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Causality between Spot and Future Markets of the Borsa Istanbul Index and the Dow Jones Industrial Average*

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Abstract:

Purpose: *Futures markets are mainly used as a tool for price discovery and for risk management on the spot markets and to enable diversification for international portfolio investments. With this study we aim (1) to investigate and confirm the causality relationship between futures markets and the spot markets and (2) to examine and confirm the causality relationship between futures markets and the spot markets in different countries.*
Design/Methodology/Approach: *We used the BIST30 spot index and BIST30 futures contract representing the Borsa Istanbul market and the Dow-Jones 30 index and Dow-Jones 30 futures contract, which are the most used indices representing the US markets. Daily closing price data for the period between 2nd January, 2009 and 18th June, 2018 were analyzed using correlation, unit root test, causality test and regression equations.*
Findings: *The results of the study confirms that the futures markets continue their price discovery role for both the spot markets and futures markets and are influential on other futures and spot markets at international level.*
Practical Implications/Originality/Value: *These findings are important for investors in Turkey and emerging market economies since they confirm and cooroborate previous findings by other authors. Moreover, these findings will help investors take informed decisions by providing them with more knowledge in the object of this research.*

Keywords: *Causality, Dow Jones 30, Borsa Istanbul, BIST30, Emerging Market Economies*.

JEL Codes:*D53, E44, G1, G1, N2.*
Article type: *Research study.*

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1. Introduction

Futures are mainly used for hedging, speculation and arbitrage and their use is increasing daily. Futures have the leading and price discovery roles for spot markets because of their characteristics. This characteristic of the futures favours the prospective transaction decisions of the investors trading in spot markets. The mechanism by which futures prices influence spot prices is not always similar and this determins the information flow in the markets (Powers, 1970). It is possible to trade in spot and futures markets when news is received. However, in order to trade in futures markets, unlinke in the spot market it is enough to pay a small margin. When transaction costs are reduced, traders will spend less time to choose stocks in the futures market then in the spot market. As a consequence, it is expected that stocks are priced faster in the futures markets than in spot markets. For that reason, futures prices are expected to affect the spot prices in markets with sufficient depth (Çevik and Pekkaya, 2007).

However, according to Madura (1992), futures prices and spot prices have important behavioral differences. Corporate investors regard futures as a portfolio insurance rather than instruments to balance their profits by selling them off. The fact that corporate investors trade in futures markets instead of selling off their assets such as stocks in the spot markets prevents the stock prices in spot markets to decrease remarkably. Markowitz (1952) suggests diversification to achieve portfolios with an optimal risk-return relationship. Diversification in securities can yield favorable results, when the choice includes stocks in sectors or markets having low correlation with each other. However, international portfolio diversification can also be performed with the help of the spot and futures markets.

When carrying out portfolio diversification, an investor who trades in the spot and futures markets in one country can simultaneously trade in the spot and futures markets in another country. For that reason, it is necessary to determine the relationships between the spot and futures markets in both countries. It is stated that international price spillovers will also be more efficient through futures rather than through spot markets due to a causality relationship generally between futures and spot prices. The individuals trading in international markets tend to analyze the international futures stock market as an indicator of future spot stock market changes (Sim and Zurbreugg, 1999; Thalassinos *et al.*, 2015; Grima and Caruana, 2017).

The purpose of this study is to investigate and confirm the causality relationship between futures and spot stock markets and to examine the causality relationship between futures and spot markets in different countries. We use the BIST30 index and BIST30 Futures Contract to represent the Borsa Istanbul markets and the Dow-Jones 30 Index and Dow-Jones 30 Futures Contract which is one of the most used indices representing the US markets for this study. We will be using the Granger causality test using daily closing price data between the 2nd January, 2009 and 18th June, 2018 so as to analys the causality relationship between the variables (Polyakova *et al.*, 2019).

Literature summerised in the next section of this article shows that the relationships among futures markets within emerging market economies such as Turkey, which can be the best example of an economy that straddles the fine line between developed and developing economies, has not be sufficiently addressed. Therefore this study adds to the literature on such economies and prepares the way for further analysis of similar markets. It will help investors take informed decisions by providing them with more knowledge to enable them to build or confirm their price estimation model within similar economies.

