CROSS-LISTED STOCKS: CONDUIT FOR CONTAGION ACROSS BORDERS

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ABSTRACT

In this paper, I examine the effects of the arrival of phony public information originating from the United-States on a sample of Canadian stocks listed both on the Toronto Stock Exchange (TSE) and on the major U.S. exchanges. I find that following the news announcement the stocks on both markets instantaneously experience a similar, highly correlated and significant log return surge along with a disruption in liquidity and a widening of the spread. Using control stocks for the sample of firms, my results suggest that the transmission mechanism is exacerbated by the presence of cross-listed stocks on the U.S. exchanges. Overall, this empirical work shows that cross-listed stocks can act as vectors for shocks, or at least strengthen the transmission mechanism of a shock from the home (foreign) market to the foreign (home) market. It also suggests that firms may have to take this potential pitfall into consideration when deciding to cross-list on a foreign exchange.

CROSS-LISTED STOCKS have been a subject of academic research for many years. Yet, it has come to my attention that most of the existing literature is concentrating on the benefits of cross-listings while very few studies mention its disadvantages.

Observing a unique type of natural experiment; the arrival of a false news announcement of an unprecedented magnitude, this empirical work aims at documenting how cross-listed stocks can strengthen the transmission mechanism of a shock between markets. In this case, I am interested in a sample of Canadian cross-listed stocks in the United-States, two countries with integrated and interdependent economies. This natural experiment proves itself to be an ideal material to observe how the cross-listed stocks react and adjust to the release of the false news announcement. First, since it is a false news announcement, we are able to observe the beginning of the event as well as its end which therefore provides a contained window and makes it a purely exogenous event. Second, the chosen natural experiment originates from the United-States (the foreign market in our case) and represents the advantage to be a market event and not only a firm specific event. As described in the next section, the arrival of this false news announcement impacted not only the American financial markets but also the Canadian stock market of Toronto. The following section provides a complete description of the natural experiment studied in this empirical work.

Description of the natural experiment

On April 23rd, 2013, at 1:07 p.m. Easter time, the Associated Press, an American not-for-profit news agency, releases the following tweet: "Breaking: Two Explosions in the White House and Barack Obama Injured." The Associated Press Twitter account having more than 1.9 million followers and known to be among the largest and most trusted agency news, it was only a

matter of seconds before this "bomb" caused panic on the stock market. Three minutes later and a new tweet from an executive from the Associated Press and it became clear that their Twitter account had been the target of hackers, presumably the Syrian Electronic Army (SEA).

In an era where information travels at the speed of light and investors have access to high frequency trading, these three minutes were of course more than enough for investors to react swiftly to the news and for the stock markets to suffer from it. The Dow Jones index and the Toronto Stock Exchange both respectively lost 100 points and 35 points before recovering it once it was clear that it had only been a phony public information while some reports suggested that only on the New York Stock Exchange (NYSE) about $20 billion worth of equity trades had been made within these two minutes.

As mentioned above, the Associated Press Twitter account being hacked represents an ideal material to study the effects of the arrival of phony public information. First, it would be difficult to refer to this event as being private information. After all, taking into account the 1.9 million followers, the magnitude of the news announcement and the speed at which the news was spread on the Internet, we can safely state that there is no information asymmetry[1] among investors. Moreover, public information is by far a more comprehensive measure and cannot be reduced to firm-specific events[2]. Second, the two minutes window between the first tweet at 1:07 p.m. and the second one at 1:10 p.m. and the fact that the news was in the end no news allowed for the stock markets to rebound after the initial fall thus giving us a purely exogenous natural experiment.

[1] Dealing with public information allows to ignore the information asymmetry issue. For more discussion about its effects, see Klein, O'Brien and Peters (2002) and Kim and Verrecchia (1991).
[2] For further discussion on the definition of public information, see Berry and Howe (1994).

I mentioned above that the TSE lost about 35 points following the arrival of the hacked tweet which represents in terms of points a third of what the DOW lost. Although a fall in the U.S. exchanges is expected in such cases, I cannot help but wonder if there might be more to the reaction of the Toronto Stock Exchange than just the level of integration between the two countries. Is it due solely to the fact that these two economies and their respective financial markets are integrated[3]? Then are we facing a case of financial contagion as defined by Dornbusch, Park and Claessens (2000) where "the higher the degree of integration, the more extensive could be the contagion effects of a common shock or a real shock to another country."? Or is it only interdependence as shown by Forbes and Rigobon[4]? While giving credit to both explanations, I believe that part of the answer might lie somewhere else: cross-listed stocks. It is common knowledge that Canadian stocks account for the largest group of foreign stocks listed in the United States from a single country and that many if not most of them are being traded actively in both countries. Moreover, the TSE and the NYSE for instance have trading times that coincide (9:30 a.m. to 4:00 p.m. Eastern Time).

One objective of this paper is to provide a straightforward intraday analysis of the price formation and liquidity of cross-listed stocks following the release of a very specific type of non-news news announcement. Furthermore, the very specific and singular nature of the news announcement chosen provides an interesting ground on which to study price formation and the arrival of public information.

[3] Kodres and Pristker (1998) and Calvo and Mendoza (2000) both show that two countries will face higher risks of financial contagion given that they have more liquid financial markets and financial assets widely traded on global markets.
[4] See Forbes and Rigobon (2002).

Another objective of this study is to investigate the role of cross-listing in the transmission mechanism of a shock from the home (foreign) market to its foreign (home) market.

My findings support the notion of "informationally efficient international stock market" observed by Eun and Shim[5] (1989). My results also suggest that stock prices on the TSE and the U.S. exchanges are cointegrated and mutually adjusting as documented by Eun and Sabherwal (2003). Where several studies (including Mitchell and Mulherin (1994) and Berry and Howe (1994)) fail to find a significant positive relationship between major public news announcements and large movements in price return, my results show a significant and instantaneous surge in price volatility in the first minutes after the news announcement.

I believe this paper contributes to the existing literature on cross-border listings in two ways. First, it provides an intraday analysis of a very specific type of public information: a phony news announcement on an international scale relating to a matter of the outmost importance. Second, it highlights one major flaw of cross-listing among all the various benefits described over time in the existing literature.

