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TESTING THE EFFICIENCY OF GLOBAL CRUDE OIL MARKETS IN THE WEAK FORM UNDER THE UNIT ROOT MODEL

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Abstract

The importance of this study is gained from the importance of its subject through the methods of one of the most important topics in economics and finance, which is the topic of fluctuations in crude oil markets. In addition, the global oil industry occupies great importance, especially at the present time, as the crude oil commodity is described as the most important global commodity among All other goods are also described as the most important good, Because of its great importance, it is subject to various fluctuations. This is due to its influence on the political, economic and social events that occur in different countries. Certainly, due to the various fluctuations witnessed by the crude oil commodity, it has become vulnerable to mispricing and control by speculators and global policy makers. From this standpoint, the importance of the study emerged. In an attempt to discover the structure, nature and how to manage the crude oil market, It is no secret to anyone that studying the nature of fluctuations in crude oil markets has become a permanent goal for researchers in recent times, especially after the Covid-19 crisis and the decline it caused in global crude oil prices that had never been witnessed before, as the price of crude oil reached below $20 per barrel. Perhaps the most important question being investigated is whether the global crude oil markets fluctuate randomly or is there someone controlling the market? The study aims to test the efficiency of the market in a weak manner and within the framework of single root tests, including the modified Dickey and Fuller test. The sample of the current study included (53) crude oil materials distributed in (12) countries around the world, it is the first research in the world to test (53) different types of global oil crudes. The study concluded that the markets for crude oils and the oil crudes sampled in the research are weakly inefficient and do not follow a random walk within the framework of the Dickey-Fuller model.

Introduction

The commodity crude oil is described as one of the most important commodities traded around the world today. It has been described as the commodity (the most wonderful, rare, unparalleled, the blood of industry), and this confirms that this commodity occupies great importance in the global economy, Because of the central role that crude oil plays in various fields, including economic, political, financial, etc., it has stimulated the conduct of various studies on oil. Once you browse the websites, you get an indescribable number of studies bearing the name of crude oil, and with the development that is taking place in The world and the rapid dynamism it is witnessing at all economic, political, financial, and even military levels, the most recent of which was the (Russian-Ukrainian) war and the changing alliances between different countries, We are witnessing unprecedented events for the first time, and consequently the world is witnessing great fluctuations and the competition for this commodity is increasing day after day. It can be said that the crude oil commodity is the most dangerous global commodity due to its constant fluctuations among the prices of all other primary commodities, while she indicated Many previous studies have shown how to hedge against the fluctuations that occur in the global oil market, as well as how to trade and invest in this commodity, especially with regard to derivatives. But not a day goes by without a new event and global change emerging, and the uncertain future of this commodity is at its most extreme today. It is worth noting that global crude oil markets are formed in highly competitive and extremely complex conditions that are almost unmatched by any other commodity. In addition, the state of monopoly controls the crude oil markets in a way that may provide stability to some extent. In return, this leads to a loss of transparency and thus an increase in prices. Usually, the equilibrium price is returned through an excess supply or government intervention. It is worth noting that the modern (current) oil market emerged after the collapse of the major oil companies in 1960 and the failure of OPEC in the early seventies to control it efficiently. To facilitate trading in hundreds of different grades of oil, three main reference standards have emerged: Brent crude, West Texas Intermediate crude, and Dubai-Oman crude. The three main trading regions are Europe, the United States and the Middle East/Asia. Therefore, when we talk about the price of oil, we usually talk about the price of one of these three reference standards, especially Brent and West Texas Intermediate crude. In order to manage price risk, all other types of crude oil are traded using one of these three price indices. These reference standards are the backbone of global oil prices. On the other hand, not all producers in the market participate in determining global crude oil prices. The oil industry is divided between those actively involved in setting and trading benchmark prices who use those benchmark prices simply for physical crude oil pricing and hedging. These benchmarks determine crude oil prices either through exchanges, “windows,” or some other method. In a normal situation, global crude oil prices are determined by all actual participants in the market, and of course this is the opposite of what exists in the oil markets. Here a big problem arises, which is that we either find the price too high or too low. The biggest problem is what if the very high prices are not sold and the market does not buy the very low prices. There will not be a mechanism to correct the reference price, so the global crude oil markets are not as ideal and efficient as other markets, as they are controlled by a small group of large players, and the setting of reference prices is often left to major traders, international retailers, or large oil companies. As a result, there is no ideal reference standard for the price of oil, and the result is more competition, monopoly, spot trading, lack of transparency, lower or higher prices, and thus more volatility. Hence the problem of the current study emerged, which attempts to provide empirical proof of this serious problem that crude oil markets have been suffering from for quite a few years, and from here the problem of the current research emerged by asking the following question: Are crude oil markets efficient within the framework of the Dickey and Fuller test? The research was divided into three parts, which includes the theoretical aspect of crude oil, the second part explaining market efficiency and the unit root test (Dickey and Fuller), while the third part was devoted to the analytical aspect of the research and concluded with conclusions and recommendations.

