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How does short selling affect liquidity in financial markets?

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A B S T R A C T

The paper seeks to determine whether short selling increases or decreases liquidity in U.S. equity markets. On one hand, prior research indicates that short sellers may act, at times, as liquidity providers. On the other hand, other research in market microstructure argues that spreads will widen in the presence of informed traders – a classification generally given to short sellers. Results from a series of new, multivariate time-series tests show that exogenous shocks to short selling activity generally lead to a widening of bid-ask spreads in smaller-cap stocks. The results, however, do not hold for larger-cap stocks.

1. Introduction

The positive and negative externalities associated with short selling have been widely debated by policy makers and regulators. The general consensus in the academic literature, however, is that short selling provides an important mechanism through which financial markets become informationally efficient.[1] Still, a growing debate in the literature has emerged about the association between short selling and liquidity. In this study, we aim to contribute to this debate by conducting a series of new, multivariate time-series tests to determine (i) whether the association is positive or negative and (ii) the direction of causation.

Much of the literature documents the role that short sellers play as arbitrageurs of temporary mispricing (Diether et al., 2009a). However, a growing number of studies have begun to examine how short sellers contribute to the provision of liquidity. Diether et al. (2009a) provide a nice description of this role by suggesting that some liquidity providers may be willing to short stocks to supply liquidity during bullish periods. Their empirical tests seem to confirm this intuition as short selling is unusually high after periods of positive returns. The role of short selling in liquidity provision can also be more subtle. Other studies have shown that short selling is an important determinant of liquidity in options markets (Evans et al., 2009; Battalio and Schultz, 2011). Existing rules set forth by the U.S. Securities and Exchange Commission (SEC) constrain short selling less for those that are considered bonafide market makers indicating that, at a minimum, regulators believe that short sales are an important part of liquidity provision.

While there are some studies that seem to highlight the positive role that short sellers play in providing liquidity to financial markets, other studies suggest the opposite. Theory in Brunnermeier and Pedersen (2005) shows that predatory traders may front run those that are attempting to liquidate their positions by using short sales. This type of front running results in less liquidity when

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[1] See, for example, Miller (1977), Diamond and Verrecchia (1987), Aitken et al. (1998), Dechow et al. (2001), Desai et al. (2002), Chang et al. (2007), Bris et al. (2007), Boehmer et al. (2008), Diether et al. (2009a,b), Saffi and Sigurdsson (2011), Blau (2012), Blau et al. (2012), Engelberg et al. (2012), Boehmer and Wu (2013), Kolasinski et al. (2013), Grullon et al. (2015) and Kelley and Tetlock (2017).

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liquidity is needed most. Shkilko et al. (2012) provide some empirical support for these arguments. A larger branch of microstructure literature seems to suggest that, in the presence of informed trading, liquidity providers will widen bid-ask spreads (Glosten and Milgrom, 1985; Kyle, 1985). To the extent that equity borrowing costs crowd out uninformed investors, only those with the most information will tend to use short sales. In this case, short selling may be associated with wider bid-ask spreads and subsequently less liquidity. In light of this debate in the literature, the objective of our study is to determine whether or not short selling improves or deteriorates liquidity in financial markets.

Determining the causal relationship between short selling and liquidity is problematic given the endogeneity between the two. Accordingly, we conduct a variety of new multivariate time-series tests where we treat both short selling activity and liquidity as endogenous. Using a vector autoregressive process, we estimate the impulse responses of traditional measures of market quality to exogenous shocks in daily short selling activity. The underlying assumptions of our modeling appear to hold as the results from these tests indicate that changes in short selling Granger-cause changes in liquidity instead of the other way around. We are quick to note, however, that this is only true for smaller-cap stocks and that for mid- and large-cap stocks, the Granger causality tests are not definitive.

