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OIL PRICE UNCERTAINTY AND STOCK MARKETS: NEW EVIDENCE FROM FOURIER-BASED APPROACHES

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ABSTRACT

The aim of this study is to explain the relationship between oil price uncertainty and the stock markets of BRICS countries. For this purpose, monthly Oil Price Uncertainty (OPU) Index and stock market data of BRICS countries in the period between August 1997 and December 2019 are used. The results are as follows: (i) FARDL, ADL and RALS-ADL test results indicated that OPU is cointegrated with all country markets except JSE Top 50. (ii) Fourier Granger and Fourier Toda-Yamamoto causality test results revealed that there is a unidirectional causality from OPU to IBOVESPA and RTS, while there is no causality relationship between OPU and other stock markets. (iii) There is a causality in variance from BRICS stock markets to OPU and volatility spillover from OPU to IBOVESPA, BSE 30 and JSE Top 50. Finally, the paper suggests some insightful implications for investors to effectively manage their portfolio strategies considering price uncertainty and for policymakers to mitigate the negative externalities associated with oil price uncertainty.

Keywords: Oil, Price, Uncertainty, BRICS, Stock Markets

Jel Codes: H54, Q43

PETROL FİYAT BELİRSİZLİĞİ VE HİSSE SENEDİ PİYASALARI: FOURIER TABANLI YAKLAŞIMLARDAN YENİ KANITLAR

ÖZ

Bu çalışmanın amacı, petrol fiyat belirsizliği ile BRICS ülkeleri hisse senedi piyasaları arasındaki ilişkiyi açıklamaktır. Bu amaçla, Ağustos 1997 – Aralık 2019 zaman aralığında aylık OPU Index ve BRICS ülkelerinin hisse senedi piyasası verileri kullanılmıştır. (i) FARDL, ADL ve RALS-ADL testi sonuçları OPU'nun JSE Top 50 dışında tüm ülke piyasaları ile eşbütünleşik olduğuna işaret etmektedir. (ii) Fourier Granger ve Fourier Toda-Yamamoto nedensellik testi sonuçları ise OPU'dan IBOVESPA ve RTS'ye doğru tek yönlü bir nedensellik olduğunu, diğer hisse senedi piyasaları ile OPU arasında herhangi bir nedensellik ilişkisi olmadığını göstermiştir. (iii) BRICS hisse senedi piyasalarından OPU'ya doğru varyansta nedensellik olduğu ve OPU'dan IBOVESPA, BSE 30 ve JSE Top 50' doğru bir oynaklık yayılımı olduğu tespit edilmiştir. Son olarak, bu çalışma piyasa paydaşları için portföy stratejilerinin fiyat belirsizliğini gözeterek etkin bir şekilde düzenlenmesi ve politika yapıcıların petrol fiyat belirsizliği sebebiyle ortaya çıkan negatif dışsallıkları önlemesi için aydınlatıcı öneriler sunmaktadır.

Anahtar Kelimeler: Petrol, Fiyat, Belirsizlik,, BRICS, Hisse Senedi Piyasaları

Jel Kodları: H54, Q43

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INTRODUCTION

Early discussions on the impact of oil price uncertainty were often associated with decision-making processes of firms, e.g., irreversible investments or fixed capital investment (Jo, 2014). Some scholars including Bernanke (1983) and Pindyck (1991) have shown that firms tend to postpone irreversible investment decisions and demand more information as a response to high oil price uncertainty when cash flows depend on oil prices. It has been claimed that this phenomenon fuels cyclical fluctuations in the economy. Moreover, oil prices may affect economic activity through various channel e.g. real equilibrium and monetary policy. On the one hand, they are associated with the well-known assumption that oil price rises lead to an upward shift in overall price levels. Hence, the real foreign exchange balances of households and enterprises are claimed to decline, which implies a fall in aggregate demand. On the other hand, the income transfer channel associated with oil price increases highlights the transfer of income from oil importers to oil exporters (Elder and Serletis, 2010). Furthermore, geopolitical risks are also considered to be the key driver of price volatility in energy markets.

Recently, there has been a growing interest in the link between oil price changes and stock returns in both the energy and finance literature. In this regard, many rigorous empirical studies have been conducted on the link between oil price shocks and financial markets. Some scholars such as Filis et al. (2011), Lee and Chiou (2011), Bouri (2015) and Pönkä (2016) have provided empirical evidence that oil prices and stock markets are related.

