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Impact of Oil Prices on BIST City Indices: Regional Differences in Company Performance

Petrol Fiyatlarının BIST Şehir Endeksleri Üzerindeki Etkisi: Şirket Performansında Bölgesel Farklılıklar

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ABSTRACT

This article examines the impact of WTI crude oil prices on nine city indices traded on the BIST, using daily data from 2014 to 2024. The study employs unit root tests, cointegration analysis, and FMOLS estimation to investigate the long-term relationship between oil prices and city indices. The results indicate that oil prices and city indices exhibit a symmetrical and significant relationship in the long run, with different degrees of impact across city indices. The XSANT Index, comprising companies in and around Antalya province, is the most influenced by crude oil prices, whereas the XSIST Index, comprising companies in Istanbul province, is the least affected. The findings have important implications for investors and policymakers who need to monitor oil price fluctuations and their effects on financial market indices.

Jel Codes: C10, C58, G12, R51
Keywords: Crude oil prices, city indices, BIST, cointegration, FMOLS.

ÖZ

Bu makale, WTI ham petrol fiyatlarının BIST'te işlem gören dokuz şehir endeksi üzerindeki etkisini 2014-2024 yılları arasındaki günlük verileri kullanarak incelemektedir. Çalışmada, petrol fiyatları ve şehir endeksleri arasındaki uzun dönemli ilişkiyi araştırmak için birim kök testleri, eşbütünleşme analizi ve FMOLS tahmini kullanılmıştır. Sonuçlar, petrol fiyatları ve şehir endekslerinin uzun dönemde simetrik ve anlamlı bir ilişki sergilediğini ve şehir endeksleri arasında farklı etki dereceleri olduğunu göstermektedir. Antalya ili ve çevresindeki şirketlerin oluşturduğu XSANT Endeksi ham petrol fiyatlarından en çok etkilenen endeks olurken, İstanbul ilindeki şirketlerin oluşturduğu XSIST Endeksi en az etkilenen endeks olmuştur. Bulgular, petrol fiyatlarındaki dalgalanmaları ve bunların finansal piyasa endeksleri üzerindeki etkilerini izlemesi gereken yatırımcılar ve politika yapıcılar için önemli çıkarımlara sahiptir.

Jel Kodları: C10, C58, G12, R51
Anahtar Kelimeler: Ham petrol fiyatları, şehir endeksleri, BIST, eşbütünleşme, FMOLS.

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Introduction

A study of the recent crude oil price history reveals that from the 1980s to the early 2000s, the average price of crude oil was approximately $20 per barrel. Since the early 2000s, it fluctuated within the range of $25 to $30. Starting in 2004, the band experienced a significant increase, reaching its highest value of $143.95 on 03.07.2008, before beginning to decline rapidly. After falling below $100 in the last quarter of 2008, it reached a low of $35.82 by the end of 2008. Crude oil prices began increasing in 2009 and fluctuated around an average of $100 between 2011 and 2014. In 2015, crude oil prices decreased by approximately 30%, and in the following five years, crude oil prices varied between $45 and $60. Following a substantial price decline in 2020, prices saw a significant rise in 2021 and 2022, surpassing $100 once more. The average price of crude oil in 2023 was approximately $80.

Figure 1. *Oil Prices, 1980-2024*

Source:
https://tradingeconomics.com/commodity/crude-oil (Access Date:05.02.2024)

Upon analyzing the causes of these price fluctuations, it becomes clear that wars were a significant turning point. OPEC's attempts to regulate the market from 1982 to 1987 partially stabilized oil prices, despite the adverse impact of the 8-year Iran-Iraq war that began in 1980. By 1990, the price increases triggered by Iraq's invasion of Kuwait and Russia's production reduction were reversed by a sharp decline due to the economic crisis originating in South-East Asia in 1997 (Elwood, 2001). The events of September 11, 2001, the attacks on the Venezuelan oil industry in 2003, the US invasion of Iraq in March 2003, and the subsequent economic growth due to increased liquidity in international markets and high demand for raw materials led to a significant increase in oil prices. Birol (2007) at The World Energy Outlook by the International Energy Agency stated that the rise in oil prices since the early 2000s was caused by the rapid increase in global oil demand from emerging economies like India and China, which experienced the highest economic growth rates during that period. The civil unrest and wars in Venezuela, Nigeria, and Iraq have worsened the already low spare capacity in crude oil production and refining due to ongoing geopolitical tensions. In 2006, profound structural issues in the US economy quickly spread, causing systemic global risk, shifts in economic growth expectations to the negative, and a decrease in oil and raw material prices. The Mortgage Crisis in 2008 prompted investors to shift away from intricate financial assets towards safer options like gold and crude oil, resulting in a surge in investor interest in crude oil and a subsequent rise in oil prices (Barrel et al., 2011). Subsequent to that year, a significant decrease in worldwide crude oil demand resulted in a decline in prices. Starting in the latter part of 2009, significant economies like China and India, along with more advanced nations, experienced an economic revival, leading to a continuous increase in crude oil prices until 2016. In 2016, OPEC policy changes and reduced geopolitical tensions led to an increase in oil supply, while decreased economic growth post-Mortgage Crisis resulted in lower oil demand. These advancements led to a decrease in the price of crude oil. During the following four years, the price of crude oil showed significant fluctuations. In 2020, amidst the negative economic impact of the Covid-19 Pandemic, crude oil prices dropped to levels similar to those seen almost three decades ago. Following the decline in the pandemic's impact, oil prices began to rise due to overall economic growth. However, the outbreak of the Russian-Ukrainian War in 2022 caused crude oil prices to drop once more.