FIRST: **THE THEORETICAL ASPECT**

1. Crude oil:

Crude oil is the most complex mixture of organic compounds known on Earth (Uribe-Flores al, 2019:495), and crude oils mostly consist of different highly complex organic components (Raljevi´c, et al, 2021:1), They are connected chains of tens of thousands of different hydrocarbon molecules, and the proportions of elements in crude oil vary within fairly narrow limits despite the wide variation that exists in the properties of lighter crude oil compared to heavier crude oil (Sjöblom & Simon, 2014:128). It also contains sulfur, nitrogen, and oxygen (Sancho, et al, 2020:541), and other minerals such as vanadium, iron, arsenic, and nickel (Taiwo & Mobo Jr, 2005:1055), and extends from methane to molecular aggregates such as asphaltene. The relative composition of these components is variable and depends on the onset depends on the type of organic matter in the parent source rock and its level of maturity at the time of expulsion, and thus on secondary influences, including phase behavior (Ziegs, et al, 2018:3),Therefore, crude oil produced from different fields in different parts of the world has unique properties (Barbosa, et al, 2016:146), and these properties can vary according to the type of hydrocarbon present in the crude oil, which can be paraffinic, naphthenic, and aromatic, and its physical properties depend on And thermodynamics, in addition to its behavior, depends mainly on its components, their relative quantities, and the thermodynamic conditions in which crude oil exists (Canan, et al, 2022:1).

2. Market efficiency:

The Efficient Market Hypothesis Has Received Great Attention in Many Academic Financial Literatures, And Perhaps It Is Not Surprising That This Hypothesis Helps in Understanding the Behavior of Financial Markets and Price Dynamics. This Is Why Many Researchers Are Constantly Studying the Concept of Efficiency (Hkiri, 2021:1). The Efficient Market Hypothesis (EMH) Stipulates the Complete Reflection of Information (Struthers& Mananyi, 1997: 142) (Stoian & Iorgulesc, 2020: 406)(Mishkin, 2004: 150), In the Market Prices of Assets (Bouoiyour, et al, 2017: 4). Financial And Real Information Quickly And Unbiased (Lo, 2005:1) (Basu, 1977:663). Because Market Prices Reflect All Relevant Information (Varamini & Kalash, 2008:18), There Is No Approach to Analysis That Would Enable Investors to Achieve Greater (Abnormal) Returns Than Those That Could Be Obtained by Holding a Randomly Selected Portfolio of Common Stocks. (Malkiel,2003:1), Whether the Approach Is Technical, Which Is Concerned with Studying Past Prices in An Attempt to Predict Future Prices (Elleuch Lahyani, 2014:1), Or Is the Approach Fundamental, Which Is Concerned with Analyzing Financial Information Such as Company Profits and Asset Values to Help Investors Choose Stocks That Are Undervalued (Malkiel,2003:1), Meaning That Prices at Any Time Reflect the Entire Information Available (Hudson, 2013:130) (Fama&Macbeth,1973:612). This Is Called Information Efficiency. In Light of The

