The causality relationship between energy prices and developed countries indices

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ARTICLE INFO

Article history:

Received 12 May 2021

Received in rev. form 21 July 2021

Accepted 17 August 2021

Keywords:

Energy prices, Cointegration test, Granger causality test

JEL Classification:

L26, L29

ABSTRACT

The aim of this study is to determine the causality relationship between energy prices, which are among the most important inputs of the economy, and selected stock market indices of developed countries. Crude oil and natural gas are used as energy variables. G7 countries were selected to represent developed countries. Stock indices used in the study are Dow & Jones (USA), DAX (Germany), CAC40 (France), FTSE250 (England), FTSE Italia All Share (Italy), NIKKEI225 (Japan), and S&P/TSX (Canada). In the study, Johansen (1988) cointegration test and Granger (1969) causality test were used to analyse the causality relationship between energy prices and selected stock market indices. The research could not find a long-term balance relationship between energy prices and developed country indices. Also, while the causality relationship was determined between crude oil prices and NIKKEI225, DAX, and CAC40 indices, a causal relationship between natural gas prices and Dow & Jones and FTSE250 indices was determined. In the study, it was found that energy prices can be used for diversification in investments to be made with stock market indices of developed countries. This study is one of the most comprehensive studies in the literature that examines the relationship between energy prices and the stock market indices of G7 countries. It is expected to contribute to the literature in this way.

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Introduction

Among the factors of production, energy is very important as it is a basic input of production. In this respect, energy prices have microeconomic and macroeconomic consequences. Therefore, countries should determine their energy policies and activities within the framework of these policies. Energy policies of the countries should include energy supply and demand balance in the short term and sustainable energy policies in the long term (Akgül and Burucu, 2013: 454). It is observed that world energy demand has varied over the years in terms of various energy sources. As of 2017, 32% of the energy demand is based on oil and 22% on natural gas resources, it is estimated that these numbers may change to 28% oil and 25% natural gas by 2040 (PwC Oil and Gas Trend Report, 2019). These data show that most of the world's energy demand will be realized in the form of oil and natural gas in the next twenty years.

When the effects of oil and natural gas prices on firms are evaluated, the increase in energy prices generally increases the input costs of firms. Increasing input costs of firms may cause a decrease in cash flows. The decrease in the discounted cash flows of firms may result in a decrease in value (Öztürk et al., 2013: 65). However, the dependence of firms on energy may differ. Whether firms are more or less dependent on energy, energy prices can significantly affect the market values of firms and thus their stock prices, as energy prices also affect other input costs. The relationship between energy prices and stock value has been examined in various studies in the literature, and studies have found a negative relationship between energy and stock prices (Diaz et al., 2016; Bastianin et al., 2016; Masood et al., 2019).

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<http://dx.doi.org/10.36096/brss.v3i2.292>

Citation: Soylemez, Y. (2021). The causality relationship between energy prices and developed countries indices. *Bussecon Review of Social Sciences* (2687-2285), 3(2), 24–40. <https://doi.org/10.36096/brss.v3i2.292>

For investors, oil and natural gas prices are not only important in terms of their impact on sector returns. While investors can invest directly in energy prices, they can also invest in securities based on energy prices. Another alternative for investors is derivative instruments based on energy prices that can be used for speculation or hedging purposes. An important problem in making investment decisions is determining which financial assets to use during portfolio creation. Within the framework of all these explanations, this study seeks answers to two basic questions.

- 1) Is there a cointegration and/or causality relationship between energy prices and selected stock market indices of developed countries?
- 2) Can investors make portfolio diversification by including energy prices in portfolios created using selected stock market indices?

In this direction, this study aims to determine the cointegration and/or causality relationship between energy prices and selected stock market indices of developed countries. Crude oil and natural gas prices were used as energy prices in the study. In terms of representing the developed countries in the most accurate way, the selected stock market indices were used in the analysis to represent the G7 countries. Accordingly, Dow Jones (USA), DAX (Germany), CAC 40 (France), FTSE 250 (England), FTSE Italia All Share (Italy), NIKKEI225 (Japan), and S&P/TSX (Canada) indices were included in the analysis. Monthly data set for all variables between 2010-2019 was used in the study. In the study, Johansen (1988) cointegration test was used to analyze the long-term equilibrium relationship between variables, and Granger (1969) causality test was used to determine the causality relationships between variables. Variance decomposition test was conducted to determine which variables are effective in the future predictions of the last variables used in the study. This study contributes to the literature in that it is among the rare studies that analyze the relationship between energy prices and the indices of G7 countries. In the study, firstly the literature review was included, then the method was explained and the findings and the discussion on the findings were put forward.

Literature Review

Studies have been conducted using different methods in the literature to examine the relationship between energy prices and financial asset prices and returns. However, when the literature is evaluated in general, it is noteworthy that the studies evaluating the relationship between energy prices and financial assets are relatively less compared to the studies on other asset prices. Considering the dependent variables used within the scope of this study, it can be said that there are more studies on oil prices compared to studies on natural gas prices. In this part of the study, the relevant literature is summarized and the difference of the study from other studies is revealed. The causality relationship between energy prices and stock market indices is also analyzed within the scope of BIST indices. Iscan (2010) analyzed the causality relationship between oil prices and the ISE 100 index and could not detect any relationship between the variables. Sandal et al. (2017) examined the causality relationship between the BIST 100 index value and gold and oil prices. In the study, no long-term cointegration relationship was found between the variables, and no relationship was found between oil prices and index value in the short run. Özmerdivanlı (2014), on the other hand, obtained evidence that there is cointegration between oil prices and the BIST 100 index. In the study, findings that the BIST 100 index is the granger cause of oil prices were also shared. There are also studies in the literature that examine the causality relationship between BIST sector indices and oil and natural gas prices. Ege and Sahin (2017) analyzed the causality relationship between BIST industrial and chemical indices and oil and natural gas prices using the Toda-Yamamoto method. In the study, while a causality relationship was established between natural gas price and industry indices, no causality relationship could be established between oil prices and industry indices. Yıldırım et al. (2014) similarly analyzed whether there is a causality relationship between oil and natural gas prices and BIST industrial sector firms. In the study, one-way causality from the crude oil price index to the industrial index and one-way causality from the industrial index to the natural gas price were determined. Abdioglu and Degirmenci (2014) analyzed whether there are a cointegration and causality relationship between BIST sub-sectors and oil prices. In the study, while determining the cointegration relationship between oil prices and food, textile, chemistry, and communication sectors, the causality relationship between oil prices and trade index was determined.

