Available online at www.sciencedirect.com

Borsa İstanbul Review

Borsa İstanbul Review 15-3 (2015) 213–221

http://www.elsevier.com/journals/borsa-istanbul-review/2214-8450

Closing price manipulation in Borsa Istanbul and the impact of call auction sessions

Eyüp Kadıoğlu [a,*], Güray Küçükkocaoğlu [b], Saim Kılıç [c]

[a] *Capital Markets Board, Eskisehir Yolu 8. Km. No:156, 06530, Ankara, Turkey*
[b] *Başkent University, Department of Management, Baglıca, 06810, Ankara, Turkey*
[c] *Istanbul Kemerburgaz University, Istanbul, Turkey*

Received 27 March 2015; revised 21 April 2015; accepted 21 April 2015
Available online 29 April 2015

Abstract

To reduce extraordinary price movement and to ensure more effective price formation at closing time, Borsa Istanbul implemented closing call auction sessions on March 2, 2012. This study tests the effect of closing call auction sessions on closing price manipulation in Borsa Istanbul using 102 shares in various indexes. The analysis focuses on 624 days from November 1, 2006 to May 31, 2012. The results reveal an upward-oriented closing price manipulation prior to the implementation of closing call auction sessions. The data show a significant elimination in closing price manipulation following the implementation of closing call auction sessions.

JEL classification: G14; G15; G18

Keywords: Closing price; Call auction; Manipulation

1. Introduction

Closing prices are used for many purposes including valuations, marking-to-market accounting, valuation of funds and their liquidations, measuring the performance of portfolio managers, and so on. These purposes provide sufficient grounds for closing price manipulation. Exchanges and policymakers have to ensure that closing prices are efficient and free of extraordinary movement or manipulation. For these reasons, closing prices are often the subject of research.

Although Terry (1986) and Harris (1989) could not identify any manipulation of closing prices, Comerton-Forde and Rydge (2006), Comerton-Forde, Lau, and McInish (2007), Comerton-Forde and Putnins (2011), Pinfold and Danyang (2012), Felixson and Pelli (1999); and Hillion and Suominen (1998b) discovered manipulation in closing prices. Many studies have proposed call auction sessions at the opening or closing of continuous auction sessions to ensure more efficient, manipulation-free prices (Barclay, Litzenberger, & Warner, 1990; Hillion & Suominen, 2004; Muscarella & Piwowar, 2001; Pagano & Schwartz, 2003, 2005; Smith, 2006; Theissen, 2000).

Market manipulation has been a pervasive issue in Borsa Istanbul since the late 1990s, and the Capital Markets Board of Turkey (CMB) and Borsa Istanbul have dealt with many manipulation cases. At one point, Borsa Istanbul began opening call auction sessions and the use of unique client IDs as precautionary measures against market manipulation. Closing call auction sessions were also proposed by CMB, Küçükkocaoğlu (2005, 2008b) and Özcan (2011) to prevent market manipulation. Finally on March 2, 2012, call auction sessions were implemented to reduce extraordinary price movements and to ensure more efficient price formation in

* Corresponding author.
E-mail addresses: eyup.kadioglu@gmail.com (E. Kadıoğlu), gurayk@baskent.edu.tr (G. Küçükkocaoğlu), saim.kilic@kemerburgaz.edu.tr (S. Kılıç).
Peer review under responsibility of Borsa İstanbul Anonim Şirketi.

http://dx.doi.org/10.1016/j.bir.2015.04.002

Borsa Istanbul. This study investigates whether or not closing call auction sessions effectively serve these purposes. Thus, this study will serve as feedback to CMB and Borsa Istanbul.

The trader performance method developed by Felixson and Pelli (1999) is utilized in this study to test for manipulation of closing prices. The data utilized in this work can be consolidated on the basis of investors; therefore, this article does not deal with the transactions of dealers or brokerage houses. Instead, this work is an investor-based analysis that consolidates the transactions of individual investors in all the brokerage houses with which they do business.

Our study does not use the price at the k[1]-15 min mark for returns in the final 15 min of trading. Instead, the weighted average price (WAP) up to the final 15 min is calculated for each investor on the basis of the shares of a particular day. Then, the WAP is calculated using the price at the k-15-min mark for returns in the final 15 min of trading. By doing so, our work manages to overcome the challenges faced by Felixson and Pelli (1999).

This study shows that there had been closing price manipulations as defined by Felixson and Pelli (1999) prior to the implementation of closing call auction sessions. Küçükkocaoğlu (2005) also emphasized the presence of upward-oriented closing price manipulation in Borsa Istanbul. Furthermore, the coefficient of the cumulative net position occurring prior to the final 15-min period to the total quantity of the transactions is positive and highly significant. This supports the argument that closing price manipulation had been occurring. It is observed that the implementation of closing call auction sessions have significantly eliminated closing price manipulation. The effect of closing call auction sessions on Borsa Istanbul conforms to the results of Comerton-Forde and Rydge (2006), Comerton-Forde et al. (2007), Comerton-Forde and Putnins (2011), and Pinfold and Danyang (2012).

The finding of this study also conform to the conclusions of both Akyol and Michayluk (2007), who found closing price manipulation within the scope of the small orders method, and Küçükkocaoğlu (2005, 2008a), who revealed the existence of closing price manipulation in Borsa Istanbul on the basis of intraday broker performance.

The remainder of this paper is as follows. The second section provides a brief literature review. Section 3 describes the data and lays out methodology. Section 4 elaborates on the empirical findings. The last section concludes the discussion.