The interaction between oil and stock markets is highly effective in terms of both returns and volatility. As such, the relationship between global energy markets and external variables such as electricity consumption of Bitcoin illustrates the interconnectedness of modern energy and financial markets (Kılıç et al., 2021). Hence, this reveals the effects of uncertainties in energy prices on stock market dynamics. Moreover, since the volatility in oil prices has a decisive role for the global economy, it can lead to significant uncertainties and changes in market expectations for the future (Nandha and Faff, 2008; Liu and Gong, 2020). Also, the balance of risk and return in the stock market is perceived as the risk preference of investors. Consequently, the uncertainty in oil prices reflects market expectations and affects the risk premiums demanded by investors to accept risk. In this regard, it is claimed to affect the risk-return relationship in the market (Wen et al., 2014; He et al., 2019). For example, by influencing investors' trading strategies, it affects stock market performances, including the stock risk-return relationship (He et al., 2020).

The objective of this paper is to analyze the relationship between stock markets and energy price uncertainty. In the study, stock markets and energy price uncertainty indices of BRICS countries (Brazil, Russia, India, China and South Africa) for the period 2015-2016 are employed. Fourier Granger and Fourier Toda Yamamoto causality tests as well as Li and Enders Fourier volatility test are used for empirical analysis. To this end, we expect that the study will provide some insightful implications for literature.

First of all, this study attempts to offer new empirical evidence on the link between oil and equity markets to enhance the understanding of risk-return dynamics and facilitate the decision-making process of market participants. As well-known, energy prices reflect global economic uncertainty and serve as key indicators that influence the financial decisions of global investors. As a result, this study provides a new perspective for investors, corporates and policy makers.

Second, this paper expands the literature on energy and financial markets by providing fresh evidence on the return and volatility relationship between energy prices and markets using advanced Fourier-based econometric methods. As known, the Fourier approach considers a number of smooth breaks as well as unknown forms and sharp structural breaks (Becker et al., 2006).

Finally, the share of BRICS economies within the global economy is rapidly growing every day. Therefore, it is of paramount interest to understand how the stock markets of these countries respond to the uncertainties in energy prices and to identify investment strategies based on these responses. The findings of this study may provide some enlightening implications for the resilience and robustness of financial markets in BRICS countries.

The paper is structured as five sections. Following the introduction, the second section briefly summarizes the empirical evidence on the relationship between oil price uncertainities and stock markets. The third section explains the variables employed in the study and the empirical methodology. The fourth section presents the relationship between energy price uncertainty and stock markets of BRICS countries via Fourier-based econometric methods. The final section presents the conclusions and policy implications of this research for all stakeholders.

1. Literature Review

Oil price uncertainty has long been regarded as a key phenomenon within financial markets and energy economics. However, the estimation of specific indices and indicators that measure this uncertainty is a relatively new field in the literature. The oil price uncertainty index is an indicator that measures the uncertainty of future oil prices and the calculation of this index provides a deeper insight for energy markets.

The fundamentals of the energy uncertainty index were introduced by Xu et al. (2021). This study suggested a new metric of uncertainty in the global energy market and analyzed its impact on oil prices. Dang et al. (2023) claimed that oil prices are an incomplete proxy for energy prices and thus developed the energy uncertainty index. On the other hand, geopolitical risks (GPRs) are important factors in energy markets and act as both transmitters and absorbers of shocks in stock market development (Böyükaslan et al., 2024; Gürsoy, 2021). In addition to volatility in both energy prices and geo-political risk, they determine how an investor acts. They also define the financial stability in emerging economies.

Significant research has been conducted on the relationship between oil price volatility and stock market performance, which reveals many linkages. For instance, Bastianin and Manera (2018) found out that the volatility in the U.S. stock market responds to oil price shocks, caused by both unexpected aggregate demand changes and oil-specific demand, but minimal response to supply shocks. Such findings are also supported by Mahmoudi and Ghaneei (2021) who stated that crude oil market fluctuations impact the Canadian stock market negatively during periods of high volatility and positively during low-volatility periods. Kokabisaghi et al. (2019) showing how geopolitical contexts such as sanctions play a role in amplifying the effects oil price volatility has on Tehran's stock and industry indexes, added to this. In addition, Shao et al. (2021) employed quantile autoregressive distributed lag methods in revealing the complicated relationships that exists between crude oil futures prices with economic policy uncertainty, stock markets, and pandemic-born panic events among other factors, thereby upholding the back-and-forth nature of such associations. Altogether, these studies show how important it is to integrate economic and geopolitical factors into the studies concerning oil price volatility and dynamic behaviors in financial markets.

