The Price-Volume Relation in the Turkish Derivatives Exchange

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Abstract

This study aims to examine the relation between closing prices and trading volume of US Dollar (USD) futures contracts in the Turkish Derivatives Exchange (TURKDEX). For this purpose, daily closing prices and volume of December-dated USD futures contracts that are traded in the TURKDEX were used for the period 2009-2011. After unit root and cointegration tests, the Granger causality test based on the vector error correction model was performed to determine the causality relations between prices and volume. The results indicate that while there is not a relation between prices and volume in the short run, there is a relation that is from volume to prices in the long run. Accordingly, it may be said that the futures market in Turkey is not efficient by the efficient market hypothesis.

Key Words: The Turkish Derivatives Exchange, Futures Contracts, Price-Volume Relation, Granger Causality Test.

1. Introduction

A currency futures contract is an agreement between two counterparties to exchange specified amount of two currencies at a given date in the future, at a predetermined exchange rate (Pilbeam, 2006). There are two sides on futures contracts: the seller has a short position, and the buyer has a long position. The long position owner expects that price will increase, while short position owner expects the reverse (Korkmaz and Ceylan, 2004). Futures contracts attract many different types of traders and have a great deal of liquidity. When an investor wants to take on one side of a contract, there is usually no problem in finding someone that prepares to take on the other side. Three broad categories of traders can be identified: hedgers, speculators, and arbitrageurs. Hedgers use derivatives to reduce the risk that they face with potential future movements in a market variable. Speculators use them to bet on the future direction of a market variable. Arbitrageurs take offsetting positions in two or more instruments to lock in a profit (Hull, 2009).

Fluctuations in exchange rates are crucial risk factor for individuals, firms, and financial institutions. Mainly those that engage in foreign trade such as importers, exporters, international companies, and shortly who do trade on foreign exchange face with foreign exchange risk. Hedgers may reduce foreign exchange risk by buying futures contracts and thus reducing the exchange risk clarifies the future for hedgers on this matter and enables them to make decisions under certainty. Since developed countries that are called "safe harbors" are in their maturity stages, speculators have also increased their investment in developing countries in recent years. Due to the high investment and return potential that are proportionally with the risk, speculators invest in developing countries. After floating exchange rate regime had been adopted in Turkey in 2001, uncertainty concerning exchange rates increased. Hence, the studies for markets where futures contracts would be traded were accelerated by authorities. As a result of these studies, futures contracts began to be traded in TURKDEX on February 4, 2005.

Although in developed and in some of developing countries derivatives exchanges deepened, yet in Turkey the TURKDEX hasn't deepened. TURKDEX is a new and the first private exchange market that has reached trading volume of over three billion Turkish Liras and over a hundred contracts by 2011. As a growing market, TURKDEX attracts individuals, firms, and financial institutions. The purpose of this study is to investigate whether there is a causality relation between closing prices and trading volume of December-dated USD futures contracts in the TURKDEX. Daily data from January 2009 to December 2011 are used as the period, and causality analysis is employed as the method in the study. The study comprises of two parts. We will present relevant literature in the first part. The second part is going to focus on an empirical study, and it is going to be the core of the study.

2. Literature Review

The relation between price and volume has been a continuing interest for researchers and implementers since Osborne's publication (1959) that examined the dependency of common-stock price changes on a large number of factors. This relation has been investigated in a number of studies in various approaches. Granger and Morgenstern (1963) analyzed New York stock price series and found that short-run movements of the series obey the simple random walk hypothesis proposed by earlier writers, but that the long-run components are of greater importance than suggested by this hypothesis. Ying (1966) examined relations between stock prices and volume of sales and found six significant results: (1) a small volume is usually accompanied by a fall in price, (2) a large volume is usually accompanied by a rise in price, (3) a large increase in volume is usually accompanied by either a large rise in price or a large fall in price, (4) a large volume is usually followed by a rise in price, (5) if the volume has been decreasing consecutively for a period of five trading days, then there will be a tendency for the price to fall over next four trading days, (6) if the volume has been increasing consecutively for a period of five trading days, then there will be a tendency for the price to rise over next four trading days. Crouch (1970) and Westerfield (1977) examined the stock price changes and volume relations and found important implications. Accordingly, the absolute value of price change is positively and linearly related to volume. Rogalski (1978) empirically examined whether security prices and volume are causally related.

