The market quality effects of the 2012 UMIR amendments to the short selling rules in Canada*

Ryan Riordan

Andriy Shkilko

Current Draft: November 2014

Abstract: We study a change in the Canadian regulatory landscape that removed impediments to short selling. We find that the change resulted in a modest decline in volatility in medium and small stocks and in a modest increase in quoted spreads in large and medium stocks. Most notably however, trading costs did not change discernibly. Neither did the components of trading costs. We conclude that the change in short selling regulation had a moderately positive effect on Canadian equity trading.

* We thank Helen Hogarth and Victoria Pinnington from IIROC for technical assistance and comments. All errors are our own.

Contact: Ryan Riordan, Queen's School of Business, Queen's University, e-mail: ryan.riordan@queensu.ca, phone: 705.761.8800. Andriy Shkilko, School of Business and Economics, Wilfrid Laurier University, e-mail: ashkilko@wlu.ca, phone: 519.884.0710 x24562.

I. Summary of results

This study examines the effects of the relaxation of short sale restrictions on the functionality of Canadian securities markets. More specifically, we use recent changes in short selling regulation to shed light on market stability, liquidity, and price discovery.

Our investigation shows that the relaxation of short sale restrictions has led to a modest decline in volatility, particularly in medium and small stocks. We also find that displayed liquidity declined slightly. Despite this change in displayed liquidity, trading costs remained the same. When it comes to spread components such as price impacts and the realized spreads, we observe a similar dynamic. Price impacts (the informational components of spreads) and realized spreads (the liquidity provider revenue minus adverse selection costs) did not change for firms of all sizes. In short, we find no evidence that trading costs were impacted negatively due to the repeal of the tick test. In the meantime, the modest decline in volatility may be considered a positive outcome of this regulatory change.

II. Setting and hypotheses

In October 2012, IIROC implemented amendments to the Universal Market Integrity Rules (UMIR) (hereafter, UMIR amendments) that had a direct impact on short selling. The amendments make it generally easier to sell shares short, via a repeal of the tick test. Consequently, the amendments may make it easier for intermediaries to provide liquidity and for arbitrageurs to manage risk in the process of mitigating pricing inefficiencies. Given the importance of short selling in trading strategies of informed traders, arbitrageurs, and liquidity providers, elimination of the barriers to short selling may have improved market quality.

Alternatively, if the tick test had not been a binding constraint prior to the amendments, market quality may have remained unchanged. Finally, if short selling had been used mainly for nefarious trading strategies, market quality may have worsened. Notably, a similar move by the U.S. regulators resulted in a slight worsening of liquidity and did not have a significant impact on price stability (e.g., Diether, Lee, and Werner, 2009a). Given notable differences in market structures of the Canadian and U.S. marketplaces, it is possible that Canadian markets were affected by the change in short sale rules in a different way.

We pay particular attention to the effects of short selling on market stability (price volatility). Critics claim that short selling has a tendency to be abusive, and that the abuses need to be curtailed by reinforcing short selling restrictions. Moved by the critics, regulators around the globe responded to the financial crisis of 2008 by instituting temporary short selling bans and implementing other policy changes aimed to restrict short selling (e.g., Battalio and Schultz, 2011; Beber and Pagano, 2013; Boehmer, Jones, and Zhang, 2013). Meanwhile, research generally argues that there is no systematic evidence of abusive short selling. Although some studies document rare price pressure episodes related to short selling (e.g., Bechmann, 2004; Mitchell, Pulvino, and Stafford, 2004; Henry and Koski, 2010; Shkilko, Van Ness, and Van Ness, 2012), a number of studies search for evidence of price pressures from short sellers in large panel datasets and conclude that short selling is not systematically abusive (e.g., Alexander and Peterson, 2008; Diether, Lee, and Werner, 2009b; and Boehmer and Wu, 2012). In light of this evidence, we examine changes in volatility that accompanied lifting of short selling restrictions in the Canadian markets.

Another issue of interest is the effect of the UMIR amendments on liquidity, and particularly on the trading costs of investors who demand liquidity. On the one hand, the finance

literature finds that short selling has a positive effect on liquidity via the market making activities of short sellers (e.g., Diether, Lee, and Werner, 2009b, Chakrabarty, Moulton, and Shkilko, 2012). The relaxation of short sale constraints resulting from the UMIR amendments may have therefore led to narrower quoted spreads and lower trading costs for liquidity demanders.