The relationship between energy prices and stock returns has been widely analyzed in the literature. The effects on energy prices and stock returns varies based on economic development level, supply-demand rates and the policies implemented by countries. For example, Zhang and Guo (2024) found that energy-related indices affect the volatility of oil prices. Moreover, Huang (1996), Wei (2003), Regnier (2007), Oberndorfer (2009), Cong and Shen (2013), Armeanu (2019), Nakhipbekova et al. (2020) and Chien et al. (2021) reported that energy price shocks have negative effects on stock returns. Benkraiem et al. (2018) and Chien et al. (2021) observed that oil price shocks have positive effects on stock returns in their oil demand-based analysis. Besides, Roger et al. (1996) and Alio et al. (2019) indicated that there is a long-term relationship between the two variables, but they did not find neither bidirectional nor unidirectional causality.

The effects of oil price shocks also differ based on the producer and consumer characteristics of countries, the utilization of dependent and alternative energy sources, the policies they implement and their development phases. Hamilton (2003), Cobo-Reyes and Perez Quiros (2005), Park and Ratti (2008), Nandha and Faff (2008), Miller and Ratti (2009), Al-Fayoumi (2009), Filis (2010), Le and Chang (2011), Basher et al. (2012), Hasan and Mahbobi (2013), Broadstock and Filis (2014), and Khamis et al. (2018) pointed out that oil price shocks have negative effects on stock prices. These effects are attributed to increasing uncertainties and cost burdens in the economy.

Finally, Chen et al. (1986), Huang et al. (1996), Wei (2003), Apergis and Miller (2009), and Le and Chang (2011) reported that oil price shocks have insignificant effect on stock returns. However, Sadorsky (1999, 2001), Basher and Sadorsky (2006), Narayan and Narayan (2010), Le and Chang (2011), Arouri and Rault (2012), Broadstock and Filis (2014), Roboredo and Rivera-Castro (2014), Diaz and De Gracia (2017), Anyalechi et al. (2019), and He et al. (2022) observed that oil price shocks have positive effects on stock returns. These studies concluded that sharp declines in oil prices stimulate economic growth by reducing energy costs.

2. Data and Metholodgy

The paper investigates the relationship between oil price uncertainty and the stock markets of Brazil (IBOVESPA), Russia (RTS), India (BSE 30), China (SSE 225) and South Africa (JSE Top 50). To do this, we used data at monthly frequency for the period from August 1997 to December 2019. The Oil Price Uncertainty Index (OPU) as a proxy for oil price uncertainty is based on English articles of at least 100 words from 50 global newspapers. They exclude sports articles, editorials, abstracts, ads, blogs, opinion pieces, country profiles, transcripts, press releases, and other non-news items. The OPU data are obtained from the Economic Policy Uncertainty database, while the stock market data are taken from Investing.com and Yahoo Finance. On the other hand, ignoring structural breaks in the series over time may affect the results of the analysis (Perron, 1989). Indeed, traditional unit root tests in previous literature that consider structural breaks through dummy variables, but they can only capture sharp structural breaks. However, Fourier-based tests can also capture smooth structural breaks (Bozoklu et al. 2020). Therefore, Fourier-based techniques were employed.

2.1. Fourier ADF Unit Root Test

Enders and Lee (2012) proposed an extended version of the Augmented Dickey-Fuller (ADF) unit root test that allows the Fourier function to adjusted to a certain frequency dimension. The Fourier ADF (hereafter FADF) enables nonlinear and unknown structural breaks in the deterministic component of the model as well as smooth transition changes through the Fourier function. Also, this procedure does not require information on their location, number, and shape.

The null hypothesis of the FADF is expressed as $H_0: y_1 = y_2 = 0$ and means that the series is non-stationary. The general form of test is as presented in Eq. (1) and (2):

$$\Delta y_t = \alpha + y_1 sin\left(\frac{2\pi kt}{T}\right) + y_2 \cos\left(\frac{2\pi kt}{T}\right) + \delta y_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \alpha + \beta_t + y_1 sin\left(\frac{2\pi kt}{T}\right) + y_2 \cos\left(\frac{2\pi kt}{T}\right) + \delta y_{t-1} + \varepsilon_t \quad (2)$$

where y is the Fourier estimation function, t is the time trend, k is the frequency of the Fourier function (1≤k≤5), and T is the sample size. If the estimated τDF-τ value is bigger than the critical values in the study of Enders and Lee (2012), this indicates that the series is stationary. However, the sine (y_1) and cosine (y_2) terms should be statistically significant. Otherwise, the results of the traditional ADF test are valid (Eylasov et al., 2022).

