

# THE Impact OF U.S. Decimalization ON CROSS-LISTED Canadian Stocks

Corporations reap  
the benefits of price  
stabilization and  
smaller spreads.

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In early 2001, the U.S. exchanges became the last major exchanges in the world to decimalize. The reasoning for implementation was clear: “[t]he Commission believes that decimal pricing could benefit investors by enhancing investor comprehension, facilitating globalization of our markets, and potentially reducing transactions costs, depending on the minimum price variant used.” (U.S. Securities and Exchange Commission, 2000.)

About five years prior to the U.S. decimalization, the Toronto Stock Exchange implemented decimalization. Its reasons for decimalization were similar to those subsequently argued in the U.S.: “to compete more effectively with U.S. markets...[f]or more efficient pricing, smaller spreads, increased trading volume, a shift from passive to active trading, and greater visibility and liquidity.” (Baikie, 2000.)

The purpose of this study is to examine the impact of U.S. decimalization on Canadian stocks cross-listed in the U.S. and on the TSX. The parameters examined—number of trades, dollar value of the shares traded, number of shares traded, distribution of number of shares traded across trade size categories, quoted and effective bid-ask spreads, depth of quotes—and

their interrelationships are of great interest to Canadian portfolio managers. The Canadian securities cross-listed in the U.S. are among the largest Canadian securities, and consequently the ones most institutional holders transact in regularly (in either the U.S. or Canada). The liquidity and trading costs of these securities are important issues for institutional portfolio managers.

## Background and Issues

There is little prior research on the impact of decimalization on Canadian securities. Ahn, Cao, and Choe (1998) utilize a sample of Canadian stocks cross-listed in the U.S. to examine the impact of TSX reduction of tick size due to decimalization. They determine that the spreads in the U.S. do not decline after TSX decimalization for the Canadian stocks cross-listed on the NYSE/AMEX, but the U.S. spreads decrease significantly for the stocks cross-listed on the NASDAQ. Further, they find that despite a significant decline in both quoted and effective spreads on the TSX, order flows do not migrate from the U.S. to the TSX. More recently, Cleary, Kerr, and Schmitz (2002) document a decline in spreads for all Canadian securities in the Canadian post-decimalization era.

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There are studies presenting preliminary impact of decimalization of the U.S. markets on U.S. stocks. The most comprehensive is a NYSE working paper (Bacidore et al., 2001), which finds that the average bid-ask spread is lowered by 30% and the average depth is lowered by 70%. In this study, our focus is on the impact of decimalization of the U.S. markets on the Canadian stocks cross-listed in the U.S. We look at the impact in both the U.S. and Canada.

One result of the decrease in tick size due to decimalization should be smaller spreads in the newly decimalized markets, lowering transaction costs for traders. It is not unreasonable to expect an increase in trading activity in affected markets because the decrease in tick size ought to improve liquidity as a result of the decline in total transaction costs. Also, traders will face a smaller barrier to trading on new information reaching the market. The consequent hypotheses are that the number of trades, the number of shares traded, and the dollar value of the trades increase subsequent to decimalization.

A second impact should be smaller spreads in the home (TSX) market. Market participants are indifferent to the marketplace for their transactions; they should utilize the marketplace with the lowest total transaction costs. Consequently, for competitive reasons, TSX market makers should lower their spreads in response to U.S. decimalization to avoid losing market orders.<sup>1</sup>

As spreads narrow, market makers face increased risk

of losing money on trades with informed traders. Consequently, market makers will attempt to protect themselves against these losses by lowering the depth of their quotes. Competition suggests lower post-decimalization depths on the TSX as well. Since reduced depths are less likely to affect retail traders than institutional traders executing large trades, it is expected that the increase in trading due to reduced spreads after decimalization will be mainly in retail trading.

### Sample and Data

A sample of 52 NYSE and 74 NASDAQ stocks was utilized. These 126 firms represent all those Canadian firms listed on the TSX that were also listed in the U.S. (NYSE or NASDAQ), and had the relevant data to execute the analyses presented below.