2. Literature Review

Most academic studies indicate that futures prices in stock markets are determined from their respective spot prices and the futures markets are in turn determined using spot market prices (Kawaller *et al.*, 1987; Harris, 1989; Tse, 1995; Ramasamy and Shanmugan, 2004; Sangyoo, 2012; Thalassinos *et al.*, 2013; Rupeika-Apoga *et al.*, 2018). Kawaller *et al.* (1987) investigated the relationship between S&P 500 spot index and S&P futures index in the USA. A correlation test was performed for one-minute data of 1984 and 1985. In this study a strong relationship was found between futures prices and spot prices. While the prices in the futures market affect the spot prices for up to forty five minutes, the prices in spot prices usually affect the futures prices for up to one minute. This result indicates that futures prices play a price discovery role for spot prices.

Harris (1989) investigated the relationship between S&P 500 spot index and S&P futures index for the October 1997 stock market collapse. Harris (1989) used five-minute data in his study and revealed that futures market affected the spot market. Tse (1995) found that there was a similar one-directional causality relationship for Nikkei stock futures and spot market. Ramasamy and Shanmugan (2004) suggested to purchase in spot market as soon as there is an increase in the futures market. They found a one-directional causality relationship from the futures market to the spot market. Sangyoo (2012) tried to explain the relationship between TFEX futures and spot prices using ten minute day prices. As a result of the Error Correction (VEC) Model, a one-directional causality was found from futures prices to spot prices.

Abhyankar (1995) using the 1-hour return of FTSE 100 spot and futures stock indices data revealed that the futures market affected the spot market returns especially in the period of high volatility between 1986 and 1990. Also, bi-directional causality between the futures and spot markets was reveled in studies such as those by Turkington and Walse (1999), Hanias *et al.* (2007) and Pizzi *et al.* (1998). Turkington and Walse (1999) investigated the high frequency causality relationship between the Australian SPI futures index and AOI spot index.

Transport Cost Model, ARMA (p,q), bi-directional VEC and VAR models and action and reaction functions were used in this study. It was revealed that two indices were cointegrated and there was a bi-directional causality relationship between the series and the action-reaction functions favoured the results obtained. The bi-directional causality relationship between futures and spot prices was also revealed in Pizzi *et al.'s* (1998) studies. Pizzi *et al.* (1998) studies used the one-minute data for the 3 and 6 month futures stock markets data from S&P 500 futures and spot stock markets and revealed a bi-directional causality relationship. According to this study, futures prices affect the spot prices for up to 20 minutes and spot prices affect the futures prices for up to 4 minutes.

Özen *et al.* (2009) investigated the causality relationship between daily future prices and spot stock index prices between 2005 and 2009 and found a causality relationship between the futures markets and the spot markets in long term. However, in short term it was found that the spot index determined the futures markets. Çelik (2012) identified a long term relationship among the markets. Ersoy and Bayrakdaroğlu (2013) performed a causality analysis using daily closing prices of the IMKB30 index spot and futures contracts in order to investigate the presence of a led-lag relationship between the spot and futures markets. As a result of the study, they identified that two markets were cointegrated and there was a bi-directional causality relationship between the spot and the futures markets, but not a led-lag relationship.

Kaur and Singh (2017) analyzed the price discovery effect of futures in the Indian stock market over a 16-year period between 2001 and 2017. The authors found a bi-directional causality relationship between the futures and spot prices using the Vector Error Correction Model (VECM). According to the study, new information is firstly priced in the futures markets and then spread to the spot markets. Yao and Lin (2017) investigated the relationship between spot and futures stock markets using Granger causality and conditional Granger tests in China.

According to the study results, the information flow from the futures markets to the spot markets is higher than the flow in the opposite direction. However, it was identified that direct information flow from the spot markets to the futures markets was higher than flows in the opposite direction. Özdemir (2017) analyzed the relationship between the BIST30 spot and futures prices using the daily closing prices. As a result of the study conducted using Granger causality test, a bi-directional causality was found between the two markets.

