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The Impact of Short Selling On Intraday Volatility: Evidence from the Istanbul Stock Exchange

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Abstract

This paper examines the interrelation between short selling and volatility as differing from previous research in that it focuses on intraday activities rather than the daily price movements. We demonstrate that the effects of short selling activity changes during the two sessions of the day and rest of trading hours. The study also presents evidence that there is a considerable amount of short selling activity in the Istanbul Stock Exchange (ISE), particularly at the beginning of opening sessions, which significantly impacts the volatility of the market for the rest of the trading day.

Keywords: Short selling, Istanbul Stock Exchange, Intraday volatility, market efficiency, financial crises

JEL classification: G01, G14, G15

1. INTRODUCTION

This study investigates the relationship between intraday short selling activities and volatility, as offering a different perspective from the previous literature by including high frequency intraday data to measure the relationship between volatility and short selling. To the best of our knowledge, this is the first study which examines the effect of intraday short selling activities on stock returns as regards the Istanbul Stock Exchange.

During the global financial crisis, the limitations of short selling activities attracted considerable attention. As in most financial crises, regulators imposed short selling bans throughout the world. Fear on behalf of investors triggered large scale shorting activities which drove down stock prices and resulted in a loss of confidence in financial markets. This loss of confidence spread to other countries and consequently resulted in a contagious restriction on short selling activities for various time periods (Mackintosh et al. 2009). Surprisingly, however, no restrictions were imposed on shorting activities in the Istanbul Stock Exchange.

There is a vast body of related literature assessing the impact of such restrictions (Bris et al. 2007). However, little attention has been given to the impact of intraday short selling activities on stocks' return volatility (Aitken et al., 1998; Shilko et al., 2008; Boehmer & Wu, 2010), and studies on short selling activities have primarily focused on a daily basis. The related research concerning these models will be discussed in greater detail later in this paper.

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The remainder of the paper is structured as follows. Section 2 discusses the literature on short selling, with particular attention on the regulation and suspension of short selling activities. This section also offers up an analysis of the related literature which examines the relations among volume-return-liquidity activities. Section 3 provides details about the data set used and the econometric methodology. Section 4 discusses the empirical results, and section 5 concludes.

2. LITERATURE REVIEW

The selling of securities that one does not actually own has long been a cryptic issue for market participants, especially for investors but also for regulators and academics. Throughout the related literature, short sellers are assumed to be rational, informed market players whose actions move prices back to fundamentals (Danielsen and Sorescu (2001), Lamont and Thaler (2003), Cohen, Diether and Malloy (2007)). This debate is not new to market participants. Gruenewald et al. (2010) points out that the first legislation against short selling was enacted on February 24, 1610. From time to time, short sellers have been considered to be the "good guys," as expressed by Boehmer et al. (2009) and conversely targeted as "scapegoats," particularly during times of financial turmoil. The most recent 2008 ban on naked short selling enacted by US and UK regulators was no different in this regard, and most Western European countries followed the precedent laid down by the interventions enacted in the US and UK. However, a notable point about these restrictions is that they were limited solely to financial sector stocks in western countries; in contrast, the measures implemented in Asian and Australian markets primarily targeted all listed companies. It is also worthy of note that during this period of global market turmoil, no short selling ban was implemented in the Istanbul Stock Exchange, even for naked short selling.

Supporters of short selling argue that if short selling were prohibited, prices would not accurately reflect all of the relevant information. This argument posits that short selling thus does not increase the volatility of the stock market, but on the contrary it acts as a stabilizer for financial markets. Angel (1997) claims that it is not short sale orders but rather ordinary orders which render the market more volatile. A number of papers have analyzed the effects of temporary restrictions which were implemented in various markets in September of 2008. Bris et al. (2008) studied the changes in stock prices, the rate of short sales, the aggressiveness of short sellers, and various liquidity measures before, during, and after the shorting ban in the US. They compared the banned stocks with a control group of non-banned stocks and found that the shorting ban caused a severe degradation in market quality, as measured by spreads, price impacts, and intraday volatility.