The remainder of this paper is organized as follows. Section II discusses the existing literature on the benefits of cross-listing. Section III gives a description of the data sources, sample details and the methods used to perform the analysis. In Section IV, I present the results. Finally, Section V provides concluding comments to this paper.

[5] Eun and Shim (1989) find evidence that among different stock markets, the Canadian exchanges respond most strongly when facing a shock origination from the United States. They find that most of the adjustments are done within the day the shock occurs, as this study does.

II. LITERATURE REVIEW

The international cross-listings literature, as we know it, is quite extensive and surprisingly most of the academic studies done on the topic have focused on the benefits of cross-listing without giving much thought to its potential pitfalls. Studies such as Alexander, Eun and Janakiramanan (1987, 1988), Foerster and Karolyi (1993), Karolyi (1998)[6] and Errunza and Miller (2000) all document a decline in cost of capital following cross-listings (mainly on the U.S. exchanges). Reduced cost of capital and the access to foreign capital used to be the main motivations behind cross-listing. For instance, the NYSE and NASDAQ both provide access to more liquid and efficient markets. Miller (1999) and more recently Baker, Nofsinger and Weaver (2002) advance increased analysts and media coverage and increased investors recognition as another major motivation which remind of Merton (1987) "shadow cost" being reduced since investors gain access to more information about stocks and decrease the riskiness of taking positions involving these stocks.

Several other studies propose change in trading costs and governance as possible benefits of cross-listing. Foerster and Karolyi (1999) observe that bid-ask spreads in Canada decrease following cross-listings. Doidge et al. (2009) suggest that it can limit the ability of controlling shareholders to extract private benefits.

On the other hand, very few studies have looked at the potential pitfalls of cross-listing. Eun and Sabherwal (2003) suggest that when deciding to list on U.S. exchanges, foreign companies

[6] Karolyi (1998) provides a complete and detailed survey of cross-listings.

take the risk of seeing these U.S. exchanges become the price discovery mechanism[7]. Facing constraints pertaining to laws, disclosure and possible enforcement actions by the Security Exchange Commission (SEC) also accounts for another potential issue when cross-listing as shown by Coffee (2002). Ironically, an increased analysts and media coverage can also be seen as a threat (Lang, Lins and Miller (2003)) since the gained exposure can harm the companies. For instance, companies might have to be more transparent about some opaque activities they have which in turn might be proven to be harmful for the company image.

However, it has come to my attention that none of these studies had examined impact of cross-listings on one aspect of price discovery between the home (foreign) market and the foreign (home) market: the transmission mechanism.

III. DATA AND METHODOLOGY

The intraday data I use for the main core of my analysis is obtained from the Bloomberg database. It consists of bid and ask (end) prices as well as the trade orders from April 1 to April 23, 2013. The Canadian-U.S. intraday currency rates were also retrieved from Bloomberg. My data on market capitalization, four-digit SIC codes and trading volume (Table 1, Appendix A and B) comes from Compustat North America and the Center for Research in Security Prices (CRSP).

[7] Lululemon Athletica (LLL) delisted from the Toronto Stock Exchange on June 2013 saying that they "believe that the minimal trading volume of its shares on the TSE no longer justifies the expenses and administrative efforts associated with maintaining the dual listing" on NASDAQ.

My main sample of stocks consists of thirty-eight Canadian firms listed on the Toronto Stock Exchange (TSE) and on one of the major U.S. exchanges (NYSE, NASDAQ and AMEX).

In April 2013, there were 151 Canadian companies listed on the TSE and on one of the major U.S. exchange. I first dropped all the firms with less than six months of active trading and for which I did not have enough intraday data. Then, I excluded from my sample stocks with a daily trading volume inferior to 300,000 daily trades across both markets, firms whose stock market valuations were smaller than 500C$ million and finally; firms with a market stock price under one Canadian dollar. The final sample of stocks is described in Table 1.

The sub-sample of stocks I use as a complementary part of my analysis is constituted exclusively of firms from the mining industry. Canadian firms with a four-digit SIC code ranging between 1000 and 1499 and meeting all the previous criteria were included in this sub-sample. Table IV gives a descriptive summary of the seventeen firms included in the sub-sample along with the U.S. exchange they are listed on.

Throughout this paper, I measure market returns as the log of price and use mid-quote bid-ask spread. For comparison purpose, all the prices are reported in Canadian dollars, based on closing Canada-US intraday exchange rate.

My approach to analyzing price formation and liquidity is similar to the one used by Fleming and Remolona (1999); an intraday analysis of price change, trading volume and bid-ask spread. Even though their approach was used to observe the reaction of treasury bonds following the arrival of public information on a regular basis, it also applies to the analysis of equity. I then proceed as Forbes and Rigobon (2002) in using cross-market correlation coefficients as a simple and straightforward approach to measure the strength of the transmission mechanism.

I also use a slightly different approach in measuring the cross-market correlation coefficients by regressing the error terms:

$$= \qquad +$$

Where *R* represents the price return on both a non-event period also defined as "stable period" and on the day the news announcement was released and is the error term. Repeating the same process for both markets, I therefore obtain the error terms from each markets and regress them:

$$.. \quad h \quad = +$$

I expect this approach to allow the error-term to capture the contagion component on both exchanges. Hence, regressing the error-terms obtained on both the TSE and the U.S. exchanges, the correlation coefficient might indicate to which extent the shock travelled from one stock exchange to another.

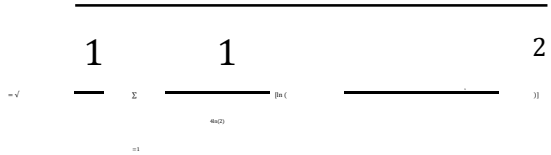
The control stocks used in the second part of the analysis were selected to match my sample of stocks based on the following minimizing function:

$$\text{Minimizing function} = \left[\left(\frac{-}{+}\right)^2 + \left(\frac{-}{+}\right)^2\right]$$

Where and represent the measure of Parkinson volatility for the stocks of the main sample and for all the Canadian stocks quoted on the TSE that are not listed on a U.S. exchange. The other part of the minimizing function takes into account the level of liquidity, and giving the trading volume for each group of stocks. Data from every trading sessions on April 2013 prior to the event day was used in order to compute this matching minimizing function. A list of these control stocks and their summary description is provided in Appendix B.