However, we also find studies investigating the relationship between the futures prices based on stocks instead of index and the spot stocks. Pradhan and Bhat (2018) in their study investigated the causality relationship between the spot asset prices and the transactions based on stocks trading in the NSE futures markets in India. The authors identified a causality between futures prices and spot prices for 9 stocks between 2001 and 2005 and future prices played a price discovery role. A bi-directional causality for 9 stocks and a one-directional causality from spot prices to futures prices for 7 stocks were revealed in the study.

Futures markets should be an active market for them to be used for price discovery in the spot markets. Zakaria and Shamsuddin (2012) found a one-directional causality between spot prices and futures prices. They investigated the causality relationship between the futures stock market and the spot stock market in Malaysia and identified that the futures market could not fulfill the task of price discovery due to low trading volumes.

A few studies investigated the causality relationship between spot-spot and/or futures market data belonging to more than one country. Sim and Zurbreugg (1999), Wahab and Lashgari (1993), Lien and Shrestha (2009), Innocenti *et al.'s* (2010) studies are examples of such. These studies should be considered as portfolio management tools in different countries. Sim and Zurbreugg (1999) analyzed the minute price information between 24th July, 1997 and 24th October, 1997 in futures and spot stock markets of Australia and Japan by using ARCH models. The study findings indicate that the Japanese market affects Australian markets and the effect of the Australian stock market on the Japan market is weak. For Australian investors the Japanese futures market is more successful than the Australian futures market in fulfilling the task of price discovery.

The Japanese futures market primarily affects the Australian futures market and in turn the Australian futures market affects the Australian spot market. It is possible to say that this result is due to the fact that the Japanese economy and the respective stock markets are larger than those in Australia. Wahab and Lashgari (1993) investigated the spot and futures markets of the US S&P 500 index and the UK FTSE 100 index.

The authors found a bi-directional relationship between futures and spot markets of the two countries. Lien and Shrestha (2009) studied the spot and futures markets of the S&P 500, the FTSE 100, the TOPIX indices in USA and the Japan and UK markets. Price discovery was revealed in all the three markets. Similarly, Yarovaya *et al.* (2016) in their study using market data of 10 developed and 11 developing countries revealed that futures markets are more successful in conveying information than spot markets.

Ren *et al.* (2019) investigated the relationship among futures, options and spot markets in Chinese Mainland, Hong Kong and USA. The analysis results reported that other two futures and option markets except for the Chinese Mainland had an effect on the spot market and the futures markets was used for price discovery. This result is due to the maturity of their derivatives markets. However, immature derivative markets are not mechanisms for price discovery in Chinese Mainland and this role is carried out by the spot market.

Innocenti *et al.* (2010) in their study investigated the relationship between the USA S&P 500 futures market and three important European spot stock markets (CAC40, DAX-100 and FTSE 100). The authors analyzed the one minute data. According to the analyses, there is a positive correlation between the USA futures market and the European spot markets. However, the degree of the relationship increases during the opening and closing hours of the European stock markets and weakens in the middle of the day.

Following Sim and Zurbreugg's (1999) study, the relationship between the futures markets of different countries were investigated in few other studies such as that by Kang and Lee's (2019). In their study, Kang and Lee (2019) used daily price data for twelve market index futures, specifically Australia, Brazil, France, Germany, Hong Kong, India, Japan, Korea, Singapore, Spain, UK, and US. The study covers the period between 2002 and 2018. They indicate that European zone futures markets have a strong connection with each other and the correlation between the global futures markets increased between the global crisis period 2008 to 2009 and the European debt crisis period between 2010 to 2012. They identify the FTSE 100 as the most significant spillover contributor, while the KOSPI 200 being the largest net receiver of market shocks.

The obtained results show that more mature futures markets have more effects on the weaker ones. Özdemir (2018) examined the relationship between the BRICS-T futures markets [Bovespa (Brazil), MICEX (Russia), BSE100 (India), CSI (China) FTSE / JSE40 (South Africa) and BIST30 (Turkey)] using daily data between the period 1st August, 2012 and 29th June, 2018. The findings show that there is a bi-directional nonlinear causality relationship between Brazil and India-South Africa; Russia and India-China; India and Brazil-Russia-China-South Africa-Turkey; China and Russia-India-South Africa; South Africa and Brazil-India-China; as well as Turkey and India stock index futures markets.