Information Generally Available to All Market Participants, Prices Move as Soon as That Information Is Announced (Yang, et al, 2012:678). This Move Would Absorb the Information Quickly and Logically (Unbiased) (Ang, et al, 1980: 309), And Accordingly, Obtaining the Abnormal Excess Return (Alpha) Is Considered Impossible in An Efficient Market (Kocha & Iwedi,2023:2). Market Efficiency Assumes That Investors Have the Same Degrees of Access and Acquisition of Information, And the Market Price Reflects All Available Information (Wang & Chen, 2018:1). Which Means That Market Efficiency Is a Basic Concept That Deals with Informational Justice (Fama, 1997:284). Or Information Efficiency (Hawaldar, et al, 2017:376) (Jovanovic, et al, 2016: 182). According To the Behavior of Prices Should Follow the Random Walk Model, Which Means That Successive Changes in Prices (Returns) Should Be Distributed Independently and Symmetrically (Naturally) (Jain, et al, 2013: 123) (Boya, 2019: 156), In the End, The Market Absorbs Any New Information and This Information Is Embodied in Prices (Griffin, et al, 2010:3230) (Bernstein, 1999:130). Accordingly, The Market Corrects Itself (Mockus & Raudys, 2010:5673). This Hypothesis Also Confirms That Investors' Expectations Are Rational and They Quickly Arbitrage to Exploit Any Deviations in Expected Returns (Agbeyegbe, 1992:141). In This Sense, Market Prices Are Unpredictable (Kakinaka & Umeno, 2022:1), Or Less Predictable (Okorie & Lin, 2021:2) (Mensi, et al, 2012:1), No Investor Can Achieve Abnormal Returns (Abnormal Profits & Returns) (Su & Roca, 2012: 684) ((Mccauley, et al. 2008: 3918) That Exceed the Returns of Other Market Participants Because They Also Adjust Their Expectations Accordingly. For New Information (Immonen, 2015:172), Thus Arbitrage Opportunities Quickly Disappear Profitable (Malkiel, 2005:1), Which Would Allow Investors to Achieve Above-Average Returns Without Taking on Above-Average Risks (Wilson & Marashdeh, 2007:87). The Random Walk Model Emphasizes the Independence of Future Prices in A Systematic Manner Over Current or Previous Price Levels (Assaf, Et Al, 2021:2). Achieving Efficiency Makes It Impossible to Price Assets Incorrectly, And Even If They Are Priced Incorrectly, There Will Be Immediate Arbitrage by Insiders That Ultimately Leads to A Correction of The Price (Subramanian, 2010:21), And Therefore It Makes the Stock Prices at Any Time a Correct Estimate. For The Real Value (Ahmed, 2021:21) (Szylar, 2014:27). The Efficient Market Hypothesis Is the Foundation of Modern Financial Theory (Ghazani & Araghi, 2014, 50), And the Cornerstone of Modern Financial Economics for Decades. Although The Validity of The Hypothesis Has Been Disproved in Many Studies, It Still Represents the Firm Theoretical Basis for The Theory of Financial Economics (Kristoufek & Vosvrda, 2014:1). This Theory Has Achieved Great Progress Among Academics and Financial Professionals Thanks to The Group of Methods Proposed and Emerging from It (Diallo, et al., 2021:1).

A. Unit root model

The statistical model that is used to test market efficiency in the weak form and random flow of time series of returns and prices is the unit root test (Habibah, et al, 2017:556) (Pant & Bishnoi, 2001:6). The most widely used model to test the presence of a unit root is the Dickey-Fuller test (Kellard, 2002:520) (Islam & Khaled, 2005:1616) (Beer & Bhuyan, 2011:84), Dickey and Fuller tests (Fuller, 1979, 1981 & 1981) are an essential tool in the toolbox of most time series researchers (da Silva Lopes, 2006; 2), and are used to evaluate the time series characteristic of economic and financial data. And to deal with the possible presence of (serial) autocorrelation. In the time series (Tam, 2013: 3495) (Paparoditis & Politis, 2018: 1). And testing the stability of time series (consistency property) (Sharma & Seth, 2011:222) (Ramenah, et al, 2018:23), and the mathematical model for the test can be written according to the following cases (Khoj & Akeel, 2020:649) (Borges, 2010:6) (Roy, 2018:229):