The results of a UK study undertaken by FSA (Financial Services Authority) in 2009 demonstrated that volatility for stocks which were placed under a temporary short selling ban in September 2008 was "substantially higher than for shares in the FTSE 350 in general." In addition, volume, which is an important measure of liquidity, showed a significant decline. When compared with the 90-day period prior to the ban, volume decreased 36% in contrast to trading volume which fell 11%. A similar study by Clifton and Snape (2008) commissioned by the London Stock Exchange compared the FTSE 100 companies which are subject to prohibition with a control sample of FTSE 100 securities which fall outside the scope of prohibition. They found evidence of wider bid-offer spreads, less market depth and reduced liquidity for the UK shares subject to the shorting ban.

In another study conducted by a regulatory authority, the Hong Kong Securities and Futures Commission (2009), the short selling patterns in the Hong Kong market were analyzed for the years spanning between 2005 and 2008. They concluded that trading volume rose as short selling increased and that short selling improved market efficiency. They also found that short selling activities contribute to tighter bid-ask spreads.
According to Miller (1977), stocks are overvalued in the presence of short-sale constraints, and the subsequent negative abnormal returns represent a correction of this overvaluation. Apart from the overvaluation hypothesis, Akbas et al. (2008) focused on the information hypothesis and proposed that short sellers act as specialized monitors who generate value-relevant information in the stock market. Saffi & Sigurdsson (2011) also claim that short sellers can "correct" market prices and effectively neutralize "irrational exuberance" in the economy. Saffi & Sigurdsson (2011) used a global data set including 12,600 stocks from 26 countries between 2005 and 2008 to show that stocks with higher short-sale constraints, as measured in terms of low lending supply, have a lower price efficiency.
Charoenrook and Daouk (2009) reported that when short selling is possible, aggregate stock returns are less volatile and there is greater liquidity. In other words, they suggest that allowing short sales improves market quality. Marsh and Niemer (2008) summarized their findings under four headings: First, they found no strong evidence that restrictions on short selling changed the behavior of stock returns. Second, they compared trading behavior among countries and found no systematic patterns consistent with the effect of the new regulations. They also found no sign of a detrimental impact of the constraints in terms of reduced efficiency of pricing. Last but not least, their regression analysis suggested that changes in stock returns were driven mainly by other factors affecting the financial sector rather than restrictions on short selling.

Opponents of short selling have argued that constraints on short selling reduce market efficiency and price discovery, and may in fact destabilize markets (Allen and Gale, 1991). Diamond and Verrecchia (1987) explore the effects of short sales constraints on the speed of price-adjustments resulting from private information regarding security prices. They found that prohibiting traders from shorting reduces the adjustment speed of prices in reaction to private information, especially to bad news. Aitken et al. (1998) used intraday short sale data from the Australian Stock Exchange and examined the price reaction to short sales and found that abnormal returns decrease almost immediately after a short sale. Diether et al. (2007) showed that short sellers trade on short-term overreaction to stock returns. Blau et al.'s (2009) findings were also consistent with Diether et al. (2007); they claimed that there is a negative relation between short activity and future intraday returns on down days. Shkilko et al. (2008) also argue that during intraday liquidity crises, short selling can destabilize the prices.
Desai et al. (2002) analyzed the level of short interest and returns. They found that increases in the level of short interest actually decrease returns for NASDAQ stocks, and they also found that heavily shorted stocks experience negative returns. Henry and McKenzie (2006) also noted that short selling has a significant impact on volatility and volume in the Hong Kong market. It should be pointed out, however, that their results indicate that short selling causes an asymmetric response to positive and negative innovations on returns. Additionally, the Hong Kong market displays greater volatility after a period of short selling.

