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Market Impact of the 2008-09 U.K. Short Selling Ban*

by

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May 2009

Abstract

In September 2008, during one of the most intense periods of the financial crisis, the Financial Services Authority (FSA) decided to ban short-selling in financial stocks during four months in the U.K. market. The aim of the ban was to guard against instability and calm the market. This paper examines the effect of the ban on the banned stocks in terms of returns and market quality measured by abnormal returns, volatility, bid-ask spreads and volumes using intraday data. Event study methods and panel regressions are used to isolate the effects of the ban as specifically as possible. We do not find evidence of any effects of the ban on abnormal returns and volatilities, largely due to the extreme levels of noise during the financial crisis. However, we do find strong evidence that the bid-ask spreads in the affected stocks widened during the ban and that the trading activity in the banned stocks decreased.

Key words: short selling, market quality, FSA, regulation

JEL Classification: G01, G14, G18

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Introduction

On September 18, 2008, the Financial Services Authority (FSA) banned short selling in financial stocks as a direct response to the financial turmoil hitting the globalized economy with brutal force. The temporary ban covered the creation and increase of net short positions in 29 financial stocks on the London Stock Exchange.[1] On the same day, the Securities and Exchange Commission (SEC) imposed a similar ban on more than 800 financial stocks in the U.S. market. At least another 24 countries followed suit and posted restrictions on short sales.[2] The ban on the U.K. market was effective from September 19, 2008 to January 16, 2009.

The announcement of the ban came only days after Lehman Brothers' demise in the U.S., when there were real fears of the financial crisis spinning out of control. The logic behind the decision was somewhat indistinctively described on the announcement day. In an FSA statement,[3] CEO Hector Sants said that action was taken to "protect the fundamental integrity and quality of markets and to guard against further instability in the financial sector". Callum McCarthy, Chairman of the FSA, expressed his concern about the volatility and incoherence in the trading of equities in a speech[4] later the same day, talking about the danger in allowing financial institutions to be targeted and subject to extreme short selling pressure and pointing out that extreme swings in equity prices may translate into uncertainty among depositors. McCarthy also described the measure as designed to have a calming effect. There was an immediate debate in the investor community worldwide, questioning whether banning short selling would indeed target the real issue. In the U.S., voices were raised that the ban was merely a result of successful lobbying from investment bank executives.[5]

The purpose of this paper is to empirically assess the effects of the short selling ban on the market quality of the stocks subject to the ban. Thus, in a sense we also evaluate the aims of the FSA. As far as we can interpret the FSA statements made at the time of the announcement, the broad aims of the FSA were to: protect the "integrity" of the market, protect the "quality" of the

[1] Minor revisions were later made to the list, see the data section below.
[2] For a comprehensive review of the short sales restrictions during the financial crisis see Clifford and Chance: http://clifford-chance.at/showimage/showimage.aspx?LangID=UK&binaryname=/short_selling_update_7.pdf
[3] FSA statement on short positions in financial stocks, September 18, 2008, FSA/PN/102/2008
[4] The speech is published in its entirety at:
http://www.fsa.gov.uk/pages/Library/Communication/Speeches/2008/0918_cm.shtml
[5] SEC Is Set To Issue Temporary Ban Against Short Selling, Wall Street Journal, September 19, 2008

market, guard against further ”instability” in the financial sector, avoid extreme short selling pressure and have a “calming effect”. In this paper, we measure market quality effects in terms of abnormal returns, volatilities, bid-ask spreads, and volumes. These measures can also be considered reasonable proxies for assessing the fulfillment of the (rather vague) aims of the FSA.

The theoretical and empirical research available to the FSA when imposing the short selling ban is not perfectly coherent in its predictions of the outcomes of such a ban. The modern discussion on short selling and the market effects thereof is largely based on Miller (1977). Under heterogeneous expectations he shows that short selling puts pressure on stock-prices as the market value is allowed to incorporate the valuation of all investors, including those with a negative view. The riskier the asset, the larger the effect as the dispersion of opinions is wider. Chang, Cheng and Yu (2007) and Jones (2008) provide empirical results confirming the outcome of Miller (1977) when short selling is difficult or prohibited. Research on the relationship between a high level of short sales interest and negative abnormal return generally provides evidence of such a relationship (Jones and Lamont, 2002; Angel, Christophe and Ferri, 2003; Asquith, Pathak, and Ritter, 2005; Boehme, Danielsen and Sorescu, 2006; Cohen, Diether, and Malloy, 2007).[6] Senchack and Starks (1993), Desai et al. (2002), Aitken, Frino, McCorry and Swan (1998) and Au Doukas and Onayev (2009) find evidence for negative returns following public disclosure of high or increasing levels of short selling.[7] Earlier studies provide contradictory results as they generally fail to establish a relationship between abnormal returns and the levels of short selling (Desai, Ramesh, Thiagarajan, and Balachandran (2002) provide a summary of such studies).[8] In the model of Diamond and Verrecchia (1987) the adjustment process to negative news becomes slower (backed empirically by Bris, Goetzmann and Zhu, 2007) but the prices remain unbiased.

Predicting the reaction in stock return volatility caused by the ban is perhaps even more difficult. The empirical research on intra-day volatility in relation to short selling bans is scarce and mixed. Chang et al. (2007) find higher daily returns volatility when short selling is allowed, Bris

[6] Short sales supply and demand is not straightforward to determine and different proxies are used in this literature.
[7] Boehmer, Huszár and Jordan (2009) provide an interesting twist as they find that a low level of short interest in liquid stocks is more informative with regards to future (positive) returns than a high level.
[8] Desai et al. (2002), Asquith et al. (2005) and Cohen et al. (2007) point at the difficulties in measuring actual supply and demand as being an important reason for some of the contradictory results.

(2008) find similar results on an intraday level in conjunction to naked short selling, while Ho (1996) and Charoenrook and Daouk (2004) find lower volatility when short selling is possible. Boehmer, Jones, and Zhang (2008a) do not find any strong correlation between daily return volatility and the level of short sales. With regards to bid-ask spreads both theory (Diamond and Verrechia, 1987) and empirical research (Jones, 2008; Bris 2008) conclude that bid-ask spreads are expected to widen when short selling is no longer allowed.[9] Au et al. (2009) provide evidence of a reasonably active short selling market in the U.K. When investors are not allowed to pursue trading strategies involving short selling, a number of potential trades will not be carried out. Hence, the volume of traded stocks is expected to fall due to the ban.

Based on the presented research we expect that abnormal returns will increase, volatilities will change, bid-ask spreads will increase and that volumes will decrease during the ban period. We use event study methodology to examine the effects around the imposing and lifting of the ban respectively. We use paired t-tests to compare the average values of the measures before, during and after the ban. We also run regressions on the market quality measures in order to evaluate the significance of the effects among the banned stocks over the entire ban period compared over time and cross-sectionally.

In our results we find little evidence to support the hypothesis that abnormal returns increased as negative investors were shut out of the market, as predicted by Miller (1977). The results are largely due to the extreme levels of noise during this period of extraordinary financial turmoil which make it difficult to identify any effects. With regards to realized intraday volatility our results are not supportive of our stated hypothesis. As in the case of abnormal returns it is presumptuous to draw any major conclusions regarding the effect of the short-selling ban on volatility when the market for financial stocks, regardless of short-selling regime, is anything but normal. We do, however, find strong evidence that the bid-ask spreads widened due to the short-selling ban. This is clearly in line with our hypothesis and with most previous research. Lastly, the trading volumes and number of trades in the banned stocks decreased significantly, as hypothesized.

[9] The so called up-tick in U.S. was removed in two steps with increasing spreads and intra-day volatility as a result (Boehmer et al., 2008c and Diether, Lee, and Werner, 2008) The contradicting results of narrower spreads under the uptick rule is due to the specific order-handling of short sales under the up-tick rule that actually creates narrower spreads (Diether et al., 2009). The results from the U.S. market are not directly applicable to the U.K. market as no up-tick rule has been in place.

Some aspects of the short selling bans in the U.S. and the U.K. have already been investigated in recent studies. Firstly, Marsh and Niemer (2008) compare markets with different short sales restrictions to other markets with respect to return distributions. Due to a limited sample and a limited estimation period in most countries, their findings are inconclusive. They assign changes in some of their statistics to sector-specific changes rather than viewing them as results of the bans. Secondly, Clifton and Snape (2008) find that average bid-ask spreads increased for all shares during the period but increased more for the banned stocks in the U.K. market using data lasting only until October 30, 2008, i.e. less than half of the ban period. The number of trades, volume and turnover of the banned stocks fell whereas they increased for the control group. Their findings are qualitatively similar to this paper, but not as rigorously backed as they have not included the entire ban period or a post ban period. Thirdly, Boehmer et al. (2008b) find a positive shift in returns when the ban was implemented on the U.S. market on the same day as in the U.K. Moreover, they find that 85 % of short selling activity evaporated under the ban combined with a degradation of market quality, measured as significantly wider bid-ask spreads and rising volatility. Our findings with regards to volatility are similar in that we find increased volatility during the three weeks when the U.S. ban was effective (until October 9, 2008). However, our conclusions differ as Boehmer et al. (2008b) conclude that this increase is directly related to the ban, whereas our results show that the volatility in the U.K. was lower than "normal" under the second half of the ban indicating that the ban did not cause the initial high volatility. Fourthly, the FSA (2009), in their discussion paper following the ban, does not find any peculiarities with regards to stock returns other than an initial increase in returns on banned stocks. Neither does the FSA draw any clear conclusions about the volatility. The FSA (2009) find widening bid-ask spreads in all shares under the ban but significantly more in the banned stocks. The FSA observes an initial increase in volumes relative to the market of the banned stocks, just after the ban started, but a decline later on.