I use the high-low volatility measure created by Parkinson in 1980 to assess whether the cross-listed stocks are more affected by the arrival of the news announcement or not. I believe that using extreme values in measuring the volatility of the sample will prove to be a better estimator in the natural experiment I study. Furthermore, this approach proves to be more practical when looking at small number of observations.

The measure of Parkinson volatility used in Table VIII is calculated as follows:



Where h and represent the highest and lowest stock prices observed on a given day.

IV. RESULTS

The summary statistics of the thirty eight companies included in the cross-listed stocks sample are reported in Table I. The four digit SIC codes indicate that approximately 29% of the companies in that sample belongs to the mining industry sector (SIC code from 1000 to 1499), 26% to the manufacturing industry sector (SIC code from 2000 to 3999) while 21% of it is from the transportation-communication-electricity-gas-retail trade industries (SIC code from 4000 to 5999). Finally, the remaining 24% of the sample represents firms from the finance-insurance-real estate industry sector (SIC code from 6000 to 6999).

[INSERT TABLE I ABOUT HERE]

A. Intraday analysis of price formation and liquidity

In Table II, I examine the price formation and liquidity of the sample of stocks following the news announcement of 13:07 p.m. on the exchanges they are listed on in both countries. It is immediately apparent that the main sample of stocks' price change, trading volume and bid-ask spread adjustments to the news announcement are very similar on both the TSE and on the U.S. exchanges as shown on Figure 1 and 2.

Following the release of the phony tweet, the main sample of stocks experiences a sudden negative price change along with a surge in trading volume and a widening of the bid-ask spread. In less than three minutes, the trading volume is respectively multiplied by seven and fourteen on the TSE and on the U.S. exchanges. The surge in log return lasts no longer than

seven minutes before it resumes its monthly average level. Unsurprisingly, it stabilizes at exact same time on both exchanges. The same cannot be said for the liquidity. Indeed, while the trading volume activity goes back to normal shortly after the news announcement on the U.S. exchanges, it remains far above its monthly average for more than sixty minutes on the TSE.

Similarly, the bid-ask spread on both markets remain significantly higher than normal for the most part of the end of the trading day. Most likely, marketmakers need time to adjust to the panic and the large movements of trade caused by the news announcement and since the shock emanated from the United-States, it may take them more time to adjust their inventory. Dealing with public information, I assume that the widening of the spread and the time it takes to adjust afterward are not related to marketmakers risking to face informed traders and thus information asymmetry.

[INSERT TABLE II ABOUT HERE]

[INSERT FIGURE I AND II ABOUT HERE]

I further investigate the dynamics of price formation, liquidity and bid-ask spread for a sample of cross-listed mining stocks which is described in Table IV. I expect the cross-listed mining stocks and the cross-listed stocks to display a negative relationship in terms of price formation.

[INSERT TABLE III ABOUT HERE]

[INSERT TABLE IV ABOUT HERE]

In Table III, I observe similar patterns across the two markets for the cross-listed mining stocks than the cross-listed stocks except for a positive surge in log return instead of a negative one. It appears that the bid-ask spreads are not as affected by the news announcement as for the cross-listed stocks while there is still a clear disruption of liquidity. We could argue that it is precisely due to the fact that the stocks belong to the mining industry. As reported in Table V, I find a significant negative relationship almost equal to -1 (-0.905 at 1% level of significance on the TSE and -0.934 on the U.S. exchanges) between the price change of the cross-listed stocks and the cross-listed mining stocks.

[INSERT TABLE V ABOUT HERE]

Regarding the findings on the intraday analysis of price formation and liquidity, one possible and convincing explanation is that investors moved from what they perceived as "newly" risky equity positions to safer ones; gold and silver for instance. It is therefore not surprising to find a negative relationship between the main sample and the sub-sample price change response to the announcement of the news.

To explore this explanation even further, I examine the nature of the trade orders received by marketmakers in the short interval following the phony news announcement. Where the

average ratio of sell orders over buy orders is 0.892 between 10:15 a.m.[8] and 13:06 p.m., it almost doubles around 13:15 p.m. to reach 1.683. These results highlight a significant increase in the number of sell orders shortly after the shock occurred. It is therefore safe to assume that following the shock, investors would flee from "risky" equity market values to safer values.

[INSERT TABLE VI ABOUT HERE]

B. Cross-market correlation

In addition to observing the intraday pattern of the price formation and liquidity following the news announcement, part of my analysis is to measure the cross-market correlation between the price series of each exchanges. Acknowledging the rather high correlation existing between Canada and the United-States, I am interested in analysing how this correlation is affected by the news announcement.

In addition to the correlation coefficients displayed in Table VI which represent the correlation between the main sample of stocks and the sub-sample of stocks across ten-minute time periods before and after the news announcement, Table V reports the correlation coefficients in returns (R^2) across thirty-minute time periods on the event day and each day of the week that preceded the event day in April, 2013, also to control for the "day of the week" effect. I use thirty-minute time periods for their convenience and the fact that it might still capture any significant change

[8] Harris (1986) demonstrates that most of the stock price movements happen within the first 45 minutes of the trading session.

in correlation. The mean and the median are obtained using all trading days in April, 2013, prior to the event day.

Overall, the correlation in returns between the two markets is high in stable period (i.e. before the event day) and reach a correlation level almost equal to 1 on the event day in the thirty minutes time period in which the news announcement was released compared to a mean of 0.889. This increase of 11.72% in R^2 suggests that the transmission mechanism strengthened and according to Forbes and Rigobon[9], it might even be referred to as contagion.

I also use a different approach to test for the strength of the transmission mechanism and as a robustness test. I suppose that by regressing the returns on the event day with the returns on a stable day it might capture the strength of the shock that occurred. Thus I obtain the error terms from regressions on both the Canadian and the U.S. markets and decide to regress each series of error terms in order to find how strongly the shock was transmitted.