There are also studies in the literature examining the causality relationship between energy prices and multiple country indices. Dursun and Özcan (2019) conducted a study examining the relationship between energy prices and stock market indices in OECD countries. In the study, a long-term cointegration relationship between electricity, natural gas, and oil prices and the stock market indices of 25 OECD countries has been determined. In the causality study, a one-way causality relationship from stock market indexes to oil prices and from natural gas prices to stock market indexes was determined. Golder et al. (2020) could not find a causality relationship between crude oil prices and the stock market index in their study. In another study, Le and Chang (2011) found that the Japanese stock market reacted positively to the change in oil prices. Wanat et al. (2015) analyzed the causality relationship between DAX and FTSE100 indices and oil and gold prices and could not identify any relationship. In another study, Anoruo (2011) analyzed the causality relationship between the S&P 500 index and crude oil prices and found a bidirectional causality relationship. Zhang et al. (2020), on the other hand, found long-term relationships between North American and European indices and energy prices in their study, which also includes FTSE Italy All Share and S&P/TSX indices.

Similar to this study, Çevik et al. (2018) analyzed the causality relationship between the stock market indexes of the G7 countries and oil prices and determining causality between these variables. Çevik et al. (2018) used the MSCI G7 index to represent the stock

markets of G7 countries. In our study, the causality relationship has been analyzed directly by using the important stock market indices of the G7 countries. The study contributes to the literature in that it is a study directly examining the relationship between crude oil and natural gas prices and G7 indices. In this study, the cointegration and causality relationships between oil and natural gas prices and stock market indices with causality are revealed.

Research and Methodology

Many methods are used in the literature to analyze the causality relationship between financial time series. Among these methods, Granger (1969) causality test and Johansen (1988) cointegration tests stand out especially in terms of their reliability statistically. To analyze the causality relationship using these methods, all variables must be I(1) cointegrated at the same degree. To perform the Johansen cointegration analysis, a VAR model must first be established. The mathematical expression of the VAR model in question can be expressed as seen in Equation 1 (Brooks, 2008: 350).

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \dots + \beta_k y_{t-k} + u_t$$

In equation 1, y_t refers to the vector of non-stationary variables, while u_t refers to the error terms of variables. To perform the cointegration test, the VAR model must be converted to the VECM model (Sarıkovanlık et al., 2019: 130). VECM model can be expressed as shown in Equation 2.

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \dots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t$$

In equation 2, it is expressed as

$$\Pi = (\sum_{i=1}^k \beta_i) - I_g \text{ ve } \Gamma_i = (\sum_{j=1}^i \beta_j) - I_g.$$

When Equation 2 is examined, on the left side of the equation are the values of the independent variables indifference, and on the right side, there are the delayed values of the differences of the dependent variable. The Γ value indicates the long-term error coefficients of the variables. Finally, two different tests are used to reveal the Johansen cointegration relationship. These tests are called "Trace Test" and "Maximum Eigenvalue Test" and they can determine the cointegration relationship by comparing the calculated values with critical values (Brooks, 2008: 351). These tests, which are also used in this study, are expressed in Equation 3 and Equation 4, respectively.

$$\lambda_{Trace}(r) = -T \sum_{i=r+1}^g \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

In the application carried out within the scope of this study, after selecting the appropriate VAR model and determining the optimal lag length of the model, trace and maximum eigenvalue tests were performed within the scope of the Johansen Cointegration method. If statistically significant values ($p < 0.05$) are found as a result of the tests, it is accepted that there is a cointegration relationship. After analyzing the long-term cointegration relationship between the variables, the Granger causality test was used to determine whether there is a causality relationship between them. Equation 5 and Equation 6 are used to investigate the causality relationship between variables (Brooks, 2008: 297-298).

$$y_{1t} = \alpha_{10} + \beta_{11} y_{1t-1} + \beta_{12} y_{2t-1} + \gamma_{11} y_{1t-2} + \gamma_{12} y_{2t-2} + \delta_{11} y_{1t-3} + \delta_{12} y_{2t-3} + u_{1t}$$

$$y_{2t} = \alpha_{20} + \beta_{21} y_{1t-1} + \beta_{22} y_{2t-1} + \gamma_{21} y_{1t-2} + \gamma_{22} y_{2t-2} + \delta_{21} y_{1t-3} + \delta_{22} y_{2t-3} + u_{2t}$$

Equations 5 and 6 express different variables. Therefore, the causality test investigates whether the changes in the y_1 variable affect the y_2 variable. It can be said that if the y_1 variable causes the y_2 variable, the lag of the y_1 variable is effective on the y_2 variable (Sarıkovanlık et al., 2019: 113). In this case, the determination should be made that y_1 variable is the Granger cause of y_2 . Conversely, if the lag of the y_2 variable affects the y_1 variable, we find that the y_2 variable is the Granger cause of the y_1 variable. If the lag values of both variables are effective on each other, then a two-way causality relationship can be mentioned. In the empirical analysis conducted within the scope of the study, Granger causality test was also used to analyze the relationship between variables and the findings were discussed. Finally, within the scope of this study, variance decomposition test is included to analyze which variables depend on the changes occurring in the variance of the variables.

Findings and Discussion

Studies on determining the effect of energy prices on stock market indices and the effects of stock market indices on energy prices are quite abundant as mentioned in the literature section. However, studies generally do not allow comparisons between the stock markets of different countries in terms of establishing a causal relationship between certain stock exchanges and energy prices. Therefore, this study aims to investigate the causality and cointegration relationship between certain stock market indexes of developed countries and energy prices. Selected stock market indices of G7 countries are used to represent developed country stock market indices. Crude oil and natural gas variables are used as energy prices. The period between 2010 and 2019 was selected as the

research period, and it was decided to use monthly data as data frequency. Basic information about the data set created in this direction is shown in Table 1.

Table 1: Data Set

Code	Explanation	Country	Period	Source
CO	Crude oil	-	2010-2019	investing.com
NG	Natural gas	-	2010-2019	investing.com
DJI	Dow&Jones Index	USA	2010-2019	investing.com
DAX	DAX Index	Germany	2010-2019	investing.com
CAC40	CAC40 Index	France	2010-2019	investing.com
FTSE250	FTSE250 Index	England	2010-2019	investing.com
FTSEITL	FTSE Italia All Share Index	Italy	2010-2019	investing.com
NIK225	NIKKEI225 Index	Japan	2010-2019	investing.com
S&P/TSX	S&P/TSX Index	Canada	2010-2019	investing.com

The graphics of the variables given in Table 1 are shown in ANNEX-1. When the graphs are examined, the natural logarithms of the variables were taken to ensure the balance of variance between the variables and to normalize the variables by clearing the outliers before the analysis. Descriptive statistics are included in Table 2 to determine the relationships between the variables and to make the first analyzes about the variables.