The empirical findings of this study suggest that security prices and volume are dependent on each other. Cornell (1981) studied the relation between the volume of trading and price variability for futures contracts and found mostly significant, positive, and contemporaneous between the changes in average daily volume and changes in the standard deviation of daily log price. Tauchen and Pitts (1983) concerned the relation between variability of the daily price change and daily volume of trading on speculative markets that the results of the estimation can reconcile a conflict between the price variability-volume relations for speculative markets. Karpoff (1987) reviewed the previous research on the relation between price changes and trading volume in financial markets and made four contributions: (1) the price-volume relation provides insight into the structure of financial markets, (2) the price-volume relation is important for event studies that use a combination of price and volume data from which to draw inferences, (3) the price-volume relation is critical to the debate over the empirical distribution of speculative prices, (4) price-volume relations have significant implications for research into futures markets. Smirlock and Starks (1988) investigated the lagged relation between absolute stock price (ABS) changes and trading volume in the New York Stock Exchange (NYSE).

They found that average firm behavior indicates a significant lagged relation between ABS and V. Jain and Jon (1988) studied hourly common stock trading volume and returns on the New York Stock Exchange and found a strong positive correlation between contemporaneous trading volume and absolute value of returns. Gallant et al. (1992) investigated price and volume co-movement using daily New York Stock Exchange data from 1928 to 1987 and found four empirical regularities: (1) positive correlation between conditional volatility and volume, (2) large price movements are followed by high volume (3) conditioning on lagged volume substantially attenuates the 'leverage" effect; and (4) after conditioning on lagged volume, there is a positive risk-return relation. Saatcioglu and Starks (1998) examined the stock price-volume relation in a set of Latin American markets and found weak evidence that stock price changes led volume. Chen et al. (2004) examined the relation between returns and trading volume of four actively traded commodity futures contracts in China. They employed the correlation analyses and the Granger causality tests to investigate contemporaneous and lead-lag relations between trading volume and return and found a significant causality that is from trading volume to absolute settlement-to-settlement return in two futures markets. Gunduz and Hatemi-j (2005) examined causal relation between stock prices and volume for stock markets in Czech Republic, Hungary, Poland, Russia, and Turkey.

They found that market efficiency and different market characteristics affect the price-volume relation. Cheng and Ying (2009) investigated the causality between prices and volume in mini Taiwan exchange market and found a significant long-run and bidirectional causality between hourly prices and trading volume.

3. Empirical Application

3.1. The Data

Closing prices (P) and trading volume (V) of the December-dated USD futures contracts that are traded in Turkish Derivatives Exchange (TURKDEX) will be used in this study. The data are daily and from January 2, 2009 to December 30, 2011. Thus, the series have 755 observations. We will use natural logarithmic values of the variables.

3.2. Unit Root and Cointegration Tests

Granger and Newbold (1974) show that researchers using nonstationary time series will face with spurious regression. Therefore, series have to be stationary in econometric analyses to find significant results. In this study, we employed Augmented Dickey-Fuller (ADF) unit root test to investigate the stationarity of the variables. If a variable is stationary, it is indicated as I(0), and if it is stationary in its first difference, it is indicated as I(1).

Table 1: ADF Test Results

Variables		**ADF Value (Level)**		**ADF Value (1st Difference)**		**Result**
		Intercept	Trend and Intercept	Intercept	Trend and Intercept	
P		-0.896 (0)	-1.323 (0)	-28.917 (0)	-29.007 (0)	I(1)
V		-2.075 (7)	-2.452 (7)	-16.602 (6)	-16.593 (6)	I(1)
Critical Values	%1	-3.438	-3.970	-3.438	-3.970	
	%5	-2.865	-3.415	-2.865	-3.415	
	%10	-2.568	-3.130	-2.568	-3.130	
The values in parentheses show the lag length that we selected according to the SIC criterion. We took maximum lag length as 19.						

As Table 1 shows, all of the variables are stationary in their first differences. In other words, all of them are I(1).

