

Evaluating the Globalization-Regionalization Hypothesis in Crude Oil Pricing through Cointegration Tests

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Abstract

This paper investigates the competing globalization versus regionalization hypothesis within global crude oil markets from 1990 to 2021. Utilizing a cointegration framework, the study examines the long-run equilibrium relationships between the three global benchmarks: Brent, West Texas Intermediate (WTI), and Dubai. Unit root testing via the Phillips-Perron method confirms that all three series are non-stationary and integrated of the same order. Subsequent application of the Phillips-Ouliaris cointegration test reveals a statistically significant long-run relationship among the benchmarks. These findings suggest that despite short-term regional decoupling caused by logistical constraints or localized geopolitical shocks, a stable linear combination exists, rendering the global crude oil market a single, integrated great pool. The results have significant implications for international arbitrage strategies and energy policy.

Keywords: Regionalization, Cointegration, Crude Oil Benchmarks

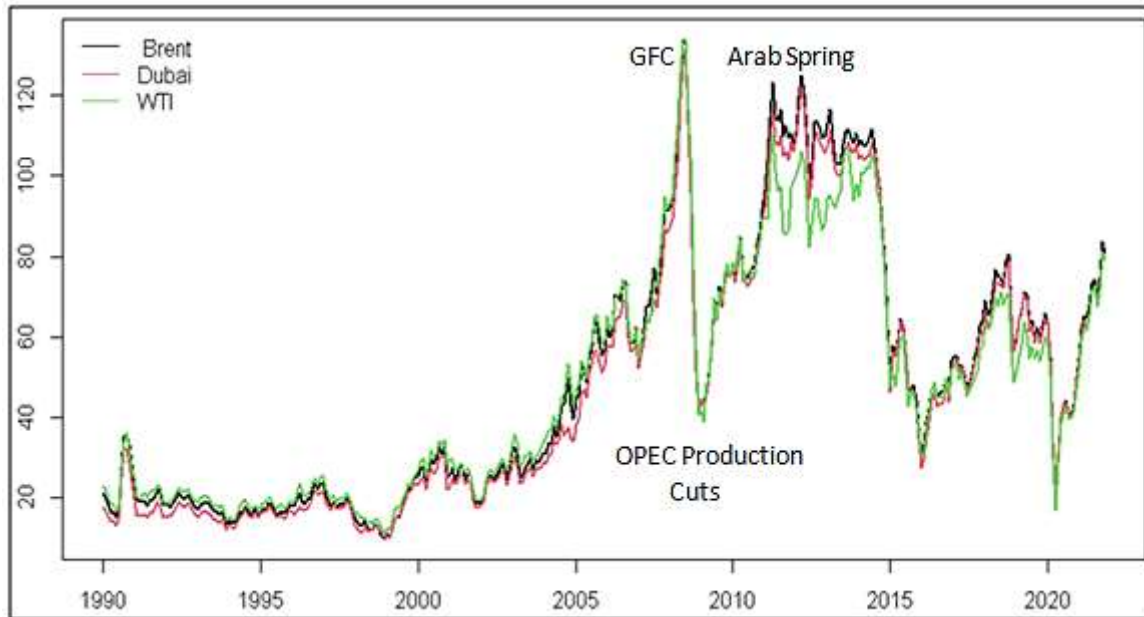
1. Introduction

The nature of the global crude oil market remains a subject of intense academic and geopolitical debate. Adelman (1984) characterized the world oil market as "one great pool," suggesting that crude oil is a highly globalized commodity where a supply shock in one region instantaneously affects prices in another. However, this hypothesis has been frequently contested in the energy literature. Critics like Weiner (1991) argue that the market is highly regionalized and there is very little evidence of integration.

Understanding whether crude oil is a globalized or regionalized commodity has profound implications for market efficiency (Fattouh, 2010). Figure 1 shows movements in benchmark crude oil prices. Major events like the global financial crisis, Arab Spring and OPEC production cuts tend to have a similar impact on all leading crude oil benchmarks.

Crude oil is the biggest commodity market in the world today. Price discovery is essential for market functioning. Price reporting agencies determine prices based on spot, future and swap transactions. Several benchmarks have emerged over the years providing signals for contract pricing. Brent Crude, Dubai Crude and West Texas Intermediate (WTI) are the key Crude Oil benchmarks. These benchmarks serve as the reference points for majority of the world's physical oil trade. The spread between the key benchmarks is an indicator of imbalances building up in the system.

Figure 1: Global Crude Oil Prices (US dollars per gallon)



Source: Based on FRED Data, Federal Reserve Bank of St. Louis

The International Crude Oil Market Handbook (2019) has profiled about 200 internationally traded crudes. New grades are being added from time to time. The two main quality characteristics of crude oils are density and sulphur content (See Table 1). EIA defines less than 1 percent sulphur as sweet. Light sweet grade requires little refining upgradation to high value products like petrol. Brent complex, crude drilled from the North Sea oil fields, is used to settle the majority of the world’s crude oil contracts. With a sulphur content of 0.37% and API gravity of 38, Brent is a light sweet crude. Platts Dubai, a medium sour crude, is primarily used for benchmarking oil exported from the Middle East, Gulf, Mexico, Russia among others (S&P Global Platts, 2021). West Texas Intermediate (WTI) is a sweet crude blend with a sulphur content of 0.24% and API gravity 39.6 produced in the United States. Other important oil markers include OPEC Reference Basket used by OPEC. India has its own price marker which is a combination of Brent Crude and Dubai and Oman Crude.

