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STOCK FUTURES MARKET EFFICIENCY AND PRICE DISCOVERY ROLE IN TURKEY

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Abstract

This study analyzes short-run and long-run relations with Johansen cointegration and Vector Error Correction Model (VECM) using Borsa İstanbul BİST 30 index daily closing spot and futures prices within the period of August 1, 2013 to July 15, 2016. In the long-run, the cointegration relationship between spot and futures markets is observed consistent with market efficiency concept. However, spot market affects the futures market in the short-run that may distort efficiency because of transaction costs, leverage, or marketability effects. The study also highlights the idea that with different periods and maturity selected in futures market, the price discovery role may change from futures market to spot market in the short-run. The price discovery roles of futures and/or spot market create inefficiency that should be tested in further studies.

Keywords: Market Efficiency, Price Discovery, Futures Market, Cointegration, Causality

JEL Classification: G10, G14, G15

TÜRKİYE'DE HİSSE SENEDİ VADELİ İŞLEMLER PİYASASI ETKİNLİĞİ VE FİYAT KEŞİF ROLÜ

Öz

Bu çalışma 01.08.2013-15.07.2016 döneminde Borsa İstanbul BİST 30 endeksi günlük spot ve vadeli işlemler kapanış fiyatlarını kullanarak Johansen Eşbütünleşme ve Vektör Hata Düzeltme Modeli (VECM) ile kısa ve uzun vadeli ilişkileri analiz etmektedir. Uzun dönemde, spot ve vadeli piyasalar arasında piyasa etkinliği kavramı ile tutarlı olarak eşbütünleşme ilişkisi gözlemlenmiştir. Ancak kısa vadede spot piyasa vadeli işlemler piyasasını işlem maliyetleri, kaldıraç veya pazarlanabilirlik etkileri nedeniyle etkilemektedir ki bu da etkinliği bozabilmektedir. Çalışma vadeli işlemler piyasasında farklı periyotlar ve vadeler seçilirse, fiyat keşif rolünün kısa vadede vadeli işlemler piyasasından spot piyasasına da kayabileceğine dikkat çekmektedir. Ve vadeli işlemler ve/veya spot piyasasının fiyat keşif rolünün yaratacağı etkinsizliğin ilerleyen çalışmalarda test edilmesi gerekmektedir.

Anahtar Kelimler: Piyasa Etkinliği, Fiyat Keşfi, Vadeli İşlemler Piyasası, Eşbütünleşme, Nedensellik

JEL Sınıflaması: G10, G14, G15

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1. Introduction

Market efficiency implies that the futures prices should be unbiased predictors of future spot prices (Samuelson, 1965). This efficiency tells market participants that they cannot use the available information to profit by speculating in the spot market based on futures prices, since spot and futures markets react together to new information. However, with transaction costs, barriers, and liquidity problems in the financial markets, discovery of prices in one market may disseminate information about the price in other markets. Generally, the popular futures markets lead the stock market as they have a price discovery role (Kawaller, Koch, and Koch, 1987).

This study aims to analyze the futures stock market efficiency in Turkey by testing whether differentiating between short-term and long-term would show a relation between spot and futures market. Turkey's salient feature is its young futures market. Following the literature as a first step, cointegration relation is searched between spot and futures price series to test long-run efficiency. Then, Vector Error Correction Model (VECM) is applied to determine the direction of long-run and short-run causality or possible lead–lag relationship (Nieto, Fernandez and Munoz, 1998; Choudhary and Bajaj, 2012).

Both spot and futures prices are found to be cointegrated that support long-run efficiency, which is consistent with previous findings of İlter and Algüner (2013) and Çağlı and Mandacı (2013) in the Turkish stock market. In addition, by applying VECM using more recent sample, I reject the hypothesis that futures market in Turkey has a price discovery role that may create short-run inefficiency in the market. Spot prices lead futures prices rather than futures prices leading spot prices in the Turkish stock market only in the short-run, since spot market is well established and may be more advantageous according to derivatives market in Turkey. For arbitrageurs and speculators, spot market may trigger a change in positions in the futures market (Moosa, 1996). However, this advantage disappears in the long-run, as shown in the VECM.