The first case: There is no constant or trend (Al-Jafari, 2011:24):

$$\Delta R_{i,t} = \alpha_1 B_i R_{i,t-1} + \sum_{i=1}^{q} \Delta R_{i,t-1} + e_{i,t} \ldots\ldots (1)$$

The second case: with a constant and no trend (Beer & Bhuyan, 2011:84) (Yaya, et al, 2024:7):

$$\Delta R_{i,t} = \alpha_0 + \alpha_1 B_i R_{i,t-1} + \sum_{i=1}^{q} \Delta R_{i,t-1} + e_{i,t} \ldots\ldots (2)$$

The third case: with a constant and a trend (Roy, 2018:229) (Borges, 2011:5) (Worthington & Higgs, 2004:6)

$$\Delta R_{i,t} = \alpha_0 + \alpha_1 + B_i R_{i,t-1} + \lambda_i + \sum_{i=1}^{q} \Delta R_{i,t-1} + e_{i,t} \ldots. (3)$$

So $\Delta R_{i,t}$ = the first difference of the time series, B_i= Dickey-Fuller parameter, $\Delta R_{i,t-1}$ = time lag differences, $e_{i,t}$= random error in duration (t), α= The constant term, λ_i = time trend (Roza, et al, 2022:109).

THIRD: STUDY SAMPLE

The sample of the current research consisted of (53) types of global crude oil distributed among (12), and the data was obtained from multiple sources, including local and international, while the period of the study was from (1/1/2004 - 2/29/2024) as is Shown in Table (1):

TABLE (1) Study Sample

Seq	Crude	Country
1	Kirkuk	(Iraq)
2	**Basra heavy**	(Iraq)
3	Basra light	(Iraq)
4	**Oman**	(Oman)
5	Dubai	(United Arab Emirates)
6	**Saudi Arabian Light Crude**	(Saudi Arabian)
7	Brent	(United Kingdom)
8	**WTI**	(USA)
9	Urals Europe CFR Spot	(United Russia)
10	**Nigeria Crude**	(Nigeria)
11	Canadian Crude	(Canadian)

12	**Colombia Crude**	(Colombia)
13	Mexican Mayan Crude	(Mexico)
14	**Alaska North Slope**	(USA)
15	Arkansas Crude	(USA)
16	**Oklahoma Crude**	(USA)
17	North Dakota Crude	(USA)
18	**West Texas Sour**	(USA)
19	California Midway-Sunset	(USA)
20	**Kansas Crude**	(USA)
21	Colorado Crude	(USA)
22	**Louisiana Crude**	(USA)
23	Wyoming Crude	(USA)
24	**Light Louisiana Sweet**	(USA)
25	Mars Blend	(USA)
26	**Wyoming Sweet**	(USA)
27	California Kern River	(USA)
28	**U.S. less Alaskan North Slope**	(USA)
29	U.S. Crude	(USA)
30	**Pennsylvania Crude**	(USA)
31	West Virginia Crude	(USA)
32	**Illinois Crude**	(USA)
33	Indiana Crude	(USA)
34	**Kentucky Crude**	(USA)
35	Michigan Crude	(USA)
36	**Nebraska Crude**	(USA)
37	Ohio Crude	(USA)
38	**South Dakota Crude**	(USA)
39	Alabama Crude	(USA)
40	**Mississippi Crude**	(USA)
41	New Mexico Crude	(USA)
42	**Texas Crude**	(USA)
43	Federal Offshore	(USA)
44	**Venezuelan crude**	(USA)
45	Montana Crude	(USA)
46	**Utah Crude**	(USA)
47	California Crude	(USA)
48	**Federal Offshore California**	(USA)
49	East Coast	(USA)
50	**Midwest**	(USA)
51	Gulf Coast	(USA)
52	**Rocky Mountain**	(USA)
53	West Coast	(USA)

FOURTH: THE APPLIED ASPECT OF THE RESEARCH

This Part Reviews the Scientific Aspect of The Research by Testing Market Efficiency in The Weak Form and Within the Framework of The Modified Dickey and Fuller Model, As Four Crudes Will Be Presented Out Of 53 Different Petroleum Crudes in The Study Sample, While the Rest Will Be Presented in The Form of a Summary Due to The Large Size of The Sample:

Table (1) Augmented Dickey-Fuller Test Results for Kirkuk Crude

Crude	**Model**	**t-Statistic**	**Test critical values:**		
			1% level	**5% level**	**10% level**
Kirkuk	**Non-Intercept**	**-11.407**	**-2.586**	**-1.953**	**-1.624**
	Intercept	**-11.395**	**-3.462**	**-2.886**	**-2.579**
	Trend And Intercept	**-11.396**	**-3.991**	**-3.433**	**-3.134**

From the results presented in the table above for the three models used, we will focus on testing the hypothesis that says (the Kirkuk crude return series is weakly inefficient and does not follow a random walk in its movement). From the results of the expanded Dickey-Fuller test in the model (without a constant and a time trend), we find that the calculated value of (($\boldsymbol{\tau}$)) reached its absolute value (11.407), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (the Kirkuk crude return series) is weakly inefficient and does not follow random walk is not rejected. As well as the expanded Dickey-Fuller test in the model (without a constant), we note that the calculated value of (($\boldsymbol{\tau}$)) reached its absolute value (11.395), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%), and thus Do not reject the hypothesis that states (that the Kirkuk crude return series is weakly inefficient and does not follow a random path). Also, the extended Dickey-Fuller test in the model (with a constant and a time trend) we note that the calculated value of (($\boldsymbol{\tau}$)) reached its absolute value (11.395), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (the Kirkuk crude return series) is not weakly efficient and does not follow random walk is not rejected.

Table (2) Augmented Dickey-Fuller Test Results for Basra heavy Crude

			Test critical values:		
Crude	**Model**	**t-Statistic**	**1% level**	**5% level**	**10% level**
Basra heavy	**Non intercept**	**-14.111**	**-2.586**	**-1.953**	**-1.624**
	intercept	**-14.093**	**-3.462**	**-2.886**	**-2.579**
	trend and intercept	**-14.077**	**-3.991**	**-3.433**	**-3.134**

From the results presented in the table above for the three models used, we will focus on testing the hypothesis that states (the Basra heavy returns series is weakly inefficient and does not follow random walk). From the results of the expanded Dickey-Fuller test in the model (without a constant and a time trend), we find that the calculated value of ((τ)) reached its absolute value (14.111), which is greater than the absolute values of the theoretical (τ) at the levels (1%, 5%, 10%). Thus, not rejecting the hypothesis that states (that the series of crude returns (Basra heavy) is weakly inefficient and does not follow random walk), As well as the expanded Dickey-Fuller test in the model (without a constant), we note that the calculated value of ((τ)) reached its absolute value (14.093), which is greater than the absolute values of the theoretical (τ) at the levels (1%, 5%, 10%), and thus Do not reject the hypothesis that states (that the series of raw returns (Basra heavy) is weakly inefficient and does not follow a random walk). Also, using the extended Dickey-Fuller test in the model (with a constant and a time trend), we note that the calculated value of ((τ)) reached its absolute value (14.077), which is greater than the absolute values of (τ) in theory at the levels (1%, 5%, 10%). Thus, the hypothesis that states (the series of raw returns (Basra heavy)) is not weakly efficient and does not follow a random walk is not rejected.

Table (3) Augmented Dickey-Fuller Test Results for Rocky Mountain Crude

			Test critical values:		
Crude	**Model**	**t-Statistic**	**1% level**	**5% level**	**10% level**
Rocky Mountain	**Non intercept**	**-10.985**	**-2.586**	**-1.953**	**-1.624**
	intercept	**-10.971**	**-3.462**	**-2.886**	**-2.579**
	trend and intercept	**-10.956**	**-3.991**	**-3.433**	**-3.134**

From the results presented in the table above for the three models used, we will focus on testing the hypothesis that states (the Rocky Mountain crude return series is weakly inefficient and does not follow random walk). From the results of the expanded Dickey-Fuller test in the model (without a constant and a time trend), we find that the calculated value of ((τ)) reached an absolute value of (10.985), which is greater than the absolute values of the theoretical (τ) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (the Rocky Mountain crude return series) is not weakly efficient and does not follow random walk is not rejected. Also, using the extended Dickey-Fuller test in the model (with a constant and a time trend), we note that the calculated value of ((τ)) reached its absolute value (10.956), which is greater than the absolute values of the theoretical (τ) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (the Rocky Mountain crude return series) is not weakly efficient and does not follow random walk is not rejected.