2. Literature review

As closing prices are used for many purposes,[2] they are always subject to manipulation. The general finding of the studies performed on this issue is that manipulation attempts and their impact on share prices are concentrated in the 1-h time period prior to close of session. Studies have also found that the reversal this effect takes place in the first 30 min of session the following day.

According to Hillion and Suominen (1998a, 1998b, 2004), Felixson and Pelli (1999), McSherry and Sofanos (1998), Lee and Mathur (1999), Cushing and Madhavan (2000) and Küçükkocaoğlu (2005), the following are some underlying motives for manipulation:

- Attempts are made to increase closing prices of shares in margin trading, short sales and the borrowing and lending of securities to either prevent decreases in the value of securities held for margin account, or to drive up their value,
- Attempts are made to drive up closing prices of shares in a given portfolio to demonstrate that the performance of the portfolio managers or brokers is sound,
- Price interventions are attempted in order to ensure convergence of both spot and forward prices to a desired price at the date of maturity in the derivatives market to either maximize profit or minimize cost,
- Intraday traders aim to intervene in prices for profit,
- Stockbrokers who perform brokerage transactions for foreign clients manipulate prices to achieve a target average price given by those clients.

While Terry (1986) and Harris (1989) did not identify any effect of manipulation on closing prices, Felixson and Pelli (1999) found that though weak, manipulative transactions influenced price movements at close of session in the Finland Stock Exchange. Hillion and Suominen (1998b) also discovered closing price manipulation. The common point of both Felixson and Pelli (1999) and Hillion and Suominen (1998b) is that dealer activities are a possible reason for closing price manipulation. Miller (1989) made this argument as well, stating that the reason for the rise in prices towards close of session was the ambition of index fund managers to increase the value of index funds by increasing the closing prices of shares included in the portfolio. Many other studies have also found that closing prices are manipulated (Comerton-Forde & Putnins, 2011; Comerton-Forde & Rydge, 2006; Comerton-Forde et al., 2007; Huang & Chan, 2014; Pinfold & Danyang, 2012).

After Hillion and Suominen (1998b) reached the conclusion that high returns and volatility towards close of session arose from closing price manipulation in the Paris Stock Exchange, they proposed closing call auction sessions for this exchange. Hillion and Suominen once again suggested call auction sessions to prevent closing price manipulation after applying their new intermediation-based theoretical model in 2004.

Comerton-Forde and Rydge (2006) in Australia; Comerton-Forde et al. (2007) in Singapore; Comerton-Forde and Putnins (2011) in Australia; Pinfold and Danyang (2012) in New Zealand; and Huang and Chan (2014) in Taiwan investigated the effect of call auctions on market manipulation. They found that closing call auction sessions reduced the incidence of market manipulation. Huang and Tsai (2008) found that

[1] *k* stands for *closing time*.

[2] See also Atilgan, Bali, and Demirtas (2013), Özcan (2012), Qian, Xu, and Yu (2014) and Kadıoğlu (2014) for more information.

closing call auction session enhanced market efficiency by reducing noise in stock closing prices in Taiwan.

Küçükkocaoğlu (2005) adapted the model developed by Felixson and Pelli (1999) to the case of Borsa Istanbul during the period from April 1, 2000 to March 9, 2012. His work looked at 33 shares—23 of which were within the BIST National 30 Index and 10 of which were outside this index. Although the R^2, F and t values in his study were statistically insignificant, the sign of the coefficients provided clues about the existence of manipulative movements towards close of session. Küçükkocaoğlu (2008a) also tested for closing price manipulation in Borsa Istanbul, analyzing the effect of the size of the net positions of day traders in 23 stocks selected from the BIST 30 Index. Küçükkocaoğlu (2008a) found that closing price manipulation through big buyers and big sellers was possible in Borsa Istanbul.

The small-orders model for detecting closing price manipulation used by Harris (1989) was tested in Borsa Istanbul by Akyol and Michayluk (2007). Their study examined data from BIST 30 shares for the month of January 2005. They reached the conclusion that the number of small orders given rose at the close of the second session in Borsa Istanbul. They viewed this as an indicator of closing price manipulation.

According to Küçükkocaoğlu (2005, 2008b) and Özcan (2011), closing call auction sessions were also proposed by the CMB as a measure to prevent market manipulation.

3. Data and methodology

3.1. Data

Out of 319 shares, 102 are used to test the effect of closing call auction sessions on closing price manipulation in Borsa Istanbul. This study focuses on 624 days from November 1, 2006 to May 31, 2012. These 102 shares are a random sample of those traded in the following indexes: 28 shares in BIST 30 Index, 15 shares in BIST 100 Index (apart from those in BIST 30), 38 shares in BIST All Shares Index (apart from those in BIST 100), and 21 shares in the Second National Market.

The total number of shares traded in BIST and the Second National Market at the end of 2012 were 242 and 77, respectively. At the same point in time, the market capitalizations of the two indexes were roughly 523.33 billion TL and 9.36 million TL, respectively. The trading volume of Borsa Istanbul was 621.98 billion TL in total and 2.46 million TL daily in 2012. The BIST 30 Index contains shares of the firms with the 30-highest market capitalizations and trading volumes. The BIST 100 index also contains shares of the top 100 firms according to the same criteria (including the top 30). Our sample consists of shares of 28 of the 30 firms in the BIST 30 Index and shares of 43 firms in the BIST 100 Index.

