

*Full Length Research Paper*

# The analysis of the effects of derivatives exchange (DE) transactions on the market efficiency of Istanbul stock exchange (ISE) national 100 index and on spot market transaction prices

Ayhan Kapusuzoglu and Aslihan Tasdemir

Hacettepe University, Department of Business Administration, 06800 Beytepe – Ankara, Turkey.

Accepted 11 November, 2009

The objective of this work is to study the ISE National 100 market efficiency on the forward transaction and option exchange and its effect on the spot transaction prices by considering in-depth the contracts being carried out on the basis of (DE) Istanbul Stock Exchange (ISE) National 100 index in the Futures Transaction and Option Exchange in Turkey and the ISE National 100 index. Within the context of this work, the analysis was concluded by using the contractual prices being carried out in the futures market as well as ISE National 100 index closing values within the scope of the period of 01.11.2005 – 30.06.2009. At the end of the analysis, it has been determined that both the futures market and also the ISE National 100 index are efficient in a weak form and do not have any effect to increase the market efficiency. Furthermore, during this work, it has been established that, while it is expected that the futures market would affect the spot market price, the spot market price has affected the futures market price.

**Key words:** Spot market, futures market, co-integration, granger causality.

## INTRODUCTION

Many researches are available as related with the studying of the relationship between the futures market transactions and the spot market transactions. In the study carried out by Floros and Vougas (2007), it is analyzed whether the feedback relationship exists between the spot index and index futures contract traded in the Athens Derivatives Exchange (ADEX) in Greece making use of a Bivariate GARCH Model with a time span ranging from 1999 to 2001. The empirical findings reveal that there are both long-run and lead-lag connection between spot market and futures market. Further they find that the futures market leads spot market due to holding lower transaction costs and higher liquidity.

Maslyuk and Smyth (2008) investigate the stationarity

of the crude oil spot and futures prices based on a unit root with structural breaks using weekly data from January 1991–December 2004. In the light of the empirical evidence the authors report that, forecasting future movements in crude oil prices based on past prices is impractical for this timeframe owing to the fact that oil spot markets and oil futures markets are efficient in the weak form with having a random walk behaviour.

Chang and Lee (2008), in their study on both spot market and futures market in Taiwan based on the intraday data in January 2001-May 2005 period, show that a bidirectional causality relationship exists between the spot market and futures market in the short-term. The causal effect of both markets is measured by the computation of the bivariate Granger Causality tests by applying the threshold error-correction model (TECM).

Liu et al. (2008) put to use TGARCH and GARCH models in order to assess the VaR(Value at Risk) of the Chinese copper futures market and spot market. Furthermore, they employ a linear Granger causality test

---

\*Corresponding author. E-mail: ayhkap@gmail.com, ayhkap@hacettepe.edu.tr . Tel: 00 90 312 297 87 00. ext: 150. Fax: 00 90 312 299 20 55.

to study the information spillovers between the futures market and the spot market and a kernel function for the relationship between the two markets. The main empirical findings of the study focus on the existence of a strong relationship between the futures market and the spot market. In other words, there is a two-way Granger causality between the copper futures market and the copper spot market. They also find that information and risk spillovers from the futures market to the latter are much more powerful due to the fact that futures market has a dynamo character for price discovery.

Bekiros and Diks (2008) examine whether linear and nonlinear causal lead-lag relationships exist between daily spot and futures prices of West Texas Intermediate (WTI) crude oil covering cover two periods, October 1999 and November 1999– October 2007. The econometric tests done in the study exhibit some empirical findings that a strong bi-directional Granger causality exists between spot and futures prices in both periods. Apart from that, the linear causality for the five-variate implementation occurs to be uni-directional.

So as to observe the existence of linkage between National Stock Exchange (NSE) spot and futures markets in India, Srinivasan and Bhat (2009) utilize Johansen's Cointegration and Vector Error Correction Model (VECM) focusing on the daily data set of spot and stock futures on 21 banking stocks traded in National Stock Exchange (NSE) in May 2005 -May 2008. Their paper exhibits how well the two markets are connected having combined findings. They observe that besides the bi-directional feedback between the two markets exists, spot market has a leading effect on futures market and vice versa.