The results of these regressions are displayed in Table VII and tend to support the notion of contagion. We find a significant 0.8953 R^2 on the week before the shock occurred. We also note that the correlation is higher when regressing price returns on the same day of the week (Tuesdays) since the correlation coefficient for the day prior to the event day is smaller.

[INSERT TABLE VII ABOUT HERE]

[9] Forbes and Rigobon (2002) use cross-market correlation coefficients methodology to test for contagion. They acknowledge contagion only if there is a significant increase in correlation in returns between stable period and after a shock.

C. Comparison between main sample and control stocks

Some will argue that these results are somewhat not surprising given the nature of the sample of stocks and the level of integration between the two financial markets we are focusing on.

Therefore, I use control stocks in order to see how similar stocks listed on the TSE react to the news announcement. To be included in the control stocks sample, I make sure that these stocks are not listed on any U.S. exchange and share similar market capitalization, trading volume and price volatility. A descriptive summary of the control stocks is given in Table IX. In Table VIII, it is interesting to note that in terms of mean, the price volatility for the main sample of stocks increased while it decreased for the control stocks. In terms of median, which in this case, ignores large price movements, the volatility remains almost the same for the main sample of stocks while it also decreased of the control stocks which I associate to the fact that the firms are listed on U.S. exchanges as well. In light of these findings, it appears that the stocks which reacted the most strongly to the phony news announcement are the Canadian cross-listed stocks. Not only did the volatility increased (both in terms of mean and median) for the cross-listed stocks, we observe a decrease in volatility for the rest of their controls. It could very well be that investors paid less attention to the stocks they perceived less risky.

[INSERT TABLE VIII ABOUT HERE]

The average market capitalization for the control stocks is smaller than the sample of stocks. It is explained by the fact that out of thirty-eight stocks included in the main sample, twenty of them are part of the S&P/TSX 60 index. That is why I decided to discard the market

capitalization size parameter from the matching function in order to focus on volatility and liquidity which are more relevant in our analysis. Moreover, we know for a fact that most of the largest Canadian firms are also listed on a U.S. exchange, which would have put a serious limitation on the quality of the control stocks since it would prove nearly impossible to find controls of similar market capitalizations.

D. Other variable

I am also interested in the level of financial and economical involvement of the Canadian firms present in the sample on the U.S. ground. I would expect Canadian firms with no activities (manufacturing, facilities, and employees) to be relatively safer from a shock occurring in the United-States. However, the annual reports and the financial quarter reports of the firms in the sample reveal that about a third of these firms have little or close to no activities in the United-States. These findings support the hypothesis that the surge in log price return and trading volume experienced by the samples on April 23, 2013, are partially explained by the cross-markets bindings of these firms.

[INSERT TABLE IX ABOUT HERE]

V. CONCLUSION

In this paper, I examined the intraday patterns of price formation and liquidity across a sample of Canadian stocks listed on both the TSE and the major U.S. exchanges with the occurrence of a shock originating from the foreign market. I find an instantaneous and highly correlated price log return surge along with a disruption of liquidity and a widening of the spreads. This answer to the release of phony public information lasts no more than a few minutes before the price log returns resume their daily average level on both markets. However, it appears that marketmakers may need more time to adjust their inventory, resulting in persistence of a wide bid-ask spread which almost last one hour after the news announcement which can also be explained by a persisting higher liquidity than normal. The comparison with a sample of control stocks, in addition to the almost total absence of economic and financial activities based in the United-States for some of the Canadian firms, highly suggest that the transmission mechanism of the shock was amplified through their cross-listed stocks on the U.S. exchanges. Regarding these results, firms may have to take into consideration this risk when making the decision of listing in a foreign market. Investors and the stock markets themselves are also entitled to become more aware of this disadvantage, given the ever increasing level of integration of the world economies and the growing concerns about the repetition of cyber-attacks.

I also recognize that my analysis has some limitations. Indeed, it relies on a sample providing a perfect overlap between the two markets, markets which are highly integrated. It would be interesting to see how a sample of European or Asian stocks which are cross-listed on U.S. exchanges adjusts to a shock similar to the one we observed in this paper. Since the European markets share a few overlapping hours with the U.S. exchanges, would the transmission mechanism be strengthen in this overlap?

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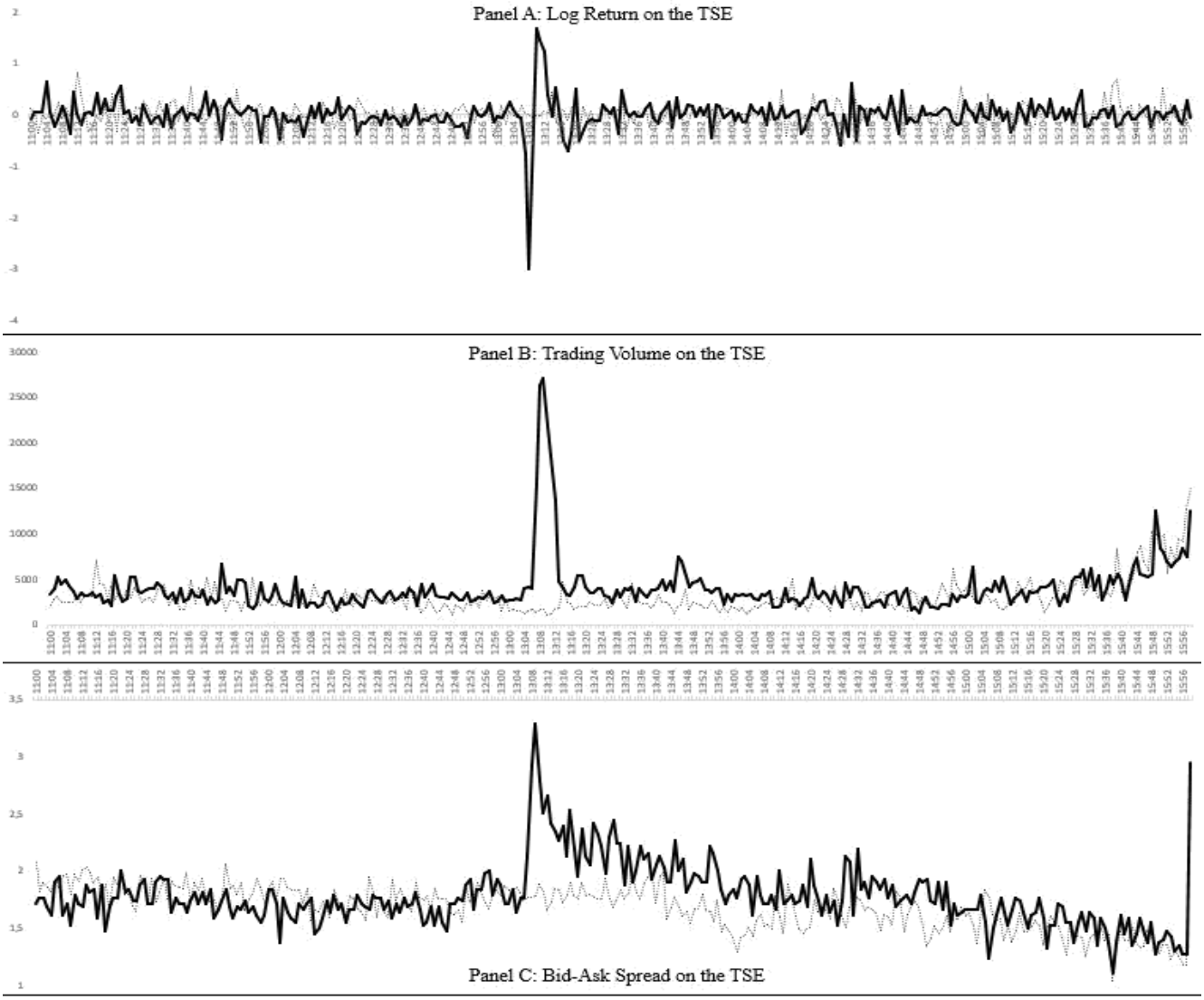