Although this is not the first study that tests causal relationships in Turkey, this study indicates, with different data set periods, the general findings about the price discovery role of futures market to the spot market in the short-term. In the long-term, market efficiency is verified with Johansen test (1991) and thereafter, VECM, which is consistent with most of the studies. Thus, the prevailing assumption in the literature that futures market or spot stock market has a price discovery role may be wrong because price discovery role may change according to selected periods and different stock market indices or futures contracts maturity chosen (Antoniou and Holmes, 1996; Ivanovic and Howley, 2004). The price discovery role tested by error correction mechanisms or Granger causality in the literature can often only show short-term causality effects that do not prevent long-run efficiency. In addition, factors in the short-run that created inefficiency is not studied in Turkey.

This study particularly analyzes the period after the İstanbul Derivatives Market (VİOP) started in 2013 by focusing on the role of short-run and long-run causality between spot and futures market separately, consistent with Sharma, Arora, and Gupta (2020). The Wald test (Wald, 1943) was employed to test the short-run causality between the futures and spot markets in Turkey.

The paper is organized as follows: Section 2 examines the literature of futures stock market efficiency and the lead–lag relationship between spot and futures markets in both developed and developing countries. Section 3 discusses the data and methodology. Section 4 provides results, and the last section discusses the results as well as the conclusion.

2. Literature

The simple efficiency or unbiasedness hypothesis assumes that spot and futures series share an identical long-run balance (Crowder and Phengpis, 2005). Spot and futures prices are assumed to exhibit a one-to-one long-run equilibrium. The standard framework for analyzing the long-run relation between spot and futures stock price series is cointegration. In asset markets, the efficiency hypothesis indicates a no-arbitrage-profit condition. Notably, a no-arbitrage-profit condition requires that spot, futures, and cost of carry will be cointegrated. If the cost of carry, defined as the cost carried by the investor for holding certain positions in the underlying spot market until the futures contract expires, is stationary, then the spot and futures market will be cointegrated. The relation between S&P 500 index futures and its main stock market analyzed by Wahab and Lashgari (1993), Arshanapalli and Doukas (1997), Pizzi, Economopoulos, and Oneill (1998), and Ghosh (1993) showed that the two markets are cointegrated.

The efficiency tests about futures market generally focus on its leading role, price discovery. Table 1 summarizes some of the findings of established literature in developed and developing markets. If new information is accepted to spread rapidly over the futures market prior to the spot market, then price discovery mechanism occurs in the futures markets and market efficiency may perish by biased predictions. The evidence indicates that futures market, in general, leads the spot market (Gupta and Singh, 2009). Futures market has leading advantages of the use of high borrowing according to the leverage hypothesis, low financing costs according to the trading cost hypothesis, leave of an uptick rule according to uptick rule hypothesis, and marketability according to market-wide information hypothesis compared with spot market (Chu, Hsieh, and Tse, 1999). Using the Spanish stock index, IBEX 35, Nieto, Fernandez, and Munoz (1998) differentiated short-run and long-run causality and proved that futures price in the short-run causes spot price and acts as an efficient market in the long-run. Booth, So, and Tse (1999) examined the intraday price discovery mechanism among stock index, index futures, and index options in Germany using DAX index securities and intraday transactions data. Their results indicate that the spot index and index futures have predominantly greater information shares than index options. Moreover, the futures markets figure out the greatest feedback effects on others. As the trading costs of the futures appear to be the lowest among the three markets analyzed and those of the index options to be the highest, the findings are in conformity with the transaction cost hypothesis.

However, Rosenberg and Traub (2008) suggested that the futures market might not show an essential role in the price discovery because of its relatively small size compared with the spot market. Using data from the Chicago Mercantile Exchange foreign exchange futures in 2006, they found that the spot market is dominant because it is more transparent. In addition, price discovery sometimes occurs in both markets simultaneously, and the spot and futures markets have bilateral lead–lag relationship (Mallikarjunappa and Afsal, 2010). Consequently, Green and Joujon (2000) stated that Granger causality between stock index futures and spot prices is inconsistent when cost of carry is considered in the Error Correction Model (ECM), since one-way causality between stock and futures return is impossible because of changing carrying costs. Analyzing the French CAC-40 stock index futures from the beginning of 1989, it showed that, in the first period between 1989 and 1990, causality ran one way from spot to futures only. In the second period between 1990 and 1992, there is bidirectional causality as cost of carry was accepted, while causality runs from futures to spot differently in the third period between 1992 and 1993. Bohl, Salm, and Schuppli (2011) searched the time-varying relation between spot and futures market with Vector Error Correction Model – Dynamic Conditional Correlations – Generalized Autoregressive Conditional Heteroskedasticity (VECM-DCC-GARCH) framework in Poland and found that during the dominance of uninformed private investors, the futures market does not make a contribution to price discovery process. Their evidence displayed information flows from futures to spot market as well-informed institutional investors' share in trading volume increases.