Özen *et al.* (2014) analyzed the daily data from the stock index futures markets of Turkey (BIST30) and four Eurozone countries - Italy (MIB30), France (CAC40), Spain (IBEX), Greece (ASE20). It is stated that there is a bidirectional causality relationship between futures markets in the Euro regions. This result provides empirical evidence that the Eurozone stock futures markets are highly integrated.

3. Data, Methodology and Findings

For our analysis we used data from the BIST30 index and BIST30 Futures contract representing the Borsa Istanbul stock markets and Dow-Jones 30 index and Dow-Jones 30 Futures contract representing the USA markets.

Logarithmic return of the daily closing data between the 2nd January, 2009 and 18th June, 2018 was calculated and used in the analyses. The data was obtained from the following online source: https://tr.investing.com and the Borsa Istanbul data distribution center. The variables and abbreviations included in the study are shown in Table 1.

Table 1. *Variables and Abbreviations Included in the Study*

Variable	**Abbreviation**
BİST 30 Spot Stock Index	BIST
BİST 30 Futures Stock Index	BISTF
Dow-Jones 30 Spot Stock Index	DOW
Dow-Jones 30 Futures Stock Index	DOWF

Source: *Authors' Compilation.*

Descriptive statistics for the futures and spot return series belonging to the DOW and the BIST indices were included in the study. We analysed the data using the statistics values obtained through descriptive statistics whether the series was normally distributed or not in Table 2.

Table 2. *Descriptive Statistics for the Returns*

	BIST	**BISTF**	**DOW**	**DOWF**
Mean	0,000512	0,000510	0,000445	0,000446
Median	0,000800	0,000534	0,000565	0,000691
Max.	0,069652	0,083699	0,066116	0,053535
Min.	-0,109019	-0,119418	-0,057065	-0,061118
Standart Deviation	0,015739	0,016070	0,009753	0,009557
Skewness	-0,319394	-0,303780	-0,304265	-0,474300
Kurtosis	5,724021	6,934921	7,707833	7,423427
Jarque-Bera	750,8681	1520,541	2161,386	1963,083
Probability	0,000000	0,000000	0,000000	0,000000
N	2302	2302	2302	2302

Source: *Authors' Compilation.*

From the return series in Table 2, we can see that skewness values having negative values for all the return series and the distribution is skewed to the left. When the kurtosis values are analyzed, we can see that the DOW and DOWF series have greater kurtoses when compared to BIST and BISTF series. According to skewness and kurtosis statistics, it is observed that the series do not comply with the normal distribution. This was investigated using Jarque-Bera test statistics. According to the test statistics, it is observed that the series are not normally distributed at 1% significance level.

Correlation analysis was performed in order to determine the direction and degree of the relationship between the return series. The purpose of the correlation analysis is to indicate the relationship between the variables. As the correlation coefficient approaches 1 and -1, it means that the relationship between the variables is strong; however, as it approaches 0, it means that the relationship is weak. The correlation coefficients for the return series are presented in Table 3.

Table 3. *Correlation between Return Series*

	BIST	BISTF	DOW	DOWF
BIST	1.00			
BISTF	0.948562	1.00		
DOW	0.297607	0.289353	1.00	
DOWF	0.349963	0.341523	0.764750	1.00

Source: *Authors' Compilation.*

It is primarily necessary to determine whether the series are stable or not in order to analyze the relationship between the return series. For the stationarity analysis the ADF (Augmented Dickey-Fuller) unit root test and PP (Phillips-Perron) unit root test were used. The unit root test results for the regression models with fixed term and trend terms for return series are presented in Table 4.

