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THE RELATIONSHIP BETWEEN EXCHANGE RATES, EQUITY INDEX AND EQUITY INDEX FUTURES: A STUDY ON BORSA ISTANBUL

Abstract:

This paper examines the linkages between the foreign exchange rates, spot equity index and equity index futures. The study aims to investigate whether there is difference between the spot and futures markets in the scope of relation with the foreign exchange rates' returns and which leads the other. The relationships are examined by using the vector autoregression (VAR) model, impulse-response functions, variance decomposition and Granger Causality tests. The sample of the study consists of US dollar to Turkish Lira rate (USD/TRY), Euro to Turkish Lira rate (EUR/TRY), BIST 30 Index and BIST 30 Index Futures. The data of the study includes the period between January 2011 and December 2014 with daily data range. Our results have evidence that the foreign exchange rate markets in Turkey are driven by the equity market.

Keywords:

Exchange Rates, Equity Index, Equity Index Futures, Causality

JEL Classification: G15, G10

1. Introduction

International capital markets have become increasingly linked, both as a result of rapid financial and technological innovation. There have been many studies examining the relationship between foreign exchange rates and stock market. On the other hand there have been some studies examining the relationship between the same variables and futures markets. This study aims to show the differences between spot and futures markets in the scope of relation with the foreign exchange rates' returns.

Additionally, we analyzed the effects of foreign exchange rates on basis between spot and futures index. Theoretically, the futures price is the sum of spot price and cost of carrying, where cost of carrying includes time value of money from the spot date to the futures date. There should be a difference between spot price and futures price in any date except the maturity. The actual basis is the difference between the futures price and the same day's spot price and it should be zero in the maturity.

2. Literature

In the early studies, Franck and Young (1972) could not find a significant relation between stock prices and foreign exchange rate. Aggarwal (1981) finds a stronger positive relation in the short term then long term using the simple regression method. However, Soenen and Hennigar (1988) find a negative relation. Roll's (1992) study show that there are three main factors effecting stock market returns. First, stock market indices vary widely in the number of constituent individual common stocks and in their diversification. Some indices are more diversified than others. Second, each country's industrial structure plays a major role in explaining stock price behavior. Third, for the majority of countries, a portion of national equity index behavior can be ascribed to foreign exchange rate behavior. Roll's basic data are equity price indices for 24 countries. The foreign exchange rate variable is statistically significant for most of the countries. Malaysia and Sweden are not significant and Norway is significant at only the 5% level. Some other studies show that stock prices have a significant effect on the exchange rate (Smith, 1992; Bahmani-Oskooee and Sohrabian, 1992; Morley 2007) and some studies (Hasan and Javed, 2009) cannot find. Gay (2008) investigates the relationship between foreign exchange rate and oil price among the equity markets Brazil, Russia, India, and China (BRIC) by employing Box-Jenkins ARIMA model and finds no evidence about existence of significant relationship among variables.

One of the studies in Turkey is Kasman (2003) analyzed the relationship between the foreign exchange rate and BIST100, finance sector index, industry index and service index. The results show that causality relationship exists only from foreign exchange rate to the industry sector index. Kasman (2003) uses the daily returns, besides Ayvaz (2006), Savaş and Can (2011), Ceylan and Şahin (2015) used the montly returns.

The results of Savaş and Can (2011) indicate that Euro-Dollar Parity and Real Effective Exchange Rate Index affect the BIST100 positively with 77,5%. In addition, according to Granger Causality Test results, a causality has been found from BIST 100 to the Euro-Dollar Parity and Real Effective Exchange Rate. The cointegration test results of Ayvaz (2006) reveal that there exists a long-term stable relationship between foreign exchange rate and BIST 100, foreign exchange rate and financial sector index, and foreign exchange rate and industry sector index. However, there is

no relationship between foreign exchange rate and service sector index. Besides, the results indicate that there is a bi-directional causality among foreign exchange rate and stock price indices. Ceylan and Şahin (2015)'s findings obtain that; rate of foreign exchange and equity indices are stationary at the same level and cointegrated, there is a strong causal correlation from the rates of foreign exchange to the indices.

3. Data and Methodology

The sample of the study consists of USD/TRY, EUR/TRY, BIST 30 Index and BIST 30 Index Futures with the nearest maturity. The data of the study includes the January 2011 and December 2014 with daily data range and obtained from Finnet.

BIST 30 Index: BIST 30 index consists of 30 stocks selected among the stocks of companies traded on the National Market and the stocks of real estate investment trusts and venture capital investment trusts traded on the Collective Products Market.

BIST 30 Futures: The underlying security of BIST30 Futures is BIST30 price index. The settlement of the futures index is by cash. The contracts months are February, April, June, August, October and December (Contracts with three different expiration months nearest to the current month shall be traded concurrently. If December is not one of those three months, an extra contract with an expiration month of December shall be launched.) The expiry date is the last business day of each contract month. In case domestic markets are closed for half day due to an official holiday, expiry date shall be the preceding business day.

Basis: Basis is the difference between the spot index price and the futures index price with the nearest maturity.