Having the main purpose of testing causal relationships among prices for crude oils from North America, Europe, Africa, and the Middle East on both spot and futures markets, Kaufmann and Ullman (2009) use a dataset of daily prices for crude oils traded in spot and future markets with their starting date, disregarding the prices of refined petroleum products in their study. The results of their empirical tests indicate that the connections between spot and futures markets are feeble. They also find that alterations in market fundamentals and speculation give rise to the increase in oil prices .

In another recent study on daily crude oil spot and future prices for the period January 1991–November 2008 by Maslyuk and Smyth (2009), it is provided some evidence that the purpose of this study is to examine whether crude oil spot and futures prices of the same and different grades are cointegrated. The sample used in the analysis compiled the US WTI and the UK Brent crudes.

## MATERIALS AND METHODS

In this work, an in-depth study of the relationship that exists between the contracts being carried out based on the ISE National 100 index in the Izmir Derivatives Exchange and the ISE National 100 market efficiency of the Derivatives Exchange, and whether or not it has any effect on the spot market transaction prices. In line

with this objective, the daily closing prices of the ISE National 100 index between 01.11.2005 – 30.06.2009, and the closing prices of the contracts being carried out in the Futures Transaction Market have been analyzed. The analysis commenced in 01.11.2005 because it is the first initial date of the demand option contracts based on the ISE National 100 index. First of all, within the scope of the analysis, the basic statistical values concerning the data thus considered have been calculated. Then, before any analysis of causality to be concluded for determining what kind of effect the Derivatives (DE) 100 has on the ISE National 100, the Unit Root test was performed for determining the stability of the data, and also the Co-integration test was performed in order to find out if there is any relationship between the DE 100 and the ISE National 100. During the stage of designing the work, the work (2008) of Özen was made use of. The basic hypothesis tested in the work is presented here below. Relevant data have been gathered from the web pages of is Investment and Securities Inc. and Izmir Derivatives Exchange. Eviews and SPSS for Windows software have been used for arranging the data and making the analyses. The basic hypothesis tested in the study is given below:

### Hypothesis 1

$H_0$ : The DE 100 Futures transactions have no effect on the market efficiency of the ISE National 100 index.

$H_1$ : The DE 100 Futures transactions have some effects on the market efficiency of the ISE National 100 index.

The most important problem being faced in the time series is the emergence of false regressions, and as a result of this, it seems that the obtained testing results such as t and F are meaningful, whereas they are not true. In order to put forth the real relationships between the series being free from the influence of time, above all, the series should be made stable. In this line, at the first stage of the process of the analysis, first of all, it has been researched whether or not the series are stable. Therefore, the ADF unit root test has been used for the ISE National 100 and also DE 100. In the event that the statistics t as found at the end of the test is smaller than Dickey-Fuller critical values, the hypothesis  $H_0$  will be accepted. Dickey and Fuller (1981) have formulated the ADF test as follows, which is used to determine the stability of the series:

$$\Delta X_t = \mu + \alpha t + \delta X_{t-1} + \sum_{i=1}^k \delta_i \Delta X_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta X_t = X_t - X_{t-1}$$

t: trend variable

$\varepsilon_t$ : stochastic error term

for  $\varepsilon_t$ :

$$E(\varepsilon_t) = 0$$

$$Var(\varepsilon_t) = \sigma_{\varepsilon t}^2$$

$$cov(\varepsilon_t, \varepsilon_{t-s}) = 0$$

$$s \neq 0$$

At the second stage of the analysis, with the aim to show if there is any relationship between the series of the first differences, which has been noted, and that if they are stable, Engle-Granger (1987) Co-integration test was applied. If the absolute value of the statistics t thus found at the end of the test is smaller than the critical value as determined by Engel and Yoo (1987), the hypothesis  $H_0$  will be accepted; in the other words, it will be concluded that there is not any co-integration. Such co-integration test can be expressed through the following equation:

$$\Delta e_t = \alpha_0 + \sum_{i=1}^k \alpha_i \Delta e_{t-i} + \beta e_{t-1} + \varepsilon_t \quad (2)$$