The remainder of this paper is outlined as follows: Section I develops our testable hypotheses. Section II describes the timing of events, the data, the four market quality measures used and the design of the tests. Section III presents the results of our tests on the identified measures, and section IV is devoted to concluding remarks.

I. Expected Effects on Market Quality

Short-sellers might be more informed than other traders on average and thus be able to better predict future negative returns and trade based on that information. Although their short positions are not disclosed to the market and the signaling effect is hence limited, short sellers can still cause certain stocks to decline by increasing the supply of them (Miller 1977). If and when the information about short selling becomes publicly available, the short-sellers can indirectly affect share prices if other investors want to follow the short sellers because they are perceived as well informed. In the rational expectations model of Diamond and Verrecchia's (1987), however, short selling constraints do not result in upward biased prices because uninformed market participants take into consideration that short selling is not allowed and that not all negative information is incorporated in the order flow. However, the adjustment process to new information, in particular negative information, becomes slower when short selling is not allowed. In their model, the announcement of an unexpected increase in short selling is a negative signal, likely to cause the stock to decline as private information is incorporated in the share price. Diamond and Verrecchia (1987) argue that short sellers are more likely to be informed and are unlikely to pursue trading for liquidity reasons because of the higher costs related to short selling compared to long positions.

In summary there is empirical evidence that, firstly, high levels of short sales are followed by negative abnormal returns. Secondly, public disclosure of high and/or increasing levels of short selling cause negative abnormal returns. Thirdly, short sales restrictions are related to positive abnormal returns. Following the overvaluation theory of Miller (1977) and the, admittedly, not unambiguous, but rather persuasive recent empirical findings presented above, it is reasonable to hypothesize that there is more friction for negative views to be incorporated in the market price. This leads to our first set of hypotheses:

Hypothesis 1a: *Banned stocks experience positive (negative) abnormal stock returns when the short sales ban is imposed (lifted).*

Hypothesis 1b: *The banned stock returns will be (more) asymmetric in relation to the rest of the market as negative views are not incorporated to the same extent as positive views.*

Previous research cannot provide any clear direction as to how the intraday return volatility of the banned stocks can be expected to react to the ban. Miller (1987) models somewhat larger price fluctuations, i.e. higher volatility when short-selling is allowed. Bai's et al.'s (2006) model on the other hand predicts higher volatility under short-selling limitations as better informed investors are held out of the market and less informed investors perceive the risk as considerably higher. Despite the somewhat mixed previous results, we can at least expect trading behavior to change as not all traders are allowed to trade in the manner they would have done without the ban. This can possibly affect the volatility in the banned stocks in one direction. This is exactly what Kraus and Rubin (2003) predict in their model. There the direction of the volatility change is dependent on exogenous variables, such as the variability of information about future payoffs. Hence we hypothesize:

Hypothesis 2: *Volatility in the restricted stocks will shift, as compared to the same stocks before and after the ban as well as compared to the rest of the market when short sale restrictions are in effect.*

The bid-ask spreads are somewhat more predictable given previous research. Diamond and Verrecchia (1987) predict larger bid-ask spreads when short-selling is not allowed. This is due to the exclusion of traders that are willing to trade on their negative views but are not allowed to because of short-selling constraints. Our third hypothesis is therefore:

Hypothesis 3: *Bid-ask spreads widen in the banned stocks during the ban period compared to other time periods as well as to a control group.*

In order to predict the effect of a short-selling ban we do not really need a model. The results of Au et al. (2009) are a good indicator of an active short selling market. Hence, the mechanical effect of some trades no longer being allowed is expected to be declining trade volumes in the affected shares.

Hypothesis 4: *The volume of shares traded in the banned companies will decrease relative to the control group.*

II. Data and Methodology

A. Timing of events

The 2008-09 ban targeted all net short positions in U.K. financials, including options and other derivatives. 29 stocks were on the original ban list announced on September 18, 2008. In the same announcement the ban period of September 19 to January 16, 2009 was declared. Seven companies were added to the short sales ban list (hereafter referred to as the ban list) during the first two weeks of the ban and six companies on the ban list were delisted during the ban period.[10]

Before the short sales ban of financial stocks the regulatory environment for short selling in the U.K. was rather liberal. For example, covered and naked short-selling was allowed and there was no up-tick rule or disclosure obligation in place. Since the FSA (2002) review of short selling, CRESTCo/Euroclear has published daily aggregated stock lending data for each stock with a three day lag (stock lending is a frequently used, yet imperfect, proxy for short selling). Moreover, in order to avoid settlement issues and "short squeezes," a warning system was put in place to notify the market when settlement problems are building up in illiquid securities. In conjunction with the short sales ban, the FSA started requiring daily disclosure of all net short positions in excess of 0.25% of the ordinary share capital in the financial stocks covered by the ban. The disclosure regime, which was set to end on June 30, 2009, was relaxed from daily disclosure to only cover changes in excess of 10 basis points.

B. Data and sample selection

Our raw dataset consists of official trades and best bid and ask quotes obtained directly from the London Stock Exchange. In the original dataset of approximately 1,500 million observations, tick-by-tick trade data is separated from the best bid and ask quotes. We have excluded trades outside of regular trading hours[11] and unrealistic and/or incorrect entries that might distort our analysis.[12] Automated scripts were designed to extract the relevant intraday data and calculate

[10] Alliance & Leicester, Bradford & Bingley, HBOS, Highway Insurance group, London Scottish group and Resolution Plc (actually delisted as of April 30, 2008 but included on the ban list on the first day of the ban period for some reason unknown to us).

[11] Regular trading is conducted between 8:00 a.m. and 4:30 p.m. at the London Stock Exchange. The sample period includes two half-days (trading ends at 12:30 p.m.). The measures are adjusted when appropriate to make inter day comparisons possible.

[12] The alterations made to the tick-by-tick dataset are removals of cancelled trades, both at initial entry and at cancellation (0.04% of all observations), and elimination of trades that took place at a date different from the date of

daily figures for each set of measures. For the purpose of volatility calculations, intraday stock price series of specified granularity are created from the tick-by-tick data. From these intraday stock prices, we extract the stock returns used for calculations. To calculate effective spreads, each trade registered in the tick-by-tick data set is matched to the prevailing set of bid-ask quotes with a specified lag. For the quoted spreads, we calculate the time that each set of quotes is applicable and time-weight each observation. The calculation of each measure is described in greater detail below.

The short selling ban list and updates thereof were obtained from the FSA and information regarding index constituents was received directly from FTSE. Other data, including daily data on the number of shares outstanding, daily close prices of market indices and daily close prices of shares adjusted for corporate actions and dividends (total return), was downloaded from the Reuters and the Datastream databases.

No information regarding short selling or stock lending is included in our dataset. In other words, one cannot know whether a particular trade involves a short seller or what the level of short sales is in a particular stock on a given day.[13] As we examine the effect of the short sales ban and not a general relation between the level of short sales in a particular security and its market quality there is no need to estimate the short sales level specifically. However, our interpretations are based on the assumption that short-selling in the banned stocks drop significantly when the ban is imposed even though market makers are exempted from the ban. FSA (2009) provides evidence that the most widely used proxy for short selling, stock lending, declined significantly when the ban was in effect.

The total sample period consists of 183 trading days, which includes the entire ban period and a 50-day estimation window before/after the ban was imposed/lifted.[14] Market conditions changed quite rapidly as the severity of the financial crisis that caused the short-selling ban unraveled,

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publication (0.04% of all observations). Trades registered in EUR in stocks where trading is normally pursued in GBP (less than 0.0004% of all observations) and trades outside of regular trading hours (2.31% of all observations) have also been removed from the dataset. Eliminations from the best prices dataset include negative spreads (0.41% of all observations) and observations where both bid and ask prices are quoted at 0 (0.035% of all observations).

[13] Note that a trade carried out by a short-seller, involving borrowed shares, is registered in the same manner as any regular trade on the stock exchange.

[14] The sample period lasted from July 10, 2008 to March 27, 2009, and the ban period ranged from September 19, 2008 to January 16, 2009.

hence the choice of a relatively short pre-ban period. Furthermore, in order to examine the consistency throughout the ban period, we divide it into two sub-periods, covering the first 41 and the last 42 days. Hence, we split the total sample period into four parts, which we from here on will refer to as "Pre Ban," "Ban 1," "Ban 2," and "Post Ban."

Our main sample is based on the 356 stocks included in the FTSE 350 index at the start of the ban period.[15, 16] Nine stocks in the sample (three banned) were delisted during our sample period and another three stocks lack sufficient historical estimation periods for the abnormal returns measures. To get consistent averages and graphical outputs, these twelve stocks are excluded. Furthermore, the late ban list additions are excluded from the ban start until ban list inclusion. Thus, our main sample includes 23 stocks that were, at some point, included on the ban list, the control group consists of the remaining 321 stocks. However, to test for robustness, avoid survivorship bias and other sample-selection related issues, all tests are performed using alternative samples where the aforementioned exclusions are included. Qualitatively different results are reported when found, and deviations in sample group constituents are specified in conjunction with the tests performed. In particular, for the bid-ask spread and volatility measures, the company-specific differences between the largest and most traded stocks and the smaller and less traded stocks can be expected to be considerable. Furthermore, these two measures are designed to give accuracy in stocks with high-frequency trading. Thus, when the trading activity is low the results can be biased. To address this issue we run all tests for the most liquid stocks on the market, the FTSE 100 constituents, and report the results when we find qualitative differences.