We used vector autoregression (VAR) model which is an econometric model used to capture the linear interdependencies among multiple time series. We chose this model, because in VAR, the researcher does not need to specify which variables are endogenous or exogenous all are endogenous (Brooks).

VAR is applied to the stable time series. We calculated the logarithmic differences and applied the unit root tests. t all of the five time series have unit root and become stable in the first differences. After that we run the VAR lag order selections. With the lag order decisions we run the VAR models.

BIST30 Index and BIST30 Index Futures are shown in Figure 1. It is clearly seen that two time series are moving together. The second figure shows the USD/TRY and EUR/TRY between 2011 and 2014. The figures from 3 to 7 show the logarithmic difference series.

Figure 1: BIST30 Index and BIST30 Index Futures

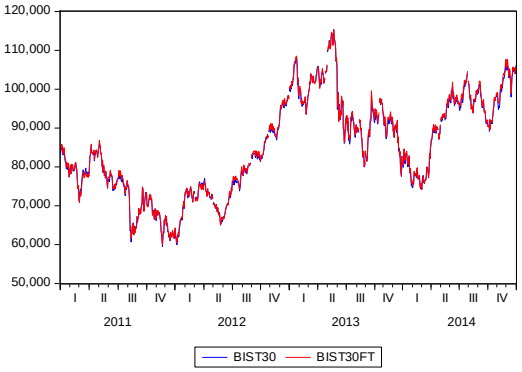


Figure 2: Foreign Exchange Rates

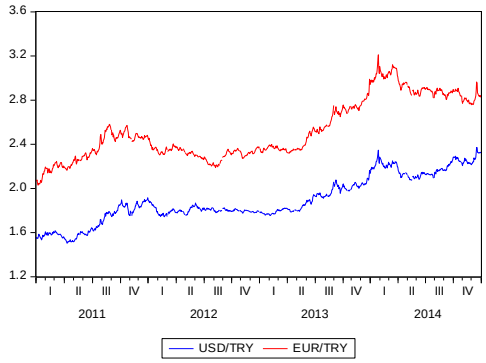


Figure 3: Log Differences of BIST30

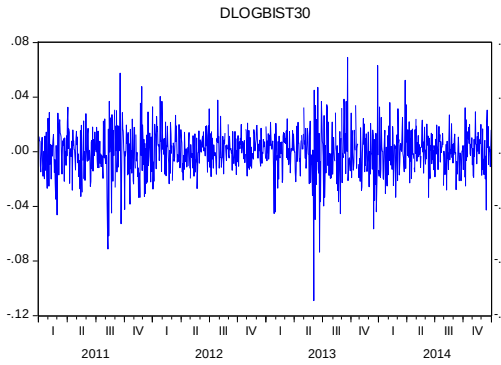


Figure 4: Log Differences of BIST30 Futures

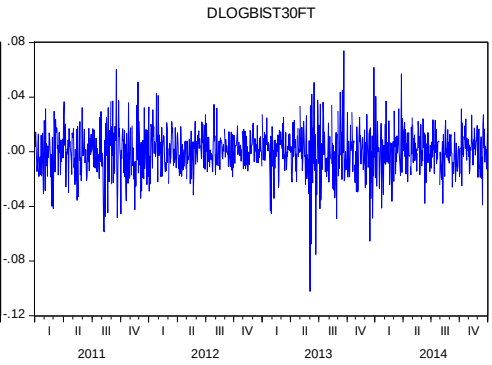


Figure 5: Log Differences of Basis

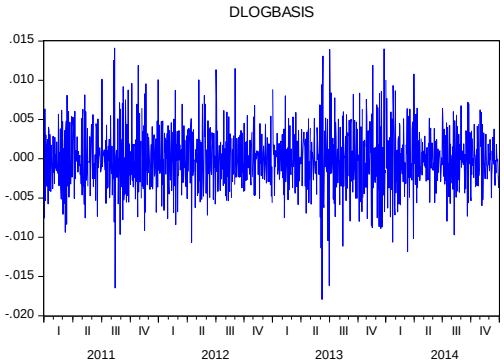
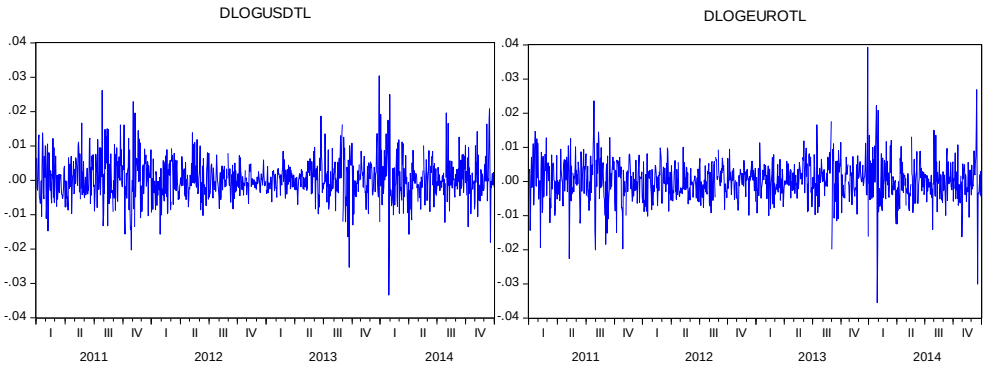