Boehmer et al.'s (2008) findings indicate that on average short sellers are important contributors to efficient stock prices. In their study, they used short sale transaction data from the period of the 2008 short sale ban period in the US. They found that when the shorting ban was in effect, market quality measures deviated more significantly, and stocks that are lightly shorted outperformed heavily shorted stocks.

Bai, Chang and Wang (2006) claim that constraining short sales impedes informed trades and that over time, asset prices do not reflect all of the available information. According to their model, this constraint on short selling causes asset prices to fall and consequently leads to lower equilibrium prices. A theoretical work by Abreu and Brunnermeier (2003) and Scheinkman and Xiong (2003) showed that short sales constraints can be the direct cause of, or at least a necessary condition for, bubble formation and excessive volatility. A more recent work by Bris et al. (2007) analyzed cross-sectional and time series information from forty-six markets around the world and found that prices incorporate negative information more quickly in countries where short sales are allowed and practiced. They also found that when short selling is prohibited, market returns display significantly less negative skewness.

3. DATA AND METHODOLOGY

This study utilizes a 28-month sample period which starts at the beginning of September 2007 and ends at the close of 2009. 15-minute intraday return values of the ISE-100 index were formed by averaging historical ten second tick data. The tick data for the entire period as well as trading volumes, short selling volumes and short selling quantities were obtained directly from the ISE. The sample period consists of 575 trading days; holidays and days when the markets were closed for other reasons have been excluded from the data.
Before discussing the details of the methodology, it will be helpful to overview the short selling regulations for the Istanbul Stock Exchange. If naked short selling,[1] which is permitted in the ISE, is covered intraday, nothing remains to be done, as settlement is done on a netting basis on T+2. If the short-sale is not covered on the transaction date, the short-selling party must borrow equities either from the OTC market or from the Securities Lending and Borrowing Market and cover its settlement obligation on T+2. In case of settlement failures, if a party fails to meet its obligations by 16:00 on T+2, it is considered as having failed. Market members have the option to settle their dues by 09:30 on T+3 by paying a default penalty interest (Fikirkoca, 2009).

The 15-minute mean returns are calculated with formula (1) and intraday 15-minute classical volatility is measured with standard deviation formula (2):

$$r_{t=\ln\left(p_t/p_{t-1}\right)} x\,100 \qquad (1)$$

$$\sigma_{T=}\,\sigma\sqrt{T} \qquad (2)$$

where p_t is the Composite Index at time t and p_{t-1} is the index observed fifteen minutes before. The generalized volatility σ_T for the time horizon T is expressed in Equation 2.

In addition to the classical volatility measure of standard deviation we also used volatility measures such as those developed by Rogers & Satchell (1991) and Yang and Zhang (2002). These methods use information on daily trading ranges such as intraday high and low prices of assets. Yang & Zhang (YZ) is an extension of the Garman & Klass (1980) estimator and it is independent of process drift and opening gaps. The main difference between the two methods is that the GK estimator only uses three items of price information, namely high, low

[1] Naked short selling is often used for intraday trading, where the position is opened and then closed at some point later in the day. In an FSA discussion paper, naked short selling is defined in the following manner: "In a naked short sale, the seller sells shares they do not own, without having set aside any shares to settle the transaction."

and close prices to estimate volatility. However, in addition to the current high, low and close prices in GK, the YZ extension also uses the opening price. The main purpose of this estimator is to capture the effects of opening jumps during session openings. In the ISE, there is a break at noon for one hour and 45 minutes. This estimator, given in formula (3) below, aims to capture information accumulated during periods of closure:

$$\sigma = \sqrt{\frac{Z}{n}\sum\left[\left(\ln\frac{O_i}{C_{i-1}}\right)^2 + \frac{1}{2}\left(\ln\frac{H_i}{L_i}\right)^2 - (2\ln 2 - 1)\left(\ln\frac{C_i}{O_i}\right)^2\right]} \quad (3)$$

