HOW LIQUID ARE Canadas?

A look at how Government of Canada debt behaves in periods of volatility and uncertainty.

BY CHRISTOPHER D'SOUZA AND CHARLES GAA

A liquid financial market is one where participants can rapidly execute large transactions with only a small impact on prices.[1] Research has indicated that market liquidity has a positive, first-order impact on asset returns.[2] Kim and Verrecchia (1994) argue that, if informed traders possess an informational advantage after an event, liquidity will remain low as long as those informed traders maintain that advantage. Volatility may also increase temporarily as investors adjust their beliefs. However, after an adjustment period, liquidity will revert to normal and volatility will subside. This may also coincide with a period of abnormally high trading activity as traders rebalance their portfolios.

Studies[3] of intraday conditions in the U.S. Treasury market have sought to measure the average level of liquidity in the market, as well as characterize how this liquidity changes over time and in periods of stress. Overall, studies suggest the U.S. Treasury market is extremely liquid, and it incorporates relevant news into prices and yields nearly instantaneously. Fleming and Remolona (1999) find U.S. Treasury markets react to public macroeconomic information with a sharp reduction in liquidity combined with rapid price changes as information is absorbed, and then a subsequent surge in trading activity as participants trade on their differing views regarding the interpretation of the new information.

It may be tempting to assume that Canadian government securities markets behave in a comparable manner, given the similar trading structure in the two markets. Most importantly, trading in both markets takes place in a continuous, over-the-counter, competitive multidealer market.[4] However, such an assumption may not be prudent. One important difference that may generate differences in liquidity dynamics is the relative size of the two markets: the U.S. Treasury market dwarfs Canada's both in terms of the value of securities outstanding and average trading volumes. The outstanding value of marketable debt issued in the Government of Canada securities market and U.S. Treasury market at the end of December 2003 was $373 billion and US$3,399 billion, respectively.[5] Even more bewildering, average daily trading volumes for Canadian and U.S. marketable government securities were $22.4 billion and US$433.5 billion, respectively, in 2003.[6]

This paper extends the existing literature by investigating the high-frequency behaviour of prices and trades around macroeconomic news releases. The analysis is not aimed at evaluating competing models of interest rate determination; instead, the paper focuses on measuring liquidity.

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TABLE 1: TWO-YEAR BENCHMARK, VOLATILITY

Five minutes ending at:	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	8:55	9:00
Announcement days, mean	0.007	0.007	0.006	0.009	0.008	0.011	0.025	0.022	0.016	0.013	0.011	0.011
Non-announcement days, mean	0.007	0.008	0.008	0.007	0.012	0.009	0.020	0.010	0.008	0.009	0.011	0.008
Ratio of means	0.973	0.900	0.707	1.179	0.715	1.192	1.225	2.215	1.855	1.330	0.987	1.413
Modified Levene F-statistic	0.100	0.300	1.053	0.051	2.674	0.797	2.546	21.02	18.21	3.513	0.995	2.361
Modified Levene, *p*-value	0.752	0.585	0.306	0.822	0.103	0.374	0.113	0.000	0.000	0.062	0.320	0.126

Volatility: Standard deviation in the midpoint of the bid-ask spread over the interval. Levene F-statistics are calculated to compare the variance in prices on event and non-event days. Under the null hypothesis of homoscedasticity, or equal variances across samples, the statistic is distributed as F(1,N-2).

The Government of Canada Bond Market

Like most sovereign securities markets, the market for Government of Canada securities is primarily a wholesale, institutional market, where a number of professional participants[7] conduct large trades—often in excess of $25 million or $50 million—on a relatively infrequent basis. The market is generally described as being divided into the primary market, where Government of Canada securities are sold through auctions, and the secondary market, which is the resale market for government securities. Most transactions on the secondary market take place between 7:30 a.m. and 5:00 p.m. Dealers in the market, usually representing financial institutions, commit themselves to trade continuously in the market by posting a bid price and an ask price for each government security. Institutional investors trade with dealers on a bilateral over-the-counter basis over the telephone.[8] Dealers, who supply liquidity in government securities markets by executing transactions against their own inventory of bonds, observe part of the overall order flow in the market. Consequently, dealers will initiate trades when their private bond valuations, conditioned on their private order-flow information, differ from market prices. The interdealer market operates partially on a direct bilateral over-the-counter basis and partially through electronic interdealer brokers (IDBs).