Stocks were selected based on three criteria: Firstly, it was ensured that at least 15 shares are included from each of the four indexes. Secondly, the shares had to be sufficiently traded to run the analysis. Thirdly, almost half of the sample was taken from outside the BIST 100 Index, in which most of the price manipulation cases have been observed. The sample consists of up to 102 shares, as the data size constrained our analysis. Therefore, instead of taking the whole period into account, the data represents the period three months prior to and three months following the regulation changes in Borsa Istanbul.

The 624 days of the sample period were selected using the period three months prior to and three months following the regulation changes in Borsa Istanbul. Table 1 shows the regulation changes in the microstructure along with the range of dates used in the sample period.

To prevent abnormal price movements and to ensure more efficient price formation, Borsa Istanbul Circular Order 288 issued on March 2, 2012 put into effect closing call auction sessions in the transaction system of the equity market in Borsa Istanbul, where closing price movements had been encountered frequently.

The closing call auction session is a special practice of transferring the remaining orders from the normal session time and accepting new orders into the trading system in a predetermined period of time without matching. This allows the maximum amount of transactions to be conducted by the end of this time period. The call auction session ensures both the calculation of a single price level known as the *closing session price* and the execution of all transactions at this price level.

The price data for 15-min periods of the shares sampled are taken from Borsa Istanbul trading book entries for the relevant period. Apart from this, the Borsa Istanbul trading book also provides data concerning transactions totaling over 3% of the overall trading activity of a given stock in a single day.

These sorts of large transactions totaling more than 3% of a given stock's daily trading are only included in the data set if they occurred within the final 15 min of a session. The transactions totaling more than 3% of a stock's daily activity constitute 625.470 lines in the data set. However, this number is reduced to 107.151 when those investors who did not trade during the final 15 min are removed.

Table 1
Rule changes in the microstructure of Borsa Istanbul and period used in analysis.

Date	Rule changes in microstructure	Sample period	
February 2, 2007	Implemented opening call auction sessions	November 1, 2006	May 6, 2007
October 13, 2008	Removed giving order on a disk	July 12, 2008	January 14, 2009
April 12, 2010	Decreased price thick	January 9, 2010	July 14, 2010
October 8, 2010	Allowed order cancellation	July 7, 2010	January 9, 2011
March 2, 2012	Implemented closing call auction sessions	November 30, 2011	May 31, 2012

This study does not use the market price at the time exactly 15 min prior the close of the second session (k-15) for returns in the final 15 min. Instead, the WAP is calculated for each investor on the basis of the shares of those trading between k-15 and close of session on the day under consideration. By doing so, this study overcomes the challenges faced by Felixson and Pelli (1999). With the advantage a trading book, we are able to find daily buy/sell trading quantity/volume up to 15 min prior to closing time for each share and daily buy/sell trading quantity/volume within the final 15 min before closing time for each share. Table 2 gives the descriptive statistics.

The sub rows of Table 2 show average, standard deviation and maximum value in each main row respectively. The columns show the values in the period that are before or after implementation of closing call auction session and total values in the whole period. The first main row shows the descriptive statistics of daily trading quantity of investors who traded in 102 shares. The second and third main row show the descriptive statistics of daily buying trading quantity and volume up to final 15 min prior to closing time. The fourth and fifth main row show the descriptive statistics of daily selling trading quantity and volume up to final 15 min prior to closing time. The sixth and seventh main row show descriptive statistics of daily buying trading quantity and volume in final 15 min prior to closing time. The eighth and ninth main row show the descriptive statistics of daily selling trading quantity and volume in final 15 min prior to closing time. For example, the average daily buying trading volume up to final 15 min prior to closing time is 3.918.691 TL when the closing call auction session is not in operation and the average daily selling trading volume in the final 15 min prior to closing time is 105.806 TL when the closing call auction session is in operation.

3.2. Methodology

To determine whether or not manipulation of closing prices exists, this study uses a trader performance test developed by Felixson and Pelli (1999), which was applied to a Turkish context by Küçükkocaoğlu (2005, 2008a). Our work constitutes a continuation and testing of the propositions of Küçükkocaoğlu (2005, 2008b); therefore, the analysis is conducted by calculating after-session performance as proposed by Collins and Fabozzi (1991). The data utilized in this work can be consolidated on the basis of investors using investor IDs. As a result, this article does not analyze the transactions of stock exchange dealers or brokerage houses. Rather, an investor-based analysis is performed by consolidating transactions of individual investors in all the brokerage houses with which they do business. The vast majority of the manipulation occurring in Borsa Istanbul involves manipulators using accounts in more than one brokerage house, giving orders on their own. The trading conducted by dealers is also done on behalf of clients.

The method for testing the existence of closing price manipulation is adapted from the work of Felixson and Pelli

Table 2
Descriptive statistics about daily buy/sell trading quantity/volume.