The results from our analyses show that exogenous shocks to daily changes in short selling activity are associated with an increase in changes in various measures of bid-ask spreads but only in the small-cap portfolio. We do not find that shocks to short selling influence liquidity in larger-cap stocks. In light of our Granger causality tests, these results are somewhat expected. We further note that our results are robust to scaling short sale volume by total trade volume or by shares outstanding. We also find that our results are robust to both effective bid-ask spreads and quoted bid-ask spreads. The implications from our study add to the general debate about advantages and disadvantages of short selling by suggesting that, for smaller stocks, unusual short selling activity seems to harm liquidity. These results tend to support microstructure theory that suggests that market makers will widen spreads in the presence of informed traders.

2. Data description

The data is obtained from two sources. The quotes are obtained from the NYSE's Trades and Quotes (TAQ) database. The data consist of all trades and quotes for securities listed on the NYSE, NASDAQ, and the regional exchanges. The short sale data is obtained from the U.S. Securities and Exchange Commission (SEC) as part of the Regulation SHO Pilot Program. The pilot program only ran from January 2005 to the first part of 2007. Therefore, we restrict our sample time period to the 503 trading days during the calendar years of 2005 and 2006. Furthermore, we restrict our sample to the universe of securities listed on the NYSE or on NASDAQ. Summary statistics for our sample are reported in Table 1. Since both the amount and impact of short selling are related to the size of the firm, we divide our sample by market capitalization with small-cap stocks reported in Panel A, mid-cap stocks reported in Panel B, and large-cap stocks reported in Panel C. The small-cap portfolio consists of 1978 unique stocks in the lowest quintile based on market capitalization. The mid-cap portfolio consists of 4546 stocks in the middle three market capitalization quintiles and the large-cap portfolio consists of 1470 stocks in the top market capitalization quintile. Portfolios are resorted daily. We have two main variables of interest. First, relative short selling (RELSS) is the daily amount of aggregated short volume (across all stocks in a particular portfolio) scaled by the daily amount of aggregated total trade volume. Second, short turnover (SH_TURN) is the daily short volume scaled by the shares outstanding (in percent). In addition to our measures of short selling, we also examine two measures of

Table 1

Summary statistics. The table shows statistics that summarize the sample. We report the relative short selling (RELSS), which is the daily amount of aggregated short volume scaled by the daily amount of aggregated total trade volume. Short turnover (SH_TURN) is the daily short volume scaled by the shares outstanding (in percent). E.SPRD is the daily effective spread obtained by averaging the effective spread across each day. Similarly, Q.SPRD is the daily quoted spread – again obtained by averaged the quoted spreads across each day. We report the various statistics for each of the three portfolios. The small-cap portfolio consists of stocks in the lowest quintile based on market capitalization. The mid-cap portfolio consists of stocks in the middle three market cap quintiles. The large-cap portfolio consists of stocks in the top, market cap quintile.

	Mean [1]	Std. Deviation [2]	Min [3]	Median [4]	Maximum [5]
Panel A. Small-Cap Portfolio (1978 securities)					
RELSS	0.1452	0.0302	0.0492	0.1430	0.3522
SH_TURN	0.9632	0.3621	0.2456	0.9128	3.6519
E.SPRD	0.0163	0.0023	0.0111	0.0160	0.0300
Q.SPRD	0.0191	0.0082	0.0126	0.0183	0.1600
Panel B. Mid-Cap Portfolio (4546 securities)					
RELSS	0.2886	0.0352	0.0712	0.2896	0.5173
SH_TURN	2.6109	0.7030	0.5913	2.5314	10.9343
E.SPRD	0.0031	0.0004	0.0021	0.0031	0.0045
Q.SPRD	0.0038	0.0012	0.0026	0.0037	0.0203
Panel C. Large-Cap Portfolio (1470 securities)					
RELSS	0.2530	0.0230	0.0548	0.2558	0.3505
SH_TURN	1.7762	0.3439	0.4768	1.7553	3.2445
E.SPRD	0.0006	0.0001	0.0005	0.0006	0.0008
Q.SPRD	0.0008	0.0001	0.0006	0.0008	0.0028