Futures market often satisfies the price discovery function but also fails at times. Hence, it is important to treat the information underwritten in futures prices carefully. Floros and Vougas (2008) showed that Greek stock index futures include knowledge about spot prices, but there is a stable long-run relation between prices.

Table 1: Price Discovery Literature in Brief for Developed and Developing Markets

	Author(s)	Country	Data Period	Frequency	Futures Instrument	Leading Market	Model
Developed Markets	Chu, Hsieh and Tse (1999)	USA	1993	Intraday	S&P 500/S&P Depository Receipts	Futures	Johansen and Juselius Cointegration, VECM
	Rosenberg and Traub (2008)	USA	1996–2006	Daily	CME currency futures	Spot	Instrumental variable regression
	Nieto, Fernandez, and Munoz (1998)	Spain	March 1, 1994–September 30, 1996	Daily	IBEX 35 futures	Futures	Granger Causality
	Floros and Vougas (2008)	Greece	August 1999–August 2001	Daily	FTSE/ASE□20 stock index futures	Futures	VECM, impulse–response functions
	Ivanovic and Howley (2004)	Australia	February 1983–December 2001	Monthly	Australian equity index futures	Futures prices with 1, 2, and 3 months to maturity	Ordinary Least Squares (OLS)
	Antonoui and Holmes (1996)	England	September 1984–June 1993	Quarterly	FTSE-100 futures contract prices	Futures prices with 1, 2, 4, and 5 months to maturity	ECM, variance bounds test
	Booth, So, and Tse (1999)	Germany	1992–March 1994	Intraday	DAX stock index futures and options	Futures	Gonzalo Granger information sharing test, VECM
	Bohl, Salm, and Schuppli (2011)	Poland	January 16, 1998–June 30, 2009	Daily	WIG 20 index futures	Spot	VECM-DCC-GARCH
	Green and Joujon (2000)	France	January 1989–March 1993	Daily	CAC-40 futures	Spot	ECM, causality tests
Developing Markets	Gupta and Singh (2009)	India	2003–2007	5 minutes interval	NIFTY/50 most liquid stocks	Futures	Johansen and Juselius Cointegration, VECM
	Mallikarjunappa and Afsal (2010)	India	July 3, 2006–December 28, 2006	One-minute interval	Most liquid stock contracts	Both spot and futures	VECM, Exponential GARCH
	Ryoo and Smith (2004)	Korea	September 1, 1993–December 28, 1998	Both daily and five-minute data	KOSPI 200 stock index futures	Futures	GARCH, ECM, Engle–Granger cointegration
	Floros (2009)	South Africa	January 2002–February 2006	Daily	FTSE/JSE Top 40 stock index futures contract	Both spot and futures	Granger causality, VECM, and ECM-Threshold GARCH (1,1)
	Ahn, Bi, and Sohn (2018)	China	April 16, 2015 to July 20, 2017	One-minute interval	SSE 50 Index□based options and futures	Futures	Engle–Granger and Johansen cointegration, VECM
	Norzalina and Mohd (2017)	Indonesia	2000–2015	Daily	KLCI futures prices	Spot prices	Autoregressive fractionally integrated moving average
	Sharma, Arora, and Gupta (2020)	Russia	December 19, 2013–July 19, 2019	Daily	RTS futures	Futures in the long-run	Johansen Cointegration, ECM, causality tests
	Sharma, Arora, and Gupta (2020)	Brazil	March 7, 2017–March 29, 2019	Daily	BOVESPA futures	Futures in the short-run	Johansen Cointegration, ECM, causality tests

Ivanovic and Howley (2004) found that Australian equity index futures series with 1, 2, and 3 months to maturity are unbiased predictors of the subsequent spot values. These futures contracts are efficient. Speculative opportunities appear to exist for 6-, 9-, and 12-month spreads since they cannot deliver unbiased signals about the future value of the spot price. By analyzing the efficiency of FTSE-100 stock index with Johansen cointegration, Antonoui and Holmes (1996) concluded that spot and futures series are cointegrated, and futures prices appear to be nonbiased estimators of spot prices for 1, 2, 4, and 5 months before maturity of the futures contract. With 15-minute, 60-minute, and hourly S&P 500 prices, Mackinlay and Ramaswamy (1988) and Lee (1988) also had evidence about the relation between spot and futures change.