Table 2: Descriptive Statistics

Variables	Number of Observations	Mean	Maximum	Minimum	Standard Deviation	Jarque-Bera	Probability
LNCO	120	4.23	4.73	3.51	0.31	8.14	0.01
LNNG	120	1.16	1.63	0.53	0.24	3.42	0.18
LNDJI	120	9.73	10.25	9.18	0.29	5.50	0.06
LNDAX	120	9.13	9.49	8.61	0.26	10.42	0.00
LNCAC40	120	8.38	8.69	8.00	0.17	5.72	0.05
LNFTSE250	120	9.63	9.99	9.13	0.24	11.30	0.00
LNFTSEITL	120	9.94	10.17	9.53	0.14	9.78	0.00
LNNIK225	120	9.61	10.09	9.04	0.33	12.04	0.00
LNS&P/TSX	120	9.54	9.74	9.31	0.11	7.36	0.02

When examining the descriptive statistics of the variables, it should be noted that the natural logarithms of the series are taken. Therefore, when analyzing average, maximum, and minimum values, it can only be meaningful to analyze the proximity or distance of values. It is seen that the variable where the maximum and minimum values are closest to each other is S&P/TSX. This situation can be considered as an indication that the Canadian stock market is less volatile compared to other developed country stock markets and energy prices. This finding is also supported when looking at the standard deviation values expressing the risk. However, it is not possible to make this evaluation for other variables. Therefore, the standard deviation measure can be considered to analyze the risk. Accordingly, it can be evaluated that the riskiest stock market index among the selected stock market indices of G7 countries is the NIKKEI225 index in Japan. The NIKKEI 225 index is followed by Dow Jones, DAX and FTSE 250 indices, respectively. In the general evaluation among energy prices, it is seen that the risk of crude oil prices is higher than natural gas prices. Performing the risk assessment of financial assets through descriptive statistics gives a general view about the risk, and the use of more sensitive econometric methods will strengthen the analysis. Since the risk assessment is not included in this study, the evaluations made on the risk analysis have been limited.

Correlation analysis is used to determine the direction of the relationships between variables. Correlation matrix for variables is included in ANNEX-2. When the correlation matrix in ANNEX-2 is examined, a statistically negative and 1% significant relationship between energy prices and stock market indices has been determined. This relationship shows that when energy prices increase, the stock market index decreases, and when energy prices decrease, the stock market index increases. On the other hand, a positive correlation of 1% was determined between oil and natural gas prices. In other words, oil and natural gas prices move in the same direction. All of the stock market indices have a 1% significance level and positive relationship with each other. If the time series of the variables that make up a data set are not stationary, false relationships may occur even though the time series are not related to each other (Gujarati, 2009; Brooks, 2008). Therefore, to reveal the relationships between time series, the series must meet the stationary condition. Besides, to use the causality tests within the scope of this study, as explained in the method section, the time series must be stationary at the first difference I(1), not at the level I(0).

Table 3: Unit Root Tests

Variables		ADF		PP		
		Constant	Constant Trend	and	Constant	Constant Trend
At Level	LNCO	-1.45	-2.28		-1.52	-2.24
	LNNG	-2.65	-3.22		-2.59	-3.24
	LNDJI	-0.62	-3.75		-0.31	-3.67
	LNDAX	-1.44	-2.77		-1.41	-2.86
	LNCAC40	-0.87	-3.06		-0.73	-3.06
	LNFTSE250	-1.41	-2.53		-1.40	-2.60
	LNFTSEITL	-1.87	-2.66		-1.89	-2.68
	LNNIK225	-0.64	-2.24		-0.65	-2.29
	LNS&P/TSX	-1.56	-2.76		-1.67	-3.05
At First Difference	LNCO	-9.21*	-9.16*		-9.08*	-9.02*
	LNNG	-11.51*	-11.46*		-11.67*	-11.62*
	LNDJI	-12.62*	-12.56*		-14.72*	-14.46*
	LNDAX	-10.48*	-10.46*		-10.52*	-10.55*
	LNCAC40	-11.17*	-11.15*		-11.28*	-11.27*
	LNFTSE250	-11.06*	-11.05*		-11.11*	-11.14*
	LNFTSEITL	-11.25*	-11.25*		-11.25*	-11.25*
	LNNIK225	-10.61*	-10.56*		-10.60*	-10.56*
	LNS&P/TSX	-10.29*	-10.25*		-10.29*	-10.24*

* 1%, ** 5% and *** 10% represent statistical significance.

In Table 3, Augmented Dickey Fuller (ADF) (Fuller, 1996) and Philips-Perron (PP) (Philips & Perron, 1988) unit root test results are given regarding the variables used within the scope of the research. In the unit root test, it was understood that all variables were not stationary in level values, and when their first differences were taken, they were stationary. The fact that the variables are stationary in the first differences indicates that the determined variables are suitable for causality tests. VAR models should be established to apply causality tests in which oil and natural gas prices, which are used to represent energy prices, are used as dependent variables. Optimal lag lengths should be determined before VAR models for variables are established. If the lag lengths for the models are determined incorrectly, the results of the impulse-response analysis and variance research may be different (Gültekin & Hayat, 2016: 618).

Table 4: Determination of Optimal Lag Lengths for Models

CRUDE OIL (CO)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	1098.09	NA	4.86e-19	-19.46	-19.27	-19.38
1	1953.27	1572.92*	3.56e-25*	-33.59*	-31.84*	-32.88*
2	1996.02	72.52	5.29e-25	-33.21	-29.91	-31.87
3	2037.11	63.83	8.31e-25	-32.80	-27.95	-30.83
4	2084.29	66.54	1.22e-24	-32.50	-26.09	-29.90
5	2149.89	83.17	1.36e-24	-32.53	-24.57	-29.30
6	2204.45	61.38	2.01e-24	-32.36	-22.85	-28.50
7	2286.62	80.70	2.03e-24	-32.68	-21.62	-28.19
8	2371.17	70.96	2.28e-24	-33.05	-20.43	-27.93
NATURAL GAS (NG)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	1112.83	NA	3.73e-19	-19.72	-19.53	-19.65
1	1914.00	473.59*	7.18e-25*	-32.89*	-31.14*	-32.18*
2	1960.64	79.12	9.95e-25	-32.58	-29.28	-31.24
3	2005.65	69.92	1.46e-24	-32.24	-27.38	-30.27
4	2063.64	81.80	1.76e-24	-32.13	-25.72	-29.53
5	2110.23	59.07	2.77e-24	-31.82	-23.86	-28.59
6	2167.71	64.65	3.88e-24	-31.70	-22.19	-27.84
7	2250.18	80.99	3.89e-24	-32.03	-20.97	-27.54
8	2329.48	66.55	4.80e-24	-32.31	-19.69	-27.19

* It is the optimum length determined by the relevant criterion.