Figure 1. Intraday patterns of price formation and liquidity. Intraday patterns for the main sample of stocks on the TSE are plotted by one-minute interval for April 23, 2013 (solid line) and April 16, 2013 (dashed line) from 11a.m. to the end of the trading session. Panel A reports the log price return times 10^3, the trading volume is reported as the sum of buy and sell orders in Panel B, and the reported bid-ask as shown in Panel C is the spread times 10^2.

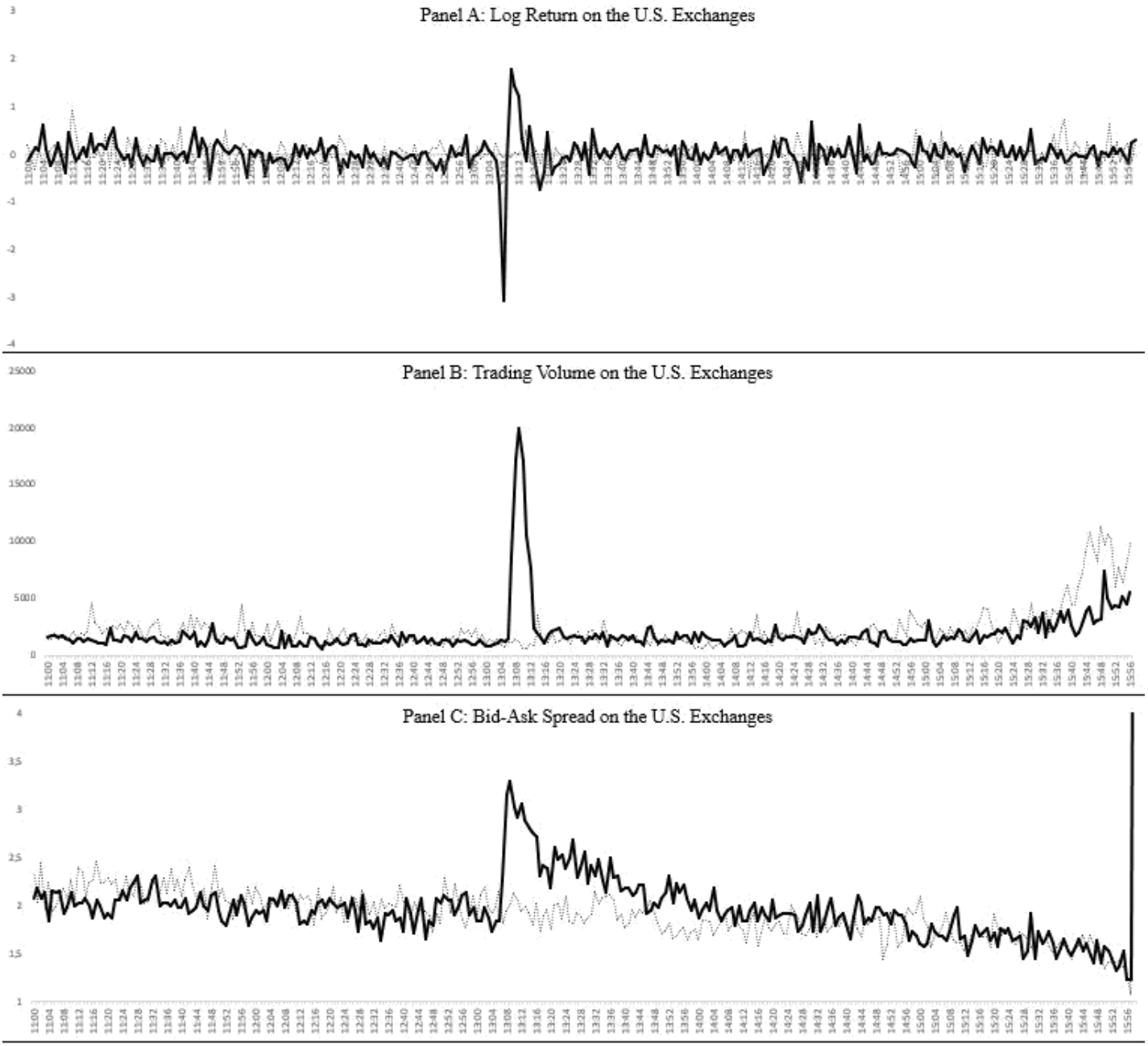

Figure 2. Intraday patterns of price formation and liquidity. Intraday patterns for the main sample of stocks on the U.S. exchanges are plotted by one-minute interval for April 23, 2013 (solid line) and April 16, 2013 (dashed line) from 11a.m. to the end of the trading session. Panel A reports the log price return times 10^3, the trading volume is reported as the sum of buy and sell orders in Panel B, and the reported bid-ask as shown in Panel C is the spread times 10^2.