C. Measures

C.1. Abnormal Returns

The abnormal return of a security is defined as the ex-post deviation in return from the estimated expected return (MacKinlay, 1997). A number of different approaches can be used to estimate expected, and thus abnormal returns. In a manner similar to Chang et al. (2007), we utilize the market adjusted model and the OLS market model following Brown and Warner (1980 and

[15] The individual companies are indentified using their International Securities Identification Number (ISIN). Seven companies changed ISIN codes during the period, which has been catered for when extracting data for analysis.

[16] 26 out of the 36 stocks that were either included in the original FSA ban list or added to the list are included in the FTSE350-group. The remaining ten stocks are excluded from the analysis because they are not FTSE 350 constituents.

1985). The Market Adjusted Return (MAR) is a straightforward measure to relate stock returns to the market return, as it does not require any parameter estimation.

$$MAR_i\ (t) = R_{it} - R_{Mt}\ ,$$

where R_{it} is the log-return of stock *i* on day *t* and R_{Mt} is the equivalent return of the FTSE All-share index. According to this rather simplistic measure, any deviation in return from the market return is considered an abnormal return.

In the somewhat more sophisticated OLS market model, each stock's expected return is linearly dependent on the market return for the same period. The expected returns are calculated using alpha and beta estimates from a regression on previous individual stock returns relative to the market. The benefit of this model is that it caters for different risk levels in individual stocks when estimating expected return. On the other hand, it is sensitive to the historic period used for parameter estimation. To ensure that the choice of estimation period does not interfere with our results, several different estimation periods are used.[17] The measures are calculated as:

$$AR_i\ (t) = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{Mt}$$

and

$$CAR_i\ (t_1, t_2) = \sum_{t=t_1}^{t_2} (R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{Mt})\ ,$$

where the CAR is calculated over the event period from t_1 to t_2, and the security specific α and β-coefficients are estimated using OLS during a pre-event estimation period:

$$R_{it} = \alpha_i + \beta_i R_{Mt} + \varepsilon\ .$$

The estimation of excess α (abnormal returns) described above is not sufficient for testing the return asymmetry relationship stated in Hypothesis 1b, i.e., that negative views are less efficiently incorporated in the share price. To test the hypothesis we estimate one beta (β^+) for days with positive market returns and one beta (β^-) for days with negative market returns in order to capture return asymmetry. The OLS technique is similar to what is used above, the difference

[17] Alternative specifications of 90-,120-,180- and 250-day OLS market return estimation periods are tested.

being that it distinguishes between days when the market goes up and down. The pooled regression is run on either the ban or the control group:

$$R_{it} = \alpha + \beta^{+} R_{Mt} I(R_{Mt} > 0) + \beta^{-} R_{Mt} I(R_{Mt} < 0),$$

where $I(R_{Mt} > 0)$ is a 1 if the market return on day *t* is positive and 0 otherwise, and $I(R_{Mt} < 0$ is 1 if the market return on day *t* is negative and 0 otherwise.

C.2. Volatility

Due to the unobservable nature of true volatility, there are several methods for estimating ex-post intraday volatility. A simple measure of intraday volatility uses the intraday range, i.e., the highest and the lowest trade prices of the day as proposed by Parkinson (1980). This is a rather common measure, used for instance by Boehmer et al. (2008b) to estimate the volatility effect of the 2008 short selling ban in the U.S. However, it utilizes very little intraday information and thus does not incorporate the full power inherent in intraday data. An increasingly popular measure of intraday volatility is the realized volatility measure as discussed by Barndorff-Nielsen and Shephard (2001) and Andersen, Bollerslev, Diebold, and Labys (2001a). It is straightforwardly calculated by summing the squared intraday returns, and is in theory an unbiased and highly efficient estimator as it can handle the large number of observations present in intraday data. Despite this measure being theoretically unbiased and efficient, there is an ongoing discussion as to which measure is the best volatility estimator.[18] According to Andersen, Bollerslev, Diebold, and Ebens (2001b) using a continuous time record renders the most efficient estimator. However, a five minute intraday return range will mitigate effects from market microstructure frictions such as infrequent trading and bid-ask bounce effects (Andersen et al., 2001b). Thus, we divide our dataset into equidistant intraday return observations by dividing each trading day into five-minute intervals:[19]

$$\widehat{\sigma}_{it}(t) = \sum_{j=1}^{N_t} r_{ij}^2 ,$$

[18] For a more comprehensive overview of different volatility estimators, see Bollen and Inder (2002).

[19] To test for robustness, we also employ an alternative specification of this measure using 10 minute intervals. We also run separate regressions including the overnight return in the realized volatility measure. The results are included and commented on when qualitatively different from the other specifications.

where r_{ij}^2 is the squared logarithmic difference between the price of stock *i* at time *j* and time *j-1* where the time between *j* and *j-1* is five-minutes, and N_t is the number of five minute intervals in trading day *t*. In line with Andersen et al. (2001b) we obtain price information for each interval by observing the average transaction price of the last two trades in each five minute range.

C.3. Bid-ask spreads

In terms of bid-ask spreads, our primary measure is the equal-weighted relative effective spread (RES), where each trade is compared to the prevalent quote midpoint. We estimate relative spreads for each company to allow for comparability over different stock price levels:

$$RES_i(t) = \sum_{j=1}^{N} \frac{2\left|P_{ij}^{Trade} - P_{ij}^{Midquote}\right|}{P_{ij}^{Midquote}} \Big/ N_{ti},$$

where P_{ij}^{Trade} is the transaction price of trade *j*, $P_{ij}^{Midquote}$ is the average of the best ask and the best bid quote and N_{ti} is the number of transactions on trading day *t* in stock *i*.

Following Huang and Stoll (2001), we also employ a trade-weighted RES measure (TRES), which accounts for the size of the transaction and is defined as:

$$TRES_i(t) = \sum_{j=1}^{N_t} \frac{2T_{ij}\left|P_{ij}^{Trade} - P_{ij}^{Midquote}\right|}{P_{ij}^{Midquote}} \Big/ \sum_{j=1}^{N_{ti}} T_{ij},$$

where T_{ij} is the number of shares transacted in trade *j*.

The matching of a trade to the correct bid-ask quote for the purpose of effective spread calculations above is not as straight-forward as one might wish. In the U.S. market, a discussion has followed Lee and Ready's (1991) proposition of an algorithm to identify trade direction and to match trades and quotes. A complicating factor is that new quotes are sometimes registered ahead of the transactions that caused the quote revisions. Thus, using the prevailing quote just prior to the time when the transaction was officially registered might cause a bias in the spread measure. The nature of this problem might vary between the U.S. and the U.K. market as the latter market does not have a manual trading floor. Lee and Ready (1991) show that the usage of the quote prevailing five seconds ahead of the transaction renders the most accurate measure on

the New York Stock Exchange. However, they also point out the fact that different delays might be appropriate for different historic periods. Using data from the London Stock Exchange, Huang and Stoll (2001) discuss that introducing a delay will likely render more accurate results. Following the above discussion, we use three alternative ways of identifying the prevailing quote: the quote time-stamped five seconds before the trade, the quote prevailing the second before the trade and the quote time-stamped the same second as the trade, referred to as RES-5, RES-1 and RES-0 respectively.[20]

Our secondary measure is the time-weighted Relative Quoted Spread (RQS), defined as

$$RQS_i(t) = \sum_{i=1}^{N} \left[\frac{s_{ij}(P_{ij}^{ask} - P_{ij}^{bid})}{P_i^{midquote}} \Big/ \sum_{j=1}^{M_{it}} s_{ij} \right],$$

where P_{ij}^{ask} is the best quoted ask (sell) price , P_{ij}^{bid} is the best quoted bid (buy) price, s_{ij} is the number of seconds the best quote is valid (before either the bid or ask quote changes) , N_{it} is number of transactions on the given day, and M_{it} is the number of seconds in trading day *t*.

C.4. Volume

We measure the daily traded volume as a fraction of shares outstanding. This is a common approach used by for instance Foster and Visanathan (1993) as the measure is comparable across companies. We also examine the number of trades and the average trade size.

D. Testing techniques

Our methodology is two-fold, and targeted at isolating the effects of the ban in the identified market quality measures. Firstly, we examine the effect on the banned stocks in relation to the rest of the market when the ban is imposed and lifted respectively. Secondly, we use a two-way fixed effects regression model to identify and quantify potential effects of the ban.

Following MacKinlay (1997) and Brown and Warner (1985), our first approach examines the effects of the ban in conjunction with the two event dates. Given an effect on our chosen measure, we would expect a shift in the curve. The event dates (day 0) represent the first trading day after the ban was imposed and lifted, respectively, and our event windows contain

[20] The RES-0 statistics are very close to RES-1 and thus omitted in the results.

observations +- 10 days surrounding these events. The results are presented graphically as no formal testing procedure is carried out. This is due to the issue of having the very same event date for all companies and the obvious interdependence due to the sector-specific ban group. To get an indication of the significance of the differences in our measures between our four sub-periods, we use simple paired t-tests.[21]

Our second, and main, approach, inspired by Boehmer et al. (2008b), is based on a two-way fixed effects regression model using panel data. The main benefit of using this type of model is that we can control for both company and time-specific effects. Thus, unlike paired t-tests, the model allows for both company-specific characteristics and events affecting all stocks such as interest-rate cuts and other macroeconomic events, which were very much present during the examined period.