Table 4. *Unit Root Test Results*

Series		**Augmented Dickey-Fuller (ADF) Test**		**Philips-Perron (PP) Test**	
		Intercept	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
BIST	Level	-14,09592***	-14,19189***	-49,06558***	-49,09633***
BISTF	Level	-14,08141***	-14,14896***	-49,11031***	-49,14378***
DOW	Level	-22,79243***	-22,78695***	-51,18752***	-51,17714***
DOWF	Level	-22,76738***	-22,76163***	-49,40007***	-49,38967***
Critical Values					
%1		-3,433009	-3,962051	-3,432996	-3,962034
%5		-2,862600	-3,411770	-2,862595	-3,411761
%10		-2,567380	-3,127770	-2,567377	-3,127765

Note: **** indicates 1%, ** indicates 5%, * indicates 10% of significance level.*
Source: *Authors' Compilation.*

It is seen that the return series do not have unit roots i.e., the series are stable at their level values since 1%, 5% and 10% significance levels of t values obtained for ADF test statistics are higher than the absolute values of their critical values. The Phillips Perron test statistic also supports the ADF test statistic.

Granger causality analysis was performed in order to determine the relationship between spot and futures return variables of DOW and BIST indices to determine that they are stationary. Causality analysis shows whether the delayed values of a variable can be used for explaining another variable. For instance, if the delayed values of X variable has a significant effect on the Y variable, X is the Granger cause of Y (Granger, 1988). There are four possibilities in causality analyses to determine the cause and effect relationship between two variables such as X and Y. X variable may affect Y variable, Y variable may affect X variable, X and Y variables may affect each other mutually or both of the variables do not affect each other.

Granger causality test which is used for determining whether there is a causal relationship or not and determines the direction of the relationship, if any, is performed with the help of the following equation (Gujarati, 2001).

$$Y_t=\alpha_0+\sum_{i=1}^{m}\alpha_i Y_{t-i}+\sum_{j=1}^{m}\beta_j X_{t-j}+u_{1t} \quad (1)$$

$$X_t=\alpha_0+\sum_{i=1}^{m}\lambda_i X_{t-i}+\sum_{j=1}^{m}\delta_j Y_{t-j}+u_{2t} \quad (2)$$

Here m indicates the length of the lag and u1t and u2t error terms are supposed to be white noise which is distributed with null average and constant variance and whose common variance is null. Equation (1) indicates the causality from X to Y, Equation (2) indicates the causality from Y to X. In Equation (1) if the null hypothesis (H_0) is β_j = 0, X is not the cause of Y; if hypothesis 1 (H_1) is $\beta_j \neq 0$, X is the cause of Y. In Equation (2) if the null hypothesis (H_0) is δ_j= 0, Y is not the cause of X; if hypothesis 1 (H_1) is $\delta_j \neq 0$, Y is the cause of X. In order to perform the Granger Causality test it is primarily necessary to determine the suitable delay value for the test. In order to determine the relationship between the spot and futures return variables of the DOW and the BIST indices that were identified to be stable, the delay length to be used in the VAR model was determined first. For this purpose, the maximum delay length was selected as 12 and the delay length which makes the critical values the least such as Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike (AIC), Schwarz (SC) and Hannan Quinn (HQ) was determined. The number of delays to be used in dual VAR model are presented in Table 5.

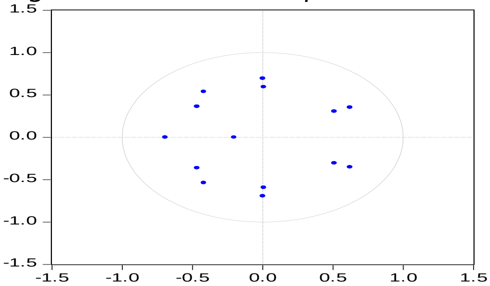
Table 5. *Suitable Delay Lengths for VAR Model*

VAR Variables	Lag Lenght
BIST Spot – BIST Futures	7
BIST Spot – DOW Spot	5
BİST Spot – DOW Futures	1
BİST Futures – DOW Spot	5
BİST Futures – DOW Futures	6
DOW Spot – DOW Futures	8

Source: *Authors' Compilation.*

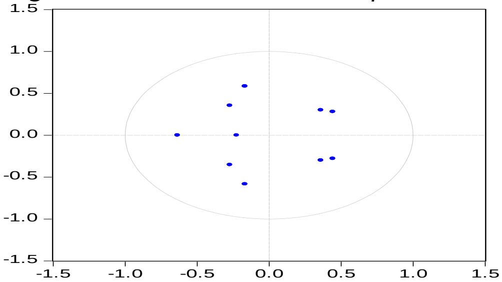
The position of the inverse roots of the AR characteristic polynomial in the unit circle was controlled to identify whether the dual VAR models estimated by considering the delay lengths include the unit root. It is understood from the following figures 1 to 6, that all of the inverse roots of the AR characteristic polynomial are in the unit circle. The fact that the inverse roots are in the unit circle presents that the estimated models are stable.

