

WTI and Brent crude oil markets: A dynamic analysis of the price differential

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Overview

WTI and Brent futures have become two major hedging instruments for crude oil. The historical relationship between the prices of these two contracts has exhibited an interesting evolution and reverting points. Motivated by this phenomenon, this paper offers a two-fold investigation. First, we break down the WTI-Brent price differential by analysing possible contributing factors. Second, we employ econometric techniques to analyse the changing nature of the long-term relationship between the prices of WTI and Brent contracts. Special focus is put on examining the role of Markov-switching cointegrating relationships. This methodology allows for identifying different equilibrium relationships, each associated with a different speed of adjustment and dynamic characteristics.

The price differential between these WTI and Brent crude oils has been affected by several economic factors. As the demand for crude requires delivery at specific locations, the geographical composition of demand relative to its supply affects the premium or discount of each specific contract. In the US, WTI oil produced by US and Canadian firms is delivered to a pipeline hub and storage facility in Cushing, Oklahoma. In recent times, the oil pipeline, bunker, rail and road transportation constraints to move oil from Cushing has led to substantial increases in inventories. As Cushing stocks build up, storage cost tends to push WTI prices up. Under the trading rules, the NYMEX provides a mechanism by which the delivery of WTI crude can be replaced by alternative international crudes including Brent Blend at a set premium or discount, as these international crudes have delivery locations.

Although the above constraints in the US crude oil market explain a great deal of the recent changes in the price differential, there are other factors to be considered. Essentially, WTI and Brent contracts offer two different types of crude oil that are used for producing different fuels and petroleum derivatives. A substantial amount of Brent crude is used for the production of diesel fuel in Europe. Demand for diesel and other oil products in Europe have been affected by the recent economic slowdown which is also associated with a high degree of uncertainty. In addition, later development of shale oil and gas and infrastructure in the US has alleviate pressure on Cushing inventories, although they may not be enough for completely eliminating the gap.

Methods

Our main tool for analysing the crude oil price differential is a Markov-switching error correction model that takes into account a transition through several long-term equilibrium relationships. This methodology provides more insights than a simple visual inspection of the WTI-Brent price differential. In the proposed cointegration model, we used the two price series in levels incorporating information about common trends that would be lost in the price differential or with differenced prices. We argue that the long-term historical relationship between WTI and Brent prices is not constant. Markov-switching techniques allow for detecting several regimes and endogenously inferring the dates of transition from a common shared trend and another one.

The Markov-switching error correction model used in this paper is rarely seen in the literature, partly due to its complexity. To the best of our knowledge, this methodology has not been applied to crude oil prices. Markov-switching cointegrating models were proposed by Krolzig (1996, 1997) and Krolzig & Toro (1999). Further applications and extensions of the baseline model are found in Camacho (2005), Clarida et al. (2003, 2006), Sarno & Valente (2005) and Krolzig et al. (2002), although none of these applications refers to energy markets.

A recent study by Robredo (2011) has shown the importance of asymmetric effects for crude oil prices. This author argues that prices are linked with the same intensity during “bull” (periods of generally increasing oil prices) and “bear” markets. With a different methodology, this paper re-examines the possibility of asymmetric adjustment from a different angle.

Results

Our econometric model allows for a more detailed interpretation of the historical relationship between WTI and Brent oil prices. First, we are able to statistically infer distinctive long-term relationships and provide some dynamic analysis. Using this framework, we are able to identify different speeds of adjustments to the long-run relationship when the individual prices are affected by idiosyncratic shocks. The identification of regimes in our model also allows for identifying those shocks that had a rather permanent effect on the cointegrating relationship (as opposed to rather transitory shocks).

Second, by matching the regime classification with periods of generally increasing or decreasing prices, we are able to re-assess Robredo’s (2011) claim that there are asymmetric adjustment dynamics are negligible. Asymmetric adjustment of crude oil prices is a novel aspect in this paper and has not been previously analysed in the context of the proposed model. However, with similar methodology to ours, Camacho (2005) and Krolzig et al. (2002) have been able to analyse asymmetries in the business cycle with macroeconomic data.

Conclusions

The historical relationship between WTI and Brent crude oil prices is a changing, reverting process. This price differential obeys to a number of factors. From an econometric perspective, the identification of long-run regimes and dynamic adjustment associated with them can be analysed with a Markov-switching error correction model. Our results provide interesting insights into both the dynamics of distinctive regimes and the asymmetric effects of increasing (decreasing) oil prices. Overall, this paper provides its audience with a summary of how different events have affected the equilibrium relationship and adjustment dynamics for these two benchmark prices and how prolonged periods with positive or negative price trends have affected this process.

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