Figure 6: Log Differences of USD/TRY **Figure 7: Log Differences of EUR/TRY**



The results of the unit root tests are shown in Table 1. The Augmented Dickey–Fuller (ADF) regression tests for the existence of unit root of the variable. The null hypothesis indicates that the variable is stationary, and the alternative hypothesis tests the existence of the unit root. Phillips-Perron (PP) developed an alternative unit root test procedure that does not affect the asymptotic distribution of the test statistics while testing for a unit root and also robust to general forms of heteroscedasticity (Teker and Alp: 2014). The null hypothesis in PP indicates that the variable is stationary, and the alternative hypothesis tests the existence of the unit root. Kwiatkowski-Phillips–Schmidt–Shin (KPSS) tests are used for testing a null hypothesis that an observable time series is stationary around a deterministic trend. The null hypothesis in KPSS is different from the other tests and tests the existence of the unit root (Kwiatkowski, Phillips, Schmidt and Shin, 1992). It is shown in Table 3 that both of the time series that calculate from logarithmic differences are stationary.

Table 1: Unit Root Tests

	ADF						PhilipsPerron			KPSS	
	Lag	Schwarz T-stat.	Prob.	Lag	Akaike T-stat.	Prob.	Bandwidth	T-stat.	Prob.	Bandwidth	L-M Stat.
BIST30	0	-33.15315	0.00	3	-15.75169	0.00	2	-33.13141	0.00	4	0.095319
BIST30FT	0	-33.64760	0.00	2	-17.31834	0.00	3	-33.60734	0.00	1	0.097463
Basis	4	-20.00573	0.00	14	-10.97287	0.00	52	-108.7631	0.00	69	0.052885
USD/TRY	0	-30.77502	0.00	0	-30.77502	0.00	3	-30.76844	0.00	4	0.056093
EUR/TRY	1	-23.04959	0.00	1	-23.04959	0.00	2	-26.97356	0.00	6	0.115159

VAR lag order selection results of USD/TRY and BIST30 are shown in Table 5. The criteria that used in the VAR are:

LR: sequential modified LR test statistic (each test at 5% level),

FPE: Final prediction error,

AIC: Akaike information criterion,

SC: Schwarz information criterion,

HQ: Hannan-Quinn information criterion.

The VAR lag order selection criteria for USD/TRY and BIST30 (log differences) are shown in Table 3. The results indicate that the model should be done by three lags.

Table 3: VAR Lag Order Selection Criteria: USD/TRY - BIST30

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6360.590	NA	9.90e-09	-12.75545	-12.74561	-12.75171
1	6397.438	73.47279	9.26e-09	-12.82134	-12.79182	-12.81012
2	6436.060	76.85825	8.64e-09	-12.89079	-12.84160*	-12.87209*
3	6441.984	11.76432*	8.61e-09*	-12.89465*	-12.82578	-12.86847
4	6445.917	7.795020	8.61e-09	-12.89452	-12.80597	-12.86086
5	6448.530	5.168471	8.63e-09	-12.89174	-12.78351	-12.85059
6	6452.565	7.964720	8.63e-09	-12.89181	-12.76390	-12.84318
7	6453.783	2.398892	8.68e-09	-12.88622	-12.73864	-12.83012
8	6454.231	0.880495	8.74e-09	-12.87910	-12.71184	-12.81552

The VAR lag order selection criteria for EUR/TRY and BIST30 (log differences) are shown in Table 4. The results indicate that the model should be done by two lags.

Table 4: VAR Lag Order Selection Criteria BIST30 –EUR/TRY

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6378.959	NA	9.54e-09	-12.79229	-12.78246	-12.78855
1	6413.112	68.10073	8.98e-09	-12.85278	-12.82327	-12.84156
2	6435.276	44.10584	8.66e-09*	-12.88922*	-12.84002*	-12.87052*
3	6437.622	4.658562	8.69e-09	-12.88590	-12.81703	-12.85972
4	6439.752	4.221532	8.72e-09	-12.88215	-12.79360	-12.84849
5	6445.023	10.42623*	8.70e-09	-12.88470	-12.77647	-12.84356
6	6445.963	1.854768	8.75e-09	-12.87856	-12.75065	-12.82994
7	6446.094	0.258081	8.82e-09	-12.87080	-12.72321	-12.81470
8	6446.624	1.042712	8.88e-09	-12.86384	-12.69658	-12.80026

The coefficients of the VAR Models between BIST30 – USD/TRY and BIST30 – EUR/TRY are shown in Table 5.