On the other hand, recent research suggests that some types of short selling in the modern high-frequency marketplace may have a negative effect on liquidity. For instance, Brogaard, Hendershott, and Riordan (2014b) find that short sales executed by the high-frequency traders are associated with negative liquidity effects. More generally, theory models by Biais, Foucault, and Moinas (2014) and Foucault, Kozhan, and Tham (2014) suggest that relaxation of restrictions on some high-frequency trading practices may lead to widening of spreads through the adverse selection channel. If the potential for such negative effects exists in the Canadian market, we may observe a deterioration of displayed liquidity, higher trading costs, and higher adverse selection.

III. Data and methodology

Sample

The data for this research are provided by the Investment Industry Regulatory Organization of Canada (IIROC). The data include a full record of orders and trades from all Canadian markets in the three months surrounding the implementation of the amendments to the UMIR. Although the data are quite detailed, the identities of the market participants are masked, and the names of the trading venues are not displayed.

Our sample of assets includes 150 stocks stratified into three size groups: large, medium, and small. In addition, we examine five ETFs: XIU, XGD, XEG, XSP, and XFN. We select the sample as follows. From the Canadian Financial Markets Research Centre (CFMRC) database, we obtain a full list of equity securities traded in Canadian markets during our sample period. We exclude issues by foreign firms, preferred shares, and stocks that trade below $5 at any time during the sample period.[1] We sort the remaining stocks by market capitalization, from largest to smallest and select every second stock for a total of 150 stocks. The first 50 stocks are large, the next 50 stocks are medium, and the remaining 50 stocks are small.

Table 1 reports mean and median summary statistics for the selected sample.[2] We compute these statistics using the data from July 2012 to prevent confounding of the sample statistics by the anticipation (and the effects) of UMIR amendments.

INSERT TABLE 1 HERE

By construction, market capitalization declines as we move from the large stocks (group 1) that have an average capitalization of $12.1 billion to the small stocks (group 3) that have an average capitalization of $340.7 million. Prices too decline gradually; from $41.40 per share in group 1 to $27.41 in group 2, and to $17.52 in group 3. The average price of an ETF is $17.49. Expectedly, market activity declines as we move to the smaller stocks, with share volume in group 1 averaging 17.2 million shares per month and volume in group 3 of about 0.66 million shares. Also expectedly, the ETFs are traded quite actively at about 29.6 million shares. We observe a similar pattern for the number of transactions. Finally, we note that 48% of the large stocks, 18%

[1] The short selling literature usually excludes stocks trading below $5, as these stocks are generally harder to borrow. Our results are similar when we lower this restriction to $1.
[2] In what follows, we discuss the mean statistics. The relations among the median statistics are similar.

of the medium stocks, and 8% of the small stocks are interlisted. Overall, our sample appears representative of the universe of Canadian equities.

Market quality metrics

We measure market quality using a number of conventional metrics such as quoted, effective, and realized spreads. We define the percent quoted spread at time t, QSP_t, as the difference between the CBBO quotes divided by the prevailing quote midpoint:

$$QSP_t = (CBBO\ Ask_t - CBBO\ Bid_t)/mid_t, \tag{1}$$

where

$$mid_t = \frac{CBBO\ Ask_t + CBBO\ Bid_t}{2}. \tag{2}$$

We omit instances when the CBBO is locked or crossed and time-weight the quoted spread measure.

Effective half-spread, ESP_t, a measure that captures the cost of a liquidity demanding transaction executed at time t, is computed as the difference between the CBBO midpoint prevailing at the time of the trade and the trade price, p_t, multiplied by an indicator variable q_t that equals to one for buyer-initiated trades and to negative one for seller-initiated trades. Effective spread metrics are scaled by the quote midpoint (transforming them into percentage measures) as follows:

$$ESP_t = q_t(p_t - mid_t)/mid_t \tag{3}$$

Further, we decompose the percentage effective spreads into the adverse selection

component measured by price impact, $PRIMP_t$, and the realized spread component, RSP_t. The former is computed as the signed difference between a future quote midpoint, mid_{t+n}, and the quote midpoint at the time of the trade scaled by the prevailing quote midpoint.

$$PRIMP_t = q_t(mid_{t+n} - mid_t)/mid_t \quad (4)$$

We use different values for n: 30 seconds, 1 minute, and 5 minutes. The adverse selection component represents the portion of the effective spread revenue that liquidity suppliers lose to the informed traders.