		Before closing call auction session	After closing call auction session	Whole sample
Daily Trading Quantity	Count	95.465	11.686	107.151
	Average	6.229.731	6.837.908	6.296.059
	Std Dev	16.777.031	15.308.207	16.624.160
	Max	648.569.938	218.159.825	648.569.938
Daily Buy Trading Quantity up to 15-min before closing	Average	323.832	373.998	329.303
	Std Dev	1.208.964	1.092.666	1.196.927
	Max	104.903.202	22.473.479	104.903.202
Daily Buy Trading Volume up to 15-min before closing	Average	1.184.878	1.476.811	1.216.716
	Std Dev	3.918.691	4.407.069	3.975.889
	Max	414.282.018	105.882.633	414.282.018
Daily Sell Trading Quantity up to 15-min before closing	Average	313.639	372.110	320.016
	Std Dev	1.229.379	1.117.334	1.217.792
	Max	109.500.000	20.066.645	109.500.000
Daily Sell Trading Volume up to 15-min before closing	Average	1.144.297	1.494.412	1.182.481
	Std Dev	3.753.129	4.653.402	3.863.041
	Max	273.402.639	106.731.090	273.402.639
Daily Buy Trading Quantity within last 15-min before closing	Average	41.630	28.166	40.161
	Std Dev	189.287	145.545	185.066
	Max	11.226.265	6.300.000	11.226.265
Daily Buy Trading Volume within last 15-min before closing	Average	154.310	109.112	149.380
	Std Dev	610.481	490.416	598.721
	Max	40.459.677	16.569.908	40.459.677
Daily Sell Trading Quantity within last 15-min before closing	Average	40.783	27.941	39.382
	Std Dev	200.587	165.120	197.070
	Max	11.458.372	10.019.390	11.458.372
Daily Sell Trading Volume within last 15-min before closing	Average	151.333	105.806	146.368
	Std Dev	58.030.590	18.495.327	58.030.590
	Max	647.958	480.174	631.986

(1999), who stated that the general market price of the share should not to be used to calculate returns for the final 15 min before close of session. Instead, they recommend that the WAP of the largest transactions be utilized. Taking this proposition into consideration, our method makes estimations for each investor on the basis of the WAP of the largest transactions. Thus, returns for the final 15 min before close of session are calculated.

Using logarithmic return formulation as done by Sumiyana (2007), Felixson and Pelli (1999), Louhichi (2012), Selçuk and Gençbay (2006), and Engle and Sokalska (2012), the returns in the final 15 min before close of session are calculated on the basis of the analysis of the 15-min data of 102 shares traded in Borsa Istanbul.

$$r_{i,t} = \ln\left(\frac{P_{i,k}}{P_{i,k-15}}\right) \quad (1)$$

Here, $r_{i,k}$ refers to the final 15-min return for share i before close of session, $P_{i,k}$ refers to the closing price of share i and $p_{i,k-15}$ refers to the price of share i at 15 min before close of session.

Our work is different from that of Küçükkocaoğlu (2005) with regard to the following points:

- The work of Küçükkocaoğlu (2005) used high-ranking brokerage houses as a base, referencing those who perform the largest transactions. In contrast, the model used in our study tests for closing price manipulation on the basis of all the transactions of direct investors existing in different brokerage houses rather than those of the houses themselves.[3] This study takes into consideration the investors who are among the net traders during the last 15 min before close of session and who produce a trading quantity at a level equal to or over 3% of all share trading in the relevant day.
- The model used in our study incorporates the ratio of share trading of net sellers or buyers during the final 15 min before close of session to total share trading into the regression as an independent variable. The impact of the magnitude of the net position during the last 15-min period on the closing price (without using a dummy variable) is measured in a direct manner. In the same vein, our model treats the ratio of transactions performed in the last 15 min to total share trading in the relevant day as an independent variable.
- While the work of Küçükkocaoğlu (2005) took into account those who perform the largest transactions in the final minute, this study considers only those performing transactions in the final 15 min before close of session.

The *performance* of an investor refers to the sum of the values at which the investor buys the shares in their portfolio under the calculated closing prices in the buying transactions and at what value the investor sells the shares from their portfolio above the calculated closing prices in selling transactions. In other words, using the closing price as a base, the more the investor buys below and sells above the closing price, the greater the investor's performance.

In a system operating on the basis of such performance criteria, the investor either bears the consequences of their poor performance or tries to manipulate the closing price. While those simply bearing the consequences of their poor performance are defined as *normal investors*, those manipulating closing prices in order to improve their performance are termed *manipulators*.

Towards close of session, the manipulator observes that their WAP in buying transactions is above the closing price, and tries to use small transactions to drive the closing price up to the level of their own WAP. Similarly, the manipulator who observes towards close of session that their WAP in selling transactions is below the closing price tries to use small transaction to drive the closing price down to their WAP in selling transactions. The manipulator attempts to influence the closing price because of the expense it may incur them. That is why transactions for changing the closing price are performed in small quantities.

Fig. 1 demonstrates Felixson and Pelli's model of closing price manipulation.

The investor who buys at the highest level during intraday transactions begins to gain insight about what their performance will be towards close of session. Whatever their performance proves to be, a normal investor would not dream of performing manipulative interventions on the closing price. Even though the normal investor considers their situation 15 min before close of session, they do not take any action. As a result, the price goes from the point A to the point B within the market equilibrium. Closing as usual, the price continues to be develop as usual after close of session, going from point B to point C.

When the investor who buys at the highest level in intraday transactions tries to enhance their performance, they attempt to drive up the closing price. A result of transactions performed to increase the closing price, the manipulated price is formed at point E. In this way, the session is closed at this price level, and the manipulator has thereby reached their target. For the manipulator who has already done so, there remains no reason to keep the manipulated price at point E after close of session because they do not consider prices 15 min after closing to be performance indicators. Therefore, the price returns to point C, which is its normal level. The similar revealing of manipulation effect also found in the study of Konga and Wang (2014).

When an investor who sells at the highest level in intraday transactions tries to enhance their performance, they try to drive down the closing price. A result of transactions performed to decrease the closing price, the manipulated price is formed at point D. In this way, the session closes at this price level, and the manipulator has reached their target. For the manipulator who has already reached done so, there remains no reason to keep the manipulated price at point D after close

[3] Because the customer-name-based custody system was put into effect in March 2003, the transactions of individual investors in all brokerage houses can be consolidated by means of customer numbers.