Table 4 shows lag lengths for models where crude oil and natural gas prices are used as dependent variables. When the lag lengths related to the models used in the research are examined, it is determined that the optimal lag length is 1 for both models. Accordingly, the mathematical representation of the VAR models established within the scope of this study is given in Equations 7 and 8.

$$\text{MODEL I} \rightarrow CO_1 = \beta_1 DJI_{t-1} + \beta_2 DAX_{t-1} + \beta_3 CAC40_{t-1} + \beta_4 FTSE250_{t-1} + \beta_5 FTSEITL_{t-1} + \beta_6 NIK225_{t-1} + \beta_7 S\&P/TSX_{t-1} + u_t$$

$$\text{MODEL II} \rightarrow NG_1 = \beta_1 DJI_{t-1} + \beta_2 DAX_{t-1} + \beta_3 CAC40_{t-1} + \beta_4 FTSE250_{t-1} + \beta_5 FTSEITL_{t-1} + \beta_6 NIK225_{t-1} + \beta_7 S\&P/TSX_{t-1} + u_t$$

For the VAR models created in the study to be used in the empirical analysis, the stationarity test of the model should also be done. Inverse roots of the AR characteristic polynomial are used for the stationarity test of the model. It has shown that VAR models whose reverse roots of the AR characteristic polynomial are established have a stable structure.

Autocorrelation and variance tests should also be performed before moving on to the cointegration and causality relationships between variables. These tests were carried out and it was concluded that there was no problem of autocorrelation and changing variance between variables for both models. In the scope of the study, Johansen cointegration test was used to determine the long-term cointegration relationship between variables. The results of the Johansen cointegration test conducted within the scope of the analysis are shown in Table 5. While Model I shown in Table 5 analyzes the long-term cointegration relationship between crude oil prices and G7 country indices, Model II analyzes the relationship between natural gas prices and related indices.

Table 5: Johansen Cointegration Test Results

MODEL I								
H₀	Eigenvalue	Track	%5 Critical	Prob.**	Max-Eigenvalue	%5 Critical	Prob.**	
Hypothesis		Statistics	Value		Statistics	Value		
	0.40	170.48	175.17	0.08	61.79	55.72	0.01*	
	0.22	108.69	139.27	0.70	30.77	49.58	0.87	
	0.19	77.91	107.34	0.78	25.40	43.41	0.88	
	0.16	52.50	79.34	0.84	21.80	37.16	0.80	
	0.12	30.70	55.24	0.91	15.33	30.81	0.88	
	0.06	15.36	35.01	0.93	7.94	24.25	0.97	
	0.04	7.42	18.39	0.74	5.57	17.14	0.85	
MODEL II								
H₀	Eigenvalue	Track	%5 Critical	Prob.**	Max-Eigenvalue	%5 Critical	Prob.**	
Hypothesis		Statistics	Value		Statistics	Value		
	0.38	180.89	175.17	0.02*	56.51	5.72	0.06	
	0.29	124.38	139.27	0.26	40.50	49.58	0.31	
	0.22	83.87	107.34	0.59	30.77	43.41	0.56	
	0.14	53.09	79.34	0.82	18.23	37.16	0.95	
	0.12	34.86	55.24	0.76	15.87	30.81	0.85	
	0.07	18.98	35.01	0.76	9.55	24.25	0.92	
	0.06	9.43	18.39	0.53	7.35	17.14	0.67	

* The null hypothesis is rejected at the 5% significance level.

** It shows the probability value according to Mac-Kinnon-Haug-Michelis (1999).

When the results given in Table 5 are evaluated, no relationship between crude oil prices and the indices of the G7 countries has been determined at a 5% significance level in the long term. In this case, the H₀ hypothesis for Model I should be accepted. The absence of a cointegration relationship between variables within the scope of Model I shows that there is an opportunity for investors to diversify in the long run among these assets. The financial meaning of this is that portfolio diversification can be made by using oil prices and indices of G7 member countries within the scope of the study. This information is extremely important for investors. The same analysis can be made for natural gas prices. In other words, it cannot be mentioned that there is any balanced relationship between crude oil and natural gas prices and the indices used within the scope of the study of G7 countries in the long-term. Therefore, investors can reduce the risk of their investments by using the relevant assets and indices to diversify their portfolio in the long term. However, analyzing the causality relationships between variables is also extremely important for investment decisions. Granger causality test was used to determine the direction of causality between variables. In this context, Granger causality relationship between crude oil prices and indices of G7 countries is given in Table 6.

Table 6: Granger Causality Test (Model I)

Variables	Chi-square	df	p
H ₀ : The D&J index is not the granger cause of oil prices.	0.10	1	0.74
H ₀ : The DAX index is not the granger cause of oil prices.	0.08	1	0.77
H ₀ : The CAC40 index is not the granger cause of oil prices.	1.20	1	0.27
H ₀ : The FTSE250 index is not the granger cause of oil prices.	0.19	1	0.66
H ₀ : The FTSEITL index is not the granger cause of oil prices.	0.09	1	0.76
H ₀ : NIKKEI225 index is not the granger cause of oil prices.	4.53	1	0.03**
H ₀ : The S&P/TSX index is not the granger cause of oil prices.	0.41	1	0.52
H ₀ : Oil prices are not the granger cause of the D&J index.	1.68	1	0.19
H ₀ : Oil prices are not the granger cause of the DAX index.	3.73	1	0.05***
H ₀ : Oil prices are not the granger cause of the CAC40 index.	2.78	1	0.09***
H ₀ : Oil prices are not the granger cause of the FTSE250 index.	0.26	1	0.60
H ₀ : Oil prices are not the granger cause of the FTSEITL index.	0.25	1	0.61
H ₀ : Oil prices are not the granger cause of the NIKKEI225 index.	0.11	1	0.73
H ₀ : Oil prices are not the granger cause of the S&P/TSX index.	1.02	1	0.31

* 1%, ** 5% and *** 10% represent statistical significance.

When Table 6 is examined, it is seen that the NIKKEI225 index is the Granger reason for crude oil prices at the 5% significance level. On the other hand, crude oil prices are the Granger reason for DAX and CAC40 indices at a 10% significance level. This means that G7 country indices excluding NIKKEI225, DAX, and CAC40 indices can offer diversification for portfolios including oil prices. In other words, other indices can be included in portfolios in which oil prices are included for risk distribution purposes. These findings provide extremely important information for investors. On the other hand, the causality relationship between natural gas prices and G7 indices is shown in Table 7.