The realized spread component, RSP_t, is computed for each trade at time t as the difference between the effective spread and the price impact. This component represents the liquidity suppliers' income net of adverse selection costs. This metric is also scaled by the prevailing quote midpoint. Effective spread and its components are volume-weighted.

Finally, we use two metrics to gauge volatility. The first metric is the trading range between the highest and the lowest prices on a trading day scaled by the lowest price. The second metric is the standard deviation of intraday prices.

To examine changes in the abovementioned market characteristics around the UMIR amendments, we use the following panel regression model:

$$DEPVAR_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLAT_{it} + \beta_3 VOLUME_{it} + \beta_4 TREND_t \quad (5)$$
$$+\beta_5 MKTVOLAT_t + \varepsilon_{it} ,$$

where $DEPVAR_{it}$ is one of the variables of interest (i.e., volatility, quoted spread, effective spread, price impact, or realized spread) in stock i on day t; $UMIR$ is the dummy variable equal

to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLAT$ is the difference between the highest daily price and the lowest daily price scaled by the lowest price (referred to earlier as the trading range volatility); $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." Using the standard deviations of intraday prices instead of the high-low ranges to proxy for stock and market volatility leads to similar results. All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. Supplementing stock fixed effects with day fixed effects leads to similar results. In regression models with volatility as the dependent variable, we omit the volatility regressor.

IV. Results

Volatility

In this section, we discuss changes in volatility, displayed liquidity, and trading costs around the UMIR amendments. Table 2 contains the results for volatility. In this table and in the subsequent tables, we report the estimated coefficients β_1 from eq. (5) for the full sample (which includes 150 stocks and 5 ETFs) and for the three stock size sub-samples (large, medium, and small). We begin with the base case specifications that controls for volatility, volume, and the stock fixed effects and then introduce additional controls such as the time trend and aggregate volatility.

In specification 1 that controls for volume and the stock fixed effects, we observe that the UMIR amendments appear to have had a positive effect on volatility in the full sample. This effect seems to be driven mostly by the large stocks. Notably however, when we add the $TREND$ variable in specification 2, the positive full sample β_1 coefficient turns negative, and the coefficient for the large stocks becomes insignificant. The coefficients for the medium and small samples are also negative in this specification. These results suggest that although the general volatility trend during the sample period may have been positive, the UMIR amendments have resulted in lower volatility, especially in medium and small stocks. These results are supported when we add the "CANVIX" regressor in specification 3, but become statistically insignificant in specification 4 when we use VIX. We note that although the results for the medium and small stocks are statistically significant, they are economically modest. For instance, the estimated full sample β_1 in specification 2 suggests that UMIR amendments resulted in a 0.198% or 19.8 bps decline in volatility.

INSERT TABLE 2 HERE

Displayed liquidity

In Table 3, we switch our attention to the quoted spreads. As we mention previously, if short sellers are liquidity providers as is suggested by Diether et al. (2009b) and Chakrabarty et al. (2012), the UMIR amendments may have a positive effect on displayed liquidity. If on the other hand, short sales are used for nefarious purposes, we may observe a deterioration of liquidity. Finally, if the short sale constraints were not binding prior to the ban, we may observe no effect on liquidity.

Our empirical results are consistent with a modest increase in the quoted spreads. In specification 2 that controls for volatility, volume, the time trend, and the stock fixed effects quoted spreads are estimated to have increased by 0.4 bps in large stocks – a rather trivial change – and by 10.3 bps. in the medium stocks. There appears to be no effect for the small stocks. These results hold in all specifications other than specification 4 that controls for VIX.

INSERT TABLE 3 HERE

Trading costs

Given the evidence of modest increases in quoted spreads, particularly in the medium-size stocks, it is possible that the trading costs of the liquidity-demanding traders have also increased after the UMIR amendments. To examine this issue, we first plot the time series of effective spreads during our sample period (the blue line in Figure 1). Upon visual inspection, we find no discernible changes in effective spreads. To examine trading costs in a more rigorous setting, we next estimate eq. (5) with effective spreads as the dependent variable. The results in Table 4 do not show any statistically significant changes in trading costs in the specifications that control for the time trend and market volatility. As such, despite modest decreases in quoted spreads, trading costs did not increase following UMIR amendments.