For the NYSE-listed stocks, the data consists of all U.S. and TSX transactions and market-maker posted quotes for the 30 trading days prior to NYSE decimalization on January 29, 2001, through the 30 trading days after decimalization (utilizing only days when both the NYSE and TSX were open). The data for NASDAQ-listed stocks is similar, and corresponds to NASDAQ's decimalization on April 9, 2001. The U.S. transaction data (number of trades, number of shares traded in each trade, and price of each trade) and quote data (bid and ask prices and their depths) are obtained from the Trade and Quote (TAQ) database created by

#### DAILY TRADING ACTIVITY BEFORE AND AFTER DECIMALIZATION

TSX-NYSE is the TSX trading of securities cross-listed on the TSX and NYSE; US-NYSE is the U.S. trading of securities cross-listed on the TSX and NYSE. TSX-NASDAQ is the TSX trading of securities cross-listed on the TSX and NASDAQ; US-NASDAQ is the U.S. trading of securities cross-listed on the TSX and NASDAQ. The dollar values are in C\$ for both TSX and U.S. trading. The U.S. figures include trading on regional exchanges.

Table 1

Means of Daily Averages Across Firms					
	Num. of Trades	C\$ Volume	Share Volume	Ave Trade Size (C\$)	Ave Trade Size (Shares)
Pre (TSX-NYSE)	443	22,019,064	593,911	49,743	1,342
Post (TSX-NYSE)	467	23,230,419	600,906	49,693	1,285
Event (TSX-NYSE)	394	16,813,971	406,539	42,656	1,031
Pre (US-NYSE)	120	9,093,969	201,367	75,634	1,675
Post (US-NYSE)	161	10,865,545	216,419	67,337	1,341
Event (US-NYSE)	117	8,007,324	163,777	68,619	1,403
Pre (TSX-NASDAQ)	155	2,405,136	119,531	15,493	770
Post (TSX-NASDAQ)	183	3,041,031	134,984	16,646	739
Event (TSX-NASDAQ)	109	1,450,091	86,879	13,290	796
Pre (US-NASDAQ)	165	3,110,700	95,441	18,840	578
Post (US-NASDAQ)	203	4,359,429	119,757	21,448	589
Event (US-NASDAQ)	115	2,175,856	80,779	18,868	700

the NYSE, with similar data for TSX trades and quotes obtained from the TSX.<sup>2</sup> Daily exchange rates obtained from the Pacific Exchange Rate Service of the University of British Columbia are used to convert prices in U.S. dollars to Canadian dollars.

## Results

The focus is on three issues: how trading parameters changed in the U.S. and TSX after decimalization; how spreads and depths changed; and how the distribution of share volume across trade size categories changed.

### Changes in Trading Activity during the Post Decimalization Periods

Table I provides a summary of daily aggregate trading activity during the period from 30 trading days prior to decimalization to 30 days after decimalization.<sup>3</sup>

The TSX trading of 52 NYSE cross-listed stocks, as measured by either the number of trades, dollar volume, or share volume, rose modestly subsequent to NYSE decimalization. For trades and dollar volume these increases are about 5%, while for share volume the increase is about 1%. The average trade size in dollar terms remained constant, but decreased by about 4% in terms of the number of shares.

In contrast to the TSX, the number of daily trades of these stocks in the U.S. rose by about 34% from 120 to 161 after NYSE decimalization.<sup>4</sup> The average dollar

and share volume rose more modestly (18% and 7%, respectively). These increases are statistically significant. The average trade size on the NYSE declined, in terms of both dollars (12%) and shares (20%), after decimalization. These results, showing that aggregate activity in the U.S. increased materially after decimalization of the NYSE while average trade size declined, are consistent with expectations. However, this increase in trading activity, apparently, did not come at the expense of the TSX, where the trading activity increased modestly.