Table 2

Granger-causality tests – Wald statistics. The table presents the results from several Granger causality tests. Here, we report the Wald statistics that test the null hypothesis that causation does not flow from some variable X to some variable Y (X→Y). When the Wald statistic is sufficiently large, we are able to reject the notion that the direction of causation does not flow from X to Y. Below, we report the statistics with the corresponding p-values in parentheses. As before, we include in our analysis, ΔE.SPRD, which is the change in the daily effective spread; ΔQ.SPRD, which is the change in the daily quoted spread; ΔRELSS, which is the change in relative short selling; and ΔSH_TURN, which is the change in short turnover. We do so for various combinations for short selling and liquidity measures. We also report the results for the small-cap, the mid-cap, and the large-cap portfolios. There are 1978 unique stocks in the small-cap portfolio, 4546 unique stocks in the mid-cap portfolio, and 1470 unique stocks in the large-cap portfolio. The number of daily observations used in the tests is 503.

	Small-Cap Portfolio [1]	Mid-Cap Portfolio [2]	Large-Cap Portfolio [3]
Panel A. Granger Causality Tests – Short Selling and Effective Spreads			
ΔRELSS→ΔE.SPRD	17.79***	10.59**	5.48
	(0.0005)	(0.0141)	(0.1397)
ΔE.SPRD→ΔRELSS	3.57	6.81*	2.77
	(0.3113)	(0.0783)	(0.4290)
ΔSH_TURN→ΔE.SPRD	20.58***	14.85***	5.04
	(0.0001)	(0.0020)	(0.1686)
ΔE.SPRD→ΔSH_TURN	1.95	7.95**	3.25
	(0.5828)	(0.0471)	(0.3540)
Panel B. Granger-Causality Tests – Short Selling and Quoted Spreads			
ΔRELSS→ΔQ.SPRD	55.47***	18.48***	3.21
	(< 0.0001)	(0.0004)	(0.3608)
ΔQ.SPRD→ΔRELSS	2.80	0.46	1.58
	(0.4227)	(0.9281)	(0.6644)
ΔSH_TURN→ΔQ.SPRD	61.58***	67.22***	2.34
	(< 0.0001)	(< 0.0001)	(0.5043)
ΔQ.SPRD→ΔSH_TURN	2.32	2.88	0.33
	(0.5080)	(0.4105)	(0.9544)

liquidity. E.SPRD is the time-weighted, effective spread obtained by averaging the effective spread across each day for each stock and Q.SPRD is the time-weighted, quoted spread – again obtained by averaging the quoted spread at the daily level.[2]

As reported in Column [1], the average amount of short selling is highest for mid-cap stocks and lowest for small-cap stocks, for both RELSS and SH_TURN. We also note that, as expected, liquidity is monotonically decreasing in firm size with the largest relative spreads for small-cap stocks.[3]

3. Empirical results

3.1. Granger-causality tests

Before determining how liquidity responds to shocks to short selling, we must first ascertain some inferences about the direction of causation. To do so, we conduct a series Granger-causality tests, which are reported in Table 2. Panel A of Table 2 examines the relation between short selling and effective spreads and Panel B of Table 2 reports the results for Granger-causality tests with respect to short selling and quoted spreads. Both panels are separated into the three size portfolios with small-cap stocks in Column [1], mid-cap stocks in Column [2], and large-cap stocks in Column [3]. We report Wald statistics with their corresponding p-values in parentheses. When Wald statistics are sufficiently large, we are able to reject the null hypothesis that X does not Granger-cause Y. For example, the first row in Panel A of Table 1 reports the Granger-causality tests for ΔRELSS→ΔE.SPRD. The corresponding Wald statistic for the small-cap portfolio is 17.79 with a p-value of 0.0005, indicating that changes in RELSS Granger cause changes in E.SPRD. When the Wald statistic is not sufficiently large, we fail to reject the null that X does not Granger cause Y. For example, the Wald statistic in the second row (ΔE.SPRD→ΔRELSS) is only 3.57 and not statistically significant, suggesting that ΔE.SPRD does not influence ΔRELSS more than lagged changes in RELSS and indicates that ΔRELSS is independent. Thus, the Granger-causality tests between ΔRELSS and ΔE.SPRD are consistent with the idea that changes in short selling lead to changes in liquidity for small-cap stocks. This is an important finding given that there are competing ideas about the relation between short selling and liquidity. For the small-cap portfolio in panel B, we find similar results when examining the relation between ΔSH_TURN and ΔE.SPRD, with a Wald statistic of 20.58 for ΔSH_TURN→ΔE.SPRD, significant at the 0.01 level and an insignificant Wald statistic for ΔE.SPRD→ΔSH_TURN.