2.2. Fourier Bootstrap ARDL Approach

Fourier Bootstrap ARDL bounds test (FARDL) stands out with several advantages. This test doesn't require the variables stationary at the level or first difference. Furthermore, the FARDL test provides reliable and consistent results in small samples.

Four different results are obtained within FARDL test. These are (Yılancı and Pata, 2020);

1. When FA, FB and t statistics are significant, cointegration occurs.
2. When FA, FB and t statistics are insignificant, no cointegration occurs.
3. When FA and FB are significant, but t is not, the first degenerate situation.
4. When FA and t are significant, but FB is not, the second degenerate situation.

Except case 1, all results indicate that there is no cointegration.

By modifying FARDL bounds test statistics to the ARDL bounds test approach developed by Pesaran, Shin and Smith (2001), it is expressed as Eq. (3):

$$\Delta U_t = \delta_0 \psi_1 sin\left(\frac{2\pi kt}{T}\right) \psi_2 \cos\left(\frac{2\pi kt}{T}\right) \delta_1 U_{t-1} \delta_2 G_{t-1} \sum_{i=1}^{p-1} \vartheta_i' \, \Delta U_{t-1} \sum_{i=1}^{p-1} \varrho_i' \, \Delta G_{t-1} \varepsilon_t \quad (3)$$

where p denotes the number of lags, ε_t represents the error term with zero mean and finite variance and Δ is the difference operator. The t-statistic value calculated by estimating of the model is greater than the critical values, which calculated by bootstrap simulation, indicates that the series are cointegrated.

2.3. Fourier Granger and Fourier Toda-Yamamoto Causality Tests

Enders and Jones (2016) developed the Fourier Granger causality test since the conventional Granger (1969) causality test with the vector autoregressive (VAR) model proposed by Sims (1980) ignores regime shifts and it is often unsatisfactory to determine the relationship with linear specifications. This test determines the unidentified regime shifts by including Gallant (1981) Fourier functions to the VAR model.

The null hypothesis of the Enders and Jones (2016) Fourier Granger causality test implies that there is no causal relationship between the series (H_0: $\vartheta = 0$). The mathematical expression of the test can be seen in Eq. (4):

$$Y_t = \beta_0 + Y_{1k} \sin\left(\frac{2\pi kt}{T}\right) + Y_{2k} \cos\left(\frac{2\pi kt}{T}\right) + \vartheta_1 Y_{t-1} + \cdots + \vartheta_u Y_{t-u} \quad (4)$$

Toda and Yamamoto (1995) causality test estimate the causality with the lags augmented VAR (p+dmax) model without considering the stationary order of the series and the cointegration relationship between them. As this test ignores regime shifts, Nazlıoğlu et al. (2016) proposed the Fourier Toda-Yamamoto causality test, which allows the regime shifts in the series by using Fourier functions instead of the constant term in the VAR model.

The null hypothesis of the Fourier Toda-Yamamoto (2016) causality test states that there is no causal relationship between the series (H_0: $\beta = 0$). The statistical formulation of the test is as shown in Eq. (5):

$$Y_t = \alpha_0 + Y_1 \sin\left(\frac{2\pi kt}{T}\right) + Y_2 \cos\left(\frac{2\pi kt}{T}\right) + \beta_1 Y_{t-1} + \cdots + \beta_{p+d} Y_{t-(p+d)} + \varepsilon_t \quad (5)$$

where d is the maximum degree of cointegration and p is the optimal lag length. If Wald or F-test statistic is greater than the asymptotic and bootstrap probability values, there is no causality relationship between the series.