In developing markets, studies that search the relationship between spot and futures markets are limited but cover more recent periods since the derivatives market is newly established in these economies. In mainland China, Ahn, Bi, and Sohn (2018) recently found that the derivatives market quickly gained the price leadership function from spot market after its introduction in 2015 and the launch of two new stock futures and options contracts. Ryoo and Smith (2004) investigated the effect on the spot stock index futures in Korea and confirmed the long-run equilibrium relation between spot and futures prices and the bidirectional causality between spot and futures markets in the short-run. Floros (2009) searched the price discovery between spot and futures stock markets in South Africa initially and concluded that stock index futures and spot markets are cointegrated but present bidirectional causality. Both futures and spot play a strong price discovery role in Floros' study because FTSE/JSE Top 40 futures prices lead spot prices and vice versa. In a more recent study in the Karachi stock market within the period of 1999–2008, Malik and Shah (2017) indicated the effects of the publicity of single stock futures (SSFs) on the underlying stocks. They showed that the introduction of SSFs has no important effect on market efficiency and volatility. Norzalina and Mohd (2017) analyzed Kuala Lumpur Composite Index (KLCI) futures contracts and spot prices in the period of 2000–2015. They concluded that futures price is inefficient; therefore, KLCI futures price is biased in predicting future spot prices and past prices might be used to guess future prices. Sharma, Arora, and Gupta (2020) evaluated the price discovery process in BRICS countries using error correction mechanism and Wald tests and suggested that the price discovery process is taking place in the long-run in the case of Russia and China, whereas the short-run causality exists between future and spot markets in the case of Brazil and Russia.

In Turkey, Çağlı and Mandaci (2013) analyzed the weekly data covering the period from February 9, 2005 to October 17, 2012 and found that spot and futures prices are cointegrated in the long-run after, considering the structural breaks, which indicated efficient Turkish markets. However, deviations between spot and futures prices may distort this efficiency in the short-run. Kayalıdere, Aracı, and Aktaş (2012) in their study divided the analyzed period of January 2, 2006 to December 30, 2011 into two: January 2006–December 2008 when the Turkish derivatives market is new and the following January 2009–December 2011 period. After the cointegration is found, VECM results indicate that the error correction term is significant; there will be no disequilibrium between the markets in the long-run. However, in the first sub-period, short-term causality results indicate that the relation goes from spot to futures whereas relation goes from futures to spot in the second sub-period. İşeri and Kaçmazer (2016) investigated the availability of causality (lead–lag) relationship between spot and futures markets in Turkey in a comprehensive period of 2005–2015 using BIST30 index and BIST30 equity index futures contracts. Causality relationship between spot and futures markets is analyzed using Johansen Cointegration Model, VECM, Granger Causality Test, Impulse–Response Analysis, and variance decomposition. Results suggested that causality relationship in the period of 2005–2015 is from the spot market to futures market. Korkmaz, Çevik, and Uygurtürk (2017) investigated the causal relationship of BIST 30 index spot and futures according to risk levels between 2005 and 2016. The causality tests of Hong, Liu, and Wang (2009) applied in this study indicated a one-way causality from spot series to futures series. Koy (2017) researched the BİST 30 index futures starting from the first establishment of Turkish futures market in Turkey until the end of 2016 with daily observations. The Markov-switching regime VAR model impulse–response functions (IRF) indicated that the response of spot market to shocks occurring in the futures market is smaller than the response of futures market to shocks occurring in the spot market.

Most of the previous studies in Turkey found either one way or two-way causality, but these studies do not focus on the role of the short-term and long-term causality (Ersoy and Bayraktaroğlu, 2013; Kayalıdere, Aracı and Aktaş, 2012; Gök and Kalaycı, 2014; Korkmaz, Çevik and Uygurtürk, 2017; Koy, 2017). In Turkey, contrary to our expectations, in the context of the relationship between spot and futures prices, the futures market turns out not to lead the spot market also (Ersoy and Çıtak, 2015). The causal relationship between two markets is two-way; hence, spot and futures markets have a bilateral interaction in terms of both price and volatility or the spot market leads futures market, which is inconsistent with empirical findings from developed countries where futures lead spot most of the time as seen from Table 1.

3. Data and Methodology

BİST 30 index daily closing spot prices that cover 30 leading national firms in Turkey with the periods between August 1, 2013 and July 15, 2016 are used for analysis. BİST 30 index daily closing futures prices from İstanbul Derivatives Market (VİOP) in 2013 began from August 2013. BİST 30 index futures contracts are more specific and have high trading volume according to the other SSFs contracts. On September 2015, Futures and Options on the BIST 30 index also became available to trade on London Stock Exchange Derivatives Market. The data set was interrupted on July 15, 2016 as the coup attempt in Turkey decreased the prices considerably.