Table (4) Augmented Dickey-Fuller Test Results for West Coast Crude

			Test Critical Values:		
Crude	**Model**	**T-Statistic**	**1% Level**	**5% Level**	**10% Level**
West Coast	**Non-Intercept**	**9.707 -**	**2.586-**	**1.953-**	**1.624-**
	Intercept	**9.699 -**	**-3.462**	**-2.886**	**-2.579**
	Trend And Intercept	**9.694-**	**-3.991**	**-3.433**	**-3.134**

From the results presented in the table above for the three models used, we will focus on testing the hypothesis that states (the West Coast crude oil return series) is weakly inefficient and does not follow random walk). From the results of the expanded Dickey-Fuller test in the model (without a constant and a time trend), we find that the calculated value of (($\boldsymbol{\tau}$)) reached an absolute value of (9.707), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (that the West Coast crude oil return series) is weakly inefficient and does not follow a random path is not rejected. As well as the extended Dickey-Fuller test in the model (without a constant), we note that the calculated value of (($\boldsymbol{\tau}$)) reached its absolute value (9.699), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%), and thus Do not reject the hypothesis that states (that the West Coast crude oil return series) is weakly inefficient and does not follow a random walk). Also, using the extended Dickey-Fuller test in the model (with a constant and a time trend), we note that the calculated value of (($\boldsymbol{\tau}$)) reached an absolute value of (9.694), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the hypothesis that states (that the West Coast crude oil return series) is weakly inefficient and does not follow a random path is not rejected.

Table (5) Augmented Dickey-Fuller Test Results for Market index Crude

			Test critical values:		
Crude	**Model**	**t-Statistic**	**1% level**	**5% level**	**10% level**
Market index	**Non intercept**	**10.5044-**	**2.586-**	**1.953-**	**1.624-**
	intercept	**10.4936 -**	**-3.462**	**-2.886**	**-2.579**
	trend and intercept	**10.4855 -**	**-3.991**	**-3.433**	**-3.134**

From the results presented in the table above for the three models used, we will focus on testing the hypothesis that states (that the series of returns of the global oil market index is weakly inefficient and does not follow a random walk). From the results of the extended Dickey-Fuller test in the model (without a constant and a time trend), we find that the calculated value of (($\boldsymbol{\tau}$)) in terms of its absolute value is (11.407), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the first and second hypothesis are not rejected, respectively (that the series of market index returns is weakly inefficient and does not follow a random walk). As well as the extended Dickey-Fuller test in the model (without a constant), we note that the calculated value of (($\boldsymbol{\tau}$)) in terms of its absolute value is (11.395), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%) and therefore Not rejecting the first and second hypothesis, respectively (that the series of market index returns is weakly inefficient and does not follow random walk). Also, in the extended Dickey-Fuller test in the model (with a constant and a time trend), we note that the calculated value of (($\boldsymbol{\tau}$)) in terms of its absolute value is (11.395), which is greater than the absolute values of the theoretical ($\boldsymbol{\tau}$) at the levels (1%, 5%, 10%). Thus, the first and second hypothesis, respectively, are not rejected (that the series of market index returns is weakly inefficient and does not follow a random walk).