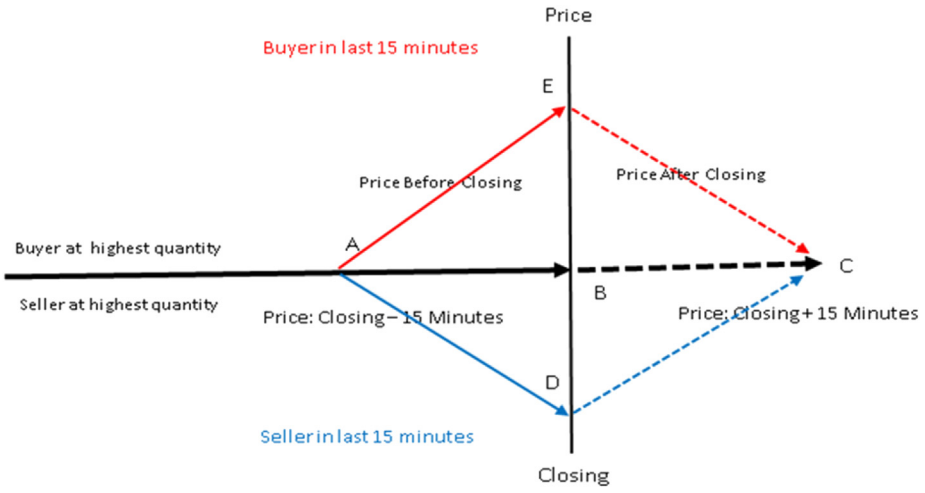

Fig. 1. Closing price manipulation according to the Felixson and Pelli (1999) model.

of session because they do not consider prices 15 min after closing to be performance indicators. Therefore, the price returns to point C, which was its normal level.

The above scenario can be represented with the following expression:

$$r_{i,k-15} = Normal\,Return_{i,k-15} + Manipulation\,Effect_{i,k-15} + e_{i,k-15} \quad (2)$$

With the elimination of the downward manipulation effect, the price comes to point C.

$$r_{i,k+15} = Normal\,Return_{i,k+15} + Return\,to\,Market\,Price\,Effect_{i,k+15} + e_{i,k+15} \quad (3)$$

There might be multiple manipulators who are differently positioned with regard to a particular share. Therefore, the effects of two different manipulations on the closing price should be measured in conjunction with one another.

In this regard, Equation (2) is as follows:

$$r_{i,k-15} = Normal\,Return_{i,k-15} + IME_{i,k-15} + DME_{i,k-15} + e_{i,k-15} \quad (4)$$

Equation (3) is as follows:

$$r_{i,k+15} = Normal\,Return_{i,k+15} + RIME_{i,k+15} + RDME_{i,k+15} + e_{i,k+15} \quad (5)$$

When examining manipulative movements occurring towards close of session, the models shown in Equation (4) and Equation (5) are used.

The impact of investors' transactions on both the returns in the final 15 min before close of session as well as the final 15-min returns after close of session, which appear in the Equations (4) and (5), is measured by means of the following equation:

$$r_{i,k-15} = \propto_1 + \beta_1 D_{nb\_b_{i,k-15}} + \beta_2 D_{ns\_s_{i,k-15}} + \beta_3 IMO_{1,i} + \beta_4 IMO_{2,i} + e_{i,k-15} \quad (6)$$

In Equations (2)–(6), $r_{i,k-15}$ refers to the returns of a given share in the final 15 min before close of session, while $r_{i,k+15}$ refers to the 15-min returns of the share after close of session. *IME* refers to manipulation aimed at increasing the closing price, while *DME* refers to manipulation aimed at decreasing the closing price. *RIME* refers to the reverse impact of manipulation aimed at increasing the closing price, while *RDME* refers to the reverse impact of manipulation aimed at decreasing the closing price. IMO_1 refers to the ratio of cumulative net position until the final 15 min to the total quantity of transactions of the share on the relevant day. IMO_2 refers to the ratio of cumulative net position in the final 15 min to the total quantity of transactions of the share on the relevant day. $D_{nb\_b_{i,k-15}}$ and $D_{ns\_s_{i,k-15}}$ are dummy variables that take the following values:

$D_{nb\_b_{i,k-15}}$: Investors who are net buyers until the final 15 minutes and remain buyers in the final 15 minutes are 1. Otherwise they are 0.

$D_{ns\_s_{i,k-15}}$: Investors who are net sellers until the final 15 minutes and remain sellers in the final 15 minutes are 1. Otherwise they are 0.

IMO_1 and IMO_2 variables are calculated by using the Borsa Istanbul trading book, which contains all data relating to transactions (share, quantity, price, buyer ID, seller ID, and so on). It is also possible to consolidate transactions in terms of clients based on investor IDs. IMO_1 and IMO_2 variables are calculated using a database program.

Equation (6) is rather different from the equations used in the work Felixson and Pelli (1999). Equation (6) contains IMO_1 and IMO_2 variables; therefore, there is no need for dummy variables to represent those who perform buying and selling transactions at the same time. Instead of dummy variables for those investors, the ratio of IMO_2 in the final 15 min to the total number of transactions is used. If there exists any manipulation, the interaction of its effect with the net quantity of transactions will be measured in this way.

Table 3
The comparative regression results for the last 15-minute returns (k-15).