The next volatility estimator is Rogers & Satchell (RS) which outperforms other estimators when the asset process includes a time-varying drift (Rogers et al., 1994). The main difference between YZ and RS is that the latter does not account for price jumps and assumes no opening jump. The RS historical volatility estimator primarily allows for non-zero drift, but assumes no opening jumps.

$$\sigma = \sqrt{\frac{Z}{n}\sum\left[\ln\frac{H_i}{C_i}\ln\frac{H_i}{O_i} + \ln\frac{L_i}{C_i}\ln\frac{L_i}{O_i}\right]} \quad (4)$$

In this study, we employ YZ and RS estimators for three time periods. First, the daily calculations are performed using both estimators. Basically, the daily estimators use the close value as the prior day's closing value of the ISE 100 Index, opening as the opening value of the Index on that specific day, and low and high values represent the minimum and maximum values for the whole trading day. The same methodology is employed for the morning and afternoon sessions in a similar manner. In the *morning* session, the estimators use the *opening* value as first session's opening value, c*losing* as the closing value of the first session on that specific day, and l*ow* and h*igh* values represent the minimum and maximum values for the first session of the trading day. Similarly, for the *afternoon* session, estimators use the *opening* value as the second session's opening value, c*losing* as the closing value in the second session on that specific day, and *low* and h*igh* values represent the minimum and maximum values for the second session of the trading day.

Table 1

The table shows the selected descriptive statistic results for Short Selling Volume(SSV), Short Selling Quantity(SSQ), and RS and YZ estimators for Daily-Morning-Afternoon sessions.

	DAILY				MORNING				AFTERNOON			
	SSV	SSQ	RS	YZ	SSV	SSQ	RS	YZ	SSV	SSQ	RS	YZ
Mean	90370831	33034657	0.007330	0.000247	61276923	22416290	0.004407	0.000137	29093907	10618367	0.004996	7.11E-05
Median	83958036	30785509	0.006711	0.000106	55598502	20404063	0.004057	5.87E-05	26659507	9825427.	0.004428	3.81E-05
Std. Dev.	34965569	15216635	0.004388	0.000414	25874472	11087427	0.002813	0.000312	13007847	5266208.	0.003265	0.000101
Skewness	0.671707	0.587358	1.637494	4.654387	0.687024	0.660318	2.016881	7.440955	1.032526	0.950697	1.149248	4.334237
Kurtosis	3.123261	2.695320	9.526418	31.61971	3.162770	2.824228	12.72354	78.64055	4.368353	3.848057	5.057337	28.19336
Jarque-Bera	43.60303	35.28556	1277.45	21700.04	45.86829	42.52549	2655.024	142383.5	147.0282	103.8474	227.9807	17006.77
Observations	575	575	575	575	575	575	575	575	575	575	575	575

All of the series display positive skewness, implying that the distribution has a long right tail. In particular, when the RS and YZ estimators are compared, it can be seen that YZ has a stronger skewness for all three time periods when compared to the RS estimator. RS has higher Kurtosis values than YZ except for the morning section. All distributions exhibit significant deviations from normality at the 5% level as seen from the reported Jarque-Bera test statistics.