INSERT FIGURE 1 HERE

INSERT TABLE 3 HERE

Recent theory models (e.g., Biais et al., 2014; Foucault et al., 2014) discuss high-speed traders gaining informational advantage over slower traders. The models show that if the slower traders perform a market making function, toxicity brought to the market by the high-speed traders may result in higher adverse selection and reduced market maker profits. A number of

modern high-frequency algorithms actively use short selling to implement their strategies. Relaxing short sale constraints may enable them to send more toxic order flow to the market. Next, we ask if UMIR amendments had such an effect. In Figure 1, the red line illustrates the trend in the five-minute price impacts around the amendments. We find no evidence of increased adverse selection resulting from the October 15 rule change. In Table 5, we carry out a more thorough analysis of price impacts using the model in eq. (5). In all specifications, changes in price impacts are statistically insignificant. We find similar results for the 30-second and 1-minute price impacts.

INSERT TABLE 5 HERE

Finally, in Table 6, we turn our attention to five-minute realized spreads, the proxy for the market maker spread revenue net of adverse selection costs. We find no changes in realized spreads once we control for the time trend. We find similar results for the 30-second and 1-minute realized spreads. In summary, we find no evidence that market quality, in terms of liquidity, was impacted positively or negatively due to the implementation of the UMIR amendments.

INSERT TABLE 6 HERE

Overall, our results are consistent with the notion that short selling in the Canadian market did not have a systematically negative effect on trading costs and volatility after the repeal of the tick test in October 2012. There is modest evidence that the repeal resulted in lower volatility.

Short selling through high-frequency accounts

One of the goals of this study was to examine short selling through the accounts of market participants who employ high-frequency trading (HFT) strategies. We identified high-frequency accounts using the following criteria: (i) make up more than 0.25% of trading volume; (ii) have an end of day inventory of less than 20% of their trading volume; and (iii) never hold more than 30% of their trading volume at one time within the trading day. Kirilenko et al. (2011) apply a similar identification methodology to CFTC data.

We identify 61 high-frequency trading IDs from a total of 1,706 trading IDs observed in the data. Such accounts often qualify for IIROC's designation *short-marking exempt* (SME), because of fully automated order generation and zero or minimal inventory at the end of the trading day. Traders who use SME accounts are no longer required to mark their short sales after October 15, 2012.[3] Specifically, Table 7 appears to suggest that short selling constitutes 31.2% of all volume in the pre-amendments period and drops to 21.3% in the post-amendments period. A decline of such magnitude (and in this direction) is not likely to be due to the effects of the repeal itself. On the contrary, one would expect an increase in short selling after impediments to short selling are removed. A further investigation indicates that the drop is attributable solely to the SME accounts, the accounts that are no longer required to report short sales after October 15. Specifically, SME short selling falls from 16.7% to 7.0% after the implementation of UMIR amendments. Notably, not all of SME accounts stop reporting short sales, but the change in reporting is large enough to affect analyses that rely on identifying SME short sales. Non-SME accounts continue to report similar proportion of short selling (about 14% of total volume),

[3] IIROC Notice 12-0300, October 11, 2012.

suggesting that the amendments may not have resulted in substantial changes in the short selling landscape.

INSERT TABLE 7 HERE

V. Conclusions

Using a stratified sample of Canadian firms and ETFs, we find that volatility modestly declined and trading costs remained unchanged after the repeal of the tick test in October 2012 in Canada. Prior to the repeal, the tick test had restricted the ability of short sellers to trade. Our findings are robust to various specifications that control for variables known to correlate with market quality.

Our second goal was to link short selling to the behaviour of traders who use high-frequency strategies. Unfortunately, the repeal has removed the requirement for some firms to report short sales. Due to this data limitation, we are unable to study changes in short selling through the accounts of high-frequency traders around the repeal.

References

Alexander, Gordon J., and Mark A. Peterson, 2008, The effect of price tests on trader behavior and market quality: An analysis of Reg SHO, Journal of Financial Markets 11, 84-111

Battalio, R. and P. Schultz, 2011, Regulatory Uncertainty and Market Liquidity: The 2008 Short Sale Ban's Impact on Equity Option Markets, Journal of Finance 66, 2013-2053.