Table 5: VAR Model - Substituted Coefficients

(BIST30- USD/TRY) (BIST30 – EUR/TRY)

	USD/TRY(-1)	**USD/TRY(-2)**	**USD/TRY(-3)**	**BIST30 (-1)**	**BIST30 (-2)**	**BIST30 (-3)**	C
BIST30	0.0912	-0.1184	-0.0307	-0.0448	0.0579	0.0441	0.0002
USD/TRY	-0.0817	-0.0538	-0.0218	-0.1016	-0.1021	0.0360	0.0005
	EUR/TRY(-1)	**EUR/TRY (-2)**		**BIST30 (-1)**	**BIST30 (-2)**		C
BIST30	0.0648	0.1504		-0.0430	0.0524		0.0002
EUR/TRY	0.1294	0.1132		-0.0755	-0.0581		0.0003

Figure 8 shows the results of impulse response tests and variance decomposition of the VAR model which applied to BIST30 and USD/TRY with two lags. If there is one standard deviation's shock is applied to BIST30, USD/TRY decreases 1.5 days, then it

approaches to zero until 4 days. If there is one standard deviation's shock is applied to USD/TRY, there is a small decrease in BIST30 in the first day, and it approaches to zero in the same day. The variance decomposition of the model shows that nearly 20% of the variance of USD/TRY can be explained by the variance of BIST30, besides the variance of BIST30 only can be explained by its own variance.

Figure 8: Impulse Response Tests and Variance Decomposition of BIST30-USD/TRY

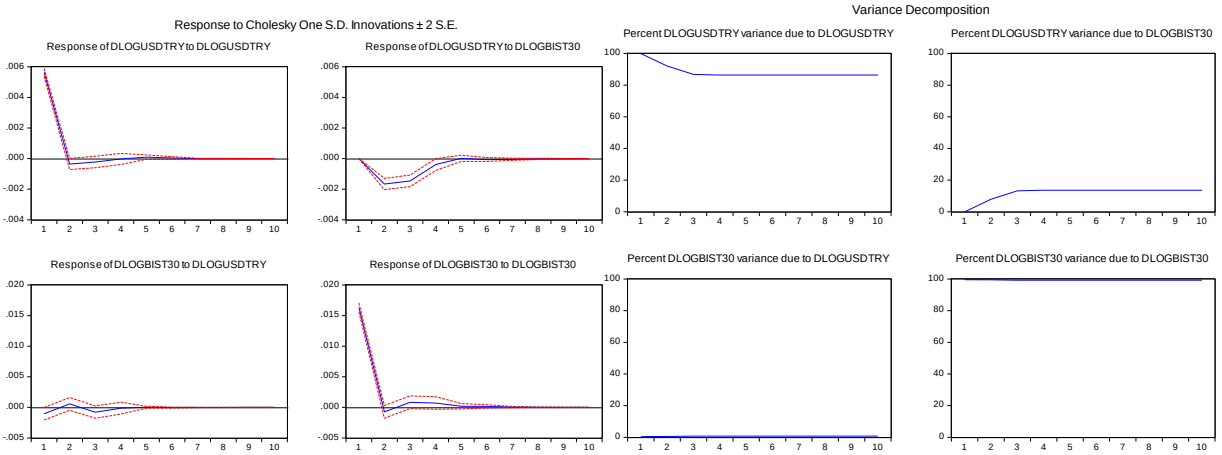
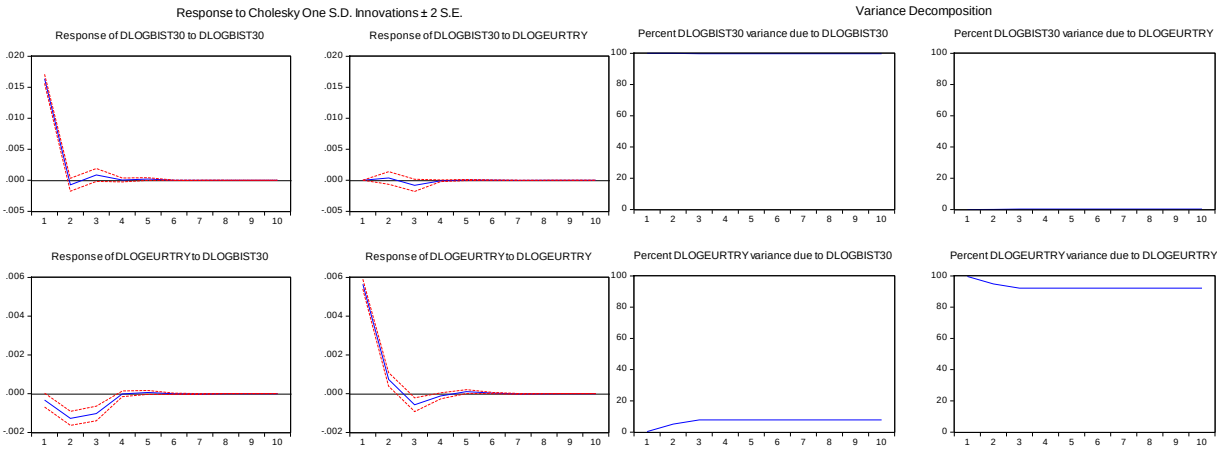


Figure 9 shows the results of impulse response tests and variance decomposition of the VAR model which applied to BIST30 and EUR/TRY with two lags. If there is one standard deviation's shock is applied to BIST30, EUR/TRY decreases 1.5 days, then it approaches to zero until 4 days. If there is one standard deviation's shock is applied to EUR/TRY, there is a very small increase in BIST30, in the second day, and it approaches to zero in the same day. The variance decomposition of the model shows that nearly 10% of the variance of EUR/TRY can be explained by the variance of BIST30, besides the variance of BIST30 only can be explained by its own variance.