The fluctuations in petroleum prices are anticipated to significantly impact both global and domestic economies due to the vital role of petroleum as a key input in all economies (Alt, 1987; Qiang et al., 2019; Sen et al., 2023). Hence, the empirical investigation of the influence of oil prices on stock market indices is necessary.

Although there are many empirical studies on the impact of oil price fluctuations on overall stock indices, there is a lack of research on the effects on city-specific indices at a more detailed level.

This study examines the WTI crude oil prices and BIST-traded city indices from January 29, 2014, to January 29, 2024. This study aims to investigate the long-term relationship between changes in oil prices and various indices, analyze the strength and stability of the relationship, compare the impact of oil prices on different indices, and provide a unique perspective to contribute to existing discussions.

The second part of our research involves a review of existing theoretical and empirical studies in this field, while the third part details the data sources and methodology used in the study. The fourth section details the study's empirical findings, while the fifth section analyzes the findings and draws conclusions.

Literature Review

Oil prices are widely acknowledged as a significant factor inflencing the global economy, while stock market indices are regarded as a reliable gauge of economic activity. Economists and finance experts have extensively examined the correlation between these two variables. Upon analysis of the literature, numerous studies can be found that seek to comprehend the impact of oil prices on stock market indices.

Jones and Kaul (1996) studied the impact of the oil shocks in 1973-1974 and 1979-1980 on the stock indices of the US, Canada, Japan, and the UK. They discovered that these oil shocks led to notable alterations in cash flows and stock returns. They contend that oil shocks did not significantly affect the US and Canadian stock indices, while the Japanese and UK markets reacted excessively to the new information. Hamilton (1983) and Hamilton (1985) demonstrated that the impact of post-World War II oil shocks on US stock markets was greater than anticipated. Chen, Roll, and Ross (1986) examined the Arbitrage Pricing Theory (APT) by analyzing numerous macroeconomic variables. They discovered a negative correlation between stock returns and oil prices, which were identified as risk factors. Fama and French (1989), Schwert (1990), Kaul and Seyhun (1990), Sentana and Wadhwani (1991), Ferson and Campell (1993), Kanoke and Lee (1995) have verified that this impact is adverse. In a study encompassing 18 stock markets, Ferson and Harvey (1995) discovered a notable correlation between crude oil prices and stock prices. Huang et al. (1996) discovered a notable correlation between S&P 500 returns and oil futures returns. Kwon et al. (1997) analyzed the impact of 4 macroeconomic variables on the Korean stock market through regression models. They found that oil prices have a notable influence on various industrial indices, with a positive effect on Fishing Industry and Food and Beverage indices, and a negative effect on Fabricated Metal Products, Machinery and Equipment, Wholesale Trade, and Transport and Storage indices. Faff and Brailsford's (1999) study demonstrated that rising oil prices positively affected Oil and Gas Diversified Resource indices, but had a negative impact on Paper and Packaging, and Transportation indices. Sadorsky (2003) asserts that industrial production, oil prices, the federal funds rate, the default risk premium, the consumer price index, and the foreign exchange rate all have a notable impact on the conditional volatility of technology stock prices. Jiménez-Rodríguez and Sanchez (2005) studied G-7 countries and Norway, while Cunado and De Gracia (2005) examined Asian countries, both concluding that unforeseen fluctuations in oil prices have a detrimental impact on stock prices. Park and Ratti (2008) conducted an empirical study on the effects of oil shocks on the US and 13 European countries from 1986 to 2005. They found a statistically significant positive correlation in Norway's stock market, a country that exports oil. In contrast, the impact in the US, a net oil exporter, was minimal. Additionally, the study revealed that the effects of oil shocks on real stock returns in other European countries, which are net oil exporters, were both positive and negative but asymmetric. Cologni and Manera (2008), and Kilian (2008) have reported comparable outcomes in their research on G-7 nations. Kandir (2008) examined the impact of 7 macroeconomic variables on Turkish stock returns from 1997 to 2005 and determined that crude oil prices did not have a significant influence on stock returns. Chiou, Lee, and Lin (2008) conducted a long-term study on daily S&P 500 and West Texas Intermediate (WTI) data from 1992:01 to 2006:07. They utilized co-integration, Granger-Causality tests, and an error-correction model, revealing a one-way relationship. Cong et al. (2008) examined the impact of oil shocks on China's real stock returns from 1996 to 2007 using a multivariate vector auto-regression method. They found that while this effect was not statistically significant on most stock market indices, it was more pronounced than the impact of interest rates on the manufacturing index. Geman and Kharoubi (2008) conducted research from 1990 to 2006 on NYMEX WTI crude oil futures and the S&P500 index. They concluded that futures oil prices have a negative correlation with stock market returns, irrespective of stock price fluctuations. Driesprong et al. (2008) conducted an empirical study on 18 developed and emerging markets from 1973 to 2003. They discovered that oil prices have a delayed yet statistically significant impact on stock market returns. O'Neill et al. (2008) studied the impact of oil price fluctuations on inflation expectations and stock market returns in key OECD nations. They found that the effects of oil price changes varied among countries, with negative effects observed in the US, the UK, and France, and positive effects in Canada and Australia. Kilian and Park (2009) found that the reaction of US real stock returns to a sudden change in oil prices differs based on whether the change is due to demand or supply shocks in the crude oil market. Dayanandan and Donker (2011) stated that oil prices impact companies' performance. Fluctuations in crude oil prices decrease company profitability, subsequently impacting stock prices negatively. Oil prices were discovered to have a limited effect on non-commodity stock markets like those in the UK or Japan, with the impact varying depending on the time period and country. Crude oil prices positively affect the stock prices of companies in the North American oil and gas sector. Basher et al. (2012) analyze the evolving relationship among oil prices, exchange rates, and emerging market stock prices. An increase in oil prices negatively impacts market exchange rates in the short term. In their 2017 study about the US, Kang et al. found that stock returns are significantly influenced by oil market shocks and economic policy uncertainty. Additionally, shocks to oil demand have a favorable effect on stock returns in the oil industry index. Diaz and De Gracia (2017) discovered that oil price shocks have a notable positive effect on stock returns in the near term. Liu (2017) studied the correlation between oil prices and stock prices of companies in the UK oil industry. The research shows that oil price shocks can have both adverse and beneficial impacts on stock prices. Financial crisis research indicates that oil prices impact stock prices across all markets, but do not have an effect on supply and demand. Atmaca (2018) analyzed the volatility processes of the city indices traded on the stock exchange using crude oil, Turkish Lira and Euro exchange rate return series data. According to the findings, volatility in crude oil and city index markets has persistent characteristics and all indices except Antalya city index are positively correlated with the crude oil series. The study of Ready (2018) analyzes oil price shocks by breaking them down into supply, demand, and risk shocks based on daily data. Clements et al. (2019) utilize Ready's (2018) oil shock decomposition to analyze the impact of structural oil shocks on US stock markets. Since the global financial crisis, modified aggregate demand shocks have been found to explain stock return fluctuations twice as effectively as Ready's (2018) demand shocks. Prior studies have employed a sectoral analysis to examine the variations in stock prices. The studies indicate that various market sectors react differently to fluctuations in oil prices. Several studies by Sakaki (2019), Das and Kannadhasan (2020), and Umar et al. (2022) provide evidence for this idea. The authors found a direct relationship between demand shocks and sectoral returns, and an inverse relationship between supply, risk, and EMU shocks and sectoral returns. Kayral (2020) studied the short-term and long-term correlations among the BIST Istanbul, BIST Ankara, and BIST Izmir City Indices within the Borsa Istanbul (BIST) City Index and the Dollar and Euro applying the ARDL model. The study's results indicate a cointegration link between City Indices and exchange rates in all models, with the exception of the relationship between BIST Ankara and the Euro. In the short-term, a positive correlation was observed between the Izmir City Index and the Euro in unlagged values. Özkan and Ünlü (2021) researched the cointegration connection among regional COVID-19 case numbers, gold prices, the Euro, and BIST city indexes. The study found a long-term relationship between the BIST Istanbul and BIST Izmir city indexes, regional Covid-19 cases, gold prices, and the Euro exchange rate. The coefficients obtained for the BIST Ankara city index lack significance. Raheem (2022) employs Ready's (2018) approach to demonstrate how oil price shocks can account for and forecast stock returns in a selection of countries. Azhgaliyeva et al. (2022) studied how crude oil shocks affect the issuance of corporate green bonds. The study found that flow supply shocks, flow demand shocks, and sovereign green bond issuance positively and significantly influence the likelihood of corporate green bond issuance. Nevertheless, these shocks do not notably affect the rate at which corporations issue green bonds. Sakur (2023) investigated the causative relationship between the monthly index values of 12 out of 14 provinces for which the BIST city index is calculated and the monthly export data of these provinces. The study applied the Toda-Yamamato causality test to analyze causal relationships, revealing a strong causal link from exports to the city index.