	Before the implementation of closing call auction session		After the implementation of closing call auction session	
	Coefficient	T-statistics	Coefficient	T-statistics
$\propto_1$	−0.0003*	−4.43	−0.001*	−9.64
$D_{nb\_b_{i,k-15}}$	0.0006*	4.20	0.000	0.17
$D_{ns\_s_{i,k-15}}$	0.0016*	9.94	0.001*	4.00
IMO_1	0.0119*	17.08	0.008*	5.99
IMO_2	0.0213*	9.45	0.014*	2.51
F	150.34*		13.48	
R^2	0.007		0.006	
# of observation	85406		11686	

Note: * indicates 1% significance level. While it is thought that the reason for the R^2 to having low values is grounded in the structure of the data utilized in this work (the data contains an excessive variety of investors and shares), the existence of the relationship between the investors who perform the highest levels of buying and selling transactions and the returns for the last 15-min period is important in revealing closing price manipulation.

$$r_{i,k+15} = \propto_2 + \delta_1 D_{nb\_b_{i,k-15}} + \delta_2 D_{ns\_s_{i,k-15}} + \delta_3 IMO_{1,i} + \delta_4 IMO_{2,i} + e_{i,k+15} \quad (7)$$

The hypotheses stated below are tested using Equations (6) and (7).

If manipulative aimed at increasing the closing price occurs, there should be price movement starting at point A moving firstly towards point E and then towards point C (Fig. 1). This movement should be caused by those investors who are net buyers until the final 15 min before close of session and continue performing transactions in the direction of net buying.

The coefficient of the dummy variable constructed for those who are net buyers until the final 15 min before close of session and remain buyers in the final 15 min should be positive and significant in Equation (6), and it should be negative and significant in Equation (7). The hypothesis for closing price manipulation aimed at increasing the closing price is shown below.

$$H_0 : \beta_1 \leq 0 \text{ and } \delta_1 \geq 0, H_1 : \beta_1 > 0 \text{ and } \delta_1 < 0 \quad (8)$$

If manipulation aimed at decreasing the closing price occurs, there should be price movement starting at point A moving firstly towards point D and then towards point C (Fig. 1). This movement should be caused by those investors who are net sellers until the last 15 min and continue performing transactions in the direction of net selling.

The coefficient of the dummy variable constructed for those who are net sellers until the final 15 min before close of session and remain sellers in the final 15 min should be negative and significant in Equation (6). This coefficient should be positive and significant in Equation (7). The hypothesis for closing price manipulation intended to decrease closing price is shown below.

$$H_0 : \beta_2 \geq 0 \text{ and } \delta_2 \leq 0, H_1 : \beta_2 < 0 \text{ and } \delta_2 > 0 \quad (9)$$

4. Empirical results

Equation (6) is used to measure the relationship between the final 15-min returns and investors who are either net buyers until the final 15 min and remain buyers or those who are net sellers until the last 15 min and remain sellers. Table 3 provides the statistical results. It is assumed that β_1 will be positive and significant and that β_2 will be negative and significant. This is because investors who are net buyers until the final 15 min and remain buyers try to ensure a higher closing price, so there will be a positive relationship between the final 15-min returns and D_{nb_b}. On the other hand, those who are net sellers until the final 15 min and remain sellers try to ensure a lower closing price, so there will be a negative relationship between the last 15-min returns and D_{ns_s}.

Table 3 provides the statistical results of Equation (6), which is used to test the existence of closing price manipulation before and after the implementation of call auction sessions. As expected, the coefficient of D_{nb_b} is positive with a fairly high level of significance.

Contrary to expectations, the coefficient of D_{ns_s} is also positive and significant before the implementation of closing call auction sessions. As noted by Küçükkocaoğlu (2005, 2008a), the reason for D_{ss} having a positive and significant coefficient is that the majority of closing price manipulations in Borsa Istanbul are aimed at increasing the closing price. Many studies suggest that this is so because of the existence of intraday structures.

Table 3 indicates that there is a positive, highly significant variable coefficient for the ratio of the cumulative net position until the final 15-min period to the total quantity of the transactions (IMO_1). This suggests the existence of closing price manipulation. In other words, the higher the net-buyer position of an investor until the last 15 min, the greater their opportunity to influence the final 15-min returns. This situation itself supports the argument that closing prices are manipulated to enhance stock performance at the close of the day. This increases the value of securities, equities and/or the valuation of all assets tied to the closing price.

The coefficient of D_{nb_b} is positive and insignificant after the implementation of closing call auction sessions. This suggests that closing call auction sessions reduce the impact of manipulation. On the other hand, the coefficient of D_{nb_b}, which was positive and significant before the implementation of closing call auction sessions, becomes insignificant with their implementation.

Table 4
The comparative regression results of 15-minute returns (k + 15).

	Before the implementation of closing call auction session		After the implementation of closing call auction session	
	Coefficient	T-statistics	Coefficient	T-statistics
$\propto_1$	0.003*	13.18	0.003*	5.97
$D_{nb\_b_{i,k+15}}$	−0.001*	−2.71	−0.003*	−3.49
$D_{ns\_s_{i,k+15}}$	−0.002*	−4.78	−0.003*	−3.22
IMO_1	0.031*	14.26	0.022*	5.41
IMO_2	0.027*	3.87	−0.0001	−0.004
F*	107.44		15.24	
R^2	0.005		0.005	
# Of observation	85406		11686	

Note: * indicates 1% significance level.