We estimate the following regression for the period July 10, 2008 to March 27, 2009 using the natural logarithms[22] of our previously defined measures of abnormal return, volatility, bid-ask spread and volume respectively, as the dependent variable (y_{it}):

$$y_{it} = \alpha_i + \beta I_{it}^{BAN} + \gamma_t + \varepsilon_{it},$$

where I_{it}^{BAN} is a dummy variable that equals 1 if and when a stock is subject to the ban. The model also includes date specific constants (i.e., calendar dummies) (γ_t), and a company-specific constant (α_i). This specification allows for the use of an unbalanced panel. As discussed above, some of the stocks included in our dataset were delisted and/or have different ban periods. Thus, with this setting we can incorporate all restricted stocks as well as the entire control group in our panel. An alternative specification is once again used, where the ban period is split into two equally sized time periods with a ban dummy for each period:

[21] For the abnormal returns measures, we compare the mean values of the ban group with those of the control group throughout the entire sample period: that is, a paired comparison of the average value for the entire ban group vis-à-vis the average of the entire control group for each day. The other measures used are, unlike abnormal returns, company specific. Thus, for a paired t-test to be informative, we compare the average values of these measures for the banned stocks for the ban period with the average values for the control period. For these measures each pair consists of the average value of one stock during one sub period and the average value of the same stock during another sub period.

[22] Natural logarithms are used to make the data better behaved and less prone to outliers.

$$y_{it} = \alpha_i + \beta_1 I_{it}^{BAN1} + \beta_2 I_{it}^{BAN2} + \gamma_t + \varepsilon_{it}.$$

For the abnormal returns, we use a specific test to address Hypothesis 1b of asymmetric stock returns. Under the null we expect the β^- estimate from the regular OLS market regression described above to decrease in relation to β^+. Hence, we test whether the difference between β^+ and β^- changes when the ban was imposed.

III. Results

A. Abnormal returns

A visual inspection of the abnormal returns in Panel A, Figure I, reveals shifts around the event dates. At a first glance, this might appear to be proof of an instantaneous reaction in stock returns on the event dates[23], as predicted by Miller (1977) and hypothesized above. Positive abnormal returns are present after the start of the ban and remain positive on a cumulative basis for the duration of the 10-day event window. Negative abnormal returns are present around the lifting of the ban.[24] However, a deeper analysis of the data unfolds a different story. By looking at the prolonged time period in panel B of Figure I it is found that the reaction in the ban group when the ban is imposed is not very extraordinary or persistent. The decline in conjunction to the lifting of the ban might be substantial, but evaporates in less than 10 days. For our first hypothesis of positive abnormal returns under the short selling ban to hold, the reaction must show persistency. Our defined model fails to find such a persistency in the cumulative abnormal returns of the banned stocks.

[INSERT FIGURE I HERE]

Rather than being a direct effect of the lifting and imposing of the ban, it is likely that the stock reactions around the event days are caused by other factors. The positive reaction among the banned stocks compared to the control group after imposing the ban is likely due to the signaling effect when the FSA (and simultaneously the SEC) showed that actions were taken. Stock price reactions in general, and in financial stocks (i.e., the banned stocks) in particular, were extremely

[23] The ban and its start and end date were announced after the market closed on the day before it came into effect.

[24] The results are qualitatively similar for different specifications of beta-estimation period and estimation group. The results are essentially the same using MAR as well. Thus, the only reported figures are based on a 180-day OLS estimation period ending July 9, 2008.

large during this intense period. Hence, the announcement of the ban might have been interpreted as a signal that the FSA was taking the financial crisis seriously and was ready to take appropriate actions. The reaction cannot be assigned only to the direct or "mechanical" effect of short selling being banned. The signaling effect story is strengthened by the fact that the stocks included in the initial ban group in Figure I are all financial stocks and share the same ban period start date. Moreover, on the first trading day after the short selling ban ceased to have effect, the Royal Bank of Scotland announced a 5,000 million pounds rights issue and disappointing quarterly results. The RBS share plummeted 67 % on the day but the news also had spill-over effects on other financial stocks as it contained signals regarding the general well-being of the entire banking sector. Hence, the temporary negative effect in abnormal returns at the end of the ban is interpreted as a mere effect of the RBS-announcement rather than as a downward shift of abnormal returns as expected in our first hypothesis. Partly due to extreme levels of noise in the financial stocks during this period, abnormal returns in terms of stable alpha-changes cannot be related to the short-selling ban.

The results in Table I show positive abnormal returns in the ban group during the first half of the ban but negative abnormal returns during the second half of the ban period. The difference in the averages of the ban and control group was significant only in the first half of the ban period and on the 10% significance level. In order to identify an effect in our two-way fixed effects regression (Table II), a rather strong effect is needed as significance implies that new unfavorable information was prevented from being incorporated in the share price of the banned stocks on average on a daily basis. Hence, the insignificant results in Table II are not surprising. The results show a positive reaction in abnormal returns among the banned stocks in the first half of the ban period only on the 10% significance level. In the other periods, and/or using the market adjusted returns, there is no significant difference between the ban group and the control group.

[INSERT TABLE I HERE]

[INSERT TABLE II HERE]

Table III shows how the banned stocks moved in comparison to up and down movements in the market. Given that only the incorporation of negative investor views is affected by the short sales

ban we can expect the relationship between the beta in an up-market vis-à-vis the beta value in a down-market to change. In other words, if Hypothesis 1 b is true, and the asymmetry in abnormal returns increases, we expect the β^- to be lower during the ban period while β^+ is unaffected, *ceteris paribus*. However, this is not the case. Both β^+ and β^- decline in the ban period, but in contrast to Hypothesis 1b the reduction in β^+ is substantially larger than the reduction in β^-, i.e. the reaction to positive news decreases more than the reaction to negative news.

[INSERT TABLE III HERE]

In summary, it is extremely difficult to isolate the effect of the short sales ban on returns of the financial stocks during a period when these stocks were affected by a record level of other external factors. Furthermore, the design of the ban targeting a specific sector (selection bias issues) makes the econometric testing of abnormal returns difficult. Potential significance of abnormal returns in the ban group can easily be assigned to sector-wide moves rather than to the ban. The results become sensitive to the model specification and beta estimation periods since the models, to different extents, are based on the assumption of somewhat stable market conditions. Given that we have tested for changes in both alpha and beta without persuasive results we consider our results rather convincing under the prevailing conditions. Our interpretation of the situation is somewhat different to that of Boehmer et al. (2008b). They find a similar reaction for the U.S. market when the ban was imposed, assign it to be an effect of the ban and argue that the reaction is consistent with most models of shorting constraints. In conclusion, we do not find support for our first hypothesis that the banned stocks experienced positive abnormal returns and/or asymmetric incorporation of views.

B. Volatility

Table IV shows how the realized intraday stock return volatilities exploded from the pre-ban period to the first half of the ban period. The realized 5-minute volatility increased by 431% in the ban group and by 219% in the control group. The pattern is the same for the two volatility measures used. For the second half of the ban period, the volatility decreased for both groups only to increase again in the post ban period. The realized 5-minute volatility is almost four times higher after the ban compared to before the ban for the ban group but not even doubled in

the control group. Hence, it does not seem premature to identify a sector specific reaction rather than an effect of the ban as all banned stocks are financial companies.

[INSERT FIGURE II HERE]

The extreme peaks of daily volatility in September and October 2008 visualized in Figure II are not very surprising in the light of the extraordinary events in stocks in general and in financial stocks (included in the ban group) in particular. This story is partially supported by the results from the two-way fixed effects regressions in Table V. The ban dummy coefficients tend to be significantly positive during the first half of the ban and significantly negative during the second half. This implies that the volatility changes might not be a direct effect of the ban but a reaction to exogenous factors. The 5-minute realized intraday volatility measure works most effectively for actively traded stocks (Andersen et al. 2001). This might serve as an explanation for the somewhat different pattern of the 5-min volatility measure for the FTSE 350 regression where some less actively traded shares are included. Furthermore, due to the fact that the average short sales activity is considerably higher among the stocks in the FTSE 100 as compared to the stocks in the FTSE 350 (Clunie, 2005), we expect the ban to have a more severe impact on the former as the difference in short sales level with and without the ban is larger.

[INSERT TABLE IV HERE]

[INSERT TABLE V HERE]

It is noteworthy how the first half of the ban partially coincides with the U.S. short selling ban, where Boehmer et al. (2008b) find increasing volatility using intraday range measures. However, our results during the second half of the U.K. ban when the market is not driven by the bombardment of news, rumors and reactions to the same extent as in the first half, the volatility effect is not the same. This is a clear indication that the short selling ban did not have a significant effect on intraday volatility. Furthermore, Figure II shows that the high volatility in the affected stocks continues after the removal of the ban. This reaction is likely driven by the results and rights issue announcement by the Royal Bank of Scotland on the first trading day after the removal of the ban.

Hence, we conclude that the even though intraday volatility was high in the banned stocks during parts of the period, this was likely not due to the imposed short selling regulation. If there was a volatility effect of the short selling ban, it was totally dominated by the general market turmoil in both banned stocks and in the control group. Hence, our results indicate that there is no strong effect on realized intraday stock return volatility caused by the ban, and our second hypothesis therefore cannot be validated.

C. Bid-ask spreads

Figure III and Table VI show that all measures of bid-ask spreads increased for the ban group as well as for the control group when the ban was imposed. However, the increase was significantly larger in the banned stocks.

[INSERT FIGURE III HERE]

[INSERT TABLE VI HERE]

The equal-weighted RES-1 for the banned stocks in the FTSE 350-index increased by 131% when the ban was imposed and the spreads in the control group increased by 55%. During the ban period, the spreads in the ban group were stable whereas the control group experienced a gradual increase. Spreads dropped significantly in both groups when the ban was lifted; once again the drop was significantly larger in the banned stocks. RES-1 dropped by 29% for the ban group and by 9% for the control group. The results are qualitatively consistent regardless of measure used and also for our alternative sample using the FTSE 100 constituents. As expected, the absolute values of TRES are larger than those of RES as larger transactions might have to dig deeper into the order book to find liquidity. These results clearly supports Hypothesis 3, that the bid-ask spreads were wider when short selling was not allowed.