Table 7: Granger Causality Test (Model II)

Variables	Chi-square	df	p
H ₀ : The D&J index is not the granger cause of natural gas prices.	3.58	1	0.05***
H ₀ : The DAX index is not the granger cause of natural gas prices.	2.11	1	0.14
H ₀ : The CAC40 index is not the granger cause of natural gas prices.	1.29	1	0.25
H ₀ : The FTSE 250 index is not the granger cause of natural gas prices.	4.09	1	0.04**
H ₀ : The FTSEITL index is not the granger cause of natural gas prices.	0.49	1	0.48
H ₀ : The NIKKEI225 index is not the granger cause of natural gas prices.	2.00	1	0.15
H ₀ : The S&P/TSX index is not the granger cause of natural gas prices.	0.54	1	0.46
H ₀ : Natural gas prices are not the granger cause of the D&J index.	0.63	1	0.42
H ₀ : Natural gas prices are not the granger cause of the DAX index.	0.59	1	0.44
H ₀ : Natural gas prices are not the granger cause of the CAC40 index.	0.01	1	0.91
H ₀ : Natural gas prices are not the granger cause of the FTSE250 index.	0.00	1	0.99
H ₀ : Natural gas prices are not the granger cause of the FTSEITL index.	0.63	1	0.42
H ₀ : Natural gas prices are not the granger cause of the NIKKEI225 index.	0.00	1	0.98
H ₀ : Natural gas prices are not the granger cause of the S&P/TSX index.	0.25	1	0.61

* 1%, ** 5% and *** 10% represent statistical significance.

When the granger causality test results between the natural gas prices given in Table 7 and the indices belonging to the G7 countries are examined, it has been determined that the natural gas prices have a relationship of FTSE250 with a significance level of 5% and with the Dow & Jones index at a 10% significance level. Therefore, it has been found that diversification can be made by including indices other than Dow & Jones and FTSE250 indices in portfolios created using natural gas prices. Variance decomposition results of variables used in the study can be seen in ANNEX-3 and ANNEX-4.

In ANNEX-3, there are error variances used to predict the future regarding crude oil prices. When the information given in ANNEX-3 is examined, it is seen that the most effective index in predicting oil prices is the NIKKEI 225 index. This situation seems to be compatible with the causality test results given in Table 6. Likewise, it was determined that the most effective variable in predicting the Dow & Jones index is crude oil prices, while the most effective variable in predicting the future for other indices is the Dow & Jones index. Therefore, it can be said that the most important variable in the estimation of G7 indices is the Dow&Jones index. Error variances to be used to make future predictions about natural gas prices are included in ANNEX-4. When the information given in ANNEX-4 is examined, it can be concluded that the error variances of the FTSE 250, NIKKEI225 and CAC40 indices are more effective in natural gas price estimation.

While the findings obtained from the study obtained similar findings with the studies performed by Dursun and Özcan (2019), Le and Chang (2011) ve Zhang et al. (2020), Golder et al. (2020) and Wanat et al. (2015) found contradictory findings with the studies conducted. However, the effect of the variables used in the studies and the length of the data set on the results should be analyzed separately.

Conclusion

Energy prices have different effects on all sectors. However, the relationship between the sector indices and the returns of the indices and energy prices is too complex to be explained by the intensity of energy demands of the sectors. Because today, energy prices do not only affect sectors through real energy consumption. Energy prices can be included in various portfolios and used as direct investment instruments, as well as traded as underlying assets for various financial assets and derivative contracts. This situation increases the use of energy prices for speculative purposes and complicates the effects of price changes on sectors. Therefore, revealing the relationship between energy prices and financial indices will provide appropriate information for investors to position themselves in the market.

In this direction, the aim of the study is to analyze the causality relationship between energy prices and selected stock market indices of developed countries. Crude oil and natural gas prices are used as energy prices to carry out the analysis. The countries covered by the research are limited to the G7 countries. In this context, Dow&Jones (USA), DAX (Germany), CAC40 (France), FTSE250 (England), FTSE Italia All Share (Italy), NIKKEI225 (Japan), and S&P/TSX (Canada) indices were included in the analysis. As the research period, the years between 2010-2019 were selected and monthly data set was used. In the study, Johansen (1988) cointegration test was used to determine the long-term cointegration relationship between variables, and Granger (1969) causality test was used to reveal the causality relationship.

As a result of the cointegration test, Johansen (1988) found that there is no equilibrium relationship between both oil and natural gas prices and selected stock market indices in the long-term. In this case, energy prices may be included in a portfolio to be formed by the investors with the said indices to diversify. This inference is also supported by the correlation table of variables given in ANNEX-2. When ANNEX-2 is examined, it is seen that there are negative and significant relationships between energy prices and stock market indices. In other words, energy prices and selected stock market indices move in the opposite direction. Therefore, by portfolio theory, assets with negative correlations can be included in the portfolio and risk diversification opportunity can be created. Energy prices and selected stock market indices can also offer this opportunity to investors.

Another analysis conducted within the scope of the study is the Granger (1969) causality test, which was applied to reveal the causality relationship between variables. Based on crude oil prices, it has been determined that the NIKKEI225 index is the Granger cause of oil prices, while crude oil prices are also the Granger cause of the DAX and CAC40 indices. With the findings obtained from the Granger causality test, it can be said that selected stock market indices excluding NIKKEI225, DAX, and CAC40 indices offer diversification opportunities for portfolios including crude oil prices. Granger causality test findings for natural gas prices are the inference that natural gas prices can be included in portfolios formed with indices other than Dow & Jones and FTSE250 indices. In the variance decomposition test conducted within the scope of the study, it was found that the Dow & Jones index was the most effective stock market index in the forecast of crude oil prices, while the FTSE250, CAC40, and NIKKEI225 indices were found in the estimation of natural gas prices.

The findings obtained within the scope of the research reveal that there is a certain level of causality between energy prices and emerging stock market indices. Another conclusion of the study is that investors can use energy prices in portfolio diversification by using selected stock market indices. However, the study does not contain any evidence as to whether oil and natural gas prices can be used together in portfolio diversification. This situation can be analyzed in future studies. Besides, by expanding the studies with developing country indices, the relationship between stock market indices and energy prices in terms of development levels can be determined.

Author Contributions: Conceptualization, Y.S.; methodology Y.S.; Data Collection, Y.S.; formal analysis, Y.S.; writing—original draft preparation, Y.S.; writing—review and editing, Y.S.; Author has read and agreed to the published the final version of the manuscript.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to that the research does not deal with vulnerable groups or sensitive issues.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy.

Conflicts of Interest: The author declares no conflict of interest.

