PHYSICAL MARKET AND WTI/BRENT PRICE SPREAD

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Overview

West Texas Intermediate (WTI) and Brent Crude are primary benchmarks in oil pricing. WTI is produced and primarily used as a benchmark in the U.S while Brent is produced in Europe and serves as an international crude oil benchmark. Despite difference in locations, WTI and Brent are of similar quality(both of them are light (low density) and sweet (low sulfur) crude oils) and are used for similar purposes. Under oil market globalization assumption (Weiner, 1991), supply and demand shocks to oil prices in one region can be transferred into other regions quickly, therefore prices of crude oils with same quality move closely together all the time. However, empirical evidence shows that notable variations exist in WTI/Brent spread, particularly after 2010, creating risks as well as potential arbitrage opportunities for oil market participants.

In this paper, we study the dynamics of WTI/Brent price spread for the period between 2004 and 2015 and investigate how WTI/Brent spread responds to different types of physical market shocks. First, a procedure suggested by Bai and Perron (1998, 2003) is used to test for structural breaks in WTI/Brent price spread. It is found that WTI/Brent price spread changed from a stationary time series to a non-stationary time series in 2010, which is consistent with our observation. Then we examine the impacts of physical-market fundamentals on the dynamics of WTI/Brent price spread. A Structural Vector Autoregressive Model (SVAR) is estimated to show how WTI/Brent price spread responds to different shocks in physical market, including shocks in WTI and Brent supply, US and international demand and inventory at Cushing.

Methods

Bai and Perron (1998, 2003) test is used for detecting structural breaks in WTI/Brent price spread. Then the augmented Dickey-Fuller (ADF) test will be applied to each sub-sample period separated by the breakpoints estimated in the previous section to check for unit roots in each sub-sample.

Following Killian (2011), a Structural Vector Autoregressive Model (SVAR) is set up for each sub-sample separated by structural break. The SVAR model is identified using recursiveness assumption.

Results

Bai and Perron (1998, 2003) shows that there exists a structural break in WTI/Brent price in December 2010, with a 95% confidence interval ranging from August 2010 to January 2011.

SVAR model is estimated for two sub-sample periods separated by the structural break interval. The first sub-sample period spans from January 2004 to August 2010 and the second lasts from January 2011 to December 2015. Then the impulse response function graphs are produced to show how WTI/Brent spread responds to unanticipated shocks in each physical market variable. The impulse response function graphs show that among 4 physical market variables, WTI/Brent spread only has statistically significant response towards unanticipated shocks in inventory, with a negative sign. And the effect peaks in the second month for the first sample period and peaks in the first month for the second sample period. After the first few months, the impact of inventory shocks on WTI/Brent spread generally fades away.

Conclusions

Based on the structural break test, it is verified that WTI/Brent spread changes from a stationary time series to a nonstationary time series in December 2010. Examing two sub-sample separately by the structural break, it is found that inventory quantity at Cushing is the only physical market variable that has significant impact on WTI/Spread.

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