Figure 1
15-Minute Volatility Using YZ

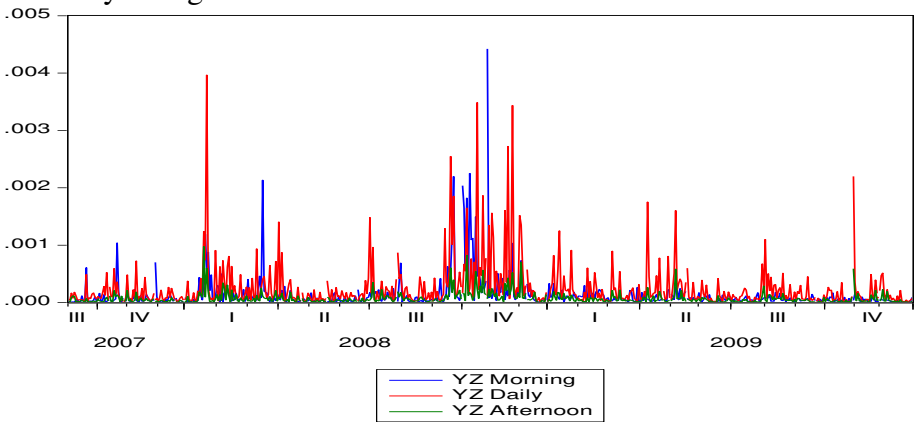
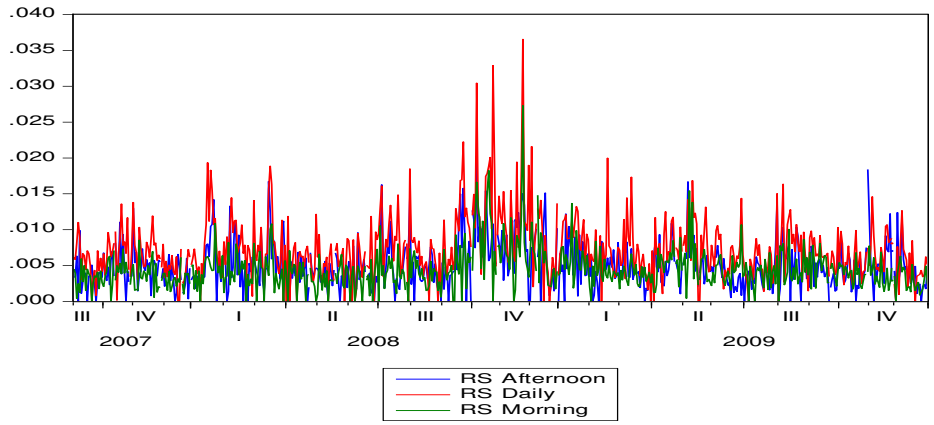


Figure 2
15-Minute Volatility Using RS



4. RESULTS & DISCUSSION

Tables 2, 3 and 4 provide the main empirical findings. Table 2 contains estimates of the GARCH-M model for the full sample. The time-varying volatility properties of the univariate economic time series are widely analyzed through autoregressive conditional heteroskedasticity (ARCH) and generalized autoregressive conditional heteroskedasticity (GARCH) models. While the univariate GARCH models examine the time-varying nature of the economic time series, its multivariate extension, commonly known as multivariate GARCH (MGARCH) models, analyses the time-varying conditional cross moments (Khalid and Rajaguru, 2006). The departing feature of this technique is that it not only analyses the mean return effects of short-selling but also the volatility outcomes of markets though GARCH specifications.

As presented in Ulusoy, Eken, and Cankaya (2011), the GARCH model allows the conditional variance to be dependent upon its previous own lags, so that the conditional variance equation in the simple case is now:

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta \sigma_{t-1}^2 . \qquad (5)$$

This GARCH (1,1) model is based on the assumption that forecasts of variance changing in time depend on the lagged variance of the asset. An unexpected increase or decrease in the return at time *t* will generate an increase in the expected variability in the next period.[2] Table 2 gives the pure results from the GARCH-M model, including the mean equation in the form:

$$Y_t = \gamma_0 + \gamma_1 Y_{t-1} + \gamma_2 \sigma_t + u_t \qquad (6)$$

where the error term may follow MA(q) terms for the stationarity of the model. This paper applies the GARCH-M estimation methodology simply because the classical risk measure of standard deviation in financial research may miss the reality, particularly when markets are experiencing turmoil. In this case, the connection between return and volatility may break down. As for the impact of short selling on market liquidity, the empirical evidence is ambiguous. Woolridge and Dickinson (1994) found a positive correlation between short interest changes and stock returns in the US market. From their results, they conclude that short sellers provide liquidity to the market by shorting into bullish markets and reducing short positions in bearish markets. Charoenrook and Daouk (2005) used turnover as a proxy for liquidity, and found that there is greater liquidity when short-selling is possible. Gao, Hao and Ma (2006) investigated short selling in the Hong Kong Stock Exchange, and found that removing short-sale constraints increased the liquidity of low-priced stocks but not high-priced ones. Chen and Zheng (2007) applied a time series methodology and found that short selling volumes do not Granger-cause market volatility.