It is less clear for mid-cap stocks as Wald statistics are significant in both directions suggesting that, for mid-cap stocks, changes in spreads lead to changes in short selling and changes in short selling also lead to changes in spreads. The causality appears to flow both ways. However, this is only true in panel A. In panel B, we find significant Wald statistics for ΔRELSS→ΔQ.SPRD and ΔSH_TURN→ ΔQ.SPRD but not for ΔQ.SPRD→ΔRELSS and ΔQ.SPRD→ΔSH_TURN. Combined, the results for the mid-cap portfolio offer weak

[2] We note that, as expected, there is less turnover in the large-cap portfolio than in the other portfolios. We further note that the effective spread is equal to 2 × |trade price – midpoint|. The quoted spread is the difference between the ask price and the bid price, scaled by the spread midpoint.

[3] In unreported results, we estimate univariate correlations between are spread and short selling measures. In general, we find a strong, positive correlation between spreads and short selling. For instance, the correlation between E.SPRD and RELSS ranges from .24 to .35 depending on the portfolio of stocks.

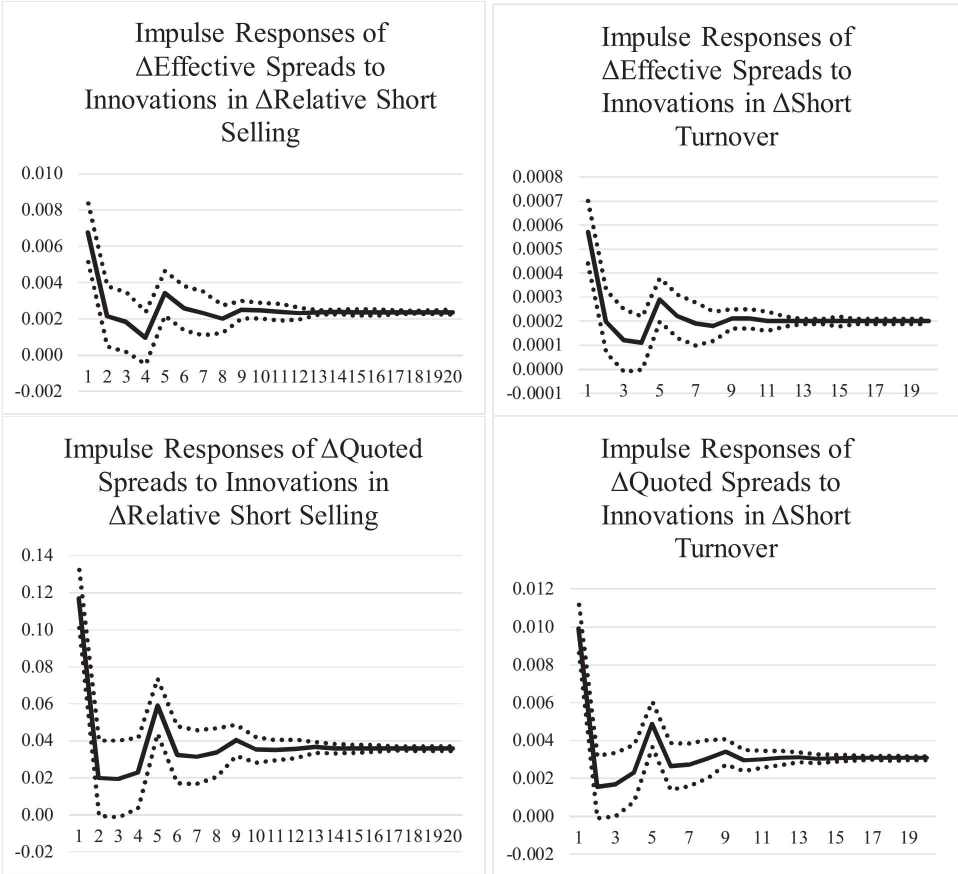

Fig. 1. The figure shows the accumulated impulse responses of daily changes (from day t + 1 to t + 20 on x-axes) in effective spreads (upper panels) and quoted spreads (lower panels) to a one standard deviation shock to changes in short selling in the small-cap portfolio using a vector autoregressive process with three lags (VAR(3)). The solid line is the impulse response functions while the dotted lines represent one-standard deviation bands surrounding the impulse responses. The left panels show the impulse responses to innovations in changes in relative short selling while the right panels show the impulse responses to innovations in changes in short turnover. The number of daily observations used in the analysis is 503.