Figure 9: Impulse Response Tests and Variance Decomposition of BIST30-EUR/TRY



The VAR lag order selection criteria for USD/TRY and BIST30 Futures (log differences) are shown in Table 8. The results indicate that the model should be done by three lags.

Table 6: VAR Lag Order Selection Criteria: BIST30 Futures-USD/TRY

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6332.066	NA	1.05e-08	-12.69823	-12.68839	-12.69449
1	6368.669	72.98689	9.81e-09	-12.76363	-12.73411	-12.75241
2	6406.024	74.33520	9.18e-09	-12.83054	-12.78135*	-12.81184*
3	6412.990	13.83416*	9.13e-09*	-12.83649*	-12.76762	-12.81031
4	6415.068	4.118653	9.16e-09	-12.83263	-12.74408	-12.79897
5	6417.893	5.587043	9.18e-09	-12.83028	-12.72205	-12.78914
6	6422.389	8.874345	9.17e-09	-12.83127	-12.70336	-12.78265
7	6423.553	2.292232	9.23e-09	-12.82558	-12.67800	-12.76948
8	6424.195	1.262832	9.29e-09	-12.81885	-12.65158	-12.75527

The VAR lag order selection criteria for EUR/TRY and BIST30 Futures (log differences) are shown in Table 9. The results indicate that the model should be done by two lags.

Table 7: VAR Lag Order Selection Criteria: BIST30 Futures-EUR/TRY

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6350.153	NA	1.01e-08	-12.73451	-12.72467	-12.73077
1	6386.040	71.55791	9.48e-09	-12.79848	-12.76896	-12.78726
2	6407.716	43.13469*	9.15e-09*	-12.83393*	-12.78474*	-12.81523*
3	6410.732	5.988954	9.17e-09	-12.83196	-12.76309	-12.80578
4	6411.453	1.429382	9.23e-09	-12.82538	-12.73683	-12.79172
5	6416.052	9.096566	9.22e-09	-12.82658	-12.71835	-12.78544
6	6416.676	1.232045	9.28e-09	-12.81981	-12.69190	-12.77119
7	6416.950	0.539386	9.35e-09	-12.81234	-12.66475	-12.75624
8	6417.443	0.968610	9.41e-09	-12.80530	-12.63804	-12.74172

The coefficients of the VAR Models between BIST30 Futures – USD/TRY and BIST30 Futures – EUR/TRY are shown in Table 8.

Table 8: VAR Models - Substituted Coefficients (BIST30 Futures- USD/TRY) (BIST30 Futures– EUR/TRY)

	USD/TRY (-1)	**USD/TRY (-2)**	**USD/TRY (-3)**	**BIST30FT (-1)**	**BIST30 FT (-2)**	**BIST30FT (-3)**	C
BIST30FT	0.0722	-0.1699	-0.0217	-0.0597	0.0249	0.0495	0.0003
USD/TRY	-0.0788	-0.0535	-0.0263	-0.0993	-0.0976	-0.0381	0.0005

	EUR/TRY (-1)	**EUR/TRY (-2)**	**BIST30FT (-1)**	**BIST30FT (-2)**	C
BIST30FT	0.0414	-0.1980	-0.0597	0.0196	0.0003
EUR/TRY	0.0133	-0.1119	-0.0759	-0.0543	0.0003

Figure 10 shows the results of impulse response tests and variance decomposition of the VAR model which applied to BIST30 Futures and USD/TRY with three lag. When

there is one standard deviation's shock is applied to BIST30 Futures, USD/TRY decreases 1.5 days, then it approaches to zero until 4 days.
When there is one standard deviation's shock is applied to USD/TRY, there is a small decrease in BIST30 Futures in the third day, and it approaches to zero in the next day. The variance decomposition of the model shows that nearly 20% of the variance of USD/TRY can be explained by the variance of BIST30 Futures, besides the variance of BIST30 Futures only can be explained by its own variance.

