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# Saudi Crude Oil Price Integration with World Main Markets and the Law of One Price

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**Abstract.** This paper aims to test the co-integration of Saudi Light Crude Oil (SAL) prices with the major world markets: Dubai Vetch (DV), West Texas Intermediate (WTI), and Europe Brent Spot (EBS). The study uses Johansen and Juselius' (1990) co-integration and vector error correction (VECM) methods to determine if these markets are co-integrated, the markets' degree of response to one another, and whether the law of one price (LOP) holds true. The results of the study indicate that all four markets are co-integrated. In the VECM estimations, the average value of the error-correction coefficients in the four estimated equations is 0.18, which means that a 1% deviation from equilibrium leads to a 0.18% price adjustment in the long-run equilibrium. The short-run coefficients are not significant in all equations; the one exception is for WTI, indicating that WTI's price of influences the others' prices but not vice versa. Thus, a unidirectional causality runs from WTI's price to the others' prices. In addition, the LOP was completely refuted in all tested markets.

## 1. Introduction

Crude oil is the primary energy source for the entire world. International trade and crude oil prices have profound effects on the macroeconomic environment and the welfare of all countries. It can be argued that oil markets are globalized, or integrated, because supply-and-demand shocks that affect prices in one region are transmitted to other markets. Globalization causes the prices of similar crudes in different markets to move together while the price differentials remain constant. Globalization, or market integration, means that prices must be associated. In addition, full market integration means that price differences will occur only in the transaction cost. Maximum integration of markets leads to price unification in the markets and what is called the law of one price (LOP). LOP states that, under free trade conditions (e.g., no tariffs, quotas), transportation costs are low relative to the value of products (e.g., gold, oil, rice). Therefore, in a competitive market, identical products sold in different markets will sell for an identical price, expressed in the same currency. The LOP for homogeneous commodities can be stated as:

$$P_{i,t}^{1} = e_t P_{i,t}^{2} \quad (1)$$

where $P_{i,t}^{1}$ is the domestic currency price of good *i* at time *t*, $P_{i,t}^{2}$ is the foreign currency price of good *i*, and $e_t$ is the exchange rate at time *t*, defined as the home-currency price of foreign currency. Since crude oil is sold in international markets priced in the U.S. dollar, Eq. (1) could be written as:

$$P_{i,t}^{1} = P_{i,t}^{2} \quad (2)$$

Stigler (1969) showed that, under the conditions of perfect competition, the price of a commodity in one geographical market is equal to the price in another geographical market, plus the cost of transportation. For two markets (market 1 and market 2), the cost of transportation from market 1 to market 2 is written as *C*, and the price in market 2 is expressed as:

$$\mathrm{P}^2 = \mathrm{P}^1 + \mathrm{C} \quad (3)$$

The basic operation of the LOP should not change substantially. Although prices will no longer be identical, they will vary by a certain constant value. Arbitragers aim to benefit from price differences, and thus their efforts ensure that prices do not deviate from this constant ratio.

The logic of the LOP assumes that an arbitrager purchases a commodity from one location and sells it in another location for a higher price than that for which it was purchased. Profit seeking drives prices in multiple locations to converge, less any transportation and transaction costs that are needed. Arbitrage practices make prices converge. For the LOP to hold true, a market must be competitive, and no monopoly or monopsony power can exist. Otherwise, noncompetitive power will generate a noncompetitive equilibrium, and the LOP cannot prevail.

Krugman and Obstfeld (1997) stated the LOP thusly: "The law of one price states that in competitive markets free of transportation costs and official barriers to trade (such as tariffs), identical goods sold in different countries must sell for the same price when their prices are expressed in terms of the same currency." A trade barrier is a general term that describes any government policy or regulation that restricts international trade. Trade barriers include import duties, import and export licenses, quotas, tariffs, subsidies, and other means of discouraging international trade whose net outcome is to raise prices.

Isard (1977) explains the conditions in which the LOP holds true. First, the products in different markets are nearly identical, so any price disparities are eliminated rapidly by arbitragers. Second, with no restrictions on commodity arbitrage, a product from any single market sold competitively in two different markets (countries) also follows the LOP, since the prices in the two markets differs only by the cost of transportation between them.