Standard OLS procedure below as presented in equation (1) that regresses the spot price at time t (S_t) on the futures prices quoted on time t-n for delivery at time t ($F_{t-n,t}$) is not appropriate since these prices generally do not show a stationary process and may present causality.

$$S_t = a + bF_{t-n,t} + e_t, \quad (1)$$

Since S_t and $F_{t-n,t}$ show an I(1) process according to classical Augmented Dickey–Fuller (ADF) procedure, Johansen methodology is appropriate to use, consistent with other numerous studies in the literature such as Floros and Vougas (2008), Floros (2009), and Kharbanda and Singh (2017).

To search the presence of a long-run equilibrium relation between spot and futures BİST 30 index prices, Johansen (1988, 1991) methodology is employed. Suppose p variables might be cointegrated. If all the variables are not stationary, and the order of integration is I(1), cointegration tests could be conducted into a p-dimensional vector, such as y_t. Then, it is constructed as a first-differenced $p \times 1$ vector, Δy_t, and formed and estimated in a VAR form (Brooks, 2008):

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

If the rank of the matrix Π is zero, then no cointegration occurs, otherwise, the rank shows the number of cointegration.

Johansen's method tests the hypotheses by applying restrictions on the cointegrating vector. If the number of cointegrating vectors in the unrestricted case is numerous, and we have simple restrictions, we may verify the restrictions without changing the eigenvalues of the estimated coefficient matrix. The test statistic for the validity of these restrictions is shown below:

$$-T\sum_{i=r+1}^{p}[\ln(1-\lambda_i^*)-\ln(1-\lambda_i)] \sim \chi^2(p\text{-}r), \qquad (3)$$

where,

λ_i^* are eigenvalues of the restricted model;

λ_i are eigenvalues of the unrestricted model;

r is the number of non-zero eigenvalues in the unrestricted model; and

p is the number of variables in the system.

Johansen statistics examine the eigenvalues of the long-run coefficient. If a system contains *g* variables, the *g* eigenvalues have an ascending order: $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_g$. The maximal eigenvalue (i.e., the λ_{max}) statistic tests each eigenvalue individually, while the trace statistic (λ_{trace}) is based on a joint test of the *g-r* largest eigenvalues. If the critical value from Johansen's tables is smaller than the test statistic, then the null hypothesis that there are *r* cointegrating vectors in opposite of the alternative and that there are *r*+1 for λ_{max} or more than *r* for λ_{trace} is rejected.

When the variables are non-stationary and cointegrated, the VECM developed by Engle and Granger (1987) is the suitable method to investigate the short-run and long-run causal relationship. The VECM is equivalent to first-differenced VAR model given in a vector of cointegrating residuals. The VECM applied in this study is represented as follows:

$$\Delta F_t = \alpha_0 + \delta_1 (F_{t-1} - \gamma_1 S_{t-1} - \gamma_o) + \sum_{i=1}^{p} \alpha_{1i}\Delta F_{t-i} + \sum_{i=1}^{p} \alpha_{2i}\Delta S_{t-i} + v_{1t}, \qquad (4)$$

$$\Delta S_t = \beta_0 + \delta_2 (F_{t-1} - \gamma_1 S_{t-1} - \gamma_o) + \sum_{i=1}^{p} \beta_{1i}\Delta F_{t-i} + \sum_{i=1}^{p} \beta_{2i}\Delta S_{t-i} + v_{2t}, \qquad (5)$$

where F_t and S_t refer to log futures prices and log spot prices, respectively. ($F_{t-1} - \gamma_1 S_{t-1} - \gamma_o$) is an error correction term taken from the cointegrating equation. (δ_1, δ_2) measures the speed of adjustment to long-run equilibrium since it indicates the speed at which return to equilibrium after a change in S_t. In addition, the coefficients on ($\Delta F_{t\text{-}i}$, $\Delta S_{t\text{-}i}$), which are (α_{1i}, α_{2i}, β_{1i} and β_{2i}), capture the short-term dynamics of the model. Lag length in the VECM is chosen one less than the lag number of standard Akaike information criterion (AIC) and Schwartz criterion (SC) found in unrestricted VAR model since the VEC model uses the raw non-stationary data, while the VAR model uses the first-differenced level data generally.