support that changes in short selling lead to changes in spreads. In contrast, none of the Wald statistics are statistically significant for the large-cap portfolio. These results seem to suggest that short selling and spreads are independent for large cap stocks with no support for causality in either direction. These results are consistent in panel B when we look at quoted spreads. Thus, the tests for the mid-cap and large-cap portfolios do not give us a clear indication of the causal direction.

3.2. Vector autoregressions and impulse response functions

In order to further examine the relation between short selling and liquidity, we estimate the following, generalized version of a vector autoregressive model.

$$\begin{bmatrix} \Delta SHORTS_{i,t} \\ \Delta SPRDS_{i,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \beta_{11}^1 & \beta_{12}^1 \\ \beta_{21}^1 & \beta_{22}^1 \end{bmatrix} \begin{bmatrix} \Delta SHORTS_{i,t-1} \\ \Delta SPRDS_{i,t-1} \end{bmatrix} + \ldots + \begin{bmatrix} \beta_{11}^j & \beta_{12}^j \\ \beta_{21}^j & \beta_{22}^j \end{bmatrix} \begin{bmatrix} \Delta SHORTS_{i,t-j} \\ \Delta SPRDS_{i,t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix} \tag{1}$$

Here, we note that the dependent variables include either of our two measures of short selling and either of our two measures of bid-ask spreads. We treat these variables as endogenous and after measuring the time-series relationship between them, we impose a one standard deviation shock in the error term ε_1 and then examine the impulse responses of bid-ask spreads. As before, we examine changes in our short selling measures and spreads to ensure stationarity. We also allow for j lags. We find that when $j = 3$, the endogenous variables are both stationary and exhibit the lowest Akaike Information Criteria scores. Therefore, we report the results when $j = 3$ although similar results are found when we include different numbers of lags ($j = 1, 2, 4, 5$, and 10).[4] In the tests that follow, we report three figures, with four panels per figure.

[4] We also report the accumulated impulse response functions although similar conclusions can be drawn when we estimate the simple responses or the orthogonalized responses.