Table I

Summary Statistics of Sample Firms

The *market capitalizations* are reported as on April 23, 2013. The *trading volume* is the daily trading volume average over the April 2013 trading sessions prior to the event-day. The four-digit Standard Industrial Classification (*SIC*) and the date are obtained from the Compustat Monthly North America database.

	Market capitalization (C$ million)	Trading volume on the TSE (in thousand)	Trading volume in the U.S. (in thousand)	SIC
Agrium Inc.	14,331	504.16	1,406.68	2873
Bank of Montreal	41,156	1,248.01	444.64	6029
Baytex Energy Corp.	4,967	513.64	228.90	1381
BCE Inc.	36,370	1,313.59	799.99	4813
Brookfield Office Properties Inc.	8,912	584.32	1,728.13	6512
Cameco Corporation	7,685	1,096.26	1,713.43	2819
Canadian Imperial Bank of Commerce	31,610	1,222.88	196.16	6029
Canadian National Railway Company	42,065	768.03	837.89	4011
Canadian Natural Resources Limited	33,934	3,744.21	2,953.12	1311
Canadian Pacific Railway Limited	21,661	559.45	1,074.40	4011
Celestica Inc.	1,346	180.47	162.40	3672
Cott Corporation	1,006	162.34	609.54	2086
Enbridge Inc.	37,503	1,576.28	1,056.92	4923
Encana Corporation	14,171	2,242.47	4,187.97	1311
Enerplus Corporation	2,774	549.94	961.80	1311
First Majestic Silver Corp.	1,635	602.40	1,364.88	1311
Gildan Activewear Inc.	4,885	603.80	490.07	2252
Gran Tierra Energy Inc.	1,531	319.29	694.90	1311
IMAX Corporation	1,833	40.49	631.89	3861
Imperial Oil Limited	33,974	654.69	308.83	2911
Lululemon Athletica	7,671	132.99	2,941.19	5600
Magna International Inc.	13,724	692.73	740.65	3714
Manulife Financial Corporation	26,158	3,030.45	1,723.06	6311
Methanex Corporation	3,782	225.74	557.23	2860
Pembina Pipeline Construction	9,569	435.94	161.46	4612
Pengrowth Energy Corporation	2,549	676.07	1,896.09	1311
Precision Drilling Corporation	2,352	1,255.73	1,924.23	1381
Ritchie Bros. Auctioneers Incorporated	2,172	96.71	427.34	7389
Royal Bank of Canada	88,212	2,568.96	665.72	6021
Sandstorm Gold Ltd.	746	356.76	824.89	6719
Sun Life Financial Inc.	16,374	1,366.37	578.59	6311
Suncor Energy Inc.	44,526	3,692.39	4,818.75	2911
Talisman Energy Inc.	12,246	2,264.63	5,119.97	1311
Telus Corporation	22,933	720.19	71.49	4813
Toronto-Dominion Bank	75,343	1,667.90	607.36	6029
TransCanada Corporation	34,344	1,157.87	542.34	4922
TransGlobe Energy Corporation	574	232.84	88.30	1311
Turquoise Hill Resources Ltd.	6,054	835.10	2,376.99	1021

Table II

Cumulative Log Return by Ten-Minute Intervals on the TSE

Ten-minute *cumulative log return* across April 23, 2013, are reported and their *t-statistic* are provided. The *median before event day* is based on the Tuesday trading days before the event day. The *trading volume* and the *bid-ask spread* are reported as the difference in means for ten-minute windows between the event day and the Tuesday trading days in April, 2013, prior to the event day. Two-tailed significance at the 1 and 5 percent levels is indicated by ** and *.

	Cumulative Log Return (times 10^3)	Median before Event day (times 10^3)	Trading Volume Difference in Means	Bid-Ask Spread Difference in Means (times 10^3)
11:07–11:17	0.079	0.459	-830.98	-2.342**
11:17–11:27	1.754	0.001	761.70	-0.408
11:27–11:37	-0.652	-0.014	510.65	-0.211
11:37–11:47	0.509	-0.057	11.10	-0.974
11:47–11:57	0.840	0.128	793.85	-1.184
11:57–12:07	-0.883	-0.088	566.56	-2.053
12:07–12:17	-0.598	-0.212	82.79	-0.842
12:17–12:27	-0.068	-0.190	41.34*	-0.329
12:27–12:37	-0.802	0.060	264.00	-0.263
12:37–12:47	-0.820	0.042	1,566.8**	-1.355
12:47–12:57	-1.153*	0.003	406.22	0.974
12:57–13:07	0.364	-0.024	1,321.4	-0.026*
13:07–13:17	**1.124****	**0.107**	**11,847****	**8.211****
13:17–13:27	-2.356**	0.009	1,921.3**	4.395**
13:27–13:37	0.593	0.126	748.30	3.395**
13:37–13:47	0.593	0.092	2,579.7**	2.342*
13:47–13:57	0.314*	-0.182	1,986.3**	3.303**
13:57–14:07	0.089	0.287	1,407.0**	3.737**
14:07–14:17	0.235*	0.001	-120.73	1.434
14:17–14:27	0.178	0.110	778.03	1.618
14:27–14:37	-0.936*	0.065	470.31	2.026
14:37–14:47	0.343*	0.027	167.78	1.803
14:47–14:57	0.218	0.032	-986.72	2.776**
14:57–15:07	-0.161	0.117	177.23*	-0.132
15:07–15:17	-0.100	0.148	479.73	1.211
15:17–15:27	0.736	-0.448	413.12	1.092
15:27–15:37	0.257	-0.100	799.77	1.000
15:37–15:47	-0.385**	0.023	-429.82	0.671
15:47–15:57	-0.096	0.248	-982.02	0.566

Table II (continued)

Cumulative Log Return by Ten-Minute Intervals on the U.S. Exchanges

Ten-minute *cumulative log return* across April 23, 2013, are reported and their *t-statistic* are provided. The *median before event day* is based on the Tuesday trading days before the event day. The *trading volume* and the *bid-ask spread* are reported as the difference in means for ten-minute windows between the event day and the Tuesday trading days in April, 2013, prior to the event day. Two-tailed significance at the 1 and 5 percent levels is indicated by ** and *.