Table 1: Key Quality Characteristics of Crude Oils

	Sulphur Content (%)	API Gravity °
Brent	0.37	38
WTI	0.24	39.6
Dubai	2	31

Source: Energy Intelligence Group—International Crude Oil Market Handbook

This study aims to test the validity of the regionalization-globalization hypothesis over a thirty-year horizon from 1990 through 2021. An attempt is made to investigate whether these geographically and

qualitatively distinct benchmarks share a common stochastic trend resulting in a unified global market in the long run by employing a cointegration framework.

The remainder of this paper is organized as follows: Section 2 reviews existing literature on long run comovement of crude oil benchmarks prices. Section 3 provides a description of the data. The results of the unit root and cointegration test are presented in section 4. The final section concludes the paper.

2. Review of Literature

The globalization-regionalization debate pertaining to the crude oil markets has received significant attention in energy literature. Numerous studies have been conducted to study the linkages between crude oil prices across regions. Hammoudeh et al (2008) found a long run relationship between four benchmarks Brent, WTI, Dubai and Maya. Fattouh (2010) employed a two-regime threshold autoregressive method to model crude price differentials. Reboredo's (2011) investigation of dependence between crude oil markets using copula functions provided evidence of globalization. The results suggested that the adjustment process holds above threshold levels. Wilmot (2013) studied cointegration between global and regional monthly crude oil spot prices over the period 1991 through 2012 and found that the regional crudes of similar and different grades were cointegrated. Threshold cointegration method showed long run relationship between Brent-WTI and WTI-Oman (Mann et al, 2016). Mastroeni et al (2021) studied major coupling and decoupling events that impact WTI and Brent price movements using Dynamic Time Warping algorithm. WTI local market conditions played a crucial role in coupling and decoupling of prices. Kuck & Schweikert (2017) employed a Markov regime-switching model to test the long run relationship between major crude oil prices. The study provided strong evidence of integration in crude oil markets. Liao et al (2014) applied the quantile unit root method to study the regionalization-globalization hypothesis and found mean reversion between price differentials of WTI and Brent Crude, thereby supporting the globalization hypothesis. Bhanja (2022) studied seven global crude oil benchmarks using Bayesian inference dynamic correlation technique and found significant correlation over the sample period. Some authors found that the time horizon is critical for the analysis of the relationship between the benchmarks. Bhanja (2018) used Wavelet Coherence approach to test the hypothesis and found that the crude oil markets remained integrated over longer time horizons but were regionalized in the short run.

3. Data

The long run movement of the three leading crude oil benchmarks Brent, WTI and Dubai will be tested. This study uses a monthly time series of global prices of Brent Crude, WTI Crude and Dubai Crude in US dollars per barrel over the period 1990 to 2021 obtained from Fred datasets. A unit root test of stationarity is conducted. The long term synchronicity between the time series is tested by conducting Phillips-Ouliaris Test.

4. Results

Stationarity of the time series is tested by conducting a Unit Root Test. The null hypothesis is that the series contains a unit root (non-stationary). Table 2 presents the results of the Phillips -Perron Test. Brent, WTI as well as Dubai crude oil price series were found to be nonstationary.

Table 2: Results of Phillips Perron Test

	Z(alpha)	Truncation Lag Parameter	p-value
Brent	-13.344	5	0.3635
WTI	-16.006	5	0.2145
Dubai	-13.411	5	0.3597

Table 3: Phillips - Ouliaris Cointegration Test Result

Test Statistic	p-value
Phillips-Ouliaris demeaned = -66.835	0.01
Truncation lag parameter = 3	

The order of integration of the three time series datasets is determined. All the three series were found to be I (1). A Phillip-Ouliaris cointegration test is conducted (See Table 3). The results in Table 3 indicate that the null hypothesis of no cointegration is rejected. The linear combination of the three time series datasets is stationary. This confirms that a stable, long-run equilibrium relationship exists between Brent, WTI, and Dubai crude prices.

5. Conclusion

This study investigated globalization-regionalization hypothesis and the long-run price dynamics of the three global crude oil benchmarks- Brent, WTI, and Dubai, over a thirty-year period from 1990 to 2021. Phillips-Perron unit root test and the Phillips-Ouliaris residual-based cointegration approach was employed in this study. The empirical evidence suggests that despite differences in chemical composition API Gravity and Sulfur content and regional logistics, these markets are highly integrated. Thus, this research supports Adelman's (1984) of a globalized market for crude oil. The presence of cointegration implies that any price divergence caused by regional shocks like, for example, geopolitical tensions in the Persian Gulf is temporary. Arbitrageurs eventually force the prices back toward a common equilibrium. From policy perspective, a high degree of cointegration implies that monitoring any single benchmark will provide a reliable signal for the overall trend of global energy costs.

A major limitation of this study is that it does not account for structural breaks in the time series data over the sample period. Future research must take into account such abrupt and unexpected shifts in the time series as well as the speed of adjustment following a geopolitical shock.

6. References

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