Table 2
GARCH-M Estimation Results

	Volumes			**Quantity**		
	Return			**Return**		
	Morning	Afternoon	Daily	Morning	Afternoon	Daily
Constant	-0.052	-0.089	-0.04	-0.038	-0.06	-0.034
	(-5.58)	(-8.06)	(-6.31)	(-5.11)	(-6.78)	(-5.43)
SS	7.65	2.86	4.91	1.55	5.58	9.43
	(6.26)	(8.21)	(6.74)	(5.82)	(6.74)	(5.88)
	Volatility			**Volatility**		
Constant	0.0003	0.0008	0.0002	0.00025	0.0013	0.0002
	(2.22)	(1.54)	(2.23)	(1.89)	(1.89)	(2.54)
Residual(-1)	0.08	0.11	0.07	0.08	0.11	0.07
	(5.02)	(3.24)	(3.34)	(4.94)	(3.10)	(3.36)
GARCH(-1)	0.90	0.72	0.89	0.89	0.65	0.89
	(55.25)	(9.27)	(29.90)	(45.93)	(5.62)	(29.11)
SS	-3.16	3.09	-4.46	-1.94	1.11	-5.18
	(-1.97)	(2.15)	(-0.59)	(-0.50)	(2.06)	(-0.30)
F-stat	5.62	16.2	7.59	4.82	10.49	5.89

Simultaneous estimation of the model for volume and quantity of short-selling using the GARCH-M model indicates that in morning sessions, short selling decreases volatility. The

[2] Using the GARCH model it is possible to interpret the current fitted variance as a weighted function of a long-term average value information about volatility during the previous period and the fitted variance from the model during the previous period.

inverse happens in the afternoon session. Daily results illustrate that volatility decreases overall. The same results are observed as well when quantities are used for short-selling in the regression model. In this case, however, the parameters of short-selling in the morning session and daily observations are not statistically significant. The GARCH parameters in the model for both regressions match perfectly, an indication that there is no collinearity between lag of volatility and corresponding short selling variables.

Table 3 and Table 4 present the set of regression results for the YZ and RS measures of volatility. The endogenous variables are the computed values of the volatility explained in Section III and the exogenous variable is the short selling volume (quantity) in the total volume (quantity) of the market transaction. The reason for using such a relative measure of the corresponding short selling measure is that YZ and RS are constructed in relative terms so that comparison of values would be direct. For all regression models, in the afternoon sessions, market volatility increases as the proportion of short selling increases. A 1-point increase in this proportion of volumes/quantities, for example, increases the YZ and RS market volatilities by 2.07 and 5.08 (2.19 and 6.05) units respectively, and these are all statistically significant. Morning sessions have different results and policy implications. Short-selling has a negative (positive) effect on YZ (RS), but the results for YZ are only statistically significant.

Table 3
YZ Estimation Results

	Volumes		**Quantity**	
	YZ		**YZ**	
	Morning	Afternoon	Morning	Afternoon
Constant	0.00034	0.00035	0.00042	-0.0001
	(3.32)	(0.21)	(3.76)	(-0.05)
SS/TOTAL	-3.09	2.07	-4.27	2.19
	(-2.02)	(4.25)	(-2.88)	(4.50)
F-Stat	4.10	18.11	43.54	35.34

The YZ Estimation results in table 3 demonstrate that as the volume or the quantity of SS/Total ratio increases, volatility increases as well in the afternoon sessions. However, in the morning sessions, as the SS/Total ratio increases, the YZ volatility decreases both in terms of short selling volume and short selling quantity. At this point we should recall the fact that the short selling volume in morning sessions is almost double the short selling volume in afternoon sessions. This may well be the reason for the negative relationship between the SS/Total ratio and YZ volatility.