According to the VECM equations, the causality between the variable (ΔF_t) and a variable (ΔS_t) can be made as follows: The variable (ΔS_t) causes a variable (ΔF_t) in two cases; in the first case (δ_1) is statistically significant (the long-run causality relationship), while the lagged variables (α_{2i}) are jointly significant (short-run causality relationship) in the second case. Likewise, the variable (ΔF_t) causes (ΔS_t) if either (δ_2) is statistically significant (the long-run causality relationship) or the lagged variables (β_{1i}) are jointly significant (short-run causality relationship). For ($\delta_1 = \delta_2 = 0$), which means that there is no long-run causality between (ΔF_t) and (ΔS_t). To test the significance of the short-term coefficients, Wald test and Chi-square Block Exogeneity Wald tests are applied. From equations (4) and (5), it is also clear that the short-run causality tests in the VECM framework correspond to the Pairwise Granger causality F test in the VAR framework, since VECM incorporates lagged variables of log prices, which means the first-differenced log returns in here (Marseet, 2015).

Finally, IRF and variance decompositions are presented in the study. IRF shows how a dependent variable responds to a one standard deviation shock in itself or to other endogenous variable by analyzing the direction, magnitude, and length of time of these shocks' dynamic effects. On the other hand, variance decomposition allows us to analyze the percentage of variance of an endogenous variable that can be imputed to a shock in itself or to another endogenous variable (Lütkepohl, 2005).

4. Results

BIST 30 index spot prices and futures prices are analyzed to test long-run market efficiency and possible causal relationships. The descriptive statistics related to these prices are shown in Table 2. All descriptive statistics are close to each other in both markets that necessitate testing the possible strong relations. There are 668 observations between August 1, 2013 and July 16, 2016. The Jarque–Bera statistic rejects the null hypothesis of a normal distribution for the rough spot and futures price series in the sample of the study because the probability value of the variables is less than 1%. Log prices are used to transform to normality and stabilize variance. Then, the stationarity of the series is checked by ADF as shown in Table 3.

Table 2: Descriptive Statistics

	SPOT	FUTURES
Mean	94,772.38	95,392.85
Median	95,855.5	96,562.5
Maximum	113,614	114,600
Minimum	74,172	74,175
Std. Dev	8074.336	8225.147
Skewness	−0.460064	−0.478063
Kurtosis	2.882213	2.93516
Jarque–Bera	23.95088	25.56157
Probability	0.000006	0.000003
Observations	668	668

Table 3: Unit Root Tests

Null Hypothesis: D(FUTURES) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey–Fuller test statistic		−26.937	0.000
Test critical values:	1% level	−3.440	
	5% level	−2.866	
	10% level	−2.569	
Null Hypothesis: D(LOGFUTURES) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey–Fuller test statistic		−27.106	0.000
Test critical values:	1% level	−3.440	
	5% level	−2.866	
	10% level	−2.569	
Null Hypothesis: D(SPOT) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey–Fuller test statistic		−26.454	0.000
Test critical values:	1% level	−3.440	
	5% level	−2.866	
	10% level	−2.569	
Null Hypothesis: D(LOGSPOT) has a unit root			
		t-Statistic	Prob.*
Augmented Dickey–Fuller test statistic		−26.601	0.000
Test critical values:	1% level	−3.440	
	5% level	−2.866	
	10% level	−2.569	
*MacKinnon (1996) one-sided p-values.			

Table 3 indicates that futures and spot series and their log transformations are considered as I(1) since the first-differenced series rather than level form presents the significant ADF t-statistics and related MacKinnon (1996) one-sided p-values. As the series are integrated of order one, the possible cointegration is checked by Johansen methodology rather than Engle–Granger two-step methodology, since Johansen maximum likelihood estimators keep from using two-step probable error that may be carried from the first step. Besides, the Johansen method can test the presence of multiple cointegrating vectors (Bilgili, 1998). The results of the Johansen test are shown on Table 4.

Table 4: Johansen Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.032286	26.73936	15.49471	0.0007
At most 1 *	0.007424	4.947897	3.841466	0.0261
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.032286	21.79147	14.2646	0.0027
At most 1 *	0.007424	4.947897	3.841466	0.0261
* denotes rejection of the hypothesis at the 0.05 level **MacKinnon–Haug–Michelis (1999) p-values				

According to Table 4, the null hypotheses of no cointegrating vectors and at most one cointegrated vectors are rejected at the 0.05 level for both trace and maximum eigenvalue statistics. Therefore, it is asserted that there is at least one cointegrating vector, and the BIST 30 spot and futures prices are cointegrated in the long-term that corrects market efficiency, which is consistent with many studies in the literature. After Johansen analysis, VECM is established to investigate short-run and long-run causality. The VECM results are exhibited in Table 5.