Figure 1. *Inverse Roots of AR Characteristic Polynomial of BIST–BISTF Model*



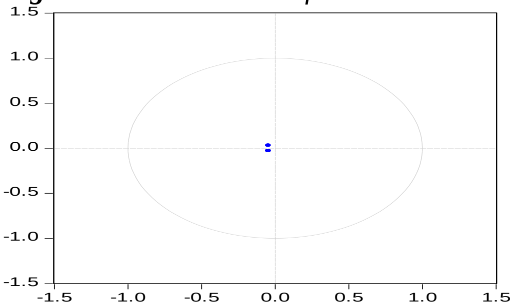
Source: *Authors' Compilation.*

Figure 2. *Inverse Roots of AR Characteristic Polynomial of BIST–DOW*



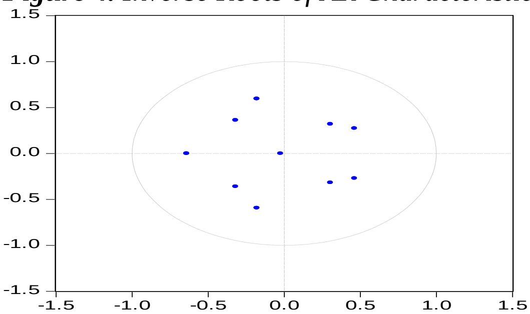
Source: *Authors' Compilation.*

Figure 3. *Inverse Roots of AR Characteristic Polynomial of BIST–DOWF Model*



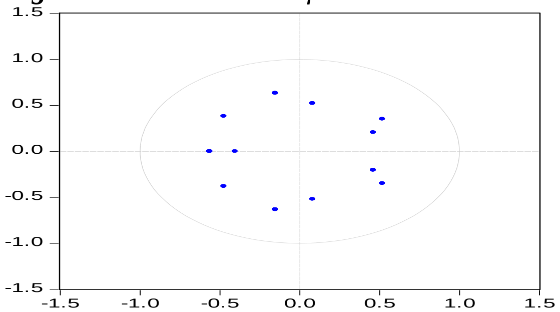
Source: *Authors' Compilation.*

Figure 4. *Inverse Roots of AR Characteristic Polynomial of BISTF–DOW Model*



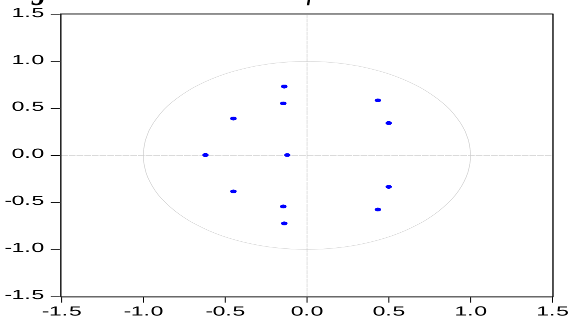
Source: *Authors' Compilation.*

Figure 5. *Inverse Roots of AR Characteristic Polynomial of BISTF–DOWF Model*



Source: *Authors' Compilation.*

Figure 6. *Inverse Roots of AR Characteristic Polynomial of DOW–DOWF Model*



Source: *Authors' Compilation.*

The models for the causality between BIST spot and BIST futures variables:

$$BIST_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, BIST_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, BISTF_{t-i} + u_{1t} \tag{3}$$

$$BISTF_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, BISTF_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, BIST_{t-i} + u_{2t} \tag{4}$$

The models for the causality between DOW spot and DOW futures variables:

$$DOW_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, DOW_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, DOWF_{t-i} + u_{1t} \tag{5}$$

$$DOWF_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, DOWF_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, DOW_{t-i} + u_{2t} \tag{6}$$