	Cumulative Log Return (times 10^{-3})	Median before Event day (times 10^{-3})	Trading Volume Difference in Means	Bid-Ask Spread Difference in Means (times 10^{-3})
11:07–11:17	0.056	0.500	-1,121**	-1.908
11:17–11:27	1.796	-0.018	-740	-2.158*
11:27–11:37	-0.658	0.054	-667	-0.263
11:37–11:47	0.523	-0.046	-845	-2.171*
11:47–11:57	0.852	0.103	-781	-1.000
11:57–12:07	-0.952	-0.021	-833	-1.079
12:07–12:17	-0.520	-0.189	-569	-0.579
12:17–12:27	-0.162	-0.175	-394	0.000
12:27–12:37	-0.680	-0.014	-500	-1.329**
12:37–12:47	-0.807	0.052	271	-1.171**
12:47–12:57	-1.144	0.000	-409	0.145
12:57–13:07	0.263	-0.045	-181	-1.171
13:07–13:17	**1.173****	**0.142**	**7,451***	**9.342****
13:17–13:27	-2.351*	-0.010	414	5.658**
13:27–13:37	0.649*	0.110	-203	3.868**
13:37–13:47	0.535	0.124	317	2.724**
13:47–13:57	0.337	-0.208	83*	3.355**
13:57–14:07	0.039	0.256	528**	2.224*
14:07–14:17	0.268*	-0.013	-788	1.263
14:17–14:27	0.123	0.092	-231	0.934
14:27–14:37	-0.849*	0.066	166	1.066
14:37–14:47	0.397*	0.093	-140	0.658
14:47–14:57	0.084	0.004	-754	1.618
14:57–15:07	-0.121	0.109	-802	-1.539
15:07–15:17	-0.186	0.114	-665	0.474
15:17–15:27	0.785	-0.497	-720	-0.079*
15:27–15:37	0.299	-0.036	-504	0.145
15:37–15:47	-0.431**	-0.060	-3,635**	-0.368
15:47–15:57	-0.052*	0.252	-4,120**	0.447

Table III

Price Change, Trading Volume and the Bid-Ask Spread Adjustments for the Cross-Listed Mining Stocks on the TSE and U.S. Exchanges

The reported log price change is given times 10^3, trading volume is reported as the sum of buy and sell orders, and the reported bid-ask spread is the spread times 10^2. The event day is April 23, 2013. The nonevent day -7 represents the trading session of April 16, 2013. The arrival of the fake public information took place on the event day at 13:07 p.m.. The intraday data is obtained on Bloomberg database.

	13:05-13:06	13:06-13:07	**13:07-13:08**	13:08-13:09	13:09-13:10	13:10-13:11	13:11-13:12	13:12-13:13	13:13-13:14	13:14-13:15
Panel A: Log Return										
TSE										
Event day	-0.210	-0.525	**1.496**	3.587	-0.863	-1.544	0.498	-0.760	0.341	-0.576
Nonevent day N-7	0.362	0.103	**0.259**	0.155	1.085	-0.465	-0.982	-0.103	0.310	1.421
U.S. Exchanges										
Event day	-0.028	-0.666	**1.647**	3.712	-1.012	-1.286	0.453	-1.252	0.619	-0.591
Nonevent day N-7	0.516	0.217	**0.271**	0.244	1.166	-0.434	-0.949	-0.380	0.190	1.648
Panel B: Trading Volume										
TSE										
Event day	5,824	6,200	**32,002**	37,221	31,771	27,055	22,830	15,663	11,740	7,122
Nonevent day N-7	6,519	2,546	**4,015**	4,783	5,892	8,347	9,194	3,630	2,428	9,819
U.S. Exchanges										
Event day	2,091	1,570	**19,710**	22,024	21,443	26,570	16,753	7,753	7,972	4,269
Nonevent day N-7	7,427	6,694	**7,558**	4,596	4,891	3,752	7,820	5,433	3,510	8,897
Panel C: Bid-Ask Spread										
TSE										
Event day	1.316	1.316	**1.579**	1.632	1.474	1.526	1.474	1.316	1.684	1.474
Nonevent day N-7	1.263	1.368	**1.368**	1.474	1.368	1.474	1.474	1.368	1.263	1.316
U.S. Exchanges										
Event day	1.368	1.158	**1.368**	1.474	1.684	1.737	1.632	1.368	1.684	1.526
Nonevent day N-7	1.316	1.316	**1.211**	1.158	1.105	1.158	1.263	1.368	1.211	1.105

Table IV

Summary Statistics of Cross-Listed Mining Firms

The *market capitalizations* and the *trading volume* are reported as on April 23, 2013. The *trading volume* is the daily trading volume.

	Market capitalization (C$ million)	Trading volume on the TSE (in thousand)	Trading volume in the U.S. (in thousand)	U.S. Exchange
Agnico Eagle Mines Limited	5,801	910	1,521	NYSE
AuRico Gold Inc.	1,212	657	3,467	NYSE
Barrick Gold Corporation	18,351	3,689	21,382	NYSE
Eldorado Gold Corporation	5,420	3,623	6,307	NYSE
Franco-Nevada Corporation	5.868	751	882	NYSE
Kinross Gold Corporation	6,426	5,771	12,298	NYSE
McEwen Mining Inc.	398	145	2,261	NYSE
Nevsun Resources Ltd.	695	310	569	AMEX
NovaGold Resources Inc.	779	152	1,739	AMEX
Pan American Silver Corp.	1,886	267	1,627	NASDAQ
Pretium Resources Inc.	639	316	232	NYSE
Rubicon Minerals Corporation	490	271	409	AMEX
Silver Standard Resources Inc.	567	147	1,259	NASDAQ
Silver Wheaton Corp.	8,212	1,318	6,136	NYSE
Silvercorp Metals Inc.	459	78	897	NYSE
Tanzanian Royalty Exploration Corp.	272	91	371	AMEX
Yamana Gold Inc.	9,067	3,479	8,043	NYSE

Table V

Price Log Return and Trading Volume Regression between the Cross-Listed Stocks and the Cross-Listed Mining Stocks

The log price returns and the number of trading orders of the sub-sample of stocks are regressed on the main sample of stocks for every 10-minute windows before and after the news announcement at 13:07p.m.. Two-tailed significance at the 1 and 5 percent levels is indicated by ** and *.