[INSERT TABLE VII HERE]

The two-way fixed effects regressions results are found in Table VII. The ban-dummy coefficient is positive and significant at the 1% level, indicating wider spreads under the ban. The results are rather persuasive as the pattern is similar for all three bid-ask measures, for a split ban period, as well as for our two sample group specifications. The RES-1 ban dummy

coefficient, with the entire ban period represented by a single ban-dummy, indicates that the average spread was approximately 25% higher for the banned stocks during the ban.

Our results are in line with the findings of Clifton and Snape (2008), Boehmer et al. (2008b) and FSA (2009), but arguably more rigorously backed than previous research on the U.K. ban. Altogether, we find strong evidence supporting Hypothesis 3 that bid-ask spreads increased under the ban.

D. Volume

As shown in Figure IV and Table VIII, the volume of shares traded and the daily number of transactions were significantly reduced for the restricted stocks during the ban period. The average traded volume as percentage of shares outstanding decreased by 24% for the banned stocks when the ban was imposed whereas trading volumes actually increased during the first half of the period for the control group. From Ban 1 to Ban 2 there was a market-wide decrease in trading activity, it is somewhat more accentuated for the banned stocks (-46% vs. -33% for the control group). Although the graph in Figure IV does not account for company specific characteristics, a widening of the gap in traded volume between the ban group and the control group during the ban period is evident.

[INSERT FIGURE IV HERE]

[INSERT TABLE VIII HERE]

When accounting for company and time-specific characteristics in our two-way fixed effects regression model, the pattern for the traded volume is clearly the same, as shown in Table IX. The regression results indicate that the average daily traded volume was approximately 70% lower for the banned stocks during the ban period when controlling for these characteristics. This result is partially due to the fact that the traded volume in the ban group was substantially reduced during the ban period while the traded volume in the control group experienced an initial increase.

[INSERT TABLE IX HERE]

A substantial part of this reduction in traded volume is simply a mechanical effect of traders with a negative view (but no shares to sell) being shut out of the market. The extraordinary market

conditions prevailing during and around the ban period probably also affected the trade volumes. However, the consistency of our results when comparing both to a turbulent period before the ban and cross-sectionally shows that the ban effect is significant. As expected, the number of transactions also displays a drastic decrease during the ban period. The average transaction size is significantly reduced for the banned stocks in the more actively traded FTSE 100-group. In summary, our results provide strong evidence supporting our fourth hypothesis i.e., that the traded volume decreased. This is also consistent with the assumption that transactions involving short sellers accounted for a sizable part of the traded volume in the affected shares.

IV. Concluding remarks

This paper examines the effects on market quality of the 2008-09 U.K. short selling ban in financial stocks. The effects on 26 banned stocks in the FTSE 350 are analyzed by testing four hypotheses on the impact on abnormal returns, intraday volatilities, bid-ask spreads, and volumes. The results are largely in line with preliminary assessments of the U.S. and U.K. bans. However, our results are considerably more rigorous as we use multiple testing techniques, more comprehensive measures, and include the entire ban period as well as a post-ban control period.

The hypothesis that abnormal returns increased when investors with a negative view were shut out of the market is not validated. Strongly positive abnormal returns were present, but not persistent, when the ban was imposed. However, the effect was likely not so much a direct effect of the short sales ban, but a signaling effect that authorities were taking actions. Furthermore, no clear pattern with regards to how intraday volatility reacted to the ban is found. As expected, the level of noise in stock returns (and thus in return volatility) during the financial turmoil was extremely high. Needless to say, the extraordinary market movements and extreme fluctuations in individual stocks throughout the studied period make it difficult to isolate the effects of the ban. Nevertheless, we do find strong evidence of widening bid-ask spreads when the short-selling ban was active. This finding is in line with what could be expected based on research on previous similar events. However, in this paper we add rigorously proven evidence for the 2008-09 events on the U.K. market. As expected, we also find strong evidence of a decrease in volumes during the ban period, since a not insignificant fraction of the trades under normal conditions are disallowed due to the ban.

Regarding the aims of the FSA, we find no evidence of calmer market conditions (measured by volatility) or protection of the "quality" of the market (measured by bid-ask spreads and volumes). On the contrary, we find a significant deterioration in market quality. Whether the number of failed banks would have been even larger and market anxiety even worse had the ban not been imposed, is impossible to determine. However, the ban did manage to shift some of the blame for the financial crisis to short sellers and the FSA did indeed "get Shorty".

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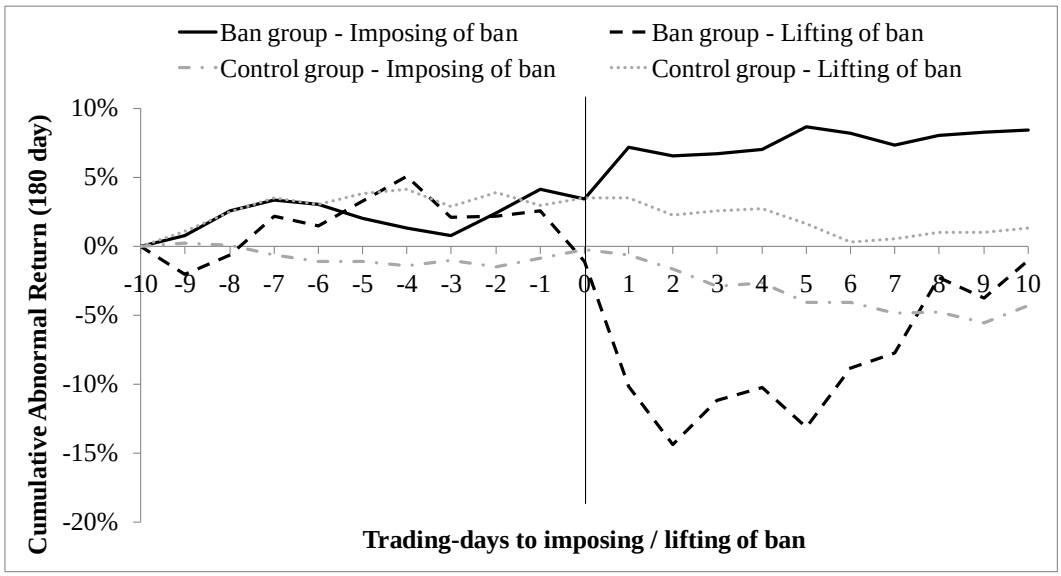
Figure I

Cumulative Abnormal Return: Around event dates and for entire sample period

Panel A reports equal-weighted average cumulative abnormal returns for the ban group 10 days before and after the ban was imposed and lifted. Panel B reports equal-weighted average cumulative abnormal returns for the entire sample period for the ban group and the control group. On any given day the cumulative abnormal return is the cumulated daily differences between the actual return and the expected return of a stock given the OLS-parameters estimated in a window 180 days prior to the first day of our sample period and the market return (FTSE All Share). The sample period ranges from July 10, 2008 to March 27, 2009 and includes 50 trading days prior to the ban, 83 trading days during the ban and 50 trading days after the ban. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The start and end dates of the ban are marked by vertical lines.

Panel A:



Panel B:

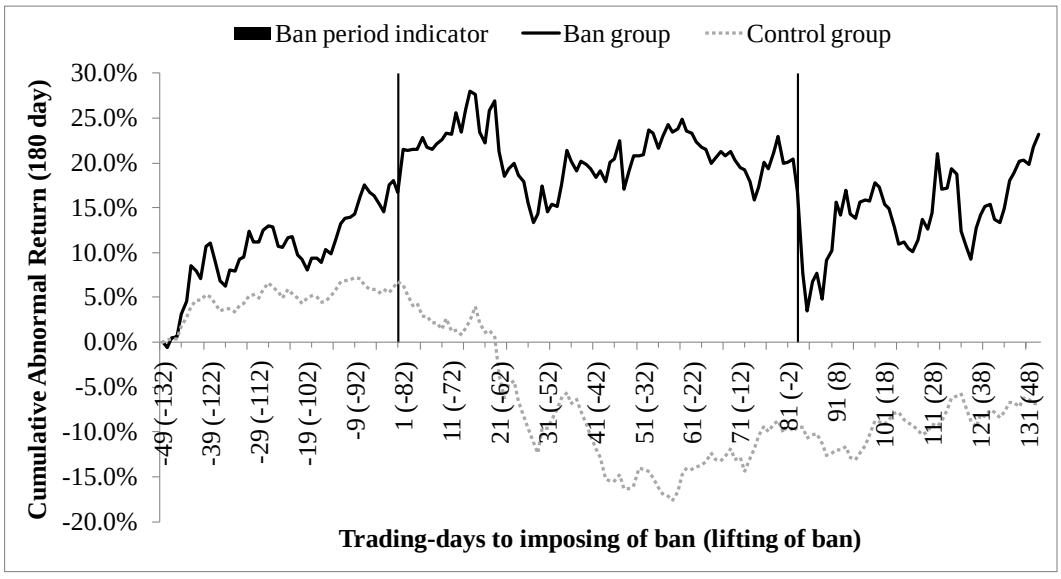


Table I

Abnormal Return: Averages & Paired t-tests

The table reports equal-weighted average abnormal returns, market adjusted abnormal returns and paired t-tests. On any given day the abnormal return is the difference between the actual return and the expected return of a stock given the OLS-parameters estimated in a window 180 days prior to the first day of our sample period and the market return (FTSE All Share). The market adjusted return is the difference between the market return and the return of the stock. Paired t-tests are used to compare the ban group to the control group. "Difference" measures the difference between the ban group and the control group and its statistical significance using a paired t-test. The sample consists of 344 FTSE 350-constituents (26 banned). Delisted stocks and stocks with insufficient data have been removed. "Pre ban" and "Post ban" represent the 50 trading-days prior to and after the ban period, respectively. "Ban 1" and "Ban 2" denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote standard deviations while *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Abnormal return (180 day)				**Market adjusted return**			
	Pre ban	Ban 1	Ban 2	Post ban	Pre ban	Ban 1	Ban 2	Post ban
Ban group	0.315	0.005	-0.037	0.013	0.166	-0.222	-0.127	0.019
	(2.870)	(6.033)	(4.728)	(6.589)	(3.021)	(5.988)	(4.606)	(6.747)
Control group	0.144	-0.456	0.059	0.053	0.122	-0.468	0.029	0.026
	(3.057)	(4.828)	(4.396)	(3.932)	(3.084)	(4.820)	(4.395)	(3.955)
Difference	0.171	0.461	-0.097	-0.041	0.044	0.246	-0.156	-0.007
t-value	0.96	1.88*	-0.37	0.19	0.20	0.91	-0.71	-0.02