The models for the causality between BIST spot and DOW spot variables:

$$BIST_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, BIST_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, DOW_{t-i} + u_{1t} \tag{7}$$

$$DOW_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, DOW_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, BIST_{t-i} + u_{2t} \qquad (8)$$

The models for the causality between BIST spot and DOW futures variables:

$$BIST_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, BIST_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, DOWF_{t-i} + u_{1t} \qquad (9)$$

$$DOWF_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, DOWF_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, BIST_{t-i} + u_{2t} \qquad (10)$$

The models for the causality between BIST Futures and DOW spot variables:

$$BISTF_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, BISTF_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, DOW_{t-i} + u_{1t} \qquad (11)$$

$$DOW_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, DOW_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, BISTF_{t-i} + u_{2t} \qquad (12)$$

The models for the causality between BIST futures and BIST futures variables:

$$BISTF_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i}\, BISTF_{t-i} + \sum_{i=1}^{n} \gamma_{1i}\, DOWF_{t-i} + u_{1t} \qquad (13)$$

$$DOWF_t = \alpha_2 + \sum_{i=1}^{n} \beta_{2i}\, DOWF_{t-i} + \sum_{i=1}^{n} \gamma_{2i}\, BISTF_{t-i} + u_{2t} \qquad (14)$$

Table 6. *Granger Causality Test Results*

Hypotheses	**F Value**	**Probability**	**Direction of Causality**
BISTF does not Granger Cause BIST BIST does not Granger Cause BISTF	1,97458 5,07924	0,0549* 1,E-05***	BIST ⟷ BISTF
DOWF does not Granger Cause DOW DOW does not Granger Cause DOWF	42,5259 1,37592	8,E-64*** 0,2020	DOW ⟵ DOWF
DOW does not Granger Cause BIST BIST does not Granger Cause DOW	4,42287 1,38397	0,0005*** 0,2271	BIST ⟵ DOW
DOWF does not Granger Cause BIST BIST does not Granger Cause DOWF	28,9339 0,21541	8,E-08*** 0,6426	BIST ⟵ DOWF
DOW does not Granger Cause BISTF BISTF does not Granger Cause DOW	3,86661 1,83637	0,0017*** 0,1025	BISTF ⟵

			DOW
DOWF does not Granger Cause BISTF BISTF does not Granger Cause DOWF	3,95603 0,94150	0,0006*** 0,4639	BISTF ← DOWF

Note: ** indicates 10% of significance level, **indicates 5% of significance level, *** indicates 1% of significance level.*
← *means a one-directional causality relationship.*
↔ *means a bi-directional causality relationship.*
Source: *Authors' Compilation.*

According to Granger causality test results, a bi-directional causality was determined between the BIST spot return and the BIST Futures variables and a one-directional causality was determined from the DOW Futures variable to the DOW spot variable. In addition, a one-directional causality was determined from the DOW spot and the DOW Futures variables to the BIST spot variable and from the DOW spot and the DOW futures variables to the BIST futures.

According to these results, it can be concluded that a change in the values of the BIST futures, the DOW spot and the DOW Futures varaibles will affect the BIST spot variable and a change in the BIST spot, the DOW spot and the DOW futures variables will affect the BIST Futures variable.

After investigating whether there is a mutual relationship among the variables, a regression analysis was performed using the least square method in order to determine the direction and the influence rate of the DOW and the DOW futures variables to BIST and BIST futures variables. Regression models were established as noted in the following equations and the results are presented in Table 7 and Table 8.

$$\text{BIST} = b_0 + b_1\ \text{DOW} + b_2\ \text{DOWF} \quad (15)$$

$$\text{BISTF} = a_0 + a_1\ \text{DOW} + a_2\ \text{DOWF} \quad (16)$$

***Table 7**. Regression Analysis Results*

Dependent Variable: BIST				
Independent Variables	**Coefficient**	**Standard Error**	**T Statistics**	**Probability**
DOW	0.116507	0.048871	2.383977	0.0172
DOWF	0.485430	0.049876	9.732762	0.0000
c	0.000244	0.000307	0.792846	0.4279
R^2: 0.124638 Adjusted R^2: 0.123876		F Statistics: 163.6708 Prop (F Statistics) :0.000000		

Source: *Authors' Compilation.*

The regression estimation results using the Least Squares Method, reveals that the DOW return affects the BIST return at 5% significance and the DOW Futures contract affects it at a 1% significance level. According to the parameters obtained from the model, it was determined that 1 unit of increase in the DOW return would cause a 0.12 of increase in the BIST return and 1 unit of increase in the DOW futures contract return would cause a 0.49 unit of increase in the BIST return.