Beber, A., and M. Pagano, 2013, Short selling bans around the world: Evidence from the 2007-09 crisis, Journal of Finance 68, 343-381.

Bechmann, Ken, 2004, Short sales, price pressure, and the stock price response to convertible bond calls, Journal of Financial Markets 7, 427-451.

Biais, Bruno, Thierry Foucault, and Sophie Moinas, 2014, Equilibrium fast trading, Journal of Financial Economics, forthcoming.

Brogaard, Jonathan, Terrence Hendershott, and Ryan Riordan, 2014a, High frequency trading and price discovery, Review of Financial Studies 27, 2267-2306.

Brogaard, Jonathan, Terrence Hendershott, and Ryan Riordan, 2014b, High frequency trading and the 2008 short sale ban, Working paper, University of Washington.

Boehmer, E., C. Jones, and Z. Zhang, 2013, Shackling short sellers: The 2008 shorting ban, Review of Financial Studies 26, 1363-1400.

Boehmer, E. and J. Wu, 2012, Short selling and the price discovery process, Review of Financial Studies 26, 287-322.

Chakrabarty, B., P. Moulton, and A. Shkilko, 2012, Short sales, long sales, and the Lee-Ready trade classification algorithm revisited, Journal of Financial Markets 15, 467-491.

Diether, C., K-H. Lee, and I. Werner, 2009a, It's SHO time! Short sale price tests and market quality, Journal of Finance 64, 37-73.

Diether, K. B., K.-H. Lee, and I. Werner, 2009b, Short sale strategies and return predictability, Review of Financial Studies 22, 575-607.

Foucault, Thierry, Roman Kozhan, and Wing Wah Tham, 2014, Toxic arbitrage, Working paper, HEC Paris.

Henry, Tyler R, and Jennifer L. Koski, 2010, Short selling around seasoned equity offerings, Review of Financial Studies 23, 4389-4418.

Kirilenko, Andrei, Albert S. Kyle, Mehrdad Samadi, and Tugkan Tuzun, 2012, The flash crash: The impact of high-frequency trading on an electronic market, Working paper, CFTC and University of Maryland.

Mitchell, Mark, Todd Pulvino, and Erik Stafford, 2004, Price pressure around mergers, Journal of Finance 59, 31-63.

Shkilko, A., Van Ness, B., Van Ness, R., 2012. Short selling and intraday price pressures. Financial Management 41, 345–370.

Table 1. Summary statistics

The table contains summary statistics for the select sample of equities and ETFs used in the analysis. The data are from July 2012. The stocks are divided into three groups by market capitalization. The data on market capitalization, prices, monthly share volume, and monthly trade totals are from the Canadian Financial Markets Research Centre (CFMRC) database. We collect a list of cross-listed firms from the eReviews published by the Toronto Stock Exchange. The statistics are averaged across stocks. The medians are in square brackets.

	# assets	capitalization, $	price, $	volume, #sh	# trades	interlisted share
group 1 (large)	50	12,197,090,824 [7,665,477,500]	41.40 [29.55]	17,233,208 [11,016,800]	65,156 [51,546]	0.48
group 2 (medium)	50	1,210,419,408 [1,054,067,650]	27.41 [15.43]	3,462,078 [2,103,650]	12,311 [8,133]	0.18
group 3 (small)	50	340,662,948 [317,667,450]	17.52 [12.39]	663,350 [398,050]	1,300 [990]	0.08
ETFs	5		17.49 [16.70]	29,574,560 [9,529,200]	17,229 [14,652]	

Table 2. Volatility changes around the UMIR amendments

The table contains regression results for the select sample of equities and ETFs. The data are from September through November 2012. We report the results for the full sample that includes 150 stocks and 5 ETFs and for the stock sample divided into three groups of 50 stocks by market capitalization (large, medium, and small). We use the following panel regression model:

$$VOLAT_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLUME_{it} + \beta_3 TREND_t + \beta_4 MKTVOLAT_t + \varepsilon_{it},$$

where $VOLAT_{it}$ is stock i's volatility on day t (in basis points) measured as the difference between the highest daily price and the lowest daily price scaled by the lowest price; $UMIR$ is the dummy variable equal to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. p-Values are in parentheses.