Figure 10: Impulse Response Tests and Variance Decomposition of BIST30 Futures-USD/TRY

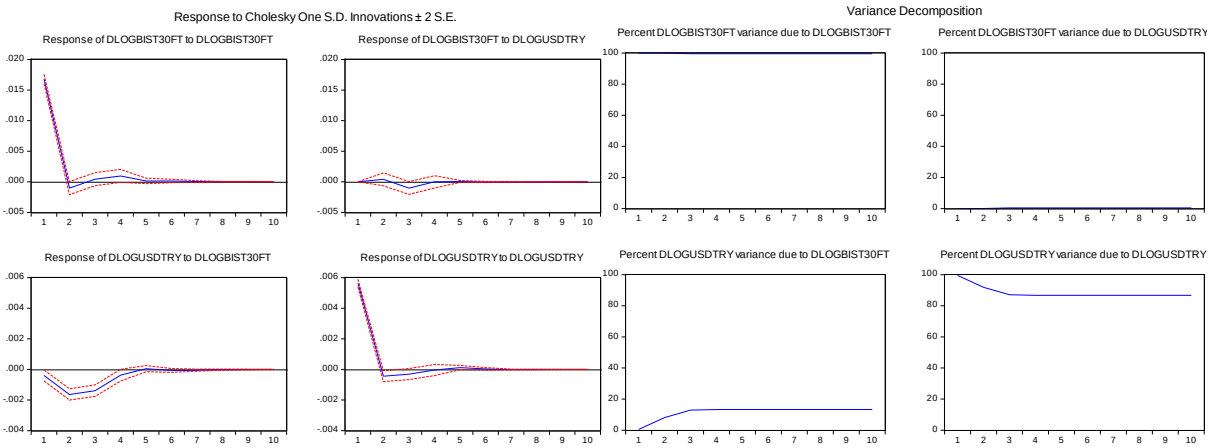
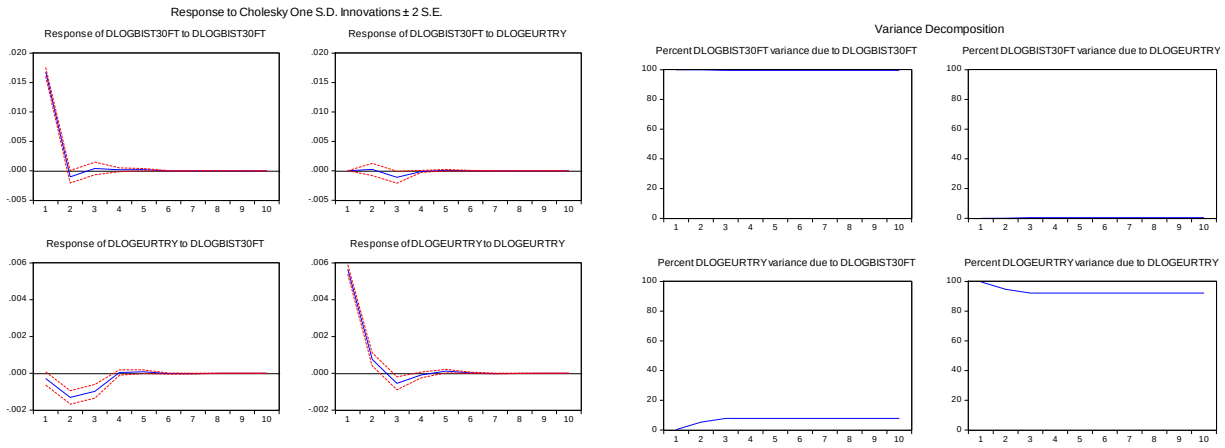


Figure 11 shows the results of impulse response tests and variance decomposition of the VAR model which applied to BIST30 Futures and EUR/TRY with two lags. If there is one standard deviation's shock is applied to BIST30 Futures, EUR/TRY decreases 1.5 days, then it approaches to zero until 4 days. Although, if there is one standard deviation's shock is applied to EUR/TRY, there is a very small decrease in BIST30 Futures in the third day, and it approaches to zero in the next day. The variance decomposition of the model shows that nearly 10% of the variance of EUR/TRY can be explained by the variance of BIST30 Futures, besides the variance of BIST30 Futures only can be explained by its own variance.

Figure 11: Impulse Response Tests and Variance Decomposition of BIST30 Futures-EUR/TRY



The VAR lag order selection criteria for USD/TRY and Basis (log differences) are shown in Table 11. The results indicate that the model should be done by six lag.

Table 9: VAR Lag Order Selection Criteria: BASIS-USD/TRY

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7738.244	NA	6.24e-10	-15.51904	-15.50921	-15.51530
1	7863.296	249.3520	4.90e-10	-15.76188	-15.73236	-15.75066
2	7895.524	64.13297	4.63e-10	-15.81850	-15.76931*	-15.79980
3	7904.494	17.81456	4.58e-10	-15.82847	-15.75960	-15.80229*
4	7907.668	6.290251	4.59e-10	-15.82682	-15.73827	-15.79316
5	7916.652	17.76859	4.54e-10	-15.83681	-15.72858	-15.79567
6	7924.567	15.62454*	4.51e-10*	-15.84467*	-15.71676	-15.79605
7	7925.179	1.205515	4.54e-10	-15.83787	-15.69029	-15.78177
8	7928.551	6.628374	4.54e-10	-15.83661	-15.66935	-15.77303

The VAR lag order selection criterias for EUR/TRY and Basis (log differences) are shown in Table 12. The results indicate that the model should be done by six lag.