F statistics expresses whether the model is significant as a whole or not. When we looked at the F statistics of the model, it was understood that the model was significant at 1% of significance.

R^2 indicates what percentage independent variables explain about the changes in the dependent variables. As such, the variables in this model explain 12% of the change in BIST return. Therfore, it can be said that the rest of the change in the BIST return is affected by the different factors.

Table 8. *Regression Analysis Results*

Dependent Variable: BISTF				
Independent Variables	**Coefficient**	**Standard Error**	**T Statistics**	**Probability**
DOWF	0.487007	0.051100	9.530525	0.0000
DOW	0.111808	0.050070	2.233025	0.0256
c	0.000242	0.000315	0.769823	0.4415
R2: 0.118550 Adjusted R2: 0.117783	F statistics: 154.6013 Prop (F statistics) :0.000000			

Source: *Authors' Compilation.*

The regression analysis results in Table 8 indicate how and to what extent the DOW and DOW futures variables affect the BIST futures variables. According to these results, it was determined that the DOW return affected the BIST Futures return at a 5% significance and the DOW Futures contract return affected it at a 1% of significance.

According to the parameters obtained from the model, it was determined that 1 unit of increase in the DOW return will cause a 0.11 unit of increase in the BIST Futures contract return and a 1 unit of increase in the DOW Futures contract return will cause 0.49 unit of increase in the BIST Futures contract return. The R^2 value of our model is equal to 12 %. This indicates that independent variables explain 12 % of the change in the BIST Futures return. F statistics value of the model is significant at a 1% significance indicating that the model is significant.

Although, the study utilizes and generalises using only data relating to the Dow Jones and the BIST 30 futures and spot stock index, these are among the most important influencing indexes in the markets and therefore the results are indicative.

4. Conclusions and Evaluation

As noted above, we can confirm similar to other authors that the futures markets are used for price discovery and risk management in spot markets and offer diversification opportunity for international portfolio investments. The ability of one futures market to influence other futures or spot markets is related to the volume of transactions in the relevant market. Moreover, from our findings we can confirm the findings of other authors that markets of economically large countries also have an effect on other markets and lead the relevant markets.

For that reason, both futures and spot market relationships and between-market interaction are investigated at an international level. As a result of the Granger causality test, we confirm that while there is a bi-directional causality between the BIST30 spot and the futures returns, there is a one-directional causality between the DOW spot and the futures returns. The DOW futures return influences the DOW spot return. According to the causality results between Turkey and the USA markets, a one-directional causality was found between the DOW spot and futures return and the BIST spot and the futures return.

Moreover, the power of the DOW futures return to explain the BIST30 futures and the BIST30 returns is much higher than the power of the DOW spot returns. Accordingly, we can confirm and cooroborate previous findings that the developments in markets are firstly priced by the USA futures market and then transferred to the Turkish futures market and at the same time the Turkish spot market is also affected by these movements. The obtained regression analysis results supports our results obtained from the correlation analysis.

We confirm and cooroborate that the findings herein are similar to the studies in previous literature summarized above. According to the study, the direction of causality in markets is from futures markets to spot markets. A bi-directional causality relationship is observed between the futures market and the spot market determined by the power of these markets. In addition, futures markets of large economies influence smaller markets. This result cooroborates to Sim and Zurbreugg (1999) and Ren *et al.'s* (2019) findings, who respectively noted similarly that Japanese futures transactions, an economically larger stock market, had a dominant effect on the Australian futures market and determined that USA derivative markets had an effect on the Chinese mainland and the Hong Kong derivative markets.

The fact that our results confirm and cooroborate findings to other authors is important for investors who want to invest in Turkey and in similar emerging economies with similar characteristics. It helps investors build or confirm their price estimation model within similar economies.

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