Table II

Abnormal Return: Two-way Fixed Effects Regressions

The table contains the results of fixed effects regressions on abnormal returns and market adjusted returns with a ban dummy as explanatory variable. On any given day the abnormal return is the difference between the actual return and the expected return of a stock given the OLS-parameters estimated in a window 180 days prior to the first day of our sample period and the market return (FTSE All Share). The market adjusted return is the difference between the market return and the return of the stock. The ban dummy is 1 for banned stocks when the ban is active. Late additions to the ban list (7 stocks) are catered for with the time-variant ban dummy. The sample consists of 353 FTSE 350-constituents (26 banned). Delisted stocks are included until delisting (9 stocks) whereas stocks with insufficient data have been removed (3 stocks). ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote t-values while *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	FTSE 350			**FTSE 100**		
	Entire ban	Ban 1	Ban 2	Entire ban	Ban 1	Ban 2
AR (180 days)	0.043	0.306	-0.217	-0.131	0.034	-0.292
	(0.34)	(1.93)*	(-1.37)	(-0.86)	(0.18)	(-1.55)
MAR	0.000	0.178	-0.177	-0.160	-0.071	-0.247
	(-0.00)	(1.11)	(-1.11)	(-1.02)	(-0.36)	(-1.31)

Table III

Asymmetric betas: Regression results and development over time

The table contains the up- and down betas for regressions on the ban group for four different time periods and the related Wald tests. Stock returns of the banned stocks are regressed on the market return (FTSE All Share). β+ is activated when the market goes up and β- is activated when the market goes down. The sample consists of the 26 FTSE 350-constituents on the ban list. Delisted stocks are included until delisting (2 stocks). ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Significance is indicated by *, **, and *** at the 10%, 5% and 1% levels, respectively.

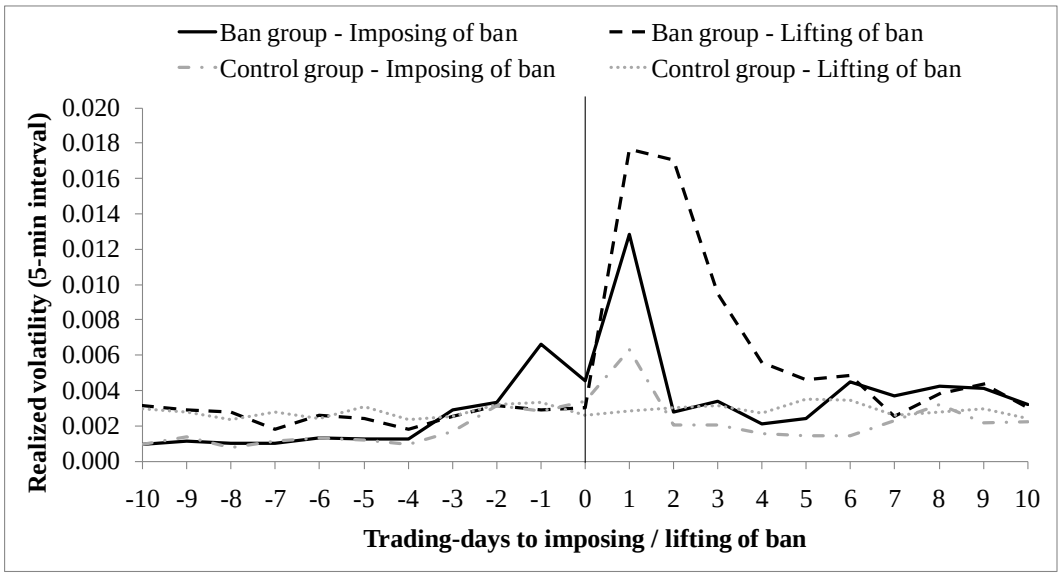
	β+				**β-**			
	Pre ban	Ban 1	Ban 2	Post ban	Pre ban	Ban 1	Ban 2	Post ban
Indicator coefficient	2.11	1.20	0.94	2.10	1.37	1.09	0.90	1.62
t-statistic	13.53***	16.97***	9.80***	16.16***	10.37***	18.21***	8.36***	12.47***
	Difference β+, β-							
		Ban 1	Ban 2	Post ban				
Pre ban		0.63	0.71	0.26				
Chi²-statistic		8.53***	9.09***	1.06				
Ban 1			0.08	-0.37				
Chi²-statistic			0.63	3.59*				
Ban 2				-0.45				
Chi²-statistic				4.21**				

Figure II

Realized Intraday Volatility: Around Event Dates and for Entire Sample Period

Panel A reports equal-weighted average realized intraday stock return volatilities for the ban group and the control group 10 days before and after the ban was imposed and lifted. Panel B reports equal-weighted average traded realized intraday volatilities for the entire sample period for the ban group and the control group. The volatilities are calculated as the sum of the squared five-minute stock return. The sample period ranges from July 10, 2008 to March 27, 2009 and includes 50 trading days prior to the ban, 83 trading days during the ban and 50 trading days after the ban. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The start and end dates of the ban are marked by vertical lines.

Panel A:



Panel B:

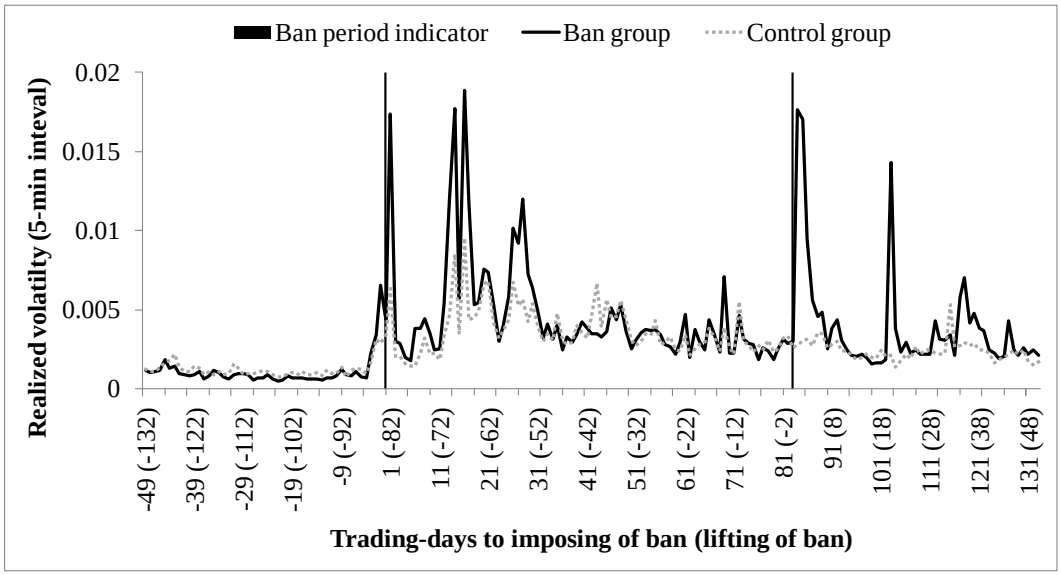


Table IV

Volatility: Averages & Paired t-tests

The table reports average values and paired t-test statistics for realized intraday stock return volatility. The time indicators refer to the granularity of returns from which the volatility is calculated. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The t-values reported in the "% change"-columns represent paired t-test statistics for the time periods in the adjacent columns. "Pre ban" and "Post ban" represent the 50 trading-days prior to and after the ban period, respectively. "Ban 1" and "Ban 2" denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote standard deviations whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Pre ban	% change	Ban 1	% change	Ban 2	% change	Post ban
				Ban group			
Realized volatility (5-min)	0.00113	430.5%	0.00600	-45.2%	0.00329	20.2%	0.00395
	(0.00195)	t = 8.54***	(0.00899)	t = -5.21***	(0.00337)	t = 0.68	(0.01357)
Realized volatility (10-min)	0.00103	379.4%	0.00494	-45.6%	0.00269	28.5%	0.00345
	(0.00190)	t = 8.43***	(0.00761)	t = -5.38***	(0.00270)	t = 0.93	(0.01202)
				Control group			
Realized volatility (5-min)	0.00125	218.8%	0.00400	-39.7%	0.00337	-28.5%	0.00241
	(0.00190)	t = 12.70***	(0.00767)	t = -3.38***	(0.00986)	t = -4.81***	(0.00904)
Realized volatility (10-min)	0.00110	216.7%	0.00348	-17.3%	0.00288	-27.2%	0.00209
	(0.00165)	t = 12.69***	(0.00696)	t = -4.14***	(0.00822)	t = -4.49***	(0.00955)