2.4. Fourier Volatility Spillover Test

To estimate volatility spillovers, the Fourier volatility spillover test developed by Li and Enders (2018), which also captures structural breaks, is employed. In terms of capturing structural breaks, this test is more efficient than the volatility spillover test proposed by Hafter and Herwartz (2006). Li and Enders (2018), in their study, consider both smooth and sharp structural breaks with trigonometric functions by integrating sines and cosines while investigating causality in variance. The Lagrange multiplier (LM), which can be used even in large samples, was employed to conduct the analysis. This method is based on the GARCH (1, 1) model and the model of Hafner and Herwartz (2006) is estimated as shown in Equation 6:

$$\varepsilon_{it} = \xi_{it} \sqrt{\sigma^2 \left(1 + z_{jt}' \pi\right)}, \qquad z_{jt} = \left(\varepsilon_{jt-1}^2, \sigma_{jt-1}^2\right) \quad (6)$$

Under this approach, structural breaks in volatility transitions are disregarded. However, the GARCH (1, 1) model can lead to incorrect results when there are long-run structural breaks between the series and the model misses these structural breaks. In this regard, Li and Enders

(2018) integrated structural breaks into the model and constructed the volatility spillover model with structural breaks as follows:

$$\sigma_{it}^2 = \omega_{0i} + \sum_{k=1}^{n} \omega_{1i,k} sin\left(\frac{2\pi k_i t}{T}\right) + \sum_{k=1}^{n} \omega_{2i,k} cos\left(\frac{2\pi k_i t}{T}\right) + \alpha_i \varepsilon_{it-1}^2 + \beta_i \sigma_{it-1}^2 \quad (7)$$

The results obtained from the model can capture not only sharp structural breaks in the series but also structural breaks with smooth transition.

3. Empirical Findings

The first stage of time series analysis is to determine the stationarity of the series through unit root tests. In this regard, the Fourier ADF unit root test proposed by Enders and Lee (2012), which can handle both sharp and smooth structural breaks, was used. The results of the Fourier ADF test indicate that Oil Price Uncertainty, Brazilian stock market IBOVESPE, Russian stock market RTS and Indian stock market BSE 30 variables are non-stationary at level but stationary at first differences. Meanwhile, Chinese stock market SSE225 and South African stock market JSE Top 50 variables are stationary at level. These results are shown in Table 1.

Table 1. Fourier ADF Unit Root Test Results

	Level	First Diff.
Oil Price Uncertainty (OPU)	-3.13 (2) (11)	-6.17 (4) (12) ***
IBOVESPA (Brazil)	-3.58 (2) (12)	-5.59 (2) (12) ***
RTS (Russia)	-3.52 (1) (9)	-5.33 (5) (12) ***
BSE 30 (India)	-3.70 (1) (4)	-10.12 (5) (4) ***
SSE 225 (China)	-5.11 (3) (7) ***	-
JSE Top 50 (South Africa)	-3.91 (3) (5) **	-

Note: ** and *** denote %5 and %10 statistical significance, respectively.

The results of the Fourier ADF unit root test indicate that SSE 225 and JSE Top 50 are stationary at level, while the other variables are stationary at first difference. These results imply a limitation for cointegration tests. As such, in time series analysis, only ARDL-based tests can be used for series stationary at different levels. Therefore, we adopted the Fourier ADL and RALS tests for cointegration between series stationary at the same level and the Fourier ARDL bounds test for series stationary at different levels. The results are presented in Table 2.

Table 2. FADL-RALS and FADL Cointegration Test Results

	Optimal frequency	FADL test statistics	RALS-FADL test statistics	Rho stat
OPU – IBOVESPA	1	-6.80*	-6.97*	0.97
OPU – RTS	1	-6.54*	-6.59*	0.98
OPU – BSE 30	1	-.683*	-6.99*	0.97

Note: The critical values for the FADL test are -5.04 (1%), -4.47 (5%) and -4.19 (10%), and for the FADL-RALS test are -5.073, -4.482 and -4.186, respectively. The * symbolizes 1% statistical significance.

The results of the FADL and RALS-FADL tests, shown in Table 2, indicate that the stock markets have a long-run cointegration relationship with the oil price uncertainty index. On the other hand, Chinese and South African stock markets, which are stationary at different levels with the oil price uncertainty index, are analyzed by Fourier ARDL bounds test and the results are presented in Table 3. All three test statistics estimated by Fourier ARDL bounds test for China are higher than their critical values. However, the test statistics estimated for the South African stock market are smaller than all critical values. As a result, OPU and Chinese stock market SSE 225 are long-term cointegrated, while OPU and JSE Top 50 are not.