Methods

This study analyzes the time span from January 29, 2014, to January 29, 2024. The daily closing prices of Brent and WTI crude oil in USD were collected from https://fred.stlouisfed.org/series/ during this timeframe. (retrieved on 01.02.2024). The daily closing values of BIST city indices for the research period were retrieved from https://tr.investing.com/. The E-views 9 software package was utilized for conducting data processing tests. Logarithmic transformations were applied to reduce variance variability in the study's data.

Table 1.
City Indices traded on BIST

CITY INDICIES	TRANSACTION CODES OF INDICES USED IN THE STUDY
BİST Adana City Indicies	XSADA
BİST Ankara City Indicies	XSANK
BİST Antalya City Indicies	XSANT
BİST Balıkesir City Indicies	XSBAL
BİST Bursa City Indicies	XSBUR
BİST Denizli City Indicies	XSDNZ
BİST İstanbul City Indicies	XSIST
BİST İzmir City Indicies	XSIZM
BİST Kocaeli City Indicies	XSKOC

The leading methods used in research to examine the long-term cointegration relationship were created by Engle and Granger (1987), Johansen (1988a), Johansen (1991b), Johansen (1995c), and Johansen and Juselius (1990). Johansen cointegration analysis is the conventional approach for examining the enduring connections between macroeconomic variables.

Traditional co-integration methods have been replaced by newer methods like FMOLS (Fully Modified Ordinary Least Squares) developed by Phillips and Hansen (1990) because of the endogeneity issue during estimation and the challenge in interpreting the long-run coefficients. FMOLS is an estimation method utilized to examine the long-term cointegration relationship. This method addresses autocorrelation and endogeneity in regression errors, ensuring that the estimations are both consistent and efficient. This method assists in identifying the extent and orientation of the long-term connection between time series data (Bulut & Yılmaz, 2019; Özbek, 2023). The FMOLS technique not only addresses endogeneity and autocorrelation but also clarifies the long-term impacts of volatility by analyzing sustained volatility in oil prices and their impact on city indices over time. This enables us to indirectly consider the cumulative impact of changes in the market.

The Engle-Granger and Johansen cointegration tests, both widely used in econometric models, suffer from endogeneity issues. FMOLS, a more robust and consistent method, addresses these limitations by correcting for autocorrelation and simultaneity biases, resulting in more accurate measurements of long-term relationships in non-stationary time series data, surpassing the reliability of traditional methods like FMOLS (Yousef, 2022; Affof et al., 2022).

All time series must exhibit the same level of stationarity in order to apply the tests for this purpose. Without stationary time series, it is not possible to examine cointegration relationships or analyze long-run equilibrium relationships. The specified method involves taking the level values of the variables in the model and estimating the regression between them using Model 1.

$$INDICES_t = \alpha_0 + \alpha_1 WTI_t + u_t \quad (1)$$

The INDICES t variable in Model 1 stands for city indices, the WTI t variable stands for WTI crude oil prices and the u t term stands for the error coefficient.

Conducting a unit root test on the estimated residual values of the equation in the model confirms the presence of cointegration among the time series. If the model chosen with the lowest lag number (p) shows autocorrelation issues, then the model with the second lowest lag number should be considered. If autocorrelation persists in the model, increase the number of lags until the issue is resolved.

If the regression residuals do not have unit roots after the unit root test in the model, it indicates the presence of cointegration between the time series.