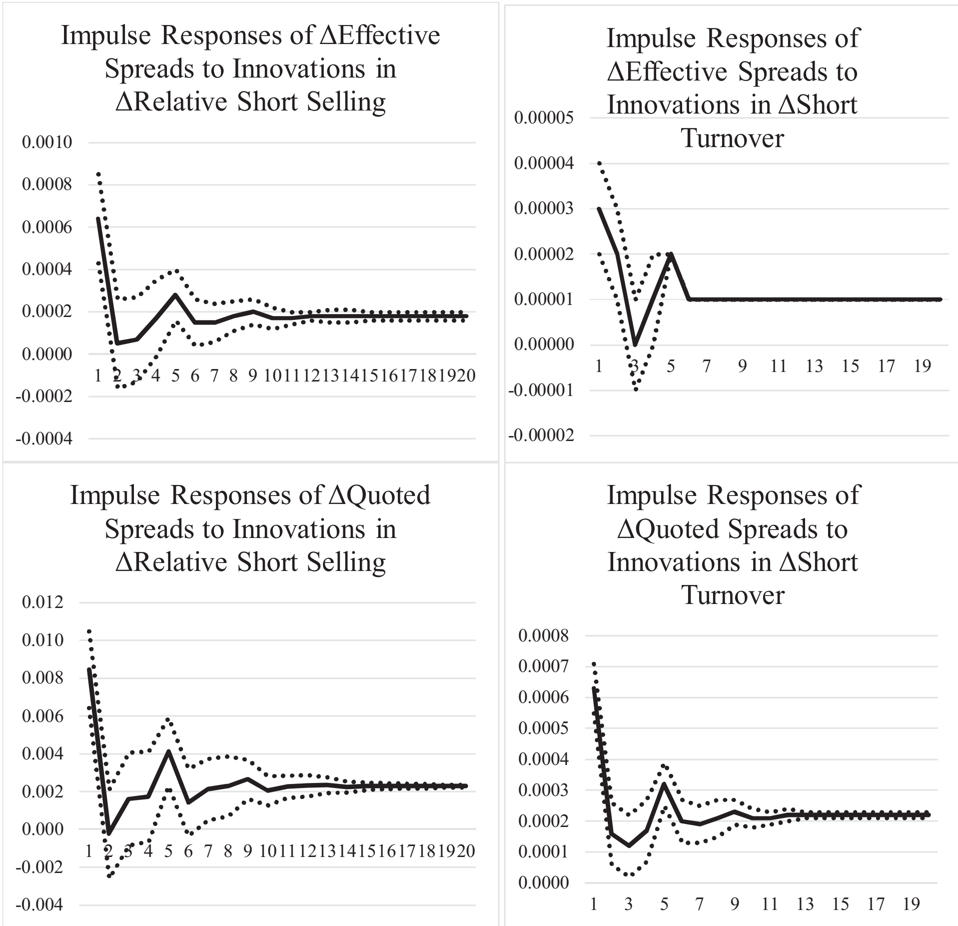

Fig. 2. The figure shows the accumulated impulse responses of daily changes (from day t + 1 to t + 20 on x-axes) in effective spreads (upper panels) and quoted spreads (lower panels) to a one standard deviation shock to changes in short selling in the mid-cap portfolio using a vector autoregressive process with three lags (VAR (3)). The solid line is the impulse response functions while the dotted lines represent one-standard deviation bands surrounding the impulse responses. The left panels show the impulse responses to innovations in changes in relative short selling while the right panels show the impulse responses to innovations in changes in short turnover. The number of daily observations used in the analysis is 503.

Fig. 1 reports the IRFs for the small-cap portfolio of stocks.[5] The top panels of Fig. 1 present the IRFs with one standard deviation bands for ΔE.SPRD while the bottom panels of Fig. 1 shows the results for ΔQ.SPRD. Focusing on the upper panels, we find that shocks to short selling cause an increase in effective spreads. We note that the lower (standard deviation) band remains positive for the first three days after the shock to short selling. Furthermore, the IRFs in Fig. 1 (left upper panel) seem to indicate that the shock to short selling destabilizes spreads for nearly 10 days. Similar results are found in the right upper panel. The bottom two panels of Fig. 1 provide very similar results when we examine the IRFs for ΔQ.SPRD.

Next, we estimate Eq. (1) for the mid-cap and large-cap portfolio of stocks. Results are shown in Figs. 2 and 3, respectively, which are formatted similar to the previous figure. In Fig. 2, we find similar evidence to that reported in Fig. 1, as both effective spreads (upper two panels) and quoted spreads (lower two panels) are destabilized but much less than in the previous figure. In Fig. 3, we find much weaker – if any – evidence of the reduced liquidity in response to increases in short selling.[6]

4. Conclusion

This study provides a number of new, multivariate time-series tests to determine the effect of short selling on liquidity. Using a

[5] A fruitful avenue for future research might be to estimate Eq. (1) for each individual security and obtain the impulse responses. Then using standard cross-sectional tests, one could determine which stock characteristics determine the effect of short selling on liquidity.