Table 5 indicates one cointegrating equation: LOGFUTURES(−1) = 1.019*LOGSPOT (−1) + 0.215. This model indicates that LOGSPOT prices cointegrate with LOGFUTURES in the long-term; however, there is no long-term causality between BİST 30 LOGSPOT and LOGFUTURES prices since the error correction terms that indicate the speed of adjustment defined as (δ_1, δ_2) in Equations (4) and (5) are not significant. Hence, in the long-term, these variables do not affect each other, and there is no long-run causality between BIST 30 spot and futures contracts prices. The coefficients of D(LOGSPOT) and D(LOGFUTURES) that are first-differenced series with two lags, which also refer to spot and futures returns, respectively, show the short-term dynamics. Lag length is chosen according to AIC criterion in the VECM. Futures market returns are affected both from itself and spot market returns according to t-statistics, as seen on Table 4. To find whether there is causality between return series in the short-run, Wald test, Block Exogeneity Wald tests of VECM, and classical Pairwise Granger causality tests are applied and presented in Table 6.

Table 5: Vector Error Correction Model (VECM)

Vector Error Correction Estimates		
Cointegrating Eq:	CointEq1	
LOGFUTURES(−1)	1.000	
LOGSPOT(−1)	−1.019	
	−0.013	
	[−81.155]	
C	0.216	
Error Correction:	D(LOGFUTURES)	D(LOGSPOT)
CointEq1	−0.063	0.078
	−0.110	−0.110
	[−0.569]	[0.708]
D(LOGFUTURES(−1))	−0.528	0.094
	−0.171	−0.171
	[−3.095]	[0.547]
D(LOGFUTURES(−2))	−0.127	−0.024
	−0.156	−0.156
	[−0.814]	[−0.151]
D(LOGSPOT(−1))	0.502	−0.118
	−0.171	−0.172
	[2.930]	[−0.683]
D(LOGSPOT(−2))	0.109	0.013
	−0.157	−0.158
	[0.694]	[0.084]
C	0.000	0.000
	−0.001	−0.001
	[0.360]	[0.311]
R-squared	0.026	0.004
F-statistic	3.518	0.539

Table 6: Causality Tests

PANEL A: Wald Tests		
D(LOGSPOT) → D(LOGFUTURES)		
Wald test:		
Test Statistic	Value	Probability
F-statistic	5.372546	0.0048
Chi-square	10.74509	0.0046
D(LOGFUTURES) → D(LOGSPOT)		
Wald test:		
Test Statistic	Value	Probability
F-statistic	0.357947	0.6992
Chi-square	0.715894	0.6991
PANEL B: Block Exogeneity Wald Tests		
Dependent variable: D(LOGFUTURES)		
	Chi-square	Prob.
D(LOGSPOT)	10.74509	0.0046
Dependent variable: D(LOGSPOT)		
	Chi-square	Prob.
D(LOGFUTURES)	0.715894	0.6991
Continued on Table 5		
PANEL C: Pairwise Granger causality Tests		
Null Hypothesis:	F-Statistic	Prob.
D(LOGSPOT) does not Granger Cause D(LOGFUTURES)	7.76203	0.0005
D(LOGFUTURES) does not Granger Cause D(LOGSPOT)	0.74476	0.4752

Wald test and Block Exogeneity Wald tests of VECM indicate whether the lagged log spot (futures) series significantly affect lagged log futures (spot). The difference between them only comes from the fact that while Wald tests the model with F-Statistic, the Block Exogeneity Wald tests the model with Chi-square. Both Wald tests show significant F and

Chi-square values in case where the direction goes from spot returns to futures returns. Hence, one can claim that BİST 30 index spot market return can lead BİST 30 index futures market return in the short-term. Pairwise Granger causality also authenticates this evidence as it shows the one-way causality from D(LOGSPOT) to D(LOGFUTURES). These evidences indicate that futures market may not be considered as a price discovery vehicle within the analyzed period, an inconsistent result compared with previous findings in most of the literature in developed markets. Moreover, to understand the dynamics of whether spot prices may lead futures prices clearly, IRF is figured out.