At the third stage of the analysis, after it has been shown that there is a relationship between the series, a Granger causality test will be made in order to determine the direction of such a direction. In respect of Granger causality test, three situations are considered; thus, there is a unilateral causality from X to Y or from Y to X, and there is a correlation between X and Y, and X and Y are independent from each other. Granger test is performed through the estimation of the following equations with the method of the smallest squares. Such equations can be expressed as follows:

$$X_t = \alpha + \sum_{j=1}^J b_j X_{t-j} + \sum_{i=1}^I c_i Y_{t-i} + \epsilon_t \quad (3)$$

$$Y_t = \alpha + \sum_{j=1}^J b_j Y_{t-j} + \sum_{i=1}^I c_i X_{t-i} + \epsilon_t \quad (4)$$

## THE RESULTS OF THE ANALYSIS

### Descriptive statistical results

At the first stage of the analysis, the basic statistical values have been calculated as directed by the DE 100 and the ISE National 100; and the results relating to the DE 100 are given in Table 1 below. In Table 1 it is seen that index (DE) average, standard deviation and kurtosis have been calculated as 22.76, 20.70 and 1.301 respectively, and that such a situation indicates that the series is oblate as compared to normal. Distortion has been founded as -0.022. This result shows that the series is distorted towards left (negative). In this series, Jargue Bera statistics has been calculated as 110.00 ( $P<0.00$ ) and it has been found out that the series does not have normal distribution. According to the basic statistical data thus studied, the DE series is not normally distributed. In Table 2, it is seen that index (ISE) average, standard deviation and kurtosis have been calculated as 39.92, 8.19 and 2.714, respectively, and that such a situation indicates that the series is oblate as compared to normal. Distortion has been founded as -0.022. This result shows that the series is distorted towards left (negative). In this series, Jargue Bera statistics has been calculated as 5.628 ( $P<0.00$ ) and it has been found out that the series does not have normal distribution. According to the basic statistical data thus studied, the ISE series is not normally distributed.

### Unit root test results

In a time series model, it should be known whether or not the obtained probabilistic (stochastic) process changes depending on time. If the quality of the probabilistic process varies throughout time, then the time series is not static. It is impossible to express past and future structure of a non-static time series with an algebraic model. If the stochastic process is static throughout time,

**Table 1.** Descriptive statistical results of DE 100.

Statistics	Values
Mean	22.76
Median	28.00
Maximum	61.00
Minimum	0.00
Std. Dev	20.70
Skewness	-0.022
Kurtosis	1.301
Jargue-Bera	110.00
Probability	0.000
Observations	914

**Table 2.** Descriptive statistical results of ISE 100.

Statistics	Values
Mean	39.92
Median	40.00
Maximum	58.00
Minimum	21.00
Std. Dev	8.19
Skewness	-0.128
Kurtosis	2.714
Jargue-Bera	5.628
Probability	0.059
Observations	916

a static-coefficient model of the series can be obtained using the past values of the series (Kutlar, 2005).

Granger and Newbold have stated that false regressions will appear in any estimation to be made in cases where the series are not stable. Although the results of the tests to be performed with unstable series are non meaningful, they can be considered meaningful (Gujarati, 2005). For this reason, the taking of the first differences of the series is to be a good way. In this line, the first differences of the series were taken, and Augmented Dickey Fuller (ADF) unit root test was carried out for both the DE 100 and also the ISE National 100. The hypotheses as created for the test are presented here below:

### Hypothesis 2

$H_0$ : The DE 100 series is not stable and has auto-correlation, and is not market-efficient.

$H_1$ : The DE 100 series is stable, and there is not any correlation, and it is market-efficient.

### Hypothesis 3

$H_0$ : The ISE National 100 series is not stable and has auto-correlation, and is not market-efficient.