[6] These results have important implications given that Diether et al. (2009b) discuss the regulatory importance of liquidity provision in small-cap stocks. Our findings suggest that, in small stocks, short sellers are takers of liquidity instead of liquidity providers. Finding that short selling can adversely affect liquidity in smaller-cap stocks has important regulatory implications. One of the limitations of our analysis is we do not have access to the traders' order choice. It might be interesting for future research to examine the order choice of short sellers measure how much liquidity is taken by short sellers versus made by short sellers. Additionally, examining the association between short selling and the limit order book could also be a fruitful avenue for future research.

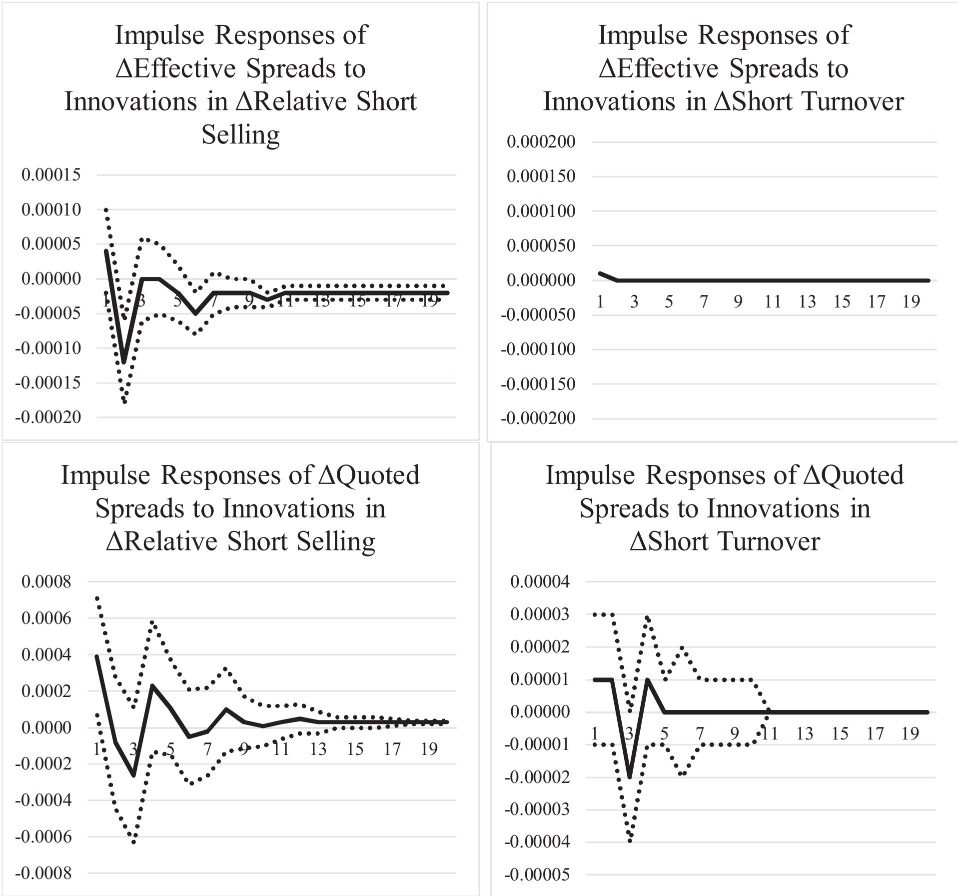

Fig. 3. The figure shows the accumulated impulse responses of daily changes (from day t + 1 to t + 20 on x-axes) in effective spreads (upper panels) and quoted spreads (lower panels) to a one standard deviation shock to changes in short selling in the large-cap portfolio using a vector autoregressive process with three lags (VAR(3)). The solid line is the impulse response functions while the dotted lines represent one-standard deviation bands surrounding the impulse responses. The left panels show the impulse responses to innovations in changes in relative short selling while the right panels show the impulse responses to innovations in changes in short turnover. The number of daily observations used in the analysis is 503.

vector autoregressive process, we find that for small-cap stocks, changes in short selling generally lead to changes in bid-ask spreads. In other tests, we show that exogenous shocks to short selling activity lead to wider bid-ask spreads in smaller-cap stocks suggesting that, for small-cap stocks, shocks to short selling deteriorate liquidity. The implications from our tests contribute to the general debate about the advantages and disadvantages of short selling and specifically to the debate about the role of short selling in the liquidity provision process. In general, our findings are consistent with theory that short sellers are informed traders and that, in the presence of informed trading, market makers will widen bid-ask spreads.