Miljkovic (1999) explains that price convergence can be disrupted by certain factors in international trade, including exchange rate risk, the currency of export prices, price responses to exchange rate changes, transportation costs, tariffs, non-tariff barriers, trade regionalization and other institutional factors, and market-specific pricing of exports due to differences in export demand elasticities across destination markets. Ardeni (1989) attributed the LOP's failure to three factors: institutional factors affecting price settings in different markets; the high cost of arbitrage, at least for short periods; and data errors.

Another constraint facing the LOP is bounded rationality, which holds that the rationality of market participants is constrained by the availability of information, their cognitive limitations, and the time needed for decision-making. Thus, bounded rationality prevents market participants from acting to eliminate price differences among markets.

The objective of this paper is to test the degree of integration of the Saudi Light Crude Oil (SAL) price with the major world crude oil markets—West Texas Intermediate (WTI), Dubai Vetch (DV), and Europe Brent Spot Price (EBS)—and to determine out if the LOP holds. The study employs co-integration and vector error correction model methodologies (VECM). The remainder of the paper is organized as follows: Section 2 reviews previous studies. Section 3 describes the data and details the empirical methodology, while Section 4 discusses the empirical results. Section 5 presents the conclusion.

## 2. Previous Studies

Many researchers have tested the LOP in numerous markets. Weiner (1991) found support for a high degree of regionalization, and Gülen (1999) showed that regionalization gives rise to arbitrage opportunities to benefit from price differences across local oil markets. The empirical evidence on globalized oil markets generated by simple correlation analysis and a switching regression system is conflicting. Mohanty *et al.* (1998) examined the LOP in international commodity markets using fractional co-integration analysis. Of the nine pairs of price series examined, fractional co-integration supported the existence of the LOP in eight cases, compared to three cases using standard co-integration procedures. Overall, these results suggest that the LOP has a long-run tendency to hold true for commodity prices. Milonas and Henker (2001) tested the price differential between Brent and WTI and found that their markets are not fully integrated. Engel and Rogers (2001) examined the operation of the LOP across U.S. cities and concluded that transportation costs and sticky nominal prices are the main causes of price deviations from equilibrium.

Outside oil markets, Goldberg and Verboven (2005) used a panel data set of car prices to study European market integration and found strong evidence of convergence toward LOP. Pinelopi and Frank (2005) investigated the relationship between integration and price convergence in international markets. Using a panel data set of car prices, they produced a strong evidence of convergence toward both the absolute and the relative versions of LOP. Vinuya (2007) used import price data from Japan, the United States, and the European Union to test whether shrimp price movements in these markets indicate an integrated world market for shrimp. The researcher employed co-integration techniques to determine if prices in these markets share a common stochastic trend and if LOP holds true. The study showed a strong connection among Japanese, American, and European markets, supporting the operation of LOP in shrimp markets. Khan and Ahmad (2009) tested the validity of LOP for Pakistan and Australia and performed co-integration analysis to assess the long-run validity of the LOP. They applied the approach of relative purchasing power parity to the analysis of exchange rate and relative prices. Covering 1972 to 1997, the study documented evidence generally supportive of LOP.

Zax and Heb (2011) investigated whether Chinese factor markets became more integrated in the period around World Trade Organization accession. They used 1998-2001 prices for 18 agricultural factors and 1999-2002 prices for 118 industrial factors, which varied significantly across 36 cities. Price variation declined temporarily for industrial but not agricultural factors. Ceglowski and Mawr (2003) investigated the behavior of intranational prices for 45 consumer commodities in 25 Canadian cities. They found that distance and provincial borders play positive roles in intercity price disparities and that a majority of intercity relative price series are stationary around small mean values, indicating that long-run price differences are close to zero. Eskandarpour *et al.* (2012) used the market co-integration approach to study the global market of meat imports and date exports and these markets' unit price test between 1961 and 2008. They concluded that the LOP operates in the global date market. However, importantly, no price co-integration was observed between global prices of red meat and Iran's imports market prices. IWAI (2011) investigated possible obstacles to the LOP in Japanese exchange-traded funds markets and suggested two major reasons for its failure in these markets: the difference in the speed of price discovery between the primary and secondary markets and idiosyncratic noise-trader risks, which prevent arbitrageurs from engaging in long-short arbitrage trading. Cruciniy *et al.* (2012) used micro-price data across U.S. cities to demonstrate that the volatility and persistence of deviations from the LOP are positively correlated with the distance between cities.

## 3. Data and Empirical Methodology

### 3.1. Data

The main series used in this study represent monthly spot price returns for crude oil from DV, SAL, WTI, and EBS in dollars per barrel. The data cover January 1988 to February 2012.

