Exploring the relationship between crude oil spot and futures prices: New perspective from multi-scale decomposition

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The price discovery mechanism between futures prices and spot prices in oil markets has been a controversial subject for decades. Due to the different patterns between various scales of oil prices, this paper targets this issue from a multi-scale perspective, which is different from previous studies. With the help of MEMD and PDC, we re-examine the relationships between spot and futures oil prices of WTI. The MEMD method decomposes the prices into short-run oscillatory modes and long-run trend modes, and then PDC is applied to explore causality in the frequency domain. In the empirical analysis, the role of futures markets in providing an efficient price for the spot market is verified. This price discovery mechanism varies according to the analyzing scale: 3-month futures prices lead the spot and 1-month futures prices primarily in high-frequency oscillatory modes, while 1-month futures prices lead the two other prices in lower-frequency oscillatory modes. Our findings reveal a deeper dependence structure between spot and futures prices for crude oil and hence may provide helpful guidance for investors and policy makers.

Keywords: Crude oil price; price discovery; multivariate empirical mode decomposition; partial directed coherence