The current Canadian IDBs are screen-based voice brokers that allow dealers to trade anonymously with each other. Each participant has a screen where bids, offers, and trade outcomes are posted. Participants post quotes and make trades by communicating with brokers over the telephone. Given the large and unpredictable inventory shocks typically faced by dealers in their trades with customers, interdealer debt markets have developed to facilitate inventory management and risk sharing. Whereas only dealers can post quotes or trade through the IDBs, both customers and dealers have viewing access to an IDB's electronic screens.

The level of transparency in the IDB market was enhanced in 2001 with the introduction of CanPX, a data service that consolidates and disseminates to interested subscribers anonymous trade and quote data submitted by Canada's fixed income IDBs. Based on dealer statistics reported to the Investment Dealers Association (IDA), the Canadian interdealer debt market represented approximately 46% of the total secondary Government of Canada bond market trading volume during 2002, of which IDB trading accounted for 86% (up from 50% in 1991 and 75% in 1997).

Canadian Bond Market Data

Trade and quote data covering the periods from July 4, 2001, to September 10, 2001, and February 25, 2002, to February 27, 2003, are employed in this study. This CanPX dataset is relatively complete in that it receives information from all of the Canadian IDBs.[9] Dealers leave firm quotes with the brokers, along with a minimum size that they are willing to trade. Unlike stock exchanges, dealer behaviour is not governed by rules that limit bid-ask spreads or price changes, so prices

TABLE 2: TWO-YEAR BENCHMARK, TRADING VOLUME

Five minutes ending at:	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	8:55	9:00
Announcement days, mean	2.232	6.020	2.071	4.081	6.848	6.192	5.545	15.68	8.712	8.414	10.62	5.657
Non-announcement days, mean	3.352	3.497	4.691	2.509	4.452	5.042	4.139	7.006	5.621	6.939	6.433	6.552
Ratio of means	0.666	1.722	0.441	1.626	1.538	1.228	1.340	2.238	1.550	1.213	1.652	0.863
t-statistic, *p*-value	0.396	0.241	0.143	0.268	0.124	0.529	0.362	0.004	0.134	0.573	0.083	0.711
Kruskal-Wallis test, *p*-value	0.729	0.979	0.452	0.975	0.498	0.029	0.061	0.000	0.004	0.032	0.025	0.304

Trading volume: is the total value of securities traded per unit of time. The Kruskal-Wallis test is used to examine whether there is a statistically significant difference between the means of each liquidity measure on announcement and non-announcement days. The test statistic is distributed Chi-squared.

can adjust endogenously. This study focuses on benchmark Government of Canada bonds in the two-year sector, though there are strong similarities in the five-, 10-, and 30-year sectors. Benchmark securities are the most actively traded and quoted issues among IDBs. The benchmark for a given sector is the most recently issued security, with a cumulative issue size over a certain threshold.

Recall that, in general, a liquid market is one where market participants can rapidly execute large transactions with only a small impact on prices. Since an exact measure of market liquidity is not available, a number of statistics are employed that may together provide a more meaningful gauge of overall liquidity.

Trading volume, or the total value of securities traded per unit of time, is an intuitive and widely cited measure of market liquidity, stemming from the fact that active markets tend to be more liquid. The popularity of the measure may be largely due to its simplicity and availability. One drawback of trading volume as a liquidity indicator is that it is also associated with price volatility, which is thought to be negatively related to market liquidity. Closely related to trading volume, trade frequency—or the number of trades observed per unit of time—is another indirect measure of liquidity. The bid-ask spread, or the difference between the best bid and offer prices, is another commonly used measure of market liquidity. It measures directly the costs of executing a small trade, and a market with very low transaction costs is characterized as liquid.[10, 11]

The price-impact coefficient reflects how much the market adjusts prices to the information content of trades or order flow. It is generally believed that liquid markets are those which accommodate trades with the least impact on prices. Price-impact coefficients are estimated by regressing log changes in prices, computed using bid-ask midpoints, on one of two measures of order flow (OF) over a five-minute interval: the volume of buyer-initiated trades minus the volume of seller-initiated trades (referred to as Kyle 1 in Table 5), or the number of buyer-initiated trades minus the number of seller-initiated trades over the five-minute interval (Kyle 2 in Table 5). Trade data explicitly indicate whether a trade "hits the bid" or "takes the offer" so that it can be signed either as a seller-initiated trade or a buyer-initiated trade.

