanese markets. By considering US fundamental oil macro-variables and the US industrial production index, Zhang et al. [24] find that rational bubbles[7] exist in the short-run dynamic of WTI crude oil prices, mainly around 2008. They explain that their findings are closely related to the new changes in international crude oil markets since the end of 2004, which consist of a vast number of investment hedge funds with implications for the financial feature of crude oil assets.

The changes in crude oil prices over time may be analyzed through the dynamic volatilities in the short and long-run. The hypothesis that we will evaluate is that the increase in OPEC crude oil price volatility can be attenuated by the decrease in non-OPEC oil price volatility and vice versa. We expect that the OPEC dynamic volatilities of oil prices cannot be the main source of price variability in comparison to the non-OPEC prices. We explore the magnitude of the extent to which the OPEC and non-OPEC price series mutually interact to reveal the competitive nature in the oil market by using nonlinear cointegration and determining their reactions to positive or negative discrepancies (i.e., oil prices that are too high or too low) in the short and long-run. Considering the dynamic volatilities in short and long-run, we suppose that the permanent component of volatility is more persistent than the transitory volatility, even if the latter has higher volatilities. However, it remains the case that these transitory volatilities impact the long-run oil price process. According to Mensi et al. [2], the presence of structural breaks reduces the persistence of volatility and improves the understanding of such volatility in oil markets.

Our contribution to the recent related literature consists of exploring, through a new modeling approach, the ECM-TAR (MTAR)-CGARCH analytical framework.[8] This approach investigates whether the prices of oil for both groups are cointegrated, with the

[4] They study the implications of spatial crude oil price divergence for the price of refined products in the US. By using monthly spot crude oil prices, they conclude that the transport constraint has caused a large price differential in crude oil. They show that the decrease in the US Midwest crude oil price has not been passed through to the refined product prices, namely, gasoline and diesel.

[5] According to the US EIA (Short-Term Energy Outlook, May 2015), China is the top annual world oil net importer.

[6] The influence of stock market risk is based on the excess oil price return defined as weekly US WTI oil price returns minus the risk-free returns approximated by weekly returns of 3-month US T-bills. Also, the excess stock market return is calculated by subtracting the weekly return of 3-month US T-bills from the stock market return.

[7] According to Lammerding et al. [25], Zhang et al. [24] define a bubble as an asymmetric, non-linear and non-stationary deviation of crude oil prices from the fundamental values.

[8] This new framework combines the ECM with the asymmetric cointegration and CGARCH errors structure (more details are in Appendix A.1.2). It leads to a parsimonious representation of some stylized features of the OPEC and non-OPEC prices, such as the time-varying volatility and volatility clustering.