If analyses are done by differencing to take away spurious regression problem, potential valuable information about long-run relations among variables will be thrown away (Maddala, 1992). Because, most of the economic theories mention a relation between levels, not first differences (Gujarati, 2006). To solve this problem, cointegration analysis has been suggested. Cointegration analysis asserts even if series of variables are not stationary, there may be a linear combination of these series, and it might be determined (Tarı, 2002). In other words, if a y series is I(d), a x series is I(d), and d is the same number, these series might be cointegrated (Gujarati, 2006). Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990) are used as cointegration tests in literature. We employed Johansen and Juselius (JJ) (1990) in this study.

Two tests were suggested to examine the presence of cointegration:

Trace Statistic = $\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\lambda_i)$ (1)

Max-Eigen Statistic = $\lambda_{max}(r, r+1) = -T\ln(1-\lambda_{r+1})$ (2)

The null hypotheses for the trace test is that the number of cointegration vectors is less than or is equal to r. The null hypothesis is that the number of cointegration vectors is r, and the alternative hypothesis is that there are r+1 cointegration vectors for the maximum eigenvalue test. T is the number of observations, and λ shows the roots assuming that series are not stationary. The critical values which λ_{trace} and λ_{max} are compared with were composed by JJ.

To investigate the cointegration relation between variables, firstly, we will determine the lag length by running VAR model, and secondly, we will select the convenient model in accordance to Pantula principle.[1]

Table 2: Results of the Lag Length Test

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.030932	2.199805	2.212216	2.204589
1	4170.615	0.000112	-3.425394	-3.338161	-3.411041
2	102.1477	9.82e-05	-3.553038	-3.490983	-3.529117
3	38.08866	9.42e-05	-3.594022	-3.507145*	-3.560532
4	23.95690	9.22e-05	-3.615894	-3.504194	-3.572835*
5	1.282013	9.30e-05	-3.606878	-3.470357	-3.554250
6	15.33410	9.21e-05	-3.617116	-3.455773	-3.554920
7	13.20942	9.14e-05	-3.624494	-3.438329	-3.552729
8	15.85251*	9.04e-05*	-3.635562*	-3.424575	-3.554229
9	0.316125	9.13e-05	-3.625232	-3.389422	-3.534330
10	1.032926	9.22e-05	-3.615895	-3.355264	-3.515424
11	5.314182	9.25e-05	-3.612509	-3.327055	-3.502469
12	2.632025	9.32e-05	-3.605408	-3.295132	-3.485799

* indicates lag order selected by the criterion.

As seen, LR, FPE and AIC criteria show 8 as the lag length. However, there are autocorrelation problems for 1, 2, and 8 lag lengths. Therefore, we selected the lag length 3 considering the SC criterion. Then, we stated the convenient model as model 3, taking account Pantula principle. Accordingly, Table 3 shows the results of the JJ cointegration test.

Table 3: Results of the JJ Cointegration Test

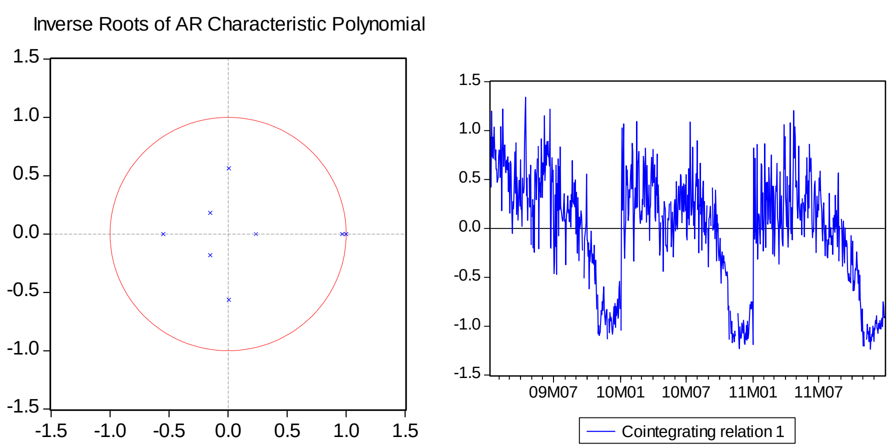
Variables: P, V						**Lag Length: 3**	
Trace Statistic				**Max-Eigen Statistic**			
Null Hypothesis (H_0)	Alternative Hypothesis (H_1)	Test Statistic	Critical Value (%10)	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)	Test Statistic	Critical Value (%10)
r=0*	r>0	14.477	13.428	r=0*	r=1	13.971	12.296
r≤1	r>1	0.506	2.705	r=1	r=2	0.506	2.705

* denotes rejection of the hypothesis at the 0.10 level.