Table 3. Fourier ARDL Bounds Test

	Test statistics		Optimal frequency Min AIC	Bootstrap Critical Values		
				%10	%5	%1
OPU – SSE 225	Fa	10.46**	0.20 -2.32	7.71	8.94	11.74
	T	-4.57**		-3.73	-4.09	-4.66
	Fb	1.88*		1.71	2.26	3.03
OPU – JSE Top 50	Fa	4.72	0.30 -2.93	8.18	9.43	12.09
	T	-3.07		-3.94	-4.25	-4.73
	Fb	-0.35		2.32	2.77	3.49

Note: * and ** represents 1% and 5% statistical significance, respectively.

In summary, the results indicate that, except for South Africa, the stock markets of BRICS countries are cointegrated with the OPU in the long-term. These findings suggest that the uncertainty of oil prices is a significant determinant for stock markets.

Table 4. Fourier Granger Causality and Fourier Toda-Yamamoto Causality Test Results

	Method	Test Statistics	Asymptotic p-value	Bootstrap p-value
OPU → IBOVESPA	Fourier Granger Causality	8.423	0.07*	0.09*
IBOVESPA → OPU		2.076	0.722	0.750
OPU → RTS		21.767	0.04**	0.08*
RTSE → OPU		6.121	0.910	0.890
OPU → BSE30		2.258	0.323	0.270
BSE30 → OPU		1.559	0.459	0.540
OPU → SSE225	Fourier Toda Yamamoto Causality	0.175	0.916	0.920
SSE225 → OPU		0.174	0.916	0.910
OPU → JSE Top 50		0.012	0.994	0.980
JSE Top 50 → OPU		0.496	0.781	0.770

Note: → represents the direction of the causality relationship, while * and ** represent 1% and 5% statistical significance, respectively.

Following the cointegration analyses, causality relationships between OPU and BRICS stock markets were examined. In this stage, different causality methods were employed, considering the stationarity levels of the series. The Fourier Granger causality test was used for variables stationary at the same level, while the Fourier Toda Yamamoto causality test was adopted for series stationary at different levels. The results of these test are presented in Table 4.

Table 5. Li and Enders Fourier Volatility Spillover Test Results

	Test Statistics	p-value
OPU → IBOVESPA	6.01**	0.049
IBOVESPA → OPU	8.73**	0.012
OPU → RTS	3.72	0.150
RTSE → OPU	4.91*	0.082
OPU → BSE30	8.971**	0.011
BSE30 → OPU	10.965***	0.001
OPU → SSE225	3.70	0.152
SSE225 → OPU	7.57**	0.022
OPU → JSE Top 50	5.82*	0.054
JSE Top 50 → OPU	6.04**	0.048

Note: *, ** and *** indicate that 1%, 5% and 10% statistical significance, respectively.

The results shown in Table 4 indicate that there is no causality between OPU and the BSE30, SSE 225 and JSE Top 50 indices, while there is a unidirectional causality from OPU to IBOVESPA and RTS. In this regard, it is understood that shocks and structural changes in OPU are the determinants of IBOVESPA and RTS.

After the analysis of cointegration and causality relationships between BRICS stock markets and OPU, volatility spillover analysis was also conducted between these variables. As shown in Table 5, there is causality in variance from BRICS stock markets to OPU. These results reveal that stock markets are key indicator for uncertainty in oil prices. Moreover, there is a volatility spillover from the OPU to the stock markets of Brazil, India and South Africa. Overall, these results suggest that oil price uncertainty affects the equity markets of these countries.

CONCLUSION and IMPLICATIONS

Considered as the "lifeblood" of the global economy and a major pillar of global trade, oil stands out as a strategic commodity. However, the uncertainty surrounding oil prices may have profound effects on financial markets. Constant fluctuations in oil prices may lead to volatility in stock markets and cause a perception of uncertainty by investors. This uncertainty has the potential to affect a wide range of sectors, from energy companies to consumers, thus triggering large-scale volatility in stock markets. Oil price volatility can put significant stress on the profitability, cost structures and future planning of companies, which in turn may affect stock prices in the stock market. Moreover, this uncertainty can arise from a numerous factor, from geopolitical events to energy supply and demand dynamics, which can affect investor behavior in the markets. Consequently, oil price uncertainty is perceived as a crucial phenomenon in financial markets and has a profound impact on the stock market.