A number of interesting observations can be drawn from Table 1. All the descriptive data variables have extremely similar values, indicating a certain level integration among the markets. The standard deviation test showed that WTI has the lowest value (least fluctuation) and EBS the highest (highest fluctuation). The positive value for skewness of all series shows that the series distribution is skewed to the right. Kurtosis tests demonstrate all series are leptokurtic (kurtosis higher than 3); in other words, large changes tend to follow large changes and small changes tend to follow small changes in a process that dies out over time.

**Table 1. Description of data**

| | WTI | EBS | DV | SAL |
|---|---|---|---|---|
| Mean | 38.68110 | 38.14590 | 35.81100 | 37.28352 |
| Median | 25.62000 | 24.25000 | 22.77000 | 23.21000 |
| Maximum | 133.8800 | 132.7200 | 131.2200 | 129.6600 |
| Minimum | 11.35000 | 9.820000 | 10.05000 | 9.680000 |
| Std. Dev. | 27.56309 | 29.57047 | 28.82491 | 29.19186 |
| Skewness | 1.305137 | 1.396812 | 1.413386 | 1.408307 |
| Kurtosis | 3.723639 | 3.922041 | 3.945475 | 3.927041 |

### 3.2. Augmented Dickey-Fuller unit root test

The co-integration test was used to determine the nature of long-run relationships among non-stationary variables. Series variables are often non-stationary, so conventional regression analysis can generate spurious results. Consequently, unit root tests should be performed before selecting the analytical tool. This study used the most common approach, the Augmented Dickey Fuller (ADF) test which is based on calculating two equations (one with an intercept and one with an intercept and a trend):

$$\Delta p_t = \propto_1 + \propto_2 T + \propto_3 p_{t-1} + \sum_{i=1}^{p} \propto_{4i} \Delta p_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta\Delta p_t = \propto_1 + \propto_2 T + \propto_3 \Delta p_{t-1} + \sum_{i=1}^{p} \propto_{4i} \Delta\Delta \mathrm{p}_{\mathrm{t-i}} + \varepsilon_t \quad (5)$$

where $\Delta$ is the difference operator, $T$ is a time trend, $q$ is the lag length set to achieve white noise in the error term, and $\varepsilon_{1t}$ and $\varepsilon_{2t}$ are the stochastic error terms. When the series are in level form, the null hypothesis is $H_0{:}\alpha_1 = 0$ ($p_t$ is non-stationary), and the alternative hypothesis is $H_1{:}\alpha_1 < 0$ ($p_t$ is stationary). The null hypothesis is rejected if the t-statistic of $\alpha_1$ is less than the critical value.

### 3.3. Co-integration test

The study used Johansen and Juselius' (1990) co-integration test since the time series variables are non-stationary variables. Johansen (1988, 1995) and Johansen and Juselius (1990) utilized a maximum likelihood procedure to tests for the number of co-integration relationships and estimate the parameters of such co-integrated relationships. The Johansen co-integration procedure is based on estimating the VECM:

$$x_t = \theta_1 + \sum_{i=1}^{p} \theta_i x_{t-i} + u_t \tag{6}$$

Equation 5 could be rewritten in the following form:

$$\Delta x_t = \theta_1 + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + u_t \tag{7}$$

where $x_t$ is price vector in different markets, $\theta_1$ is the intercept vector, and $u_t$ is a vector white-noise process. $\Gamma$ is a matrix of coefficients and contains information about the short-run relationships among the variables. The matrix $\Pi$ includes the long-run information in the time series data. When the rank of $\Pi$ is $r$ and $r \leq n - 1$, then $\Pi$ can be decomposed into two $n \times r$ matrices, α and β, so that $\Pi = \alpha\beta$ is $\beta$, the matrix of co-integrating vectors. The elements of $\alpha$ are the VECM adjustment parameters.

To identify the number of co-integrating vectors, the Johansen-Juselius test uses two VAR modeling test statistics: the trace and the maximum eigenvalue test statistics. The trace test statistic is represented as:

$$Trace = -T \sum_{i=r+1}^{n} In(1 - \hat{\lambda}_i) \tag{8}$$

The trace test's null hypothesis is $r = 0$ co-integrating vectors against the alternative hypothesis of $n$ co-integrating vectors. The maximum eigenvalue test is represented as:

$$\lambda_{max} = -TIn(1 - \hat{\lambda}_{r+1} \tag{9}$$

This equation, on the other hand, tests the null hypothesis of $r$cointegrating vectors against the alternative hypothesis of ($r$ + $1$) cointegrating vectors.