Table 3 shows there is one cointegrating equation according to trace statistic and max-eigen statistic. In other words, there is a long-term relation among variables.

The charts below show inverse roots of AR characteristic polynomial and the cointegration relation of the system. Due to the fact that all of the roots are in the circle and have symmetrical projections, and the cointegration relation fluctuates around zero, the model has no problems for stationarity.

Charts 1 and 2: Locations of Inverse Roots of AR Characteristic Polynomial in the Unit Circle and the Cointegration Graph



3.3. Granger Causality Test Based on Vector Error Correction Model

Though the JJ cointegration test shows that there is a long-term relation between variables, it does not inform about the direction of Granger causality. Granger (1988) argues that causal relations should be examined within the framework of vector error correction model (VECM) if variables are cointegrated. We can generate error correction models in which the causalities among P and V are investigated as below:

$$\Delta P_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i}\Delta P_{t-i} + \sum_{i=1}^{n} \alpha_{2i}\Delta V_{t-i} + \Phi EC_{t-1} + u_{1t} \quad (3)$$

$$\Delta V_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i}\Delta V_{t-i} + \sum_{i=1}^{n} \beta_{2i}\Delta P_{t-i} + \Omega EC_{t-1} + v_{1t} \quad (4)$$

To determine the source of the causality that comes up depending on vector error correction model, we should watch the Wald test that is applied to all coefficients of explanatory variables, and the t test that is applied to coefficient of the one period lagged error correction terms that are obtained from the long-term cointegration relation. We can say that there is a short-term causality if coefficients of explanatory variables are statistically significant according to the F test, and there is a long-term relation if coefficients of error correction terms are statistically significant according to the t test (Altıntaş and Öz, 2010).

For example, if α_{2i} is significant, trading volume granger causes price in short term. The significance of the α_{2i} is examined by using Wald test. Besides, we test significances of Φ and Ω via t test and come through whether there are long-term causalities. We give the results for the error correction models in the following table that is constituted to investigate short-term and long-term relations among variables.

Table 4: The Results of the Granger Causality Tests Based on Error Correction Models

	Independent Variables		Error Correction Term
Dependent Variables	ΔP F-sta	ΔV F-sta	ECT_{t-1}
ΔP	-	2.700 (0.440)	-0.007 (0.005)
ΔV	3.107 (0.375)	-	0.284 (0.082)

The values in parentheses show prob. values for independent variables and show standard errors for error correction terms.* shows significance 0.10 level.

As denoted previously, significant coefficients of error correction terms indicate long-term causal relations among variables. When we examine long-term causal relations, it is seen that there is a long-term relation from trading volume to closing prices. In practice, a negative coefficient is expected for the error correction term. In this respect, we can assert that VECM is not suitable for the second equation. When short-term causal relations are analyzed, we see that variables do not granger cause each others, and there aren't any short-term causal relations in the system in the short run.

4. Conclusion

In this study, we investigated whether there was a causal relation between daily closing prices and trading volume of USD futures contracts in the TURKDEX. The results indicate that while there is not a relation between prices and trading volume in the short run, there is a relation that is from trading volume to prices in the long run. These results have important implications regarding market efficiency. As Mishkin (2004) stated, according to the efficient market hypothesis, prices of stocks reflect all available information, and there are no unexploited profit opportunities. Besides, stock prices should follow a random walk and thus prices of stocks should be unpredictable. However, our findings show that the data concerning trading volume affect prices. Hence, we can say that trading volume changes might be used in price forecasts, and some market participants cannot receive information simultaneously about prices due to asymmetric information. Consequently, they cannot act rationally and thus the futures market in Turkey is not efficient. Finally, we can say that this study might be useful for future empirical and theoretical studies on the TURKDEX.

Footnotes

[1] You can browse Sevüktekin and Nargeleçekenler (2010) for an explanation of Pantula principle.

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