In this context, this study investigates the effects of energy price uncertainty on stock markets. The developed by Dang et al. (2023) is used as the explanatory variable. Although this index is newly constructed, it is widely applied in recent literature. On the other hand, data for this study are collected monthly and empirical analyses are carried out via Fourier Granger and Fourier Toda Yamamoto causality tests and Li and Enders Fourier volatility test.

Different from other studies that emphasise the direct relationship between geopolitical risks, energy price uncertainty or macroeconomic uncertainty on financial markets, this study takes a different path and focuses on oil price uncertainty as an important transmission mechanism in the relationship between BRICS stock markets and global energy dynamics. By adopting advanced econometric techniques such as Fourier Granger and Fourier Toda-Yamamoto causality tests, this study shows how to confidently capture linear and non-linear causal relationships that have often been ignored by previous researchers (Elder and Serletis, 2010; Böyükaslan et al., 2024). Thus, this approach extends its examination from oil price uncertainty to the volatility that pervades equity markets in some emerging economies, possibly providing a more sophisticated understanding of how regional markets respond to changes in external energy. Consequently, this approach addresses a very crucial gap in literature and informs useful actions for policy makers and market players on the strategic necessity of energy in the financial markets context.

Initially, we conducted Fourier ADF unit root test, which developed by Enders and Lee (2012). According to results of this test Chinese stock market SSE225 and South African stock market JSE Top 50 were found stationary at level while Oil Price Uncertainty (OPU), Brazilian stock market IBOVESPA, Russian stock market RTS and Indian stock market BSE 30 are stationary at first difference.

Based on the Fourier ADF unit root test results, we performed Fourier ADL-RALS cointegration analysis and found that IBOVESPA, RTS and BSE 30 are cointegrated with OPU. Moreover, according to the Fourier ARDL test results, there is a cointegration relationship between SSE 225 and OPU but not JSE Top 50. On the other hand, the Fourier Granger causality test showed that there is a unidirectional causality from OPU to IBOVESPA and RTS. However, Fourier Toda Yamamoto causality test revealed that there is no causality from OPU to SSE225 or JSE Top 50 or vice versa.

Finally, it is determined that there is variance causality from all the country stock market to OPU by Lee and Enders Fourier volatility spillover analysis. Particularly, it has been observed that the stock markets of Brazil, India, and South Africa are affected by OPU, and this uncertainty spreads to stock market volatilities. As a result, our findings indicate that oil price uncertainty has significant effect on the stock markets and this effect is stronger economic dynamics of certain countries compared to the others. The results reveal that there is a strong link between oil price uncertainty and several major stock market indices.

The findings of this study reveal that oil price uncertainty has a significant impact on global stock markets and particularly affects the economic dynamics of certain countries. In this regard, this study proposes some implications for investors and policymakers. First, investors should be aware of the effects of energy price uncertainty and adjust their portfolio strategies appropriately. Secondly, policymakers should evaluate policies to mitigate the uncertainties in the energy industry and should formulate policies to increase the transparency and predictability of energy policies. Finally, future research should analyze various parameters that cause oil price uncertainty and price volatility to better grasp the effects of energy price uncertainty on financial markets.

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EXTENDED ABSTRACT

GENİŞLETİLMİŞ ÖZET

PETROL FİYAT BELİRSİZLİĞİ VE HİSSE SENEDİ PİYASALARI: FOURIER TABANLI YAKLAŞIMLARDAN YENİ KANITLAR

Petrol fiyatı belirsizliği, hem enerji piyasalarında hem de finansal piyasalarda önemli bir unsur olarak kabul edilmektedir. Bu belirsizlik, firmaların yatırım kararlarını ertelemesine ve daha fazla bilgi talep etmesine yol açarak ekonomik dalgalanmalara neden olmaktadır. Petrol fiyatlarındaki değişimler, gelir transferleri, toplam talep üzerindeki etkiler ve jeopolitik riskler gibi çeşitli mekanizmalar üzerinden ekonomik faaliyetleri etkilemektedir. Son yıllarda petrol fiyatları ile hisse senedi getirileri arasındaki ilişki, hem enerji hem de finans literatüründe artan bir ilgiyle karşılanmaktadır. Bu bağlamda, petrol fiyatı belirsizliği yatırımcıların risk tercihlerini, piyasa beklentilerini ve hisse senedi piyasasındaki risk-getiri dinamiklerini şekillendiren kritik bir faktör olarak değerlendirilmektedir. Bu çalışmanın amacı, BRICS ülkelerinin (Brezilya, Rusya, Hindistan, Çin ve Güney Afrika) petrol fiyatı belirsizliği ile hisse senedi piyasaları arasındaki ilişkisini analiz etmektir.