### 3.4. Vector error correction model

Once co-integration between variables is established, an error-correction mechanism needs to be constructed to model the dynamic relationship. The aim of this model is to indicate the speed of adjustment from the short-run to the long-run equilibrium. VECM is a restricted VAR used with co-integrated, non-stationary series. When equilibrium conditions are imposed, the VECM describes how the model adjusts in each time period toward long-run equilibrium. Since the variables are assumed to be co-integrated, any short-run deviations from the long-run equilibrium prompt changes in the dependent variables in order to direct their movement toward long-run equilibrium. For this study, the VECM is expressed as:

$$\begin{aligned}\Delta In\mathrm{DV}_t = {} & \propto_1 + \propto_2 \Delta Ine_{t-1} + \propto_3 \Delta In\mathrm{DV}_{t-1} \\ & + \propto_4 \Delta InS\mathrm{AL}_{t-i} \\ & + \propto_5 \Delta In\mathrm{EBS}_{t-1} \\ & + \propto_6 \Delta In\mathrm{WTI}_{t-1} + \delta_i\end{aligned} \tag{10}$$

$$\begin{aligned}\Delta InSAL_t = {} & \beta_1 + \beta_2 \Delta Ine_{t-1} + \beta_3 \Delta In\mathrm{DV}_{t-1} \\ & + \beta_4 \Delta InS\mathrm{AL}_{t-i} \\ & + \beta_5 \Delta In\mathrm{EBS}_{t-1} \\ & + \beta_6 \Delta In\mathrm{WTI}_{t-1} + \varepsilon_i\end{aligned} \tag{11}$$

$$\begin{aligned}\Delta In\mathrm{EBS}_t = {} & \theta_1 + \theta_2 \Delta Ine_{t-1} + \theta_3 \Delta In\mathrm{DV}_{t-1} \\ & + \theta_4 \Delta InS\mathrm{AL}_{t-i} \\ & + \theta_5 \Delta In\mathrm{EBS}_{t-1} \\ & + \theta_6 \Delta In\mathrm{WTI}_{t-1} + \vartheta_i\end{aligned} \tag{12}$$

$$\begin{aligned}\Delta InWTI_t = {} & \gamma_1 + \gamma_2 \Delta Ine_{t-1} + \gamma_3 \Delta In\mathrm{DV}_{t-1} \\ & + \gamma_4 \Delta InS\mathrm{AL}_{t-i} \\ & + \gamma_5 \Delta In\mathrm{EBS}_{t-1} \\ & + \gamma_6 \Delta In\mathrm{WTI}_{t-1} + \nu_i\end{aligned} \tag{13}$$

where the four markets defined are the crude oil prices of DV, SAL, EBS, and WTI, and $e_{t-1}$ is the error correction term lagged one period, with coefficient $\propto_2$ as the measure adjustment of the model from the short-run to the long-run. The lagged coefficients of the dependent variable ($\propto_i$) measure the short-run adjustment.

## 4. Empirical Results

### 4.1. Augmented Dickey-Fuller unit root test

Before testing for a long-run equilibrium in the time series, the ADF was applied to determine the integrated properties of the variables. The ADF test results at level and first difference are reported in Table 2. They indicate that the t-statistics for all series tests are statistically insignificant for both equations (one with an intercept and one with an intercept and a trend); thus, the null hypothesis of non-stationarity at level cannot be rejected, indicating that these variables have a unit root problem. When the ADF test was conducted at the first difference of each variable, the null hypothesis of non-stationarity was rejected for both equations (with an intercept and with an intercept and a trend), as indicated in Table 2**.** Thus, all price series were integrated with order 1, and co-integration tests could be applied to examine whether a long-run relationship among the markets existed.

### 4.2. Co-integration test results

The co-integration test results are shown in Table 3. The trace test indicates one co-integrating equation at 1% level of significance, and the Max-eigenvalue test indicates one co-integrating equation at 1% level of significance. Therefore, both tests reject the null hypothesis of no co-integrating vector (*r* = 0) in favor of one co-integrating vector (r = 1) from all conducted co-integration tests. This result shows that a long-run equilibrium relationship exists among all the studied markets.