We used ADF and PP tests to analyze the residual values derived from regression estimations in our research. The Akaike Information Criterion (AIC) was used to determine the optimal lag length.

The study seeks to establish the correlation between daily fluctuations in WTI crude oil price and BIST City Indices, as well as to quantify the extent of this impact on city indices. The goal is to assess how sensitive city indices, representing the return change of a portfolio of firms in specific geographical clusters, are to fluctuations in crude oil prices.

The stationarity of the level values of the time series, which includes oil price and each index, is tested using a unit root test. The long-run equilibrium relationships are then analyzed through FMOLS analysis.

Results

Financial time series are typically non-stationary due to their tendency to display a leptokurtic distribution and heteroscedasticity, as noted by Engle and Yoo in 1987. Financial time series must exhibit stationarity for accurate analysis and reliable statistical procedures. A stationary series is defined by homoscedasticity, where the mean and variance remain constant and the variance is not influenced by time, although it may be affected by the time interval (Gujarati, 1995).

A unit root test is used to assess if two distinct time series exhibit the same level of stationarity. When two time series are both stationary at the same order, it suggests that there is a cointegration between them, and the regression between the two series is not spurious. Put simply, if there is a random trend between the two series, their initial order differences are stable, and there is a connection between the variables.

Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests are employed to assess the stationarity of time series data containing daily WTI crude oil prices and city indices. The ADF test determines the optimal lag length (p) by utilizing the Akaike Information Criterion (AIC). The non-stationary series underwent a unit root test after being transformed using the ln(x)-ln(x-1) method to achieve stationary means and variances.

Table 2. *ADF Test Results of the Series*

	ADF Test Statistics							
	Intercept				Trend and Intercept			
	Level		1. Difference		Level		1. Difference	
	Test Statistics	Prob.	Test Statistics	Prob.	Test Statistics	Prob.	Test Statistics	Prob.
WTI Oil_t $I(1)$	-1.735622	0.4130	-8.166138	0.0000	-1.903932	0.6518	-8.189770	0.0000
$XSADA_t$ $I(1)$	-0.706377	0.8433	-9.419563	0.0000	-1.861675	0.6740	-9.456250	0.0000
$XSANK_t$ $I(1)$	2.139028	0.9999	-7.458373	0.0000	0.693285	0.9997	-7.852532	0.0000
$XSANT_t$ $I(1)$	0.557909	0.9886	-8.056284	0.0000	-1.101326	0.9273	-8.251586	0.0000
$XSBAL_t$ $I(1)$	-4.033612	0.0013	-51.11627	0.0001	-3.895583	0.0124	-51.13787	0.0000
$XSBUR_t$ $I(1)$	1.559862	0.9995	-9.515093	0.0000	-0.154048	0.9940	-9.785826	0.0000
$XSDNZ_t$ $I(1)$	0.626338	0.9905	-9.451096	0.0000	-1.089243	0.9293	-9.588293	0.0000
$XSIST_t$ $I(1)$	3.145389	1.0000	-7.516500	0.0000	1.486062	1.0000	-8.167002	0.0000
$XSIZM_t$ $I(1)$	1.467875	0.9993	-8.536493	0.0000	-0.287237	0.9910	-8.802587	0.0000
$XSKOC_t$ $I(1)$	1.838588	0.9998	-7.686416	0.0000	0.162935	0.9978	-8.071409	0.0000

Table 3. *PP Test Results of the Series*

	PP Test Statistics							
	Intercept				Trend and Intercept			
	Level		1. Difference		Level		1. Difference	
	Test Statistics	Prob.	Test Statistics	Prob.	Test Statistics	Prob.	Test Statistics	Prob.
WTI Oil_t $I(1)$	-2.110729	0.2405	-62.50955	0.0001	-2.393246	0.3829	-62.68488	0.0000
$XSADA_t$ $I(1)$	-0.700671	0.8447	-46.55086	0.0001	-1.871861	0.6688	-46.55511	0.0000
$XSANK_t$ $I(1)$	3.514921	1.0000	-54.36738	0.0001	1.625041	1.0000	-54.33873	0.0000
$XSANT_t$ $I(1)$	1.267069	0.9986	-48.65083	0.0001	-0.483459	0.9843	-48.66026	0.0000
$XSBAL_t$ $I(1)$	-4.082334	0.0011	-51.10612	0.0001	-3.944494	0.0106	-51.12692	0.0000
$XSBUR_t$ $I(1)$	1.691395	0.9997	-53.50739	0.0001	-0.123892	0.9945	-53.61727	0.0000
$XSDNZ_t$ $I(1)$	0.957258	0.9962	-51.25382	0.0001	-0.842767	0.9603	-51.28585	0.0000
$XSIST_t$ $I(1)$	4.778604	1.0000	-55.34162	0.0001	2.417987	1.0000	-55.72206	0.0000
$XSIZM_t$ $I(1)$	1.909843	0.9999	-51.60742	0.0001	-0.010144	0.9962	-51.67588	0.0000
$XSKOC_t$ $I(1)$	2.928632	1.0000	-52.33591	0.0001	0.826901	0.9998	-52.58454	0.0000