$H_1$ : The ISE National 100 series is stable, and there is not any correlation, and it is market-efficient.

In Table 3 are shown the results of the unit root test as

**Table 3.** DE 100 unit root test.

<b>Augmented Dickey-Fuller Test Equation</b>			
<b>Null Hypothesis: D(DE 100) has a unit root</b>			
		t-Statistic	Probability*
Augmented Dickey-Fuller Test Stat.		-20.29473	0.0000
Critical Value	%1*	-3.4402	-
	%5	-2.8651	-
	%10	-2.5687	-

\*MacKinnon (1996) one way p-value

\*\*\* represent the statistical significance levels of 1%.

**Table 4.** ISE 100 unit root test.

<b>Augmented Dickey-Fuller Test Equation</b>			
<b>Null Hypothesis: D(ISE National 100) has a unit root</b>			
		t-Statistic	Probability*
Augmented Dickey-Fuller Test Stat.		-13.15033	0.0000
Critical Value	%1*	-3.4402	-
	%5	-2.8651	-
	%10	-2.5687	-

\*MacKinnon (1996) one way p-value

\*\*\*represent the statistical significance levels of 1%.

performed for the DE 100 series. As seen in Table 3, in the tests of stability, the absolute value of the ADF statistics of the DE 100 series, the difference of which has been taken, has been found as -20.29473, and since the critical values of the meaning levels of 1, 5 and 10% are greater than their absolute values, the DE 100 series is in a stable position. In line of this finding, the hypothesis  $H_0$  has been rejected, and hence, it has been understood that the market is efficient. The ADF unit root test as carried out after the first differences of the DE 100 series have been indicated that the series, the difference of which has been taken, has a random walk nature; and as a result of this, it can be said that the DE 100 index is efficient in weak form.

In Table 4 are shown the results of the unit root test as performed for the ISE National 100 series. As seen in the table, in the tests constant stability, the absolute value of the ADF statistics of the ISE National 100 series, the difference of which has been taken, was found as -13.15033, and since the critical values of the mean levels of 1, 5 and 10% are greater than their absolute values, the ISE National 100 series is in a stable position. In line of this finding, the hypothesis  $H_0$  has been rejected, and hence, it has been understood that the market is efficient. The ADF unit root test as carried out after the first differences of the ISE National 100 series indicated that the series, the difference of which has been taken, has a random walk nature; and as a result of this, it can be said that the ISE National 100 index is efficient in weak form.

It has been observed, upon drawing the figures (Figures 1-2) of static series, that the data floated around a fixed average and that the fluctuation variance remained fixed throughout time for DE 100 and ISE National 100 indices. This observation demonstrates that the series are static.

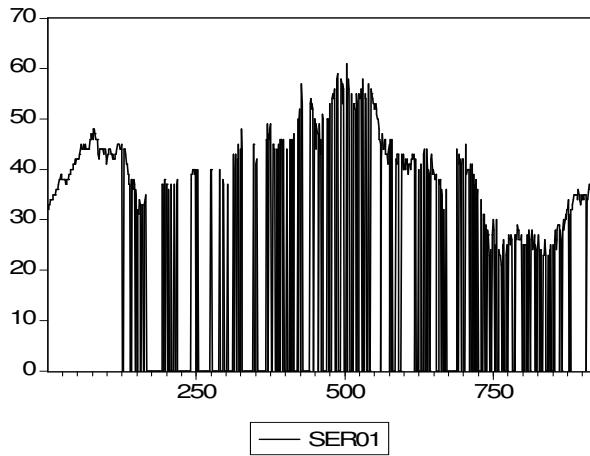
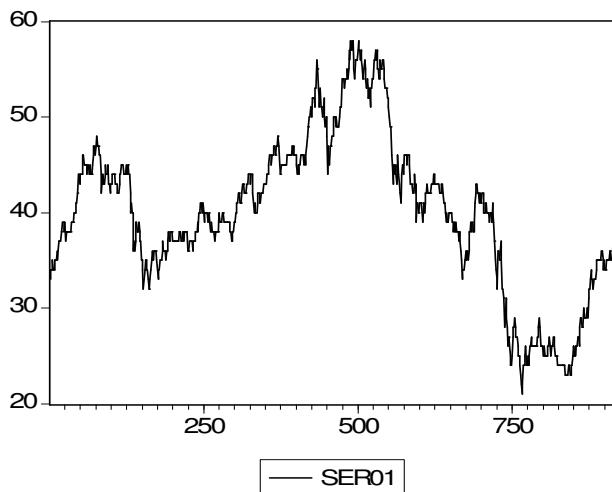
### Cointegration test results