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ANNEX-1 Variable Graphics

Annex-2 Correlation Matrix of Variables

	LNCO	LNNG	LNDJI	LNDAX	LNCAC40	LNFTSE250	LNFTSEITL	LNNIK225	LNS&P/TSX
LNCO	1.00								
LNNG	0.63*	1.00							
LNDJI	-0.56*	-0.53*	1.00						
LNDAX	-0.63*	-0.50*	0.94*	1.00					
LNCAC40	-0.60*	-0.41*	0.90*	0.94*	1.00				
LNFTSE250	-0.61*	-0.50*	0.95*	0.98*	0.92*	1.00			
LNFTSEITL	-0.40*	-0.11*	0.55*	0.65*	0.82*	0.60*	1.00		
LNNIK225	-0.66*	-0.48*	0.93*	0.96*	0.95*	0.96*	0.69*	1.00	
LNS&P/TSX	-0.45*	-0.34*	0.90*	0.90*	0.91*	0.89*	0.70*	0.86*	1.00

* 1%, ** 5% and *** 10% represent statistical significance.

ANNEX-3 Variance Decomposition Results (Crude Oil-CO)

CRUDE OIL									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.084678	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.115541	99.12761	0.000145	0.003008	0.248231	0.019727	0.013014	0.543527	0.044739
3	0.136565	97.65319	0.000901	0.002181	0.613776	0.040117	0.020770	1.538787	0.130278
4	0.152172	95.91913	0.008131	0.012415	0.975062	0.050017	0.020307	2.773324	0.241611
5	0.164197	94.09642	0.029145	0.055989	1.280602	0.049657	0.017442	4.103088	0.367652
6	0.173684	92.26368	0.070402	0.153774	1.515762	0.044809	0.019592	5.431967	0.500014
7	0.181317	90.45356	0.136441	0.321196	1.683683	0.042952	0.032817	6.697077	0.632277
8	0.187585	88.67827	0.229494	0.566679	1.794887	0.051022	0.060868	7.859178	0.759600
9	0.192841	86.94272	0.349557	0.891578	1.861819	0.074267	0.105181	8.896385	0.878490
10	0.197345	85.25055	0.494727	1.291078	1.896174	0.115834	0.165288	9.799706	0.986639
DOW&JONES									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.035280	22.87428	77.12572	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.048816	21.66054	77.84636	0.180481	0.005665	0.157358	0.056866	0.032317	0.060416
3	0.058663	20.38136	78.38646	0.453509	0.008839	0.368366	0.164097	0.085838	0.151534
4	0.066578	19.12242	78.84598	0.757531	0.008424	0.572184	0.296811	0.147181	0.249461
5	0.073251	17.92387	79.25672	1.070226	0.006959	0.751401	0.437590	0.208651	0.344582
6	0.079043	16.80420	79.62730	1.382624	0.007613	0.903454	0.575867	0.265683	0.433263
7	0.084172	15.77063	79.95937	1.690203	0.013039	1.030608	0.706042	0.315692	0.514418
8	0.088784	14.82411	80.25331	1.989917	0.025020	1.136426	0.825713	0.357449	0.588051
9	0.092983	13.96195	80.51013	2.279273	0.044456	1.224527	0.934382	0.390669	0.654614
10	0.096844	13.17940	80.73180	2.556125	0.071500	1.298180	1.032582	0.415701	0.714714
DAX									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.046146	7.255679	37.39961	55.34471	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.060014	6.931109	40.44275	51.74992	0.006736	0.689257	0.007869	0.012454	0.159911
3	0.068849	6.420191	42.73082	48.77360	0.008320	1.610626	0.042899	0.020898	0.392648
4	0.075330	5.868353	44.54787	46.32301	0.006962	2.487738	0.112561	0.022647	0.630864
5	0.080432	5.348930	46.04675	44.26518	0.009060	3.246080	0.213926	0.020793	0.849278
6	0.084631	4.894853	47.31219	42.49288	0.020012	3.881148	0.339629	0.018883	1.040401
7	0.088200	4.517128	48.39511	40.93114	0.043100	4.408402	0.481764	0.019612	1.203742
8	0.091308	4.215053	49.32935	39.52989	0.079679	4.846352	0.633583	0.024724	1.341367

9	0.094068	3.981966	50.13961	38.25591	0.129654	5.211615	0.789933	0.035174	1.456134
10	0.096560	3.808562	50.84532	37.08679	0.191957	5.517935	0.947143	0.051312	1.550985
CAC40									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.042478	12.95659	38.18111	28.25662	20.60568	0.000000	0.000000	0.000000	0.000000
2	0.055522	12.37231	40.76175	25.85060	20.67797	0.169471	0.000569	0.003159	0.164171
3	0.063624	11.69768	42.99412	24.09113	20.36577	0.386582	0.000526	0.015739	0.448452
4	0.069365	11.01952	44.95815	22.74177	19.85360	0.591581	0.003206	0.039803	0.792377
5	0.073740	10.37872	46.69765	21.65915	19.24653	0.772322	0.011437	0.074195	1.159984
6	0.077248	9.792885	48.24259	20.75745	18.60477	0.930375	0.026560	0.116357	1.529002
7	0.080167	9.267524	49.61723	19.98451	17.96286	1.070144	0.048761	0.163543	1.885425
8	0.082667	8.801886	50.84280	19.30765	17.34030	1.195775	0.077565	0.213381	2.220642
9	0.084860	8.392077	51.93819	18.70559	16.74766	1.310507	0.112189	0.264048	2.529736
10	0.086816	8.032814	52.92013	18.16381	16.19014	1.416729	0.151763	0.314245	2.810368

ANNEX-3 Variance Decomposition Results (Crude Oil-CO) Continued

FTSE250									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.034890	17.78155	39.39322	15.83005	1.526403	25.46877	0.000000	0.000000	0.000000
2	0.047315	15.92007	41.49106	19.30098	1.096280	21.86110	0.282651	0.035478	0.012385
3	0.055811	14.25524	43.04243	21.26234	0.828775	19.81432	0.706126	0.073829	0.016938
4	0.062213	12.82606	44.33230	22.26912	0.667297	18.62152	1.162480	0.105429	0.015808
5	0.067284	11.61335	45.45695	22.68915	0.582208	17.90466	1.608978	0.131130	0.013566
6	0.071444	10.59129	46.45180	22.74782	0.557172	17.45739	2.028603	0.153323	0.012593
7	0.074954	9.735968	47.33332	22.58268	0.581703	17.16360	2.415156	0.174005	0.013574
8	0.077987	9.025696	48.11254	22.27921	0.647699	16.95656	2.767360	0.194567	0.016376
9	0.080660	8.440495	48.79930	21.89183	0.748009	16.79756	3.086310	0.215914	0.020585
10	0.083057	7.961866	49.40331	21.45601	0.875963	16.66426	3.374247	0.238590	0.025752
FTSEITL									
Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.055828	11.93150	23.00832	27.14983	15.91214	0.435880	21.56233	0.000000	0.000000
2	0.073563	11.78113	24.10828	27.47917	16.40617	0.411729	19.54831	0.086955	0.178255