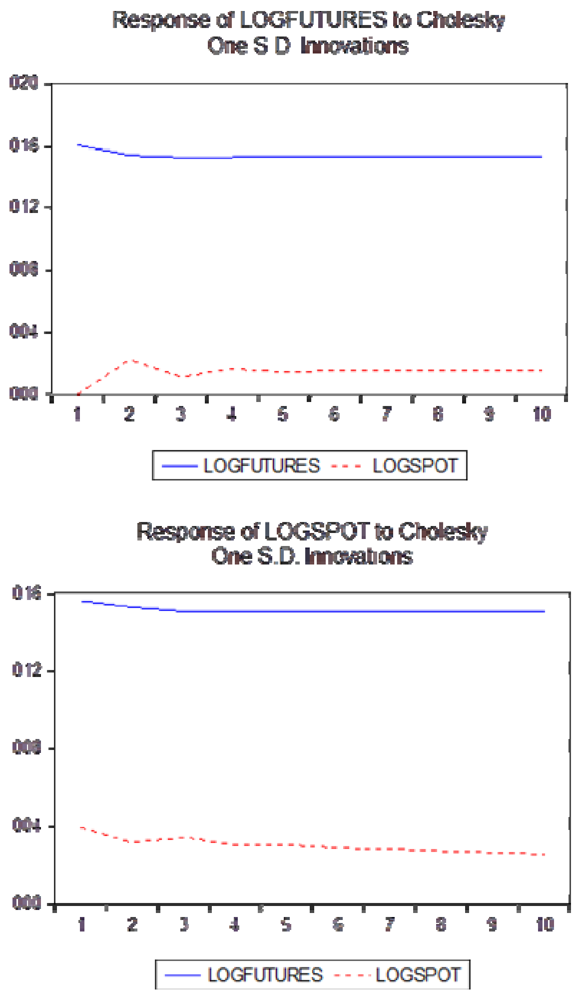

Figure 1: Impulse–response function (IRF)

IRF shows how one standard deviation innovations in spot (futures) prices affect futures (spot) prices besides their own innovations. Figure 1 shows both responses of LOGFUTURES and LOGSPOT. A little kink starts within the first period and continues until the third period in LOGSPOT prices to LOGFUTURES prices. The other shocks in the markets seem constant.

Finally, variance decomposition presented in Table 7 emphasizes a smaller than 1% variance effect of shocks of spot prices on futures prices and is expected to decrease after the third period. Thus, it is not possible to claim that BİST 30 spot market shocks affect futures market strongly and permanently.

Table 7: Variance Decomposition

Variance Decomposition of LOGFUTURES:			
Period	S.E.	LOGFUTURES	LOGSPOT
1	0.016	100.000	0.000
2	0.022	99.012	0.988
3	0.027	99.147	0.853
4	0.031	99.080	0.920
5	0.035	99.086	0.914
Variance Decomposition of LOGSPOT:			
Period	S.E.	LOGSPOT	LOGFUTURES
1	0.016	94.052	5.948
2	0.022	94.959	5.041
3	0.027	95.002	4.998
4	0.031	95.264	4.736
5	0.035	95.421	4.579

5. Conclusion and Discussion

This paper analyzes the relations between spot and futures index market in Turkey, an emerging country. Though comovement between two markets is observed in the long-run, spot market becomes dominant in the short-run because of its leading role on future market, which is inconsistent with the results of most of the studies in Turkey and other countries. If the returns of spot market can significantly affect the returns of futures market in the short-run, speculator or arbitrageurs may benefit this market inefficiency caused by price discovery temporarily by buying the cheapest in the market rather than selling the expensive one. Because futures and spot markets are expected to differ in the short-term, the expected hedging mechanism of futures market also becomes obsolete. Futures prices are expected to be higher than spot prices in case a cost of carry premium on spot prices is added; on the other hand, futures prices are expected to be lower than spot prices because of heavy selling, which occurs because of speculative reasons.

Generally applied error correction mechanisms and Granger causality findings in the literature can only be short-term indications about feedback relations between markets. Unfortunately, whether price discovery found in the short-run may eliminate the market efficiency or not has not been decently discussed in the literature, since the market is usually efficient in the long-term. Further tests about the role of carrying costs, transaction costs, leverage, or marketability factor hypotheses should be conducted to better understand how and under what conditions price discovery may distort market efficiency.

The other problem in the stock price literature observed is accepting futures or spot stock market as a price discovery tool superficially without respecting different periods, index, or maturity. Since Turkey has a young futures market, this study is limited to selecting the most liquid BIST 30 futures index contracts after VIOP is established. However, the relatively small size of futures market with uninformed private investors in Turkey is expected to be altered in the future when financial literacy and development will increase. With this change, further research should be conducted again with different available futures contacts rather than BİST 30 with different periods and maturities in the future.

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