Table 10: VAR Lag Order Selection Criteria: BASIS-EUR/TRY

Lag	LogL	LR	FPE	AIC	SC	HQ
0	7759.177	NA	5.98e-10	-15.56104	-15.55120	-15.55730
1	7896.122	273.0660	4.58e-10	-15.82773	-15.79821	-15.81651
2	7933.541	74.46329	4.29e-10	-15.89477	-15.84557*	-15.87607
3	7943.174	19.12974	4.24e-10	-15.90607	-15.83719	-15.87989*
4	7946.946	7.475967	4.24e-10	-15.90561	-15.81706	-15.87195
5	7954.588	15.11473	4.21e-10	-15.91291	-15.80468	-15.87177
6	7962.547	15.71180*	4.18e-10*	-15.92086*	-15.79295	-15.87224
7	7963.589	2.052827	4.20e-10	-15.91492	-15.76734	-15.85882
8	7965.837	4.418689	4.22e-10	-15.91141	-15.74414	-15.84783

The coefficients of the VAR Models between Basis – USD/TRY and Basis – EUR/TRY are shown in Table 11.

Table 11: VAR Models: Basis and USD/TRY, Basis and EUR/TRY

	Basis	USD/TRY		Basis	EUR/TRY
USD/TRY (-1)	0.0136	-0.0204	**EUR/TRY (-1)**	0.0111	0.1769
USD/TRY (-2)	-0.0448	0.0148	**EUR/TRY (-2)**	-0.0435	-0.1235
USD/TRY (-3)	-0.0167	0.0197	**EUR/TRY (-3)**	-0.0192	0.0459
USD/TRY (-4)	0.01	0.0075	**EUR/TRY (-4)**	0.0031	-0.0237
USD/TRY (-5)	0.0022	-0.0271	**EUR/TRY (-5)**	-0.0042	0.056
USD/TRY (-6)	-0.0257	-0.1384	**EUR/TRY (-6)**	-0.0304	-0.0224
Basis (-1)	-0.6409	0.0305	**Basis (-1)**	-0.6427	-0.0983
Basis (-2)	-0.3649	-0.0159	**Basis (-2)**	-0.3649	-0.0649
Basis (-3)	-0.2309	0.0001	**Basis (-3)**	-0.2333	-0.0977
Basis (-4)	-0.1769	0.0008	**Basis (-4)**	-0.1803	-0.1318
Basis (-5)	-0.1621	0.0687	**Basis (-5)**	-0.1644	-0.1233
Basis (-6)	-0.799	0.0341	**Basis (-6)**	-0.0805	-0.1289
C	9.75E-06	0.0004	C	1.18E-05	0.0003

Figure 12 shows the results of impulse response tests and variance decomposition of the VAR model which applied to Basis and USD/TRY with six lag. If there is one standard deviation's shock is applied to Basis, USD/TRY has a late and weak response in the seventh day. Besides if there is one standard deviation's shock is applied to USD/TRY, there is a small decrease in Basis in the third day, and it approaches to zero in the same day. The variance decomposition of the model shows that Basis and USD/TRY only can be explained by their own variances.

Figure 12: Impulse Response Tests and Variance Decomposition of Basis-USD/TRY

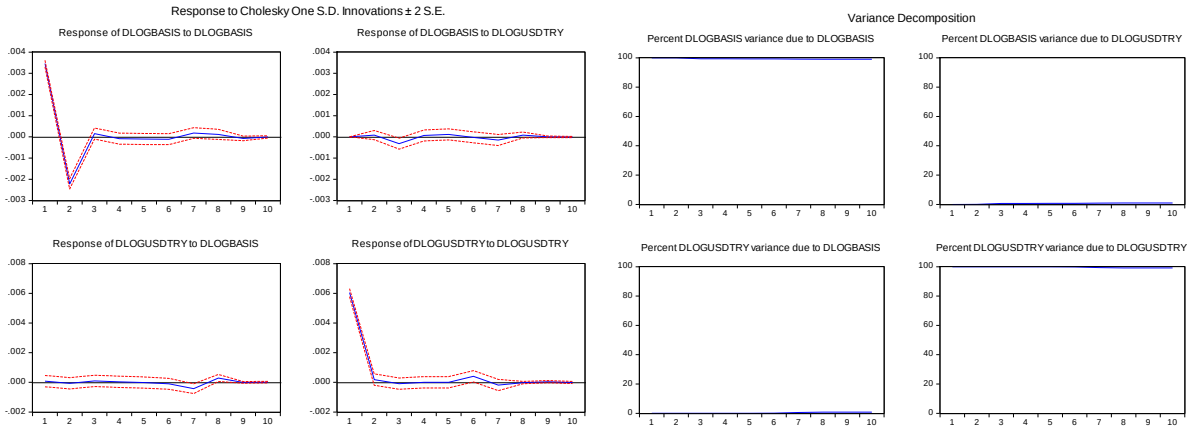
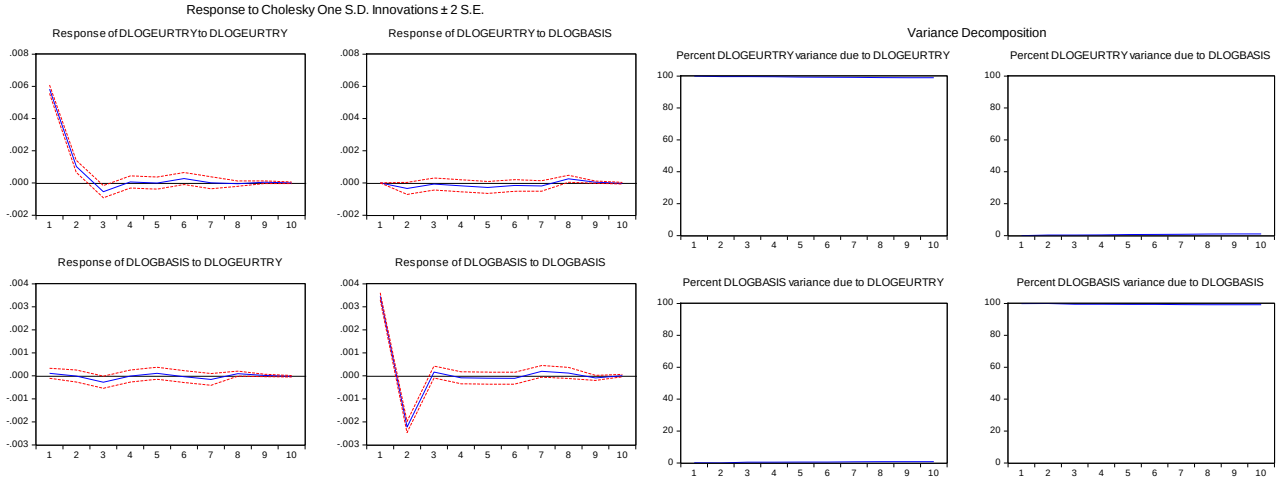