Whether or not there is any relationship between the DE 100 and the ISE National 100 can be hardly determined at the end of the co-integration test. At the end of the test to be thus performed, if the conclusion that there is not any relationship between the series is found out, the application of the causality test which is made for determining the direction of such a relation between the series will not be required. The test results as obtained in the work, which concern whether or not there is any relationship between the series, are given in Table 5.

As seen in the table studied, both Trace and also Maximum Eigen statistics indicate there is 1 (one) co-integrated equation between the variables at the level of 1% meaningfulness. In this line of this result, it can be said that there is a relationship between these two series. After it is determined that the ISE National 100 series and the DE 100 series are co-integrated (say, that there is a relationship between them), the direction of this relationship will be determined in next stage. So, the following

**Table 5.** Cointegration test.

Hypothesis	Eigen value	Trace statistic	Max. eigen statistic	5% critical value		1% critical value	
				Trace	Max	Trace	Max
Model	0.158792	160.2137	157.7000	15.41	14.07	20.04	18.63
	0.002752	2.513738	2.513738	3.76	3.76	6.65	6.65

**Figure 1.** DE 100 graph.**Figure 2.** ISE 100 graph.

will be found out respectively: the direction of the relationship between two series, and which series affects the other one first, that means, which series is the conclusion of which series and why.

### Causality test results

After it is found out that the ISE National 100 series and

the DE 100 series are co-integrated, in this stage, the direction of the relation will be determined. So, the following will be found out respectively: the direction of the relationship between two series, and which series affects the other one first, that means, which series is the conclusion of which series and why. The hypotheses as created for the test of causality as well as the analysis findings thus obtained are presented here below:

#### Hypothesis 4

$H_0$ : There is not any relationship of causality between the DE 100 and the ISE National 100.

$H_1$ : There is a relationship of causality between the DE 100 and the ISE National 100.

#### Hypothesis 5

$H_0$ : The DE 100 is not the Granger reason of the ISE National 100.

$H_1$ : The DE 100 is the Granger reason of the ISE National 100.

#### Hypothesis 6

$H_0$ : The ISE National 100 is not the Granger reason of the DE 100.

$H_1$ : The ISE National 100 is the Granger reason of the DE 100.

The values obtained from the Standard Granger Causality test as applied to the variables of the ISE National 100 and the DE 100 are shown in Table 6. According to this Table, the zero hypothesis accepting that there is not any relationship of causality between the ISE National 100 and the DE 100 has been rejected (Hypothesis 4). In the first of the other hypotheses thus created, the hypothesis  $H_0$  has been accepted (Hypothesis 5), and in the second one, the hypothesis  $H_0$  has been rejected (Hypothesis 6). Hence, in line of the results thus obtained, at the level of 1% statistical meaningfulness, while the ISE National 100 is the Granger reason of the DE 100, the DE 100 is not the Granger reason of the ISE National 100.

According to the results thus obtained, it has been found that there is a unilateral Granger causality relationship towards the DE 100 from the ISE National 100. When it is looked at the Granger relationship, the causality relationship between the two series has been by the direction of the DE 100 to the ISE National 100. Therefore, in the main hypothesis as created in the work, the hypothesis  $H_0$  has been accepted (hypothesis 1).

