

ONE GREAT POOL, BUT WITH VARYING DEPTH: DYNAMIC EFFICIENCY OF GLOBAL CRUDE OIL MARKETS

Marc Gronwald, International Business School Suzhou, Xi'an Jiaotong-Liverpool University, CESifo and ifo Institute, +8651288161717, marc.gronwald@xjtlu.edu.cn
Kingsley E. Dogah, International Business School Suzhou, Xi'an Jiaotong-Liverpool University, +8613401443797, kingsley.dogah@xjtlu.edu.cn
Sania Wadud, Department of Economics, University of Essex, sania.wadud@essex.ac.uk

Overview

This paper deals with informational efficiency of global crude oil markets. It applies the quantitative measure for market efficiency recently proposed by Duan et al. (2021) in order to quantify the degree of informational efficiency of the following five crude oil price series: West Texas Intermediate, UK Brent, Bonny Light, Dubai, and Tapis. These price series represent five important oil producing regions: North America, North Sea, West Africa, Persian Gulf, and Asia Pacific. Note that UK Brent is also considered a global benchmark.

It contributes to two important streams of literature. The first is the literature on integration of crude oil markets which is epitomised by recent contributions such as Plante and Strickler (2021) as well as Bravo Caro et al. (2020). The main question this literature is concerned with is whether or not the world oil market is "one great pool". It is a unique feature of this market that crude oil is seemingly a homogenous product and, thus, the price for this product should not differ across markets in which crude oil is traded. However, the crude price series analysed in this paper not only represent different regions, there are also certain quality differences across the different streams of crude. West Texas Intermediate, to provide just one example, is sweeter than UK Brent¹. To express this differently, this literature is concerned with the question whether the oil market is globalised or regionalised. The two papers mentioned above reflect the two main approaches used in this literature: While Plante and Strickler (2021) uses so-called differentials between different crude oil price series, Bravo Caro et al. (2020) apply cointegration-type approaches in order to analyse the relationship between two crude oil prices. This paper adds a new perspective to this literature by investigating whether or not the markets in question also differ in their degree of efficiency. To be more precise, the paper investigates whether or not these markets became more efficient over time and in comparison to each other.

This leads to the second contribution this paper makes: It also contributes to the literature which deals with empirical tests of the so-called Efficient Market Hypothesis (EMH). Among the most recent contribution to this literature is Assaf et al.'s (2021) analysis of the efficiency of art markets, Hull and McGroarty's (2014) analysis of financial markets in emerging economies, and Urquhart's (2016) investigation into the inefficiency of the Bitcoin market. As this paper is concerned with the degree of efficiency, the application of a quantitative measure is required. Duan et al. (2021) is useful in this regard. The advantage of market efficiency measures such as that it allows one to compare the *relative degree of efficiency* of one market over time or of different markets, e.g. ones which are geographically separated. The extant qualitative ones such as variance ratio tests, in contrast, only allow one to test whether a certain market is *efficient* or *not efficient* in a certain period.

Methods

The idea of a deviation from a random walk takes centre stage in the vast literature that empirically tests the (weak-form) EMH. The conventional view is that a deviation from a random walk in financial time series implies predictability, which is not in line with the notion of efficient markets according to which all publicly available information is reflected. Assaf et al. (2021), for example, use long-memory models, fractal dimension, and approximate entropy to analyse a possible deviation from a random walk and, thus, weak-form efficient markets. Hull and McGroarty (2014) apply the Hurst-Mandelbrot-Wallis rescaled range measure in their analysis of emerging markets while Urquhart (2016) resorts, among other methods, to the established variance ratio test. These papers' contribution lies in their analysis of under-researched or newly emerged markets; the methods they apply are already established in the literature. This catalogue of methods, however, is still being expanded upon. Recently, Kristoufek and Vosvrda (2013) proposed the so-called Efficiency Index which measures the distance from the efficient market situation using Hurst exponents, fractal dimension, and approximate entropy. Kristoufek and Vosvrda (2014) apply that method in their analysis of various energy as well as metal markets. The method used in this paper, Duan et al.'s (2021) novel measure for market efficiency, is based on the new interpretation of fractional integration. In that

¹ See Plante and Strickler (2021) for an excellent discussion of these different markets and crude streams.

approach, the order of integration d of a time series can be a fractional number between 0 and 1. Duan et al. (2021) gauge the degree of efficiency of a market using the absolute difference between the estimate of d and 1. This paper employs the so-called Feasible Exact Local Whittle estimator.

Results

The main findings of this paper are the following: (1) there is evidence of time-varying informational efficiency in the crude oil markets under consideration. Efficiency is found to be low in particular during extreme oil price episodes 2008-2009, 2014, and 2020. (2) There is also evidence of differences in informational efficiency across markets.

Conclusions

The paper finds that these markets are efficient to different degrees. Thus, even though the global crude oil market is considered “one great pool”, the regional markets under consideration exhibit different degrees of informational efficiency.

References

- Assaf, A., Kristoufek, L., Demir, E., and Kumar Mitra, S. (2021). Market efficiency in the art markets using a combination of long memory, fractal dimension, and approximate entropy measures. *Journal of International Financial Markets, Institutions and Money*, 71:101312.
- Bravo Caro, J. M., Golpe, A. A., Iglesias, J., and Vides, J. C. (2020). A new way of measuring the WTI Brent spread. Globalization, shock persistence and common trends. *Energy Economics*, 85:104546.
- Duan, K., Li, Z., Urquhart, A., and Ye, J. (2021). Dynamic efficiency and arbitrage potential in Bitcoin: A long-memory approach. *International Review of Financial Analysis*, 75(Zeming Li):1-47.
- Hull, M. and McGroarty, F. (2014). Do emerging markets become more efficient as they develop? Long memory persistence in equity indices. *Emerging Markets Review*, 18:45-61.
- Kristoufek, L. and Vosvrda, M. (2013). Measuring capital market efficiency: Global and local correlations structure. *Physica A: Statistical Mechanics and its Applications*, 392(1):184-193.
- Kristoufek, L. and Vosvrda, M. (2014). Commodity futures and market efficiency. *Energy Economics*, 42:50-57.
- Plante, M. and Strickler, G. (2021). Closer to one great pool? evidence from structural breaks in oil price differentials. *Energy Journal*, 42(2):1-30.
- Urquhart, A. (2016). The inefficiency of Bitcoin. *Economics Letters*, 148:80- 82.