	12:18-12:28	12:28-12:38	12:38-12:48	12:48-12:58	12:58-13:08	13:08-13:18	13:18-13:28	13:28-13:38	13:38-13:48	13:48-13:58	13:58-14:08
Panel A: Log Return Regression											
TSE											
Variable	1.031	-0.736	1.029	-0.878	0.200	-0.905**	1.740*	0.357	-0.182	-0.057	0.086
R^2	0.027	0.013	0.062	0.386	0.004	0.673	0.340	0.061	0.016	0.001	0.000
U.S. Exchanges											
Variable	0.272	0.426	0.527	-0.837	0.121	-0.934**	1.813	0.744	-0.218	0.209	0.518
R^2	0.002	0.009	0.018	0.269	0.004	0.677	0.293	0.374	0.013	0.022	0.017
Panel B: Trading Volume Regression											
TSE											
Variable	-0.344	2.861*	0.423	-1.131	0.689	1.178**	0.802	0.873	0.551	-0.216	-0.315
R^2	0.004	0.441	0.020	0.023	0.063	0.874	0.071	0.101	0.301	0.047	0.003
U.S. Exchanges											
Variable	-1.758	1.071	1.639	6.871	-1.331	1.154**	-2.007	0.835	0.671	1.396*	0.868
R^2	0.038	0.038	0.077	0.143	0.242	0.677	0.201	0.099	0.215	0.446	0.047

Table VI

Price Change Correlation for the Main Sample of Stocks between the TSE and the U.S. Exchanges series

	9:30-10:00	10:00-10:30	10:30-11:00	11:00-11:30	11:30-12:00	12:00-12:30	12:30-13:00	13:00-13:30	13:30-14:00	14:00-14:30	14:30-15:00	15:00:15:30	15:30:16:00
Event day	0.960	0.964	0.964	0.951	0.964	0.927	0.754	0.994	0.901	0.910	0.960	0.937	0.753
Nonevent day N-7	0.995	0.977	0.968	0.918	0.922	0.873	0.833	0.897	0.887	0.931	0.919	0.945	0.813
Nonevent day N-14	0.968	0.976	0.965	0.936	0.828	0.850	0.902	0.851	0.974	0.915	0.920	0.905	0.852
Nonevent day N-21	0.946	0.948	0.935	0.888	0.844	0.828	0.740	0.836	0.865	0.766	0.915	0.970	0.208
Mean	0.976	0.963	0.944	0.932	0.927	0.895	0.902	0.889	0.900	0.881	0.902	0.929	0.748
Median	0.982	0.966	0.955	0.935	0.932	0.881	0.916	0.898	0.893	0.886	0.920	0.950	0.832

Table VII

Error Term Correlation Coefficients between the TSE and the U.S. Exchanges series

With Event day N-1	0.8475
With Event day N-7	0.8953
With Event day N-14	0.8488

Table VIII

Price Volatility Difference between the Cross-Listed Stocks and their Control Stocks on the TSE

The reported *Parkinson Volatility* is the average Parkinson volatility observed over the trading sessions of every Tuesdays in April, 2013, before the event day. The *trading volume* is the average daily trading volume (in thousands) in every Tuesdays on April, 2013, before the event day.

	Trading Volume before Event day	Trading Volume on the Event day	Parkinson Volatility before Event day	Parkinson Volatility on the Event day
Sample Stocks				
Mean	1,067.73	1,131.32	0.01012	0.01140
Median	683.41	849.36	0.00867	0.00866
Control Stocks				
Mean	721.17	410.21	0.01181	0.01026
Median	405.96	479.77	0.00840	0.00773

Table IX

Summary Statistics of Control Stocks

The *market capitalizations*, *Parkinson volatility* and *daily trading volume* are reported as averages on April, 2013, before the event day.

	Market capitalization (C$ million)	Daily trading volume on the TSE (in thousand)	Parkinson Volatility	Ticker
AGF Management Ltd. -CL B	976.89	203.40	0.00980	AGF.B
Bombardier Inc. -CL B	5,602.33	1,585.64	0.00178	BBD.B
Boardwalk Real Estate Trust	3,103.69	51.62	0.01236	BEI.UN
Birchcliff Energy Ltd.	1,162.28	315.93	0.01409	BIR
Chorus Aviation Inc.	446.89	183.60	0.00768	CHR.B
Dorel Industries Inc.	1,161.58	41.23	0.00950	DII.B
DPF India Opportunities Fund	72.189	83.30	0.00564	DPF.UN
Horizons Betapro S&PTSX60 BE	90.27	506.32	0.01940	HXD
Horizons Betapro S&PTSX60 BU	59.91	436.97	0.00971	HXU
Just Energy Group Inc.	900.68	378.42	0.00599	JE
Kirkland Lake Gold Inc.	197.124	273.89	0.01158	KGI
Mercator Minerals Ltd.	101.44	364.40	0.02421	ML
Nuvista Energy Ltd.	816.80	254.33	0.01735	NVA
Paramount Resources Ltd.	3,228.71	142.36	0.01355	POU
Power Corp Canada	10,742.60	859.47	0.00840	POW
Pretium Resources Inc.	642.199	316.20	0.02309	PVG
Riocan Reit	8,327.79	473.51	0.00477	REI.UN
Twin Butte Energy Ltd.	578.28	613.22	0.04344	TBE
WestJet Airlines Ltd.	3,080.45	601.26	0.00688	WJA