Table V

Volatility: Two-way Fixed Effects Regressions

The table contains the results of fixed effects regressions on the logarithm of realized intraday stock return volatilities with a ban dummy as explanatory variable. The ban dummy is 1 for banned stocks when the ban is active. Late additions to the ban list (7 stocks) are catered for with the time-variant ban dummy. The time indicators of the volatility refer to the granularity of returns from which the volatility is calculated. The sample consists of 356 FTSE 350-constituents (26 banned). Delisted stocks are included until delisting (9 stocks) whereas stocks with insufficient data have been removed (3 stocks). ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote t-values whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

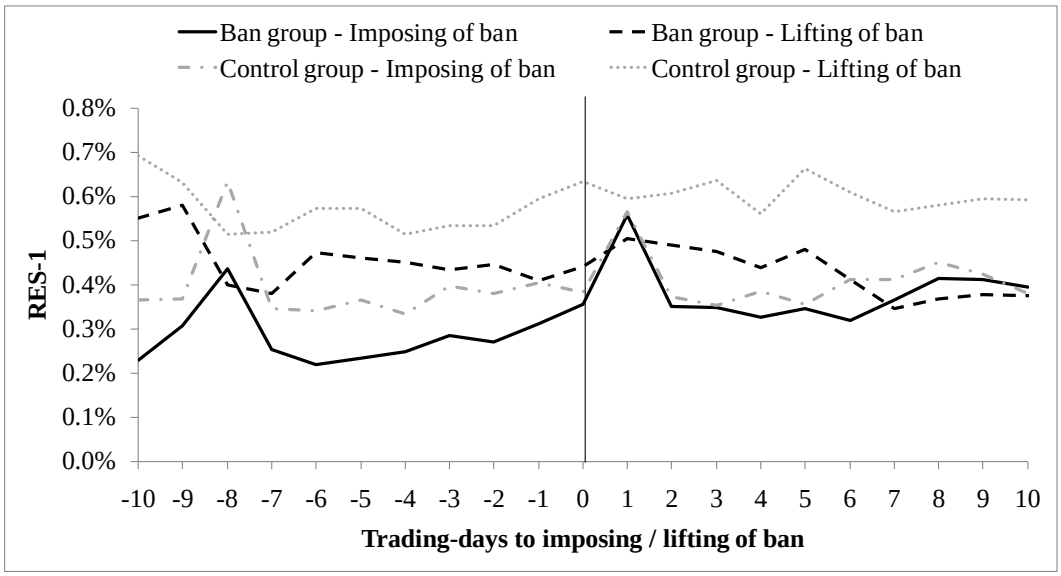
	FTSE 350			**FTSE 100**		
	Entire ban	Ban 1	Ban 2	Entire ban	Ban 1	Ban 2
Realized volatility (5-min)	0.165	0.269	0.062	0.026	0.107	-0.054
	(8.59)***	(11.23)***	(2.61)***	(1.32)	(4.41)***	(-2.22)***
Realized volatility (10-min)	0.102	0.213	-0.007	-0.041	0.050	-0.129
	(5.12)***	(8.57)***	(-0.30)***	(-1.99)**	(1.97)**	(-5.13)***

Figure III

Relative Effective Spread: Around Event Dates and for Entire Sample Period

Panel A reports equal-weighted relative effective spreads for the ban group and the control group 10 days before and after the ban was imposed and lifted. Panel B reports equal-weighted relative effective spreads as a percentage of shares outstanding for the entire sample period for the ban group and the control group. RES is the equal-weighted Relative Effective Spread measured as twice the distance between the trade price and the quote midpoint 1 second before the trade divided by the quote midpoint. The sample period ranges from July 10, 2008 to March 27, 2009 and includes 50 trading days prior to the ban, 83 trading days during the ban and 50 trading days after the ban. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The start and end dates of the ban are marked by vertical lines.

Panel A:



Panel B:

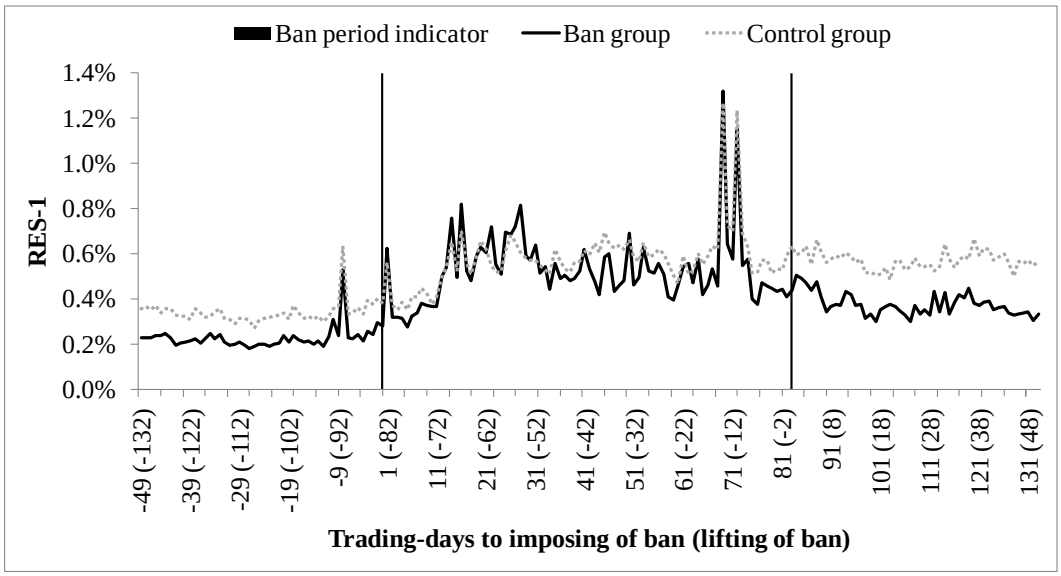


Table VI

Bid-Ask Spread: Averages & Paired t-tests

The table reports averages and paired t-test statistics for bid-ask spreads. RES is the equal-weighted Relative Effective Spread measured as twice the distance between the trade price and the quote midpoint before the trade divided by the quote midpoint expressed in percentages. TRES is the Trade-weighted Relative Effective Spread expressed in percentages. The time lag in seconds between the quote and the trade is indicated with 1 or 5. RQS is the time-weighted Relative Quoted Spread where each set of best quotes during the trading day is weighted with the time it is valid. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The t-values reported in the "% change"-columns represent paired t-test statistics for the time periods in the adjacent columns. "Pre ban" and "Post ban" represent the 50 trading-days prior to and after the ban period, respectively. "Ban 1" and "Ban 2" denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote standard deviations whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Pre ban	% change	Ban 1	% change	Ban 2	% change	Post ban
				Ban group			
RES-1	0.230	130.6%	0.530	0.6%	0.533	-29.4%	0.376
	(0.136)	t = 7.05***	(0.389)	t = 0.09	(0.497)	t = -3.21***	(0.226)
RES-5	0.250	123.7%	0.560	-1.5%	0.552	-92.7%	0.040
	(0.146)	t = 7.26***	(0.396)	t = -0.60	(0.496)	t = -3.05***	(0.235)
TRES-1	0.309	142.4%	0.749	-8.4%	0.686	-21.8%	0.536
	(0.325)	t = 8.08***	(0.812)	t = 2.40**	(0.722)	t = -2.48**	(0.630)
TRES-5	0.327	138.2%	0.778	-9.7%	0.702	-20.9%	0.556
	(0.322)	t = 7.97***	(0.828)	t = 2.86***	(0.723)	t = -2.43**	(0.636)
RQS	0.230	157.0%	0.592	8.8%	0.644	-34.3%	0.423
	(0.169)	t = 5.62***	(0.540)	t = 1.99*	(0.635)	t = -3.99***	(0.342)
				Control group			
RES-1	0.343	55.2%	0.532	17.9%	0.627	-8.9%	0.571
	(0.259)	t = 16.74***	(0.412)	t = 7.32***	(0.665)	t = -4.83***	(0.655)
RES-5	0.357	55.0%	0.554	16.4%	0.645	-9.1%	0.586
	(0.261)	t = 17.28***	(0.415)	t = 6.85***	(0.672)	t = -5.04***	(0.660)
TRES-1	0.413	61.7%	0.667	16.2%	0.775	-11.9%	0.683
	(0.396)	t = 20.37***	(0.607)	t = 6.42***	(1.050)	t = -5.53***	(1.260)
TRES-5	0.427	61.4%	0.689	15.1%	0.793	-12.1%	0.698
	(0.400)	t = 20.62***	(0.615)	t = 6.13***	(1.057)	t = -5.67***	(1.270)
RQS	0.386	63.7%	0.632	20.1%	0.760	-7.9%	0.700
	(0.308)	t = 17.05***	(0.528)	t = 7.30***	(0.851)	t = -4.32***	(0.773)

Table VII

Bid-Ask Spread: Two-way Fixed Effects Regressions

The table contains the results of two-way fixed effects regressions on the logarithms of relative effective bid-ask spreads and relative quoted spreads with a ban dummy as explanatory variable. RES is the logarithm of the equal-weighted Relative Effective Spread measured as twice the distance between the trade price and the quote midpoint before the trade divided by the quote midpoint. TRES is the logarithm of the Trade-weighted Relative Effective Spread. The time lag in seconds between the quote and the trade is indicated with 1 or 5. RQS is the logarithm of the time-weighted Relative Quoted Spread where each set of best quotes during the trading day is weighted with the time it is valid. The ban dummy is 1 for banned stocks when the ban is active, late additions to the ban list (7 stocks) are catered for with the time-variant ban dummy. The time indicators of the volatility refer to the granularity of returns from which the volatility is calculated. The sample consists of 356 FTSE 350-constituents (26 banned). Delisted stocks are included until delisting (9 stocks) whereas stocks with insufficient data have been removed (3 stocks). ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote t-values whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