Equation (7) is used to measure the relationship between returns 15 min after close of session and investors who are either net buyers until the last 15 min and remain buyers or those who are net sellers until the last 15 min and remain sellers. Table 4 provides the statistical results. It is expected that δ_1 will be negative and significant and that δ_2 will be positive and significant. This is because the investors who are net buyers until the last 15 min and remain buyers will no longer be able to drive up the closing price (turnaround the normal market price). Thus, there will be a negative relationship between returns 15 min after close of session and D_{nb_b}. On the other hand, investors who are net sellers until the last 15 min and remain sellers will no longer be able to drive down the closing price (turnaround the normal market price). Thus, there will be a positive relationship between returns 15 min after close of session and D_{ns_s}.

Table 4 provides the statistical results of Equation (7), which is used to test the existence of closing price manipulation before and after the implementation of closing call sessions. As expected, the coefficient of D_{nb_b} is negative with a fairly high level of significance.

Contrary to expectations, however, the coefficient of D_{ns_s} is also negative and significant. As noted by Küçükkocaoğlu (2005, 2008a), the reason for D_{ns_s} having a negative and significant coefficient is that the majority of closing price manipulations in Borsa Istanbul are aimed at increasing the closing price. Many studies suggest that this is so because of the existence of intraday structures.

Table 3 supports the first pillar of the argument of Felixson and Pelli (1999) stating that manipulators perform upwardly manipulative interventions on closing prices in order to enhance the performance of investors making the largest buying transactions prior to the final 15 min. The second pillar of their argument is that prices will return to normal levels because manipulators, who have already reached their targets after closing, will no longer intervene in prices after close of session. The results in Table 4 support this argument, as well. The impact of market price turnaround as noted by Felixson and Pelli (1999) is negative and significant.

According to the model of Felixson and Pelli (1999), investors who perform the largest buying transactions[4] engage in manipulative transactions to increase closing prices, thus enhancing their closing performance. This causes increased closing prices. This situation itself presents parallels with the argument that closing prices are manipulated to enhance performance at the end of the day. This improves the valuation of margin securities and all assets tied to closing prices. On the other hand, the implementation of closing call auction sessions has made this relationship statistically insignificant.

To summarize the findings:

1 There is a clear evidence of closing price manipulation in Borsa Istanbul prior to the implementation of the closing call auction sessions.
2 The results obtained in this work support the conclusions of Akyol and Michayluk (2007), who found closing price manipulation within the scope of the small orders model. Findings are also consistent with those of Küçükkocaoğlu (2005, 2008a), who revealed the existence of closing price manipulation in Borsa Istanbul on the basis of the intraday performance model.
3 As emphasized by Küçükkocaoğlu (2005, 2008a), closing price manipulation seen in Borsa Istanbul is aimed at increasing closing prices.
4 The variable coefficient of the ratio of cumulative net position until the final 15-min period to the total quantity of transactions is positive and highly significant. This proves the existence of closing price manipulation.
5 The implementation of closing call auction sessions has significantly eliminated closing price manipulation. The obstructing effect of call auction sessions on closing price manipulation was also found in the work of Comerton-Forde and Rydge (2006), Comerton-Forde et al. (2007), Comerton-Forde and Putnins (2011), Pinfold and Danyang (2012) and Huang and Chan (2014).

5. Conclusion

Closing call auction sessions were one of the measures proposed to prevent market manipulation. They entered into force on March 2, 2012 to reduce extraordinary price

[4] In our model, they refer to the investors performing buying transactions that are equal to or over 3% of the total quantity of day trading.

movements and to ensure more efficient price formation in Borsa Istanbul.

Our study aims to test the existence of closing price manipulation and the effect of closing call auction sessions on closing price manipulation by analyzing 102 shares in Borsa Istanbul. The analysis is conducted on 624 trading days from November 1, 2006 to May 31, 2012.

The trader performance method developed by Felixson and Pelli (1999) is utilized in this work to test whether or not closing prices were manipulated. Unlike in Felixson and Pelli's model, however, the weighted average price (WAP) is calculated for individual investors on the basis of the shares of those trading at the k-15 mark until the last 15 min of the day under consideration. By doing so, our work manages to overcome the challenges faced by Felixson and Pelli (1999).

Within of the model of Felixson and Pelli (1999), it is statistically possible to discuss the existence of closing price manipulation in Borsa Istanbul prior to the implementation of closing call auction sessions. As emphasized by Küçükkocaoğlu (2005, 2008a), closing price manipulation seen in Borsa Istanbul is aimed at increasing closing prices.

The findings of our study also support the conclusions of Akyol and Michayluk (2007), who found closing price manipulation within the scope of the small orders model. They also support the conclusions of Küçükkocaoğlu (2005, 2008a), who revealed the existence of closing price manipulation in Borsa Istanbul on the basis of the intraday performance model.

As revealed by other studies, the implementation of closing call auction sessions has significantly eliminated closing price manipulation.

It would be beneficial for future studies to test closing price manipulation with reference to the intermediation model proposed by Hillion and Suominen (2004).

References

Akyol, A., & Michayluk, D. (2007). *Is there closing Price manipulation on the Istanbul stock exchange*. Australian School of Business. Working paper.

Atilgan, Y., Bali, T. G., & Demirtas, K. O. (2013). The performance of hedge fund indices. *Borsa Istanbul Review, 13*(3), 30–52.

Barclay, M., Litzenberger, R., & Warner, J. (1990). Private information, trading volume, and stock-return variances. *Review of Financial Studies, 3*, 233–253.

Collins, B., & Fabozzi, F. (1991). A methodology for measuring transaction costs. *Financial Analyst Journal*, 27–44. March–April.

Comerton-Forde, C., Lau, S. T., & McInish, T. (2007). Opening and closing behavior following the introduction of call auctions in Singapore. *Pacific Basin Finance Journal, 15*, 18–35.