The results for the TSX-NASDAQ cross-listed stocks are somewhat different from those for the TSX-NYSE stocks. The average number of daily trades of these stocks on the TSX increased by 18% during the post (NASDAQ) decimalization period, while average daily dollar volume of these trades increased by 26%, and average daily share volume increased by about 13%. All of these increases are statistically significant. The average trade size in Canadian dollars increased, insignificantly, by about 7%, while average trade size in shares declined by about 4%.

On NASDAQ, there are significant post-decimalization increases in number of trades per day (over 23%), daily dollar volume (over 40%), and daily share volume (over 25%). For the sample firms, trading sizes increase on the NASDAQ: average number of shares per trade increased by about 2% and average trade size measured in dollars increased by almost 15%.

### SPREADS AND DEPTHS BEFORE AND AFTER DECIMALIZATION

TSX-NYSE is the TSX trading of securities cross-listed on the TSX and NYSE; US-NYSE is the U.S. trading of securities cross-listed on the TSX and NYSE. TSX-NASDAQ is the TSX trading of securities cross-listed on the TSX and NASDAQ; US-NASDAQ is the U.S. trading of securities cross-listed on the TSX and NASDAQ. The \$ quoted spreads are in C\$ for both the TSX and U.S. trading. The bid and ask sizes are in 100s of shares.

Table 2

	Means of Daily Averages Across Firms				
	Quotes	\$ Qtd Sp	% Qtd Sp	Bid Size	Ask Size
Pre (TSX-NYSE)	641	0.21	1.19%	42.0	41.9
Post (TSX-NYSE)	714	0.17	0.97%	31.7	32.9
Event (TSX-NYSE)	561	0.18	1.12%	29.3	37.8
Pre (US-NYSE)	482	0.26	1.60%	67.4	69.8
Post (US-NYSE)	634	0.20	1.06%	23.7	27.0
Event (US-NYSE)	485	0.20	1.08%	22.0	32.2
Pre (TSX-NASDAQ)	381	0.34	3.44%	19.9	20.7
Post (TSX-NASDAQ)	459	0.26	2.85%	18.4	20.0
Event (TSX-NASDAQ)	276	0.30	3.64%	19.3	19.2
Pre (US-NASDAQ)	320	0.33	3.46%	12.2	11.4
Post (US-NASDAQ)	468	0.25	2.67%	8.5	8.2
Event (US-NASDAQ)	391	0.28	2.75%	9.5	7.6

## Market Maker Activities

Table 2 presents the results of market-maker activity in these stocks: number of quotes, spreads, and depths.

Considering first the stocks cross-listed on the NYSE and TSX, the mean number of U.S. quotes per firm per day rose significantly, by over 30%. The mean quoted spread dropped significantly, from C\$0.26 (1.60%) to C\$0.20 (1.06%).<sup>5</sup> Finally, the U.S. quoted depth for these stocks dropped by over 60%—from about 6,800 to about 2,500 shares. These results are consistent with expectations. The large drop in quoted NYSE depth may partially lead to the significant drop in average trade size on the NYSE reported in Table 1, if it is assumed that many NYSE trades are with market makers (with their reduced quoted depth) and others are with limit order traders (who also likely provide reduced depth in their orders subsequent to decimalization).

On the TSX, the average number of quotes also increased significantly, by about 11%. The mean quoted spread dropped from C\$0.21 (1.19%) to C\$0.17 (0.97%). On average, the spreads for these stocks on the TSX after U.S. decimalization remained below those on the NYSE. Finally, the TSX quoted depth also dropped significantly, from about 4,200 to 3,200 shares. However, while depths on the NYSE, on average, were much greater than on the TSX prior to decimalization, the TSX depths are greater after decimalization.

For the stocks cross-listed on NASDAQ, the average number of quotes on NASDAQ increased after decimalization by almost 50%. The quoted spread declined significantly from about C\$0.33 (3.46%) to C\$0.25 (2.67%). The highest quoted depth declines by almost 30%, from about 1,200 shares to about 840 shares.<sup>6</sup> For these firms, the average number of quotes on the TSX increased by about 20% after decimalization. The quoted spread declined significantly from C\$0.34 (3.44%) to C\$0.26 (2.85%). The depth declined slightly from about 2,000 to 1,900 shares. Thus, when we consider firms cross-listed on NASDAQ and TSX, we find that in contrast to firms cross-listed on the NYSE and TSX, spread declines are similar in both countries (and spreads remain nearly identical, on average, in each country). Also, the declines in depths of quotes are more modest.