Considering that information is accumulated during the time when the ISE is closed, in the opening session depending on market sentiment the jump could be in either direction. In the opening session, short selling or buying on margin trading is most preferred, due to the fact that during the opening, prices are still higher (lower) to short sell (margin trade) them. After the first or mega jump in prices, short selling (margin trading) loses its attractiveness, unless market sentiment becomes even worse (better). Therefore, generally, after the opening jumps, stock prices tend to remain stable with little fluctuation until the end of the morning session. Then, in the afternoon session, stock prices tend to fluctuate with wider swings towards

closing time when short-sellers start to buy back the stocks that they sold (bought) short in the morning session. So, apart from the opening jumps, the fluctuations in the morning session remain much smaller than those that occur in the afternoon session.

Table 4
RS Estimation Results

	Volumes		**Quantity**	
	RS		**RS**	
	Morning	Afternoon	Morning	Afternoon
Constant	0.0028	0.0033	0.0033	0.003
	(3.00)	(6.23)	(3.29)	(5.00)
SS/TOTAL	2.38	5.08	1.62	6.05
	(1.72)	(3.20)	(1.18)	(3.78)
F-Stat	2.98	10.24	35.10	27.55

The RS estimation results in table 4 show that as the SS/Total ratio increases, volatility increases as well. This movement is stronger in afternoon sessions. When we consider the specifications of both of the estimators (the RS historical volatility estimator allows for non-zero drift, but assumes no opening jumps) and draw a comparison between them, we can conclude that YZ is a better estimator for explaining the relationship between short selling and volatility. There is clearly an opening jump in the beginning of the morning sessions in terms of short selling activity, and according to the YZ estimator results, this activity curbs volatility in the morning sessions and triggers it in the afternoons. Taking the daily picture into account, it may seem as though opposing forces cancel each other out, and short selling serves the market efficiency principle. However, the aim of this paper is to underscore intraday activities, and it shows that the relationship between intraday short selling and volatility requires further investigation and that there remains room for speculation.

CONCLUSION

The activity of short selling has sparked ongoing debate, especially when a negative market sentiment predominates, like the crisis which lasted from 2007 to 2009. The debate about whether short selling restrictions help improve market efficiency and move prices back to fundamentals or whether they increase price volatility has become a widely discussed issue around the world. This paper has attempted to approach this debate from a novel perspective.

The evidence that we found supports the view that short selling activities decrease the volatility of stock returns on a daily basis. However, we also conclude that the impact of intraday activities should be studied in further detail, as there is a notable amount of fluctuation in short selling activities on an intraday basis. The two sessions in the ISE demonstrate different behavioral patterns in terms of short selling and volatility. Even the opening of morning sessions bears unique traits, and we believe that this specific opening behavior is deserving of further research.
The speculative intraday activity within a trading day may result in major fluctuations in investors' returns and profitability, especially during periods of financial crisis such as occurred in the years between 2007 and 2009 in which market sentiment was predominantly negative. We believe that shorter fluctuations in investor moods in trading days should be

observed and analyzed with volatility estimators such as RS and YZ rather than standard volatility measures.

In this paper our findings suggest that YZ is a better estimator than RS as it assumes opening jumps. The jumps in opening sessions play a crucial role in reflecting market sentiment at the start of the trading day. Accumulated information, or the perceptions held by investors from the previous day, will be immediately reflected in the market. If these are marked by a negative sentiment, this will trigger short selling activities at the start of the morning session, leading to the expectation that there will be higher volatility. After the opening jump, the rest of the morning session tends to move in a much narrower band, exposing a negative connection to volatility.

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