The series became stationary after taking the first differences, as indicated by the ADF test results in Table 2 and PP test results in Table 3. We are able to continue on to the second phase of the study, which involves determining the cointegration relationship.

The regression model (INDICES t = α0 + α1 WTI t + u t) is estimated using the Least Squares Method based on the level values of the variables. The essential data extracted from the estimation results are displayed in Table 4.

Table 4.

Regression Equations of the Variables

XSADA	$XSADA_t = -0.002161 + 0.026323 WTI\ Oil_t + u_t$
XSANK	$XSANK_t = -0.001245 + 0.031429\ WTI\ Oil_t + u_t$
XSANT	$XSANT_t = -0.001502 + 0.041525\ WTI\ Oil_t + u_t$
XSBAL	$XSBAL_t = 0.000529 + 0.030730\ WTI\ Oil_t + u_t$
XSBUR	$XSBUR_t = -0.001236 + 0.028153\ WTI\ Oil_t + u_t$
XSDNZ	$XSDNZ_t = -0.001188 + 0.033003\ WTI\ Oil_t + u_t$
XSIST	$XSIST_t = -0.001129 + 0.025886\ WTI\ Oil_t + u_t$
XSIZM	$XSIZM_t = -0.001271 + 0.039359\ WTI\ Oil_t + u_t$
XSKOC	$XSKOC_t = -0.001434 + 0.039776\ WTI\ Oil_t + u_t$

The ADF and PP test results on whether the regression residuals obtained from the regression equations contain unit roots or not and the results on the existence of cointegration are presented in Table 5 and Table 6.

Table 5.

The ADF Test Results of the Regression Residuals and Existence of Cointegration

	ADF Test Statistics of u_t					
	Intercept			Trend and Intercept		
	Test Statistics	Prob.	Results	Test Statistics	Prob.	Results
XSADA	-49.2601	0.0001	Cointegrated	-49.2671	0.0000	Cointegrated
XSANK	-51.9369	0.0001	Cointegrated	-52.0380	0.0000	Cointegrated
XSANT	-16.5854	0.0000	Cointegrated	-16.6506	0.0000	Cointegrated
XSBAL	-49.2105	0.0001	Cointegrated	-49.2683	0.0001	Cointegrated
XSBUR	-51.0898	0.0001	Cointegrated	-51.1129	0.0000	Cointegrated
XSDNZ	-50.0820	0.0001	Cointegrated	-50.0823	0.0000	Cointegrated
XSIST	-23.2760	0.0000	Cointegrated	-23.4634	0.0000	Cointegrated
XSIZM	-20.1644	0.0000	Cointegrated	-20.2057	0.0000	Cointegrated
XSKOC	-11.1041	0.0000	Cointegrated	-11.1964	0.0000	Cointegrated

Table 6.

The PP Test Results of the Regression Residuals and Existence of Cointegration

	PP Test Statistics of u_t					
	Intercept			Trend and Intercept		
	Test Statistics	Prob.	Results	Test Statistics	Prob.	Results
XSADA	-49.2608	0.0001	Cointegrated	-49.2675	0.0000	Cointegrated
XSANK	-51.8861	0.0001	Cointegrated	-51.9951	0.0000	Cointegrated
XSANT	-48.8863	0.0001	Cointegrated	-48.9035	0.0000	Cointegrated
XSBAL	-49.2106	0.0001	Cointegrated	-49.2683	0.0001	Cointegrated
XSBUR	-51.0575	0.0001	Cointegrated	-51.0791	0.0000	Cointegrated
XSDNZ	-50.1242	0.0001	Cointegrated	-50.1219	0.0000	Cointegrated
XSIST	-52.7782	0.0001	Cointegrated	-52.9538	0.0000	Cointegrated
XSIZM	-51.6458	0.0001	Cointegrated	-51.6776	0.0000	Cointegrated
XSKOC	-51.9058	0.0001	Cointegrated	-51.9593	0.0000	Cointegrated

All city indices traded on BIST show cointegration with WTI crude oil prices, as indicated in Table 5 and Table 6.