### 4.3. VECM estimation results

As mentioned, a long-run equilibrium exists among these four markets. Therefore, it is safe to estimate equations for the VECM. The results of VECM are in Eqs. (14) to (17) (see Table 4 for details). The error-correction coefficients are significant in four equations (Eqs. 14, 15, 16 and 17) at 1% level of significance, indicating that a deviation from the long-run equilibrium value in one period is corrected in the next period by the size of that coefficient. The average value of error correction coefficients in the four equations is 0.18, meaning that a 1% deviation from equilibrium leads to a 0.18% price adjustment toward the long-run equilibrium. In all equations, the short-run coefficients are not significant, except for WTI, indicating that its price influence the others' but not vice versa. Thus, a unidirectional causality runs from WTI's price to the others'. For the LOP to hold, the long-run coefficient must have a value of one, meaning that a change in one price leads to an equal change in the others' price. No long-run coefficient has a value equal to one; therefore, the results do not support the LOP. As mentioned, there are several explanation for the LOP's failure to hold true empirically, including institutional factors affecting price settings in different markets, the high cost of arbitrage, bounded rationality, the availability of only limited information, market participants' cognitive limitations, and the time needed for decision-making. Future studies should be directed at these causes of the LOP's failure.

**Table 2. Augmented Dickey-Fuller unit root test**

| Variable | Level with Constant | Level with Constant with Linear Trend | First with Difference Constant | First with Difference Constant, Linear Trend |
|---|---|---|---|---|
| DV | -0.501097 | -2.569552 | -8.674755 | -8.753022 |
| 1% | (-3.453072) | (-3.990470) | (-3.453072) | (-3.990470) |
| 5% | (-2.871438) | (-3.425616) | (-2.871438) | (-3.425616) |
| SAL | -0.029580 | -1.956254 | -9.330517 | -9.430648 |
| 1% | (-3.453153) | (-3.990585) | (-3.453153) | (-3.990585) |
| 5% | (-2.871474) | (-3.425671) | (-2.871474) | (-3.425671) |
| EBS | -0.757985 | -2.678396 | -11.06037 | -11.10559 |
| 1% | (-3.452911) | (-3.990243) | (-3.452911) | (-3.990243) |
| 5% | (-2.871367) | (-3.425506) | (-2.871367) | (-3.425506) |
| WTI | -1.337296 | -3.776707 | -11.17318 | -11.18358 |
| 1% | (-3.452911) | (-3.990356) | (-3.452911) | (-3.990243) |
| 5% | (-2.871367) | (-3.425561) | (-2.871367) | (-3.425506) |

**Table 3. DV, SAL, EBS, WTI(January 1988- February 2012)**

| *r* | Trace statistic | 5% Critical Value | Max-eigen statistic | 5% Critical Value |
|---|---|---|---|---|
| None | 96.74243 | 62.99 | 55.19226 | 31.46 |
| At most1 | 41.55017 | 42.44 | 21.88047 | 25.54 |
| At most 2 | 19.66970 | 25.32 | 14.66524 | 18.96 |
| At most 3 | 5.004462 | 12.25 | 5.004462 | 12.25 |

$$\Delta In\text{DV}_t = 0.005 - -0.22e_{t-1}{}^{**} + 0.31\text{DV}_{t-1} - 0.26SAL_{t-i} + 0.16\text{EBS}_{t-1} - -0.47\text{WTI}_{t-1}^{**} \quad (14)$$

$$\Delta In\text{SAL}_t = 0.004 - -0.08e_{t-1}{}^{**} + 0.09\text{DV}_{t-1} - 0.42SAL_{t-i} + 0.16\text{EBS}_{t-1} - 0.37\text{WTI}_{t-1}^{**} \quad (15)$$

$$\Delta In\text{UR}_t = 0.005 - 0.23e_{t-1}{}^{**} + 0.29\text{DV}_{t-1} - 0.23SAL_{t-i} + 0.09\text{EBS}_{t-1} - 0.42\text{WTI}_{t-1}^{**} \quad (16)$$

$$\Delta In\text{WTI}_t = 0.0043 - -0.2e_{t-1}{}^{**} + 0.31\text{DV}_{T-1} - 0.27\text{SAL}_{t-i} + 0.21\text{EBS}_{t-1} - 0.4\text{WTI}_{t-1}^{**} \quad (17)$$