	(1)	(2)	(3)	(4)
Full sample	0.057	-0.198	-0.159	-0.121
	(0.04)	(0.00)	(0.00)	(0.11)
Large	0.088	-0.004	0.038	-0.051
	(0.00)	(0.95)	(0.53)	(0.58)
Medium	0.000	-0.368	-0.314	-0.267
	(1.00)	(0.01)	(0.02)	(0.11)
Small	0.083	-0.223	-0.205	-0.003
	(0.07)	(0.02)	(0.03)	(0.98)
VOLUME	Y	Y	Y	Y
TREND		Y	Y	Y
"CANVIX"			Y	
VIX				Y
Stock FE	Y	Y	Y	Y

Table 3. Quoted spread changes around the UMIR amendments

The table contains regression results for the select sample of equities and ETFs. The data are from September through November 2012. We report the results for the full sample that includes 150 stocks and 5 ETFs and for the stock sample divided into three groups of 50 stocks by market capitalization (large, medium, and small). We use the following panel regression model:

$$QSP_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLAT_{it} + \beta_3 VOLUME_{it} + \beta_4 TREND_t + \beta_5 MKTVOLAT_t + \varepsilon_{it} ,$$

where QSP_{it} is the daily time-weighted quoted spread (in basis points) in stock i on day t estimated as the difference between the best Canadian offer and bid scaled by the CBBO midpoint; $UMIR$ is the dummy variable equal to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLAT_{it}$ is the stock volatility measured as the difference between the highest daily price and the lowest daily price scaled by the lowest price; $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. p-Values are in parentheses.

	(1)	(2)	(3)	(4)
Full sample	0.012	0.030	0.031	0.031
	(0.14)	(0.06)	(0.06)	(0.39)
Large	0.006	0.004	0.004	-0.009
	(0.00)	(0.01)	(0.01)	(0.07)
Medium	0.054	0.103	0.104	0.092
	(0.00)	(0.00)	(0.00)	(0.15)
Small	-0.015	-0.010	-0.010	-0.025
	(0.42)	(0.79)	(0.79)	(0.78)
VOLAT	Y	Y	Y	Y
VOLUME	Y	Y	Y	Y
TREND		Y	Y	Y
"CANVIX"			Y	
VIX				Y
Stock FE	Y	Y	Y	Y

Table 4. Effective spread changes around the UMIR amendments

The table contains regression results for the select sample of equities and ETFs. The data are from September through November 2012. We report the results for the full sample that includes 150 stocks and 5 ETFs and for the stock sample divided into three groups of 50 stocks by market capitalization (large, medium, and small). We use the following panel regression model:

$$ESP_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLAT_{it} + \beta_3 VOLUME_{it} + \beta_4 TREND_t + \beta_5 MKTVOLAT_t + \varepsilon_{it},$$

where ESP_{it} is the daily volume-weighted effective half-spread in stock i on day t estimated as the signed difference between the transaction price and the contemporaneous CBBO midpoint scaled by the CBBO midpoint; $UMIR$ is the dummy variable equal to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLAT_{it}$ is the stock volatility measured as the difference between the highest daily price and the lowest daily price scaled by the lowest price; $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. p-Values are in parentheses.

	(1)	(2)	(3)	(4)
Full sample	0.002	0.005	0.002	0.012
	(0.44)	(0.45)	(0.46)	(0.11)
Large	0.000	0.001	0.000	0.000
	(0.45)	(0.34)	(0.47)	(0.40)
Medium	0.014	0.026	0.000	0.023
	(0.04)	(0.07)	(0.09)	(0.19)
Small	-0.004	-0.011	-0.004	0.008
	(0.58)	(0.46)	(0.58)	(0.59)
VOLAT	Y	Y	Y	Y
VOLUME	Y	Y	Y	Y
TREND		Y	Y	Y
"CANVIX"			Y	
VIX				Y
Stock FE	Y	Y	Y	Y

Table 5. Price impact changes around the UMIR amendments

The table contains regression results for the select sample of equities and ETFs. The data are from September through November 2012. We report the results for the full sample that includes 150 stocks and 5 ETFs and for the stock sample divided into three groups of 50 stocks by market capitalization (large, medium, and small). We use the following panel regression model:

$$PRIMP_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLAT_{it} + \beta_3 VOLUME_{it} + \beta_4 TREND_t + \beta_5 MKTVOLAT_t + \varepsilon_{it},$$

where $PRIMP_{it}$ is the daily volume-weighted price impact in stock i on day t estimated as the signed difference between the CBBO midpoint five minutes after the trade and the contemporaneous CBBO midpoint scaled by the CBBO midpoint; $UMIR$ is the dummy variable equal to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLAT_{it}$ is the stock volatility measured as the difference between the highest daily price and the lowest daily price scaled by the lowest price; $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. p-Values are in parentheses.