References

Aitken, M., Frino, A., McCorry, M., Swan, P., 1998. Short sales are almost instantaneously bad news: evidence from the Australian stock exchange. J. Finance 53, 2205–2223.
Battalio, R., Schultz, P., 2011. Regulatory uncertainty and market liquidity: the 2008 short Sale Ban's impact on equity option markets. J. Finance 66, 2013–2053.
Blau, B.M., 2012. Short interest and frictions in the flow of information. Financial Manage. 41, 371–394.
Blau, B.M., Van Ness, R.A., Warr, R.S., 2012. Short selling of ADRs and foreign market short-sale constraints. J. Banking Finance 36, 886–897.
Boehmer, E., Jones, C.M., Zhang, X., 2008. Which shorts are informed? J. Finance 63, 491–527.
Boehmer, E., Wu, J., 2013. Short selling and the price discovery process. Rev. Financial Stud. 26, 287–322.
Bris, A., Goetzmann, W.N., Zhu, N., 2007. Efficiency and the bear: short sales and markets around the world. J. Finance 62, 1029–1079.
Brunnermeier, M.K., Pedersen, L.H., 2005. Predatory trading. J. Finance 60, 1825–1863.
Chang, E.C., Cheng, J.W., Yu, Y., 2007. Short-sales constraints and price discovery: evidence from the Hong Kong market. J. Finance 62, 2097–2121.
Dechow, P.M., Hutton, A.P., Meulbroek, L., Sloan, R.G., 2001. Short-sellers, fundamental analysis, and stock returns. J. Financial Econ. 61, 77–106.
Desai, H., Ramesh, K., Thiagarajan, S., Balachandran, B., 2002. An investigation of the -information role of short interest in the NASDAQ market. J. Finance 52, 2263–2287.
Diamond, D., Verrecchia, R., 1987. Constraints on short selling and asset price adjustment to private information. J. Financial Econ. 18, 277–312.
Diether, K., Lee, K., Werner, I., 2009a. Short-sale strategies and return predictability. Rev. Financial Stud. 22, 575–607.
Diether, K., Lee, K., Werner, I., 2009b. It's SHO time! short-sale price tests and market quaility. J. Finance 64, 37–73.
Engelberg, J.E., Reed, A.V., Ringennberg, M.C., 2012. How are shorts informed?: short sellers, news, and information processing. J. Financial Econ. 105, 260–278.

Evans, R.B., Geczy, C.C., Musto, D.K., Reed, A.V., 2009. Failure is an option: impediments to short selling and options prices. Rev. Financial Stud. 22, 1955–1980.
Glosten, L.R., Milgrom, P.R., 1985. Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. J. Financial Econ. 14, 71–100.
Grullon, G., Michenaud, S., Weston, J.P., 2015. The real effects of short-selling constraints. Rev. Financial Stud. 28, 1737–1767.
Kelley, E.K., Tetlock, P.C., 2017. Retail short selling and stock prices. Rev. Financial Stud. 30, 801–834.
Kolasinski, A.C., Reed, A., Thornlock, J.R., 2013. Can short restrictions actually increase informed short selling? Financial Manage. 42, 155–181.
Kyle, A.S., 1985. Continuous auctions and insider trading. Econometrica 53, 1315–1335.
Miller, E.M., 1977. Risk, uncertainty, and divergence of opinion. J. Finance 32, 1151–1168.
Saffi, P.A.C., Sigurdsson, K., 2011. Price efficiency and short selling. Rev. Financial Stud. 24, 821–852.
Shkilko, A., Van Ness, B.F., Van Ness, R.A., 2012. Short selling and intraday price pressures. Financial Manage. 41, 345–370.