Table (7) shows a summary of the testing of the raw materials of the study sample using the Dickey-Fuller test. Only four raw materials were analyses. As for the remaining raw materials, only the final results were reviewed. This is due to the large number of pages needed to analyze and test these raw materials due to the large size of the research sample. The results showed that all raw materials, as well as the global market index, were weakly inefficient, as shown in the following figure:

Table (6) Summary of the market efficiency test for petroleum raw materials, study sample:

Seq	Petroleum Raw Materials	ADF
(1)	Kirkuk	(Unefficient)
(2)	Basra Heavy	(Unefficient)
(3)	Basra Light	(Unefficient)
(4)	Oman	(Unefficient)
(5)	Dubai	(Unefficient)
(6)	Saudi Arabian Light Crude Oil	(Unefficient)
(7)	Brent	(Unefficient)
(8)	WTI	(Unefficient)
(9)	Urals Europe CFR Spot	(Unefficient)
(10)	Nigeria Crude Oil	(Unefficient)
(11)	Canadian Crude Oil	(Unefficient)
(12)	Colombia Crude Oil	(Unefficient)
(13)	Mexican Mayan Crude Oil	(Unefficient)
(14)	Alaska North Slope	(Unefficient)
(15)	Arkansas Crude Oil	(Unefficient)
(16)	Oklahoma Crude Oil	(Unefficient)
(17)	North Dakota Crude	(Unefficient)
(18)	West Texas Sour	(Unefficient)
(19)	California Midway-Sunset	(Unefficient)
(20)	Kansas Crude Oil	(Unefficient)
(21)	Colorado Crude Oil	(Unefficient)
(22)	Louisiana Crude Oil	(Unefficient)
(23)	Wyoming Crude Oil	(Unefficient)
(24)	Light Louisiana Sweet	(Unefficient)
(25)	Mars Blend	(Unefficient)
(26)	Wyoming Sweet	(Unefficient)
(27)	California Kern River	(Unefficient)
(28)	U.S. Less Alaskan North Slope	(Unefficient)
(29)	U.S. Crude Oil	(Unefficient)
(30)	Pennsylvania Crude Oil	(Unefficient)
(31)	West Virginia Crude Oil	(Unefficient)
(32)	Illinois Crude Oil	(Unefficient)

(33)	**Indiana Crude Oil**	**(Unefficient)**
(34)	**Kentucky Crude Oil**	**(Unefficient)**
(35)	**Michigan Crude Oil**	**(Unefficient)**
(36)	**Nebraska Crude Oil**	**(Unefficient)**
(37)	**Ohio Crude Oil**	**(Unefficient)**
(38)	**South Dakota Crude**	**(Unefficient)**
(39)	**Alabama Crude Oil**	**(Unefficient)**
(40)	**Mississippi Crude Oil**	**(Unefficient)**
(41)	**New Mexico Crude**	**(Unefficient)**
(42)	**Texas Crude Oil**	**(Unefficient)**
(43)	**Federal Offshore U.S. Gulf Coast**	**(Unefficient)**
(44)	**Venezuelan Crude Oil**	**(Unefficient)**
(45)	**Montana Crude Oil**	**(Unefficient)**
(46)	**Utah Crude Oil**	**(Unefficient)**
(47)	**California Crude Oil**	**(Unefficient)**
(48)	**Federal Offshore California**	**(Unefficient)**
(49)	**East Coast**	**(Unefficient)**
(50)	**Midwest**	**(Unefficient)**
(51)	**Gulf Coast**	**(Unefficient)**
(52)	**Rocky Mountain**	**(Unefficient)**
(53)	**West Coast**	**(Unefficient)**
(54)	**Market Index**	**(Unefficient)**

CONCLUSIONS

The aim of the current research is to test the efficiency of crude oil markets in the weak form and within the framework of the unit root model, including the Dickey and Fuller test, as crude oil markets are considered one of the most important markets in the world and the crude oil commodity is described as the most important global commodity among all primary commodities. the other, Because of its importance, it witnesses continuous fluctuations described as (severe - destructive) fluctuations on different economies, whether importing or exporting. Therefore, the current research attempts to study the nature of these fluctuations and find out whether these fluctuations are random fluctuations or there is someone controlling them. Then we try to provide appropriate solutions to control these fluctuations. The current study is also the first study in the world to test (53) different crude oils around the world, as the researcher needed more than two years to obtain the data necessary to complete the research. The research reached a set of conclusions, including that the markets for crude oils and petroleum raw materials, the research sample, are weakly inefficient. It does not follow random movement in its movement. Therefore, the results of the current study place governments and policy makers in different countries before a major challenge: how to control these fluctuations in the future.

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