**Table 6.** Pairwise Granger causality tests.

Null hypothesis	Obs	F-statistic	Probability
ISE 100-ISE 100 does not Granger Cause DE 100-DE 100(-1)	913	15.7087	0.00008***
DE 100-DE 100 does not Granger Cause ISE 100-ISE 100(-1)		0.01626	0.89857

\*\*\*represent the statistical significance levels of 1%.

While it is expected that the futures price would determine the spot price, the spot price has been effective in determining the futures price. In the other words, while it is expected that the DE 100 would be effective on the price movements of the ISE National 100 index, it has been observed that the ISE National 100 index has directed the price movements of the DE 100 index.

## DISCUSSION

In the work as realized within the scope of the period of 01.11.2005 – 30.06.2009 in Turkey, the impact of the DE transactions on the efficiency of the ISE National 100 market as well as on the spot market transaction prices has been studied. In line of the work, the following tests have been performed: the unit root test as related with the stability of the series, and the co-integration test as related with the understanding of whether or not there is any relationship between the ISE ad DE series, and the test of causality for determining the direction of the relationship between the existence of which has been proven. At the end of the work, it has been concluded that the DE and ISE markets are both efficient in weak form, and that the futures market price is not effective on the spot market price. On the contrary of expected, the spot market price is effective on the futures market price. These results are parallel to the outcomes of the study conducted by Özden (2008) based on ISE National 30 index. An examination of obtained results will tell that the DE market could not provide the expected efficiency. Therefore, in order to be able to increase the level of efficiency, we may conclude that development of the DE market and increasing the volume of transactions, and doing not only speculative but also risk-hedging transactions in the market will contribute positively.

## REFERENCES

- Bekiros SD, Diks CGH (2008). The relationship between crude oil spot and futures prices: cointegration, linear and nonlinear causality. *Energy Economics*. 30: 2673-2685.
- Chang CC, Lee YH (2008). Asymmetric causal relationship between spot and futures in Taiwan. *Int. Res. J. Finance Econ.* 14: 113-121.
- Dickey DA, Fuller WA (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*. 49(4): 1057-1072.
- Engle RF, Granger WJ (1987). Co-integration and error correction: representation, estimation and testing. *Econometrica*. 55(2): 251-276.
- Engle RF, Yoo BS (1987). Forecasting and testing in co-integrated systems. *J. Econ.* 35(1): 143-159.
- Floros C, Vougas DV (2008). Lead-lag relationship between futures and spot markets in Greece: 1999-2001. *Int. Res. J. Finance Econ.* 7: 168-174.
- Gujarati DN (2001). *Temel ekonometri*, (Çev: Şenses Ü, Şensen G.). İstanbul: Literatür Yayıncılık.
- Kaufmann RK, Ullman B (2009). Oil prices, speculation and fundamentals: interpreting causal relations among spot and futures prices. *Energy Economics*. 31: 550-558.
- Kutlar A (2005). *Uygulamalı ekonometri*, Ankara: Nobel Yayın Dağıtım. 2:252.
- Liu X, Cheng S, Wang S, Hong Y, Li Y (2008). An empirical study on information spillover effects between the chinese copper futures market and spot market. *Physica A*. 387: 899-914.
- Maslyuk S, Smyth R (2009). Conintegration between oil spot and futures prices of the same and different grades in the presence of structural change. *Energy Policy*. 37: 1687-1693.
- Maslyuk S, Smyth R (2008). Unit root properties of crude oil spot and futures prices. *Energy Policy*. 36: 2591-2600.
- Özen E (2008). *Izmir vadeli işlem ve opsiyon borsası'nda hisse senedine dayalı futures işlemlerinin spot piyasa etkinliğine katkısı: imkb 30 endeksi için bir uygulama*. Afyonkarahisar Kocatepe Üniversitesi Sosyal Bilimler Enstitüsü, Yayınlanmamış Doktora Tezi, Afyon.
- Srinivasan P, Bhat KS (2009). Spot and futures markets of selected commercial banks in India: what causes what? *International Research Journal of Finance and Economics*. 31: 28-40.