	(1)	(2)	(3)	(4)
Full sample	-0.001	-0.001	-0.001	0.001
	(0.49)	(0.71)	(0.53)	(0.84)
Large	-0.001	0.000	-0.001	0.001
	(0.23)	(0.95)	(0.19)	(0.33)
Medium	-0.003	-0.011	-0.003	-0.007
	(0.32)	(0.07)	(0.32)	(0.26)
Small	-0.003	0.008	-0.003	0.000
	(0.57)	(0.47)	(0.61)	(0.99)
VOLAT	Y	Y	Y	Y
VOLUME	Y	Y	Y	Y
TREND		Y	Y	Y
"CANVIX"			Y	
VIX				Y
Stock FE	Y	Y	Y	Y
Day FE				

Table 6. Realized spread changes around the UMIR amendments

The table contains regression results for the select sample of equities and ETFs. The data are from September through November 2012. We report the results for the full sample that includes 150 stocks and 5 ETFs and for the stock sample divided into three groups of 50 stocks by market capitalization (large, medium, and small). We use the following panel regression model:

$$RSP_{it} = \alpha + \beta_1 UMIR_t + \beta_2 VOLAT_{it} + \beta_3 VOLUME_{it} + \beta_4 TREND_t + \beta_5 MKTVOLAT_t + \varepsilon_{it},$$

where RSP_{it} is the daily volume-weighted realized half-spread in stock i on day t estimated as the difference between the effective half-spread and the price impact of a trade scaled by the CBBO midpoint; $UMIR$ is the dummy variable equal to one after the October 15, 2012 implementation of the UMIR amendments and equal to zero otherwise; $VOLAT_{it}$ is the stock volatility measured as the difference between the highest daily price and the lowest daily price scaled by the lowest price; $VOLUME$ is the daily trading volume derived from the IIROC database; $TREND$ is the time trend variable; and $MKTVOLAT$ is aggregate volatility. We use two proxies for aggregate volatility: (i) the daily high-low trading range of the XIU ETF and (ii) the U.S. VIX. We call the former proxy "$CANVIX$." All models are estimated with stock-fixed effects. We cluster standard errors by stock and day. p-Values are in parentheses.

	(1)	(2)	(3)	(4)
Full sample	0.002	0.006	0.002	0.011
	(0.48)	(0.42)	(0.53)	(0.18)
Large	0.001	0.001	0.001	-0.001
	(0.09)	(0.59)	(0.08)	(0.65)
Medium	0.018	0.000	0.001	0.030
	(0.01)	(0.14)	(0.08)	(0.06)
Small	-0.006	-0.025	-0.006	0.003
	(0.45)	(0.13)	(0.43)	(0.89)
VOLAT	Y	Y	Y	Y
VOLUME	Y	Y	Y	Y
TREND		Y	Y	Y
"CANVIX"			Y	
VIX				Y
Stock FE	Y	Y	Y	Y
Day FE				

Table 7. Observable short selling around the UMIR amendments

The table contains summary statistics for the proportion of short selling in total volume for the select sample of equities and ETFs. The data are from September through November 2012. We report the proportion of overall short selling and short selling by the short-marking exempt accounts (SME) and the non-SME (nSME) accounts. We report statistics for the pre-UMIR amendments period and the post-amendments period. p-Values from the mean difference tests are in parentheses.

	short	SME short	nSME short
pre	0.312	0.167	0.145
post	0.213	0.070	0.143
p-value for diff	(0.00)	(0.00)	(0.38)

Figure 1: Time series of effective spreads and price impacts
The figure plots the time series of effective spreads (blue line) and price impacts (red line) during the September-November 2012 sample period. We report the results for the full sample that includes 150 stocks and 5 ETFs. Effective half-spread is the daily volume-weighted effective half-spread in stock i on day t estimated as the signed difference between the transaction price and the contemporaneous CBBO midpoint scaled by the CBBO midpoint. The price impact is the signed difference between the midpoint at time $t + 5$ min and the contemporaneous midpoint scaled by the contemporaneous midpoint.