Comerton-Forde, C., & Putnins, T. J. (2011). Measuring closing Price manipulation. *Journal of Financial Intermediation, 20*(2), 135–158.

Comerton-Forde, C., & Rydge, J. (2006). Call auction algorithm design and market manipulation. *Journal of Multinational Financial Management, 16*(2), 184–198.

Cushing, D., & Madhavan, A. (2000). Stock returns and trading at the close. *Journal of Financial Markets, 3*, 45–67.

Engle, R. F., & Sokalska, M. E. (2012). Forecasting intraday volatility in the US equity market. Multiplicative component GARCH. *Journal of Financial Econometrics, 10*(1), 54–83.

Felixson, K., & Pelli, A. (1999). Day-end returns – stock price manipulation. *Journal of Multinational Financial Management, 9*, 95–127.

Harris, L. (1989). A day-end transaction price anomaly. *Journal of Financial and Quantitative Analysis, 24*, 29–45.

Hillion, P., & Suominen, M. (1998a). *Deadline effect of an order driven market: An analysis of the last trading minute on the Paris Bourse*. Unpublished Work. INSEAD.

Hillion, P., & Suominen, M. (1998b). *Broker manipulation*. Unpublished Work. INSEAD.

Hillion, P., & Suominen, M. (2004). The manipulation of closing prices. *Journal of Financial Markets, 7*, 351–375.

Huang, Y. C., & Chan, S. H. (2014). The trading behavior of attention securities with different closing mechanisms: evidence from Taiwan. *Review of Pacific Basin Financial Markets & Policies, 17*(4), 1–17.

Huang, Y. C., & Tsai, P. L. (2008). Effectiveness of closing call auctions: evidence from the Taiwan Stock Exchange. *Emerging Markets Finance and Trade, 4*(3), 5–20.

Kadıoğlu, E. (2014). *Borsa Istanbul'un Mikro Yapisindaki Değişikliklerin Gün İçi Getiri, Volatilite ve Kapaniş Fiyatina Etkisi*. Unpublished PHD's Thesis. Ankara: Baskent University, Institute of Social Sciences, Department of Business Administration, Accounting and Finance.

Konga, D., & Wang, M. (2014). The manipulator's poker: order-based manipulation in the Chinese Stock Market. *Emerging Markets Finance and Trade, 49*(2), 73–98.

Küçükkocaoğlu, G. (2005). *Borsa İstanbul'da Gün İçi Getiri, Volatilite ve Kapanış Fiyatı Manipülasyonu*. Sermaye Piyasası Kurulu, 180. Ankara.

Küçükkocaoğlu, G. (2008a). Intra-day stock returns and close-end price manipulation in the Istanbul Stock Exchange. *Frontiers in Finance and Economics, 5*(1), 46–84.

Küçükkocaoğlu, G. (2008b). Single price auction system for the Istanbul Stock Exchange. *Borsa Istanbul Review, 8*(29), 75–91.

Lee, C. L., & Mathur, I. (1999). The influence of information arrival on market microstructure: evidence from three related markets. *The Financial Review, 34*, 1–26.

Louhichi, W. (2012). Does trading activity contain information to predict stock returns? Evidence from Euronext Paris. *Applied Financial Economics, 22*, 625–632.

McSherry, R., & Sofanos, G. (1998). U.S. Institutional investor trading in NYSE-listed non-U.S. Stocks. In *NYSE-Paris Bourse Conference, Paris*.

Miller, E. M. (1989). Explaining intraday and overnight price behavior. *Journal of Portfolio Management, 5*, 10–16.

Muscarella, C. J., & Piwowar, M. S. (2001). Market microstructure and securities values: evidence from the Paris Bourse. *Journal of Financial Markets, 4*, 209–229.

Özcan, R. (2011). Strategic Measures to Prevent Opening and Closing Price Manipulation in Stock Markets. *Iktisat İşletme ve Finans, 26*(306), 53–67.

Özcan, R. (2012). Hisse Senedi Piyasalarında Manipülasyon Stratejileri. *Borsa Istanbul Review, 13*(49), 19–42.

Pagano, M., & Schwartz, R. (2003). A closing call's impact on market quality at euronext Paris. *Journal of Financial Economics, 68*(3), 439–484.

Pagano, M., & Schwartz, R. (2005). Nasdaq's closing cross: has its new call auction given Nasdaq better closing prices? Early findings. *Journal of Portfolio Management, 31*, 100–111.

Pinfold, J., & Danyang, H. F. (2012). The impact of introducing a pre-close on the New Zealand share market. *Journal of Financial Regulation & Compliance, 20*(1), 99–110.

Qian, M., Xu, C., & Yu, B. (2014). Performance manipulation and fund flow: evidence from China. *Emerging Markets Finance and Trade, 50*(3), 221–239.

Selçuk, F., & Gençbay, R. (2006). Intraday dynamics of stock market returns and volatility. *Physica, 367*, 375–387.

Smith, J. (2006). Nasdaq's electronic closing cross: An empirical analysis. *Journal of Trading, 1*(3), 47–64.

Sumiyana. (2007). Behavior of stock price variability over trading and non-trading periods, and daily return volatility. *Gadjah Mada International Journal of Business, 9*(3), 409–453.

Terry, E. (1986). *End of the day returns and the bid-ask spread*. Unpublished working paper. Stanford University.

Theissen, E. (2000). Market structure, informational efficiency and liquidity: An experimental comparison of auction and dealer markets. *Journal of Financial Markets, 3*, 333–363.