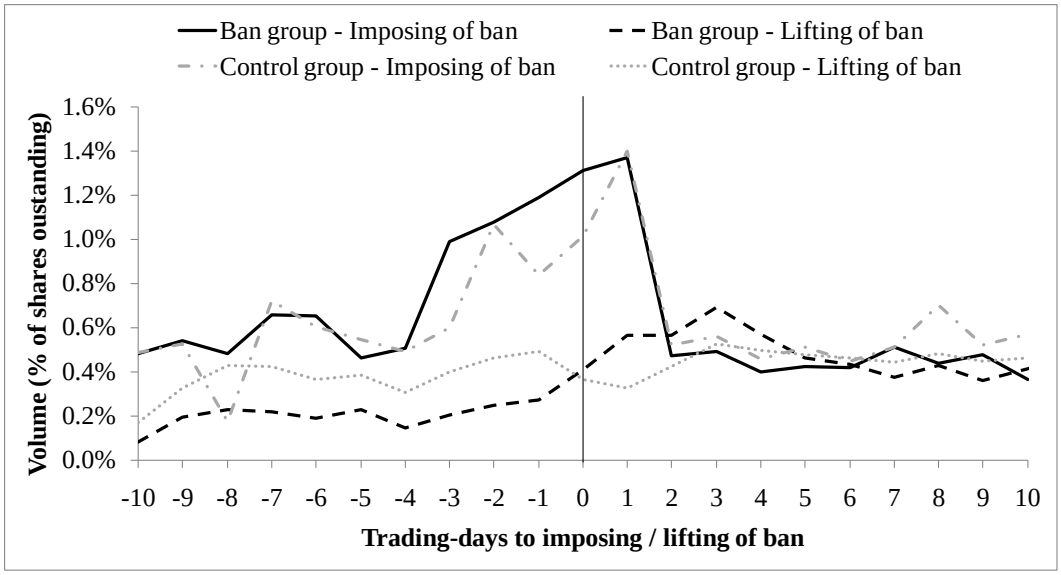
	FTSE 350			**FTSE 100**		
	Entire ban	Ban 1	Ban 2	Entire ban	Ban 1	Ban 2
RES-1	0.221	0.267	0.176	0.129	0.150	0.109
	(22.45)***	(21.75)***	(14.36)***	(11.21)***	(10.46)***	(7.65)***
RES-5	0.197	0.248	0.146	0.090	0.110	0.071
	(20.03)***	(20.23)***	(12.01)***	(8.09)***	(7.93)***	(5.14)***
TRES-1	0.200	0.268	0.133	0.126	0.149	0.104
	(13.56)***	(14.55)***	(7.27)***	(6.21)***	(5.89)***	(4.14)***
TRES-5	0.182	0.251	0.114	0.098	0.117	0.079
	(12.55)***	(13.89)***	(6.31)***	(5.03)***	(4.85)***	(3.28)***
RQS	0.268	0.274	0.262	0.190	0.154	0.226
	(28.70)***	(23.57)***	(22.56)***	(19.93)***	(12.96)***	(19.15)***

Figure IV

Volume: Around Event Dates and for Entire Sample Period

Panel A reports equal-weighted average traded volumes as a percentage of shares outstanding for the ban group and the control group 10 days before and after the ban was imposed and lifted. Panel B reports equal-weighted average traded volumes as a percentage of shares outstanding for the entire sample period for the ban group and the control group. The sample period ranges from July 10, 2008 to March 27, 2009 and includes 50 trading days prior to the ban, 83 trading days during the ban and 50 trading days after the ban. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The start and end dates of the ban are marked by vertical lines.

Panel A:



Panel B:

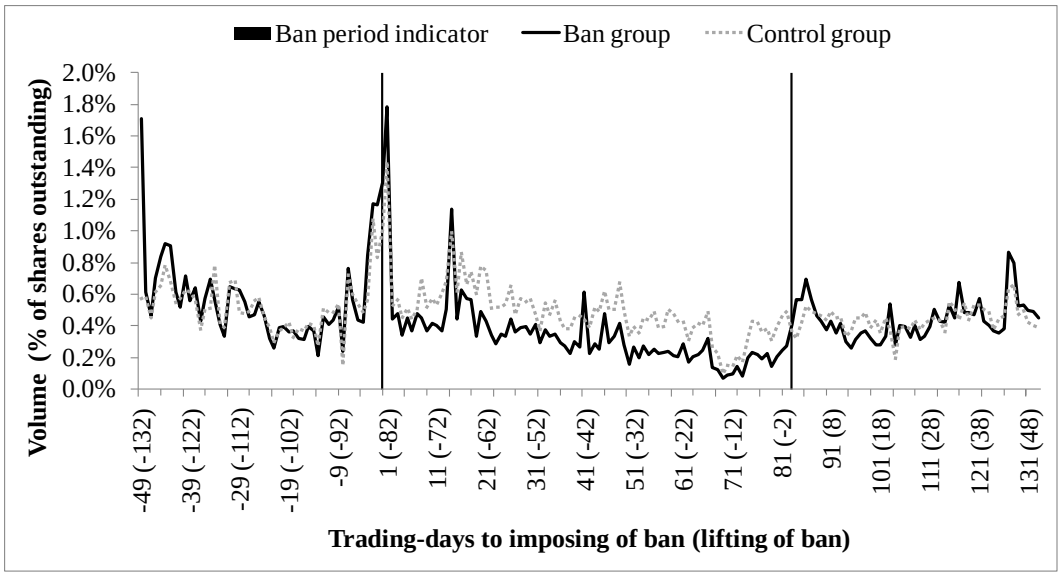


Table VIII

Volume: Averages & Paired t-tests

The table reports average values and paired t-test statistics for traded volume, trade size and number of transactions. Traded volume and average trade size are daily figures expressed as percentages of shares outstanding. The sample consists of 344 FTSE 350-constituents (23 banned). Delisted stocks and stocks with insufficient data have been removed. The t-values reported in the ”% change”-columns represent paired t-test statistics for the time periods in the adjacent columns. ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote standard deviations whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	Pre ban	% change	Ban 1	% change	Ban 2	% change	Post ban
				Ban group			
Traded volume	0.581	-24.3%	0.440	-46.4%	0.228	89.0%	0.443
	(0.956)	t = -2.56**	(0.629)	t = -5.19***	(0.209)	t = 5.28***	(0.403)
Trade size	0.00029	20.9%	0.00036	-24.4%	0.00027	-0.3%	0.00027
	(0.0004)	t = 1.12	(0.0012)	t = -1.98*	(0.0004)	t = -0.04	(0.0004)
Number of transactions	4864.3	-13.4%	4211.5	-38.2%	2602.4	73.5%	4514.9
	(6131.1)	t = -4.70***	(5761.9)	t = -3.11**	(4281.8)	t = 3.72***	(5869.2)
				Control group			
Traded volume	0.533	9.5%	0.584	-32.7%	0.393	13.0%	0.444
	(0.975)	t = 3.66***	(0.706)	t = -14.02***	(0.451)	t = 3.13**	(0.715)
Average trade size	0.00075	-11.3%	0.00066	9.5%	0.00073	34.9%	0.00098
	(0.0054)	t = -1.20	(0.0009)	t = -1.23	(0.0030)	t = 3.19***	(0.0069)
Number of transactions	1821.0	24.2%	2262.4	-28.1%	1626.8	6.9%	1739.7
	(2530.7)	t = 6.36***	(3623.0)	t = -11.34***	(2833.4)	t = -4.23***	(2797.7)

Table IX

Traded Volume, Trade Size and Number of Transactions: Two-way Fixed Effects Regressions

The table contains the results of two-way fixed effects regressions on the logarithm of traded volume, trade size and number of transactions with a ban dummy as explanatory variable. The ban dummy is 1 for banned stocks when the ban is active, late additions to the ban list (7 stocks) are catered for with the time-variant ban dummy. Traded volume and average trade size are daily figures expressed as logarithms of the percentage of shares outstanding. The time indicators of the volatility refer to the granularity of returns from which the volatility is calculated. The sample consists of 356 FTSE 350-constituents (23 banned). Delisted stocks are included until delisting (9 stocks) whereas stocks with insufficient data have been removed (3 stocks). ”Pre ban” and ”Post ban” represent the 50 trading-days prior to and after the ban period, respectively. ”Ban 1” and ”Ban 2” denote the first (41 days) and second (42 days) half of the ban period, respectively. Parentheses denote t-values whilst *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

	FTSE 350			**FTSE 100**		
	Entire ban	Ban 1	Ban 2	Entire ban	Ban 1	Ban 2
Traded volume	-0.559	-0.469	-0.648	-0.588	-0.505	-0.669
	(-30.17)***	(-20.30)***	(-28.18)***	(-36.17)***	(-24.98)***	(-33.36)***
Trade size	-0.073	0.001	-0.146	-0.115	-0.054	-0.175
	(-5.25)***	(0.06)	(-8.48)***	(-11.73)***	(-4.41)***	(-14.47)***
Number of transactions	-0.486	-0.470	-0.503	-0.473	-0.452	-0.494
	(-35.41)***	(-27.43)***	(29.46)***	(-37.25)***	(-28.55)***	(-31.50)***