FMOLS analysis was conducted using the residual values of the variables to test the long-run co-integration relationship. The results of the analysis can be seen in Table 7.

Table 7.
FMOLS Results

Indicies	Variables	Coefficient	Prob.
XSADA	WTI	0.026323	0.0000
	C	-0.002161	0.0000
XSANK	WTI	0.031429	0.0000
	C	-0.001245	0.0000
XSANT	WTI	0.041525	0.0000
	C	-0.001502	0.0000
XSBAL	WTI	0.030730	0.0000
	C	0.000529	0.0000
XSBUR	WTI	0.028153	0.0000
	C	-0.001236	0.0000
XSDNZ	WTI	0.033003	0.0000
	C	-0.001188	0.0000
XSIST	WTI	0.025886	0.0000
	C	-0.001129	0.0000
XSIZM	WTI	0.039359	0.0000
	C	-0.001271	0.0000
XSKOC	WTI	0.039776	0.0000
	C	-0.001434	0.0000

All FMOLS estimation results in Table 7 are statistically significant at the 1% level. FMOLS findings indicate that a 1% change in WTI crude oil price is expected to affect the following indices as follows: XSADA Index by 2.6323%, XSANK Index by 3.1429%, XSANT Index by 4.1525%, XBAL Index by 3.0730%, XSBUR Index by 2.8153%, XDNZ Index by 3.3003%, XIST Index by 2.5886%, XSIZM Index by 3.9359%, and XKOC Index by 3.9776%, all in the same direction. The XSANT Index, comprising companies in and around Antalya province, is the most influenced by crude oil prices, whereas the XSIST Index, comprising companies in Istanbul province, is the least affected.

Conclusion and Recommendations

Crude oil prices are a significant cost factor for all operating companies, either directly or indirectly. Hence, the correlation between crude oil prices and company performances is crucial for firms and investors involved in indices. This study examines the impact of WTI crude oil prices on nine city indices traded on the BIST, using data from city indices available from 29.01.2014 to 29.01.2024.

The study's findings suggest that WTI crude oil prices and BIST-traded City Indices exhibit a symmetrical relationship in the long term. The long-term cointegration analysis indicates that crude oil prices significantly influence the returns of city indices over time, confirming a long-term relationship. Furthermore, the FMOLS and cointegration studies implicitly reflect the long-term consequences of market volatility. This method illustrates how variations in oil prices aggregate over time, impacting city indices in a consistent and enduring manner. While a detailed geographical clustering study was not performed, the comparison of city indices indicates different regional economic characteristics and market sensitivity. Each index reflects the performance of companies focused in a specific geographical region, enabling an indirect analysis of how regional characteristics may affect the correlation between oil prices and city indices.

The results indicate that volatility in oil prices affects various city indexes differently. The XSANT index, indicative of companies in Antalya, exhibited the highest sensitivity to volatility in oil prices, likely attributable to the region's dependence on tourism and transportation sectors, which are directly affected by fuel costs. Conversely, the XSIST index, representing companies in Istanbul, had the lowest sensitivity, probably attributable to the city's diversified industrial structure and more robust financial markets.

When compared to the studies by Chen, Roll, and Ross (1986), Fama and French (1989), Schwert (1990), Kaul and Seyhun (1990), Sentana and Wadhwani (1991), Ferson and Campbell (1993), Kanoke and Lee (1995), Kandir (2008), and Basher et al. (2012), the findings differ regarding the impact of crude oil prices on stock returns. The study's findings align with previous research by Jiménez-Rodríguez and Sanchez (2005), Cunado and De Gracia (2005), Driesprong et al. (2008), Kang et al. (2017), Diaz and De Gracia (2017), Sakaki (2019), Das and Kannadhasan (2020), and Umar et al. (2022), indicating that crude oil prices have a symmetrical impact on stock returns.

The analysis shows that crude oil prices have a symmetrical impact on city indices. This discovery underscores the significance of crude oil prices' influence on financial market indices. Investors and policymakers should closely track crude oil prices to comprehend market trends and anticipate future price fluctuations. According to the differing sensitivity of city indices to volatility in oil prices, authorities had to carefully observe regions with greater susceptibility to oil price volatility, such as Antalya. Implementing specific initiatives to reduce risks in certain places might improve economic stability. Moreover, investors could evaluate the geographical characteristics of city indexes when formulating portfolio strategies, concentrating on sectors that exhibit less sensitivity to oil price volatility during turbulent periods.