The changes in the effective spreads on the TSX parallel the results of the quoted spreads. For the stocks cross-list-

ed on the NYSE, the effective spreads on the TSX decline from C\$0.16 (0.82%) to C\$0.13 (0.69%). For the stocks cross-listed on NASDAQ, the TSX effective spreads decline from C\$0.22 (2.17%) to C\$0.17 (1.80%).

## Changes in Share Volume across Trade Size Categories

The analysis in the previous section indicates that depths decline substantially on the NYSE, while the declines in depths are less on the TSX and NASDAQ. Consistent with this, the earlier results about trading volume and trade size indicated that the size of trades decreases on the NYSE. It appears that the size of trades on the TSX remains relatively stable and increases on NASDAQ. This leads to the issue whether the distributions of trade sizes (related to whether trades are likely retail trades or institutional trades) on the exchanges change after decimalization. We will now analyze this issue.

We classify each trade on each exchange for each security during the 61 trading days around decimalization as being in one of four mutually exclusive categories: a trade of 100 to 499 shares (Category 1), 500 to 2,499 shares (Category 2), 2,500 to 9,999 shares (Category 3), or greater than or equal to 10,000 shares (Category 4). This classification system reflects the

### DISTRIBUTION OF SHARE VOLUME ACROSS TRADE SIZE CATEGORIES

TSX-NYSE is the TSX trading of securities cross-listed on the TSX and NYSE; US-NYSE is the U.S. trading of securities cross-listed on the TSX and NYSE. TSX-NASDAQ is the TSX trading of securities cross-listed on the TSX and NASDAQ; US-NASDAQ is the U.S. trading of securities cross-listed on the TSX and NASDAQ. Category 1 includes trades of 100 - 499 shares, Category 2 includes trades of 500 - 2,499 shares, Category 3 includes trades of 2,500 - 9,999 shares, and Category 4 includes trades of 10,000 shares or more. The U.S. figures include trading on regional exchanges.

Table 3

	Share Volume ('000s) - Averages per Firm per Day			
	Cat. 1	Cat. 2	Cat. 3	Cat. 4
Pre (TSX-NYSE)	52.2	131.8	122.6	287.3
Post (TSX-NYSE)	54.3	138.2	128.4	280.0
Event (TSX-NYSE)	47.6	105.1	85.5	168.3
Pre (US-NYSE)	11.0	50.3	58.8	81.3
Post (US-NYSE)	15.0	65.8	68.9	66.6
Event (US-NYSE)	11.0	47.9	51.5	53.4
Pre (TSX-NASDAQ)	19.4	34.8	20.4	44.9
Post (TSX-NASDAQ)	22.9	45.6	25.2	41.3
Event (TSX-NASDAQ)	13.4	31.9	15.2	26.5
Pre (US-NASDAQ)	19.3	33.3	19.4	23.4
Post (US-NASDAQ)	24.1	43.2	22.1	30.2
Event (US-NASDAQ)	12.6	27.3	16.4	24.4

common belief that trades of more than 10,000 shares are typically institutional in nature, those of fewer than 500 shares are typically retail in nature and the two intermediate categories each typically reflect a mixture of institutional and retail trading, with the 2,500 to 9,999 share category potentially reflecting a heavier mix of institutional trading than the 500 to 2,499 share category. Within each category, for each firm, we determine the share volume. The results of this analysis are presented in Table 3.