**Table 4. VECM estimates**

| Error Correction | D(LOG DV) | D(LOGSAL) | D(LOG EBS) | D(LOG WTI) |
|---|---|---|---|---|
| CointEq1 | -0.218426<br>(0.02064)<br>[-10.5837] | -0.083813<br>(0.02226)<br>[-3.76456] | -0.232186<br>(0.02199)<br>[-10.5570] | -0.203557<br>(0.02016)<br>[-10.0973] |
| D(LOG DV(-1)) | 0.314217<br>(0.12976)<br>[ 2.42161] | 0.088815<br>(0.13998)<br>[ 0.63450] | 0.295371<br>(0.13828)<br>[ 2.13607] | 0.152082<br>(0.12675)<br>[ 1.19987] |
| D(LOGSAL(-1)) | 0.256857<br>(0.09845)<br>[ 2.60901] | 0.423488<br>(0.10620)<br>[ 3.98746] | 0.234189<br>(0.10492)<br>[ 2.23215] | 0.271927<br>(0.09617)<br>[ 2.82761] |
| D(LOG EBS (-1)) | 0.159657<br>(0.15656)<br>[ 1.01978] | 0.164412<br>(0.16889)<br>[ 0.97347] | 0.097213<br>(0.16684)<br>[ 0.58266] | 0.217536<br>(0.15293)<br>[ 1.42244] |
| D(LOG WTI (-1)) | -0.472650<br>(0.12748)<br>[-3.70773] | -0.369011<br>(0.13752)<br>[-2.68336] | -0.427612<br>(0.13585)<br>[-3.14768] | -0.406148<br>(0.12452)<br>[-3.26163] |
| C | 0.004946<br>(0.00340)<br>[ 1.45677] | 0.004859<br>(0.00366)<br>[ 1.32658] | 0.005343<br>(0.00362)<br>[ 1.47681] | 0.004362<br>(0.00332)<br>[ 1.31524] |

## 5. Conclusion

This paper aimed to test the co-integration of SAL with DV, WTI, and EBS. The study employed Johansen and Juselius' (1990) co-integration and VECM techniques to determine if these markets are co-integrated, their response to one another, and whether the LOP holds true. The study used data on the spot price of crude oil from January 1988 to February 2012. The results indicate that all four markets are co-integrated. In the VECM estimation, the average value of the error-correction coefficients in the four estimated equations is 0.18, meaning that a 1% deviation from equilibrium results in a 0.18% price adjustment toward long-run equilibrium. The short-run coefficients are significant only in one equation for WTI, indicating that this price influences that of other markets but not vice versa. Thus, unidirectional causality runs WTI's price to those of others. In addition, the LOP was completely refuted among all tested markets. Deviations from the LOP and the markets' relatively sluggish response can be attributed to several factors, including transportation costs, market structure, and legal and market institutions. Special attention should be directed at market institutions, which can lead to differences in information, transaction, transportation, and communication costs. All of these costs reduce the possibilities of market integration and lead to the failure of the LOP. Future studies should target these factors.

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# تكامل سعر النفط السعودي مع الأسواق العالمية الرئيسية وقانون السعر الواحد

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**الكلمات المفتاحية**: قانون السعر الواحد، اندماج الأسواق، التكامل، كفاءة السوق، تكلفة التبادل.

**ملخص البحث**. تهدف هذه الورقة إلى اختبار امكانية تكامل سعر النفط السعودي مع أسعار النفط في الأسواق الرئيسية في العالم، وهي أسعار غرب تكساس وبرنت الأوروبي ودبي فتش. وهدفت الدراسة كذلك إلى معرفة ما إذا كان التكامل بين تلك الأسعار يرتقي إلى درجة وجود ما يسمى بقانون السعر الواحد the law of one price. ولتحقيق هذه الغاية استخدمت الدراسة منهجية Johansen and Juselius للتكامل وكذلك أنموذج VECM. وقد دل اختبار التكامل المشترك على أن تلك الأسواق (الأسعار) متكاملة، ودل اختبار VECM على أن الأسعار في تلك الأسواق تتجه إلى قدر من حالة التوازن في الأجل الطويل فيما بينها إذا ما حدث اختلالات في الأجل القصير، وفي الأجل القصير وُجد أن هناك تأثير أحادي الجانب يمتد من سوق غرب تكساس إلى باقي الأسواق. وفيما يخص قانون السعر الواحد فقد دلت الدراسة على عدم وجوده في تلك الأسواق.