Figure 13 shows the results of impulse response tests and variance decomposition of the VAR model which applied to Basis and EUR/TRY with six lag. If there is one standard deviation's shock is applied to Basis, EUR/TRY has a weak decrease in the second day. Although, if there is one standard deviation's shock is applied to EUR/TRY, there is a small decrease in Basis in the third day, and it approaches to zero in the same day. The variance decomposition of the model shows that Basis and EUR/TRY only can be explained by their own variances.

Figure 13: Impulse Response Tests and Variance Decomposition of Basis-EUR/TRY



The results of the Granger Causality for all of the VAR Models are shown in Table 12. The Granger causality test is a statistical hypothesis test to determine whether one time series is an explaining variable for the other. While the impulse-response tests and the variance decomposition tests explain the short run relationship, the Granger Causality Test explains the long run relationship.

The results indicate that the logarithmic differences of BIST30 and BIST30 Futures are Granger Causality of the logarithmic differences of the foreign exchange rates.

Table:12 Granger Causality Tests

Dependent Variable	Causality Variable	Chi- sq	Lags	Probability
BIST30	USD/TRY	3.101373	3	0.3763
USD/TRY	BIST30	161.8467	3	0.0000
BIST30	EUR/TRY	3.150822	2	0.2069
EUR/TRY	BIST30	70.73169	2	0.0000
BIST30 FT	USD /TRY	4.331771	3	0.2278
USD/TRY	BIST30 FT	156.4857	3	0.0000
BIST30 FT	EUR/TRY	4.813934	2	0.0901
EUR/TRY	BIST30 FT	71.36155	2	0.0000
BASIS	USD/TRY	9.891038	6	0.1293
USD/TRY	BASIS	7.960712	6	0.2410
BASIS	EUR/TRY	10.28294	6	0.1252
EUR/TRY	BASIS	9.987547	6	0.1132

4. Conclusion

Both BIST30 and BIST30 Futures have the same effect on the foreign exchange rates. The impulse response tests indicates that if there is a shock in spot or futures index Borsa Istanbul, each of the two foreign exchange rates (USD/TRY and EUR/TRY) give the same response. They decrease in the first two days, and the response disappears

in the fourth day. Besides, the variance decomposition tests show that nearly 10%-20% of the variance of foreign exchange rates can be explained by the variance of the spot or futures equity indices. However foreign exchange rates' variances don't explain the variances of the equity indexes. In addition, basis between spot and futures indices do not have a prominent response to the changes in foreign exchange rates and foreign exchange rates do not have to the change in basis too.

While the impulse-response tests and the variance decomposition tests explain the short run relationship, the Granger Causality Test explains the long run relationship. The results indicate that the logarithmic differences of BIST30 and BIST30 Futures are Granger Causality of the logarithmic differences of the foreign exchange rates.

In literature, there are different results for the relationship between foreign exchange rates and Borsa Istanbul equity market. We found an evident result in the short run and also long run. Our results confirm Ayvaz (2006), Savaş and Can (2011) thus the foreign exchange rate markets in Turkey are driven by the equity market. One of the reasons might be the international investors who interest in those equities in BIST30. Therefor BIST30 is an important indicator for Turkey financial markets.

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