First consider firms cross-listed on the NYSE. It is evident that the institutional trading in these firms is much heavier on the TSX than the NYSE. On average, there are over three times the number of institutional shares traded daily per firm on the TSX than on the NYSE. After the NYSE decimalization, the share volume on the TSX increases in each category except Category 4, where there is a slight decrease. None of the changes is statistically significant at the 10% level. Thus there seems to be little change in the distribution of trades on the TSX after NYSE decimalization. In contrast to the TSX, average share volume in Categories 1 and 2 increases significantly by more than 30% on the NYSE. In Category 3, there is an increase in trading activity. The average share volume in Category 4 decreases significantly. The pattern of these results on the NYSE and TSX suggests that retail trading in these stocks increases markedly after decimalization, but not institutional trading. We find no evidence that NYSE decimalization causes a shift in institutional trading from the NYSE to the TSX, or vice versa.

The TSX trading of firms cross-listed on NASDAQ increases in each category except Category 4, where there is a slight decrease. The increases in Categories 1 and 2 are statistically significant. The NASDAQ trading of these stocks seems to increase greatly for all categories; however, these increases are only statistically significant for Categories 1 and 2. Thus, in general, retail-sized trades of these stocks increase; institutional trading on NASDAQ seems to increase, but the increase is not statistically significant at conventional levels. As with the NYSE cross-listed stocks, we find no evidence that the institutional trading of NASDAQ cross-listed stocks shifts from the TSX to NASDAQ, or vice versa, after NASDAQ decimalization.

## Conclusions

This paper examines the impact of U.S. decimalization on the trading of Canadian stocks cross-listed on the TSX and either the NYSE or NASDAQ. U.S. trading of these stocks increases materially after decimalization, but not at the expense of the TSX volume. Indeed, the TSX volume for those stocks that trade on NASDAQ increases as well. Most of the increase in volume is in retail-sized trades. The bid-ask spreads and quote depths decline on all exchanges, but by a greater amount in the U.S. than in Canada. The depths on the NYSE go from being greater than to being smaller than the depths in Canada.

The results should be considered in relationship to the reasons for decimalization and in terms of implications for portfolio managers. Consistent with promulgated reasons for decimalization, that overall pricing of securities is more efficient, spreads are smaller, and there is more overall trading volume, but not at the expense of the home exchange. Average depth declines by almost two-thirds on the NYSE. This is consistent with smaller NYSE trades. Despite the fact that its depth also significantly declines (though becoming greater than the NYSE depth), average trade size for these securities on the TSX does not decline. The results are suggestive that the portfolio managers wishing to trade large blocks quickly on the NYSE may have become disadvantaged. However, we find no evidence that a proportion of larger trades migrated from the NYSE to the TSX. The size distribution of trades on the NYSE simply changed after decimalization, reflecting either more retail trading or traders breaking up large blocks into more manageable sizes, or both. Overall, the results suggest that decimalization in the U.S. was a "good thing" for those trading in U.S./TSX cross-listed securities. ■

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## Endnotes

1. Several studies, such as Eun and Sabherwal (2003), Foerster and Karolyi (1998), and Werner and Kleidon (1996), discuss competition among market makers for internationally cross-listed securities.
2. Most trades on NASDAQ are market maker-broker (for principal) trades. In contrast, on the NYSE and TSX, far more trades are broker (principal)-broker (principal) trades. Thus, the NASDAQ volume is overstated relative to the NYSE or TSX volume. Researchers usually apply either a 50% or a 65% correction factor on NASDAQ trading data to achieve equivalence. Since a 50% correction factor implies that all trades on NASDAQ are market maker-broker trades and all trades on the NYSE and TSX are broker-broker trades, this study uses a 65% correction factor.
3. To conserve space, only means are presented in Table I; results using medians are substantially identical and are available from the authors.
4. These are the total U.S. trades. About 10-15% of them were on regional exchanges.
5. To assure comparability with TSX analysis, the US\$ spreads have been converted to C\$ spreads.
6. There is a single market maker for each stock on the NYSE and TSX while there could be more than one market maker for a stock on NASDAQ. We measure the depth on NASDAQ as the depth quoted by the market maker displaying the largest depth at the best price. Assuming investors endeavor, in any one trade, to transact with only one market maker, this statistic is a good representation of the depth immediately available and comparable to NYSE and TSX depths (where each stock has one market maker).