This study primarily investigates city indices within BIST and crude oil prices, with results limited to the Turkish market environment. The findings may lack adaptability to other countries or markets. The research focuses entirely on the influence of oil prices, excluding other macroeconomic variables such as exchange rates and interest rates. The analysis corresponds to a specific period of time, and the results may not adequately reflect the impact of current events or future changes in the markets. Although FMOLS provides reliable long-term estimates, more advanced econometric methods may provide additional insights. This study solely investigates the correlation between oil prices and city indices to provide an accurate analysis. Although other macroeconomic factors, like exchange rates and interest rates, might affect the results, their combined effect is reserved for future studies.

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Genişletilmiş Özet

Bu çalışma, WTI ham petrol fiyatları ile BIST şehir endeksleri arasındaki karmaşık ilişkiyi ele almakta ve özellikle bu endekslerin petrol fiyatı dalgalanmalarına verdiği tepkilerdeki bölgesel farklılıkları ortaya koymayı amaçlamaktadır. 2014-2024 yıllarını kapsayan günlük veriler kullanılarak gerçekleştirilen analizde, birim kök testleri, Johansen eşbütünleşme analizi ve Tam Değiştirilmiş En Küçük Kareler (FMOLS) tahminleri gibi ileri düzey ekonometrik yöntemler uygulanmıştır. Uzun dönemli dinamiklerin hassasiyetle yakalanmasını sağlayan bu yöntemler, verilerin güvenilirliğini artırmak için logaritmik dönüşümler ve durağanlık testleri (ADF ve PP testleri) ile desteklenmiştir.

Sonuçlar, ham petrol fiyatları ile BIST şehir endeksleri arasında uzun dönemde anlamlı ve simetrik bir ilişki bulunduğunu ortaya koymaktadır. İncelenen endeksler arasında, Antalya bölgesindeki şirketlerden oluşan XSANT endeksinin petrol fiyatı dalgalanmalarına en yüksek duyarlılığı gösterdiği tespit edilmiştir. Bu yüksek duyarlılığın, bölgenin turizm ve ulaşım sektörlerine olan bağımlılığı ile yakından ilişkili olduğu düşünülmektedir. Öte yandan, İstanbul'daki şirketleri temsil eden XSIST endeksi, ekonomik çeşitliliği ve dayanıklı yapısıyla petrol fiyatlarına en düşük duyarlılığı sergilemiştir. Bu bulgular, Türkiye'deki bölgesel ekonomilerin heterojen yapısını ve küresel emtia fiyat şoklarına karşı değişen hassasiyetlerini gözler önüne sermektedir.

Bu bulgular, hem politika yapıcılar hem de yatırımcılar için önemli çıkarımlar taşımaktadır. Politika yapıcılar açısından, petrol fiyatı dalgalanmalarına karşı daha hassas olan bölgelerde riskleri azaltmaya yönelik hedefli müdahalelerin önemini vurgulamaktadır. Özellikle Antalya gibi bölgelerde, yakıta bağımlılığı azaltan stratejilerin uygulanması veya yerel sanayilerin dayanıklılığının artırılması, ekonomik istikrarı güçlendirebilir. Yatırımcılar açısından ise çalışma, portföy stratejilerini yeniden şekillendirmek için değerli bir rehber sunmaktadır. Petrol fiyatı dalgalanmalarından daha az etkilenen endekslerin veya sektörlerin önceliklendirilmesi, özellikle belirsiz ekonomik dönemlerde risk yönetimi ve getiri optimizasyonu açısından faydalı olabilir.

Bu araştırma, ulusal veya sektörel analizlerden daha mikro bir düzeye inerek şehir bazlı bir perspektif sunmasıyla literatüre önemli bir katkı sağlamaktadır. Bu sayede, ham petrol fiyatları gibi makroekonomik faktörlerin bölgesel düzeydeki finansal piyasalar üzerindeki etkileri daha detaylı bir şekilde anlaşılabilmektedir. Gelecekteki çalışmalar, bu bulguları desteklemek ve genişletmek amacıyla ek makroekonomik değişkenleri içerebilir, farklı zaman dilimlerini inceleyebilir veya uluslararası bağlamda analizler gerçekleştirerek çalışmanın kapsayıcılığını artırabilir. Bu çalışma, sadece Türkiye için değil, küresel emtia fiyatlarının yerel finansal performans üzerindeki etkisini anlamaya çalışan diğer ekonomiler için de değerli çıkarımlar sunmaktadır.