

International Oil Market Risk Anticipations and the Cushing Bottleneck: Option-implied Evidence

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A. The motivations underlying the research:

WTI (US) and Brent (Europe) are the world's two most important crude oil indexes. Prior research has found they have not achieved complete integration due to macroeconomic, production, and transportation infrastructure frictions. From a practitioner's point of view, it matters to what extent the two indexes are substitutes for one another, whether risk anticipations are similar in the two markets and how they are transmitted, or whether managers can hedge or diversify extreme risks--such as those linked to supply disruptions or economic slowdowns. This paper's objective is to contribute to a better understanding of how Brent and WTI risk expectations are related, how they co-move, in which market they are formed (discovered) and transmitted, and how risk equilibria can become weakened or fragmented during crisis periods. The results should deepen our knowledge of international oil market integration and have clear practical implications for portfolio diversification, cross-hedging, forecasting, and risk management. The paper also pays special attention to the impacts of the Cushing bottleneck on market risk expectations.

B. Short account of the research performed:

This paper investigates the equilibrium dynamics in prices and risk anticipations in crude oil markets between WTI and Brent over the period 2006-2019. We compute daily time series observations of option-implied WTI and Brent volatility, skewness, and kurtosis, thereby obtaining new risk metrics to capture market expectations of evolving risks. We analyze these variables pairwise using a bivariate time series system highlighting the channels of international linkages and risk spillovers. The framework we use is the fractionally cointegrated VAR (FCVAR), which generalizes classic cointegration to allow for variables that are stationary but display long memory. We interpret the estimates and the hypothesis tests to assess the degree of oil market integration. This framework allows us to measure long- and short-run adjustments to and analyze them using formal hypothesis tests, documenting comovement and spillovers between WTI and Brent. First, we test whether there is an international equilibrium (a cointegration relation) in investor anticipations of volatility, asymmetric risks, and tail risks. Second, we investigate whether significant WTI-Brent spreads in prices and risk metrics are supported in the long run. Third, we perform weak exogeneity tests to assess speeds of adjustment in the model. These tests have practical relevance because they highlight the adjustment process following disequilibrium between the two markets. Finally, we measure Brent and WTI discovery (information) shares for prices and risk expectations. The results describe whether news about prices and risk expectations tend to originate more in a specific market, or whether both markets contribute information equally.

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C. Conclusions

This study provides four important conclusions:

- i) Persistence (long memory) matters for crude oil markets. This paper documents ‘limits to arbitrage’, as we find that market disruptions can have a lasting effect on oil prices. We also document that risk anticipations are persistent in crude oil markets and that accounting for persistence is required in order to effectively model risk dynamics.
- ii) International oil markets are partially integrated in risk expectations, as they share a common equilibrium *ex ante*. Brent-WTI risk expectations are integrated over the full sample period, but they diverge during the Cushing bottleneck sub-period.
- iii) Fragmentation of the common oil market equilibria, associated to the Cushing bottleneck. We document a volatility differential during this period. The joint market dynamics for extreme risks appears to matter less than regional constraints.
- iv) The Brent-WTI relationship in risk expectations holds across investment horizons, but it is more fragile for extreme risks valued at longer horizons.

D. Potential benefits and applications:

These conclusions lead to several practical implications:

- a) Despite partial integration, WTI and Brent are not substitutes for one another to cross-hedge volatility or extreme risks. However, there is a silver lining. Diversification across indexes for extreme risks may be possible during periods of disruption, as the joint dynamics breaks and investor risk anticipations regarding oil indexes are more locally driven.
- b) Oil market risk forecasts could be improved using the combined information from both indexes rather than from only one market and by using the forward-looking information provided in the option markets. Indeed, using option data is advantageous because it is challenging to measure higher moments accurately using historical price data.
- c) Brent plays an increasing international role, but the discovery of extreme risk anticipations still occurs mostly on the WTI index. These findings underscore for crude oil markets the importance of accounting for higher-order moments, which behave differently than expected in a traditional risk-return asset allocation strategy.
- d) Understanding the joint dynamics of crude oil higher moments is valuable for modeling and forecasting purposes, even though the relationship is harder to capture at longer horizons.