Literatürde, petrol fiyatı belirsizliği enerji piyasaları ve finansal piyasalar üzerindeki etkileri bakımından geniş bir şekilde incelenmiştir. Araştırmalar, petrol fiyatı oynaklığının genellikle hisse senedi getirileri üzerinde olumsuz etkiler yarattığını, ancak bu etkilerin ülkelerin enerji üretici veya tüketici olma durumlarına, politikalarına ve ekonomik gelişmişlik düzeylerine göre değiştiğini göstermektedir. Örneğin, Bastianin ve Manera (2018), ABD hisse senedi piyasasının petrol fiyatı şoklarına verdiği tepkilerin, talep kaynaklı şoklar karşısında güçlü, arz şokları karşısında ise zayıf olduğunu ortaya koymuştur. Bununla birlikte, bazı çalışmalar, petrol fiyatı şoklarının hisse senedi getirileri üzerinde pozitif etkiler yaratabileceğini de öne sürmektedir. Bu durum, petrol fiyatlarındaki düşüşlerin enerji maliyetlerini azaltarak ekonomik büyümeyi desteklemesiyle ilişkilendirilmiştir.

Çalışmada, BRICS hisse senedi piyasalarının petrol fiyatı belirsizliğine tepkisi Fourier tabanlı ekonometrik yöntemlerle incelenmiştir. Fourier tabanlı testler önceki yapısal kırılmalı yakalayabilen testlere kıyasla daha gelişkindir. Geleneksel yapısal kırılmalı testler yapısal kırılmaları kukla değişkenler ile yakalamaktadır. Ancak bu durum, sadece keskin yapısal kırılmaların yakalanabilmesine olanak vermektedir. Fourier tabanlı yöntemler ise hem keskin hem de yumuşak geçişli kırılmaları yakalayabilme kapasitesiyle öne çıkmaktadır. Bu bağlamda, ilk uygulanan test Fourier ADF birim kök testi olmuştur. Fourier ADF birim kök testi sonuçlarına göre, Çin ve Güney Afrika hisse senedi piyasaları seviyede durağan bulunurken, diğer piyasalar birinci farkta durağanlaşmaktadır. Fourier ADL-RALS eşbütünleşme analizi, Brezilya, Rusya ve Hindistan hisse senedi piyasalarının petrol fiyatı belirsizliği ile eşbütünleşik olduğunu göstermiştir. Fourier Granger nedensellik testi sonuçları ise Brezilya ve Rusya piyasalarının petrol fiyatı belirsizliğinden tek yönlü olarak etkilendiğini, ancak Çin ve Güney Afrika piyasalarında böyle bir ilişkinin bulunmadığını ortaya koymuştur. Ayrıca, Lee ve Enders Fourier volatilite testi, petrol fiyatı belirsizliğinin özellikle Brezilya, Hindistan ve Güney Afrika piyasalarının oynaklığı üzerinde belirgin bir etkiye sahip olduğunu göstermiştir.

Sonuç olarak, petrol fiyatı belirsizliği, finansal piyasalar üzerinde önemli bir etkiye sahiptir ve bu etkinin büyüklüğü ülkelere göre değişiklik göstermektedir. Çalışmanın bulguları, yatırımcıların portföy stratejilerini belirlerken petrol fiyatları belirsizliğini göz önünde bulundurarak portföylerini şekillendirmesi gerektiğini vurgulamaktadır. Ayrıca, politika yapıcıların enerji piyasalarındaki belirsizlikleri azaltmak ve enerji politikalarının şeffaflığını artırmak için önlemler alması önerilmektedir. Gelecekteki çalışmaların, petrol fiyatı belirsizliğini etkileyen jeopolitik, ekonomik ve politik faktörleri daha ayrıntılı inceleyerek finansal piyasalar üzerindeki etkilerini daha iyi anlaması gerektiği ifade edilmektedir. Bu kapsamda, çalışma, enerji fiyatı belirsizliğinin finansal piyasalar üzerindeki etkisini anlamaya yönelik önemli bir katkı sağlamaktadır.

KATKI ORANI BEYANI VE ÇIKAR ÇATIŞMASI BİLDİRİMİ

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