3	0.084655	11.57063	25.04883	27.56481	16.84450	0.364993	17.84183	0.228263	0.536153
4	0.092498	11.31212	25.85153	27.50544	17.20719	0.317557	16.41046	0.384425	1.011278
5	0.098428	11.02110	26.54041	27.36501	17.48935	0.280713	15.22016	0.534313	1.548958
6	0.103111	10.71274	27.13828	27.18424	17.69454	0.258517	14.23595	0.668413	2.107324
7	0.106922	10.40004	27.66471	26.98826	17.83049	0.250940	13.42422	0.783972	2.657371
8	0.110089	10.09320	28.13535	26.79183	17.90649	0.256047	12.75453	0.881759	3.180781
9	0.112762	9.799661	28.56214	26.60305	17.93202	0.271286	12.20055	0.964083	3.667213
10	0.115047	9.524414	28.95388	26.42578	17.91603	0.294150	11.74022	1.033682	4.111855

NIKKEI225

Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.049645	7.249858	37.35777	12.48927	0.123953	0.016293	0.025320	42.73753	0.000000
2	0.068455	7.761976	39.10804	13.24392	0.376495	0.372085	0.400635	38.68585	0.050997
3	0.082009	7.980556	40.52083	13.86354	0.628587	0.904295	0.930872	35.03910	0.132207
4	0.092769	7.974741	41.71757	14.35959	0.832058	1.505118	1.500159	31.88944	0.221316
5	0.101671	7.810689	42.77564	14.74561	0.971344	2.113502	2.047726	29.22768	0.307807
6	0.109200	7.544215	43.74068	15.03485	1.048769	2.696792	2.546217	27.00114	0.387335
7	0.115658	7.219332	44.63758	15.23950	1.075077	3.238933	2.986741	25.14426	0.458587
8	0.121258	6.869170	45.47863	15.37061	1.063876	3.733332	3.369794	23.59296	0.521628
9	0.126162	6.517619	46.26904	15.43828	1.028604	4.178685	3.700154	22.29053	0.577081
10	0.130495	6.181052	47.01048	15.45174	0.981013	4.576564	3.984150	21.18927	0.625732

S&P/TSX

Period	St. Error	CO	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.027288	21.60788	29.74797	3.832786	1.636278	3.216449	0.002511	0.881088	39.07504
2	0.037178	20.52027	31.44991	4.265796	2.236684	3.142882	0.001356	1.394027	36.98908
3	0.043877	19.38795	32.99231	4.477583	2.744213	3.091917	0.001058	1.888755	35.41622
4	0.048837	18.28775	34.42855	4.536121	3.142978	3.046379	0.001700	2.324808	34.23172
5	0.052662	17.26105	35.78392	4.494966	3.437714	2.999721	0.003865	2.683574	33.33519
6	0.055689	16.32793	37.06877	4.393424	3.642236	2.950450	0.007640	2.960724	32.64883
7	0.058134	15.49525	38.28624	4.259355	3.773133	2.899245	0.012601	3.160677	32.11350
8	0.060146	14.76168	39.43675	4.111907	3.846563	2.847476	0.018048	3.292703	31.68488
9	0.061831	14.12095	40.52032	3.963694	3.876764	2.796515	0.023252	3.368240	31.33027
10	0.063269	13.56409	41.53773	3.822500	3.875548	2.747458	0.027629	3.399097	31.02595

ANNEX-4 Variance Decomposition Results (Natural Gas-NG)

NATURAL GAS									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.104603	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.136327	97.93191	0.000105	0.049950	0.480598	1.068929	0.090855	0.310382	0.067273
3	0.156028	95.11363	0.001490	0.053966	1.177024	2.428808	0.257382	0.842474	0.125225
4	0.169632	92.37514	0.013186	0.046051	1.858361	3.644468	0.452975	1.455417	0.154400
5	0.179410	89.96526	0.048095	0.062892	2.432740	4.618694	0.644852	2.065399	0.162065
6	0.186570	87.92225	0.119491	0.117095	2.876854	5.364586	0.814301	2.626898	0.158528
7	0.191873	86.21324	0.238801	0.205244	3.198042	5.922152	0.953057	3.118032	0.151433
8	0.195840	84.78471	0.414359	0.317503	3.415575	6.331661	1.059616	3.531191	0.145389
9	0.198845	83.58104	0.650876	0.443222	3.551644	6.626824	1.136399	3.867249	0.142746
10	0.201162	82.55164	0.949438	0.573395	3.627147	6.834279	1.187779	4.131932	0.144386
DOW&JONES									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.035448	0.934294	99.06571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.049582	0.603769	99.05379	0.052073	0.013005	0.079115	0.146141	0.000933	0.051176
3	0.060184	0.415263	98.73664	0.120720	0.027196	0.176532	0.398053	0.002676	0.122924
4	0.068948	0.324985	98.29991	0.188781	0.036587	0.260742	0.690827	0.004839	0.193330
5	0.076523	0.304963	97.82785	0.253289	0.040525	0.325043	0.986383	0.007110	0.254843
6	0.083244	0.336115	97.35867	0.315110	0.040262	0.370593	1.264213	0.009257	0.305776
7	0.089310	0.404653	96.90892	0.375801	0.037508	0.400616	1.514647	0.011131	0.346724
8	0.094853	0.500192	96.48469	0.436729	0.033834	0.418475	1.734381	0.012656	0.379048
9	0.099968	0.614698	96.08712	0.498894	0.030460	0.427102	1.923668	0.013812	0.404245
10	0.104723	0.741876	95.71516	0.562946	0.028223	0.428888	2.084591	0.014618	0.423701
DAX									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.046798	0.053306	45.06148	54.88522	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.062422	0.058330	47.84305	51.50219	0.011796	0.366593	0.103760	0.015528	0.098754
3	0.073042	0.147936	49.74896	48.63862	0.022457	0.849425	0.318759	0.046686	0.227159
4	0.081222	0.281381	51.12514	46.22770	0.027720	1.300589	0.608022	0.087341	0.342113
5	0.087907	0.439975	52.17404	44.17379	0.028399	1.681187	0.938014	0.132554	0.432037
6	0.093559	0.614784	53.01476	42.39477	0.026505	1.989783	1.283188	0.178992	0.497212
7	0.098446	0.801023	53.71892	40.82830	0.023998	2.235620	1.625889	0.224636	0.541613

8	0.102737	0.995639	54.33064	39.42876	0.022462	2.429505	1.954827	0.268369	0.569796
9	0.106552	1.196305	54.87776	38.16293	0.023058	2.581098	2.263383	0.309637	0.585830
10	0.109976	1.401012	55.37824	37.00637	0.026565	2.698380	2.548190	0.348215	0.593029
CAC40									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.043011	0.128651	52.00561	27.78031	20.08543	0.000000	0.000000	0.000000	0.000000
2	0.057424	0.124123	54.14677	26.31264	19.20680	0.030437	0.039849	0.068167	0.071210
3	0.066947	0.120087	55.90341	25.05387	18.33655	0.086198	0.128064	0.178476	0.193344
4	0.074054	0.115053	57.36470	23.96539	17.50830	0.157959	0.256229	0.297321	0.335051
5	0.079709	0.108587	58.60050	23.01727	16.73618	0.239589	0.414266	0.406556	0.477049
6	0.084390	0.101023	59.66390	22.18538	16.02395	0.326537	0.592355	0.498379	0.608472
7	0.088371	0.093221	60.59447	21.44988	15.37021	0.415230	0.781905	0.571061	0.724029
8	0.091821	0.086352	61.42135	20.79435	14.77127	0.502845	0.975910	0.625999	0.821930
9	0.094855	0.081700	62.16592	20.20521	14.22266	0.587210	1.168958	0.665884	0.902452
10	0.097552	0.080513	62.84381	19.67129	13.71991	0.666733	1.357061	0.693686	0.966989

ANNEX-4 Variance Decomposition Results (Natural Gas-NG) Continued

FTSE250									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.034932	0.054630	57.81147	14.33906	1.610283	26.18456	0.000000	0.000000	0.000000
2	0.047707	0.052185	58.45614	18.37412	1.132459	21.53675	0.360050	0.065260	0.023036
3	0.056884	0.092343	58.43869	20.83529	0.845916	18.62896	0.957777	0.165003	0.036020
4	0.064181	0.190193	58.24246	22.23144	0.668990	16.71722	1.638482	0.272322	0.038884
5	0.070259	0.351628	58.02124	22.94767	0.559093	15.38678	2.320155	0.376283	0.037145
6	0.075469	0.572317	57.82383	23.23380	0.493836	14.40804	2.961163	0.472924	0.034097
7	0.080020	0.842470	57.66544	23.24624	0.460696	13.65050	3.542340	0.561230	0.031084
8	0.084055	1.150532	57.54983	23.08294	0.451992	13.03770	4.057131	0.641383	0.028493
9	0.087672	1.485236	57.47653	22.80605	0.462476	12.52343	4.505938	0.713983	0.026356
10	0.090944	1.836528	57.44328	22.45582	0.488187	12.07904	4.892815	0.779720	0.024606
FTSEITL									
Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.055733	0.411747	35.15960	26.22371	15.75832	0.168526	22.27809	0.000000	0.000000
2	0.073972	0.821397	36.34057	27.32805	15.65735	0.259823	19.37974	0.131958	0.081105

3	0.085696	1.237023	37.36388	27.84703	15.71092	0.268458	16.98547	0.328017	0.259205
4	0.094223	1.621880	38.22379	28.02471	15.82735	0.239118	15.03893	0.522326	0.501898
5	0.100862	1.958121	38.92973	28.01063	15.95412	0.208714	13.48001	0.685425	0.773250
6	0.106257	2.238656	39.50283	27.89642	16.06341	0.196855	12.24860	0.808891	1.044330
7	0.110766	2.462988	39.96863	27.73757	16.14226	0.209956	11.28749	0.895031	1.296066
8	0.114601	2.634622	40.35183	27.56668	16.18638	0.246851	10.54492	0.950527	1.518204
9	0.117897	2.759297	40.67358	27.40179	16.19635	0.302940	9.976126	0.982939	1.706970
10	0.120750	2.843770	40.95077	27.25188	16.17536	0.372666	9.543764	0.999055	1.862737

NIKKEI225

Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.049670	0.049827	44.50451	11.99726	0.052381	0.025891	0.009493	43.36064	0.000000
2	0.068895	0.039445	46.89900	12.94137	0.256421	0.320185	0.408304	39.09751	0.037765
3	0.083143	0.028669	48.63840	13.76245	0.481837	0.723930	1.037130	35.23476	0.092825
4	0.094836	0.022865	49.91545	14.45730	0.678000	1.154615	1.755499	31.86934	0.146930
5	0.104860	0.027264	50.87619	15.03169	0.825373	1.569088	2.479400	28.99832	0.192677
6	0.113646	0.046146	51.62433	15.49528	0.921669	1.946827	3.163598	26.57406	0.228093
7	0.121444	0.082513	52.23081	15.85893	0.972940	2.279847	3.786942	24.53434	0.253679
8	0.128418	0.138078	52.74300	16.13341	0.988414	2.566857	4.342230	22.81713	0.270884
9	0.134692	0.213402	53.19211	16.32885	0.977738	2.809967	4.829844	21.36671	0.281379
10	0.140360	0.308088	53.59848	16.45463	0.949658	3.012866	5.253966	20.13558	0.286726

S&P/TSX

Period	St. Error	NG	DJI	DAX	CAC40	FTSE250	FTSEITL	NIK225	S&P/TSX
1	0.027383	1.713646	49.23862	3.616629	1.827379	4.145777	0.000961	1.103786	38.35320
2	0.037549	2.006617	51.25559	4.749964	2.303822	3.468190	0.042161	1.382727	34.79092
3	0.044701	2.172433	52.82431	5.498011	2.743160	3.068906	0.104783	1.622629	31.96577
4	0.050221	2.249409	54.14339	5.952217	3.124443	2.818840	0.176574	1.819645	29.71549
5	0.054656	2.267231	55.31126	6.200135	3.439634	2.653362	0.251346	1.975503	27.90153
6	0.058301	2.246770	56.37872	6.307703	3.689199	2.537899	0.325916	2.094586	26.41920
7	0.061343	2.202353	57.37270	6.321278	3.878407	2.452969	0.398615	2.182230	25.19145
8	0.063911	2.143829	58.30755	6.272856	4.014771	2.387168	0.468571	2.243796	24.16146
9	0.066102	2.078024	59.19092	6.184526	4.106472	2.333634	0.535339	2.284212	23.28687
10	0.067988	2.009704	60.02685	6.071635	4.161447	2.288148	0.598715	2.307790	22.53571