$$\log P_t - \log P_{t-1} = \beta_0 + \beta_1 (OF_t) + \varepsilon_t$$

All of the macroeconomic news announcements we examine occurred at 8:30 a.m., Eastern Standard Time. We use six Canadian news announcements (producer price index [PPI], real gross domestic product, current account, merchandise trade balance, retail sales, and raw materials price index) and nine U.S. economic announcements (non-farm payrolls, CPI, PPI, unemployment, hourly earnings, trade in goods and services, final gross domestic product, housing starts, and U.S. retail sales).[12] There are 199 days with no 8:30 a.m. macroeconomic announcement and 101 days with one 8:30 a.m. macroeconomic release. Since the sample consists of just over

TABLE 3: TWO-YEAR BENCHMARK, TRADE FREQUENCY

Five minutes ending at:	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	8:55	9:00
Announcement days, mean	0.232	0.222	0.253	0.232	0.455	0.566	0.626	1.152	0.808	0.818	0.788	0.475
Non-announcement days, mean	0.261	0.279	0.291	0.261	0.442	0.418	0.388	0.448	0.430	0.473	0.539	0.382
Ratio of means	0.891	0.797	0.868	0.891	1.027	1.353	1.615	2.568	1.878	1.731	1.461	1.243
t-statistic, *p*-value	0.687	0.433	0.623	0.694	0.906	0.197	0.022	0.000	0.001	0.006	0.033	0.403
Kruskal-Wallis test, *p*-value	0.833	0.827	0.489	0.884	0.673	0.030	0.059	0.000	0.002	0.020	0.013	0.311

Trade frequency: the number of trades observed per unit of time. The Kruskal-Wallis test is used to examine whether there is a statistically significant difference between the means of each liquidity measure on announcement and non-announcement days. The test statistic is distributed Chi-squared.

14 months of trade and quote data, there are too few 8:30 a.m. macroeconomic news announcements during this period to identify statistically significant effects related to the impact of each type of macroeconomic announcement. Therefore, all macroeconomic news announcements are pooled together.

Event Study and Results

Macroeconomic news announcements are public information which affect prices before anyone can trade on them. Theory predicts that liquidity will deteriorate before the release due to the associated uncertainty. At the time of the news release, price volatility should increase temporarily as investors revise their beliefs. Private information may exist if participants differ on how to interpret the macroeconomic news; alternatively, some traders in government securities may be better able to process public information, or they may have access to a larger proportion of market order flow. Over time, private information in the market will dissipate once it is first reflected in trades and order flow, and then subsequently in prices. As soon as the new information is fully processed by the market, volatility should decline, along with the reduced informational asymmetry in the market. Afterwards, there may be a period of increased trading volumes and trade activity as investors rebalance their portfolios. The speed with which the market returns to normal will indicate how liquid the market is, and how well the market processes new information.

The event study conducted here attempts to characterize price and trade dynamics in the Government of Canada secondary market on days with and without news releases. Intraday price and trade dynamics in the secondary market for Government of Canada securities are examined with a particular focus on times just before and just after the release of news. "Normal" trade and price dynamics from non-announcement days are contrasted with those on announcement days. The null hypothesis is that trade and price dynamics are similar on event and non-event days. Statistically significant differences in liquidity measures on announcement and non-announcement days are determined by using a number of parametric and non-parametric tests.[13]

Table 1 documents the average level of volatility for the two-year benchmark bond in a series of five-minute intervals before and after each news release. Time intervals are chosen to best measure intraday adjustments in the volatility of prices. For brevity, since there are many similarities across bond maturities, only results for the two-year benchmark are presented.[14] Volatility is significantly higher on days of macroeconomic news announcements than non-announcement days for 20 minutes following the release of news. This amount of time reflects how long it takes for traders in the market as a group to adjust their beliefs and form a consensus view.

Tables 2 and 3 indicate that trading volumes and frequencies exhibit a pattern of persistently higher trade volume and activity following the release of news. Each table documents whether any statistical difference exists between the liquidity measures on days with and

TABLE 4: TWO-YEAR BENCHMARK, BID-ASK SPREAD

Five minutes ending at:	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	8:55	9:00
Announcement days, mean	1.396	1.454	1.277	1.313	1.236	2.007	1.789	1.479	1.222	1.202	1.330	1.249
Non-announcement days, mean	1.492	1.477	1.415	1.465	1.409	1.425	1.586	1.362	1.198	1.210	1.222	1.226
Ratio of means	0.936	0.984	0.903	0.896	0.877	1.409	1.128	1.086	1.020	0.993	1.089	1.019
t-statistic, *p*-value	0.467	0.842	0.240	0.220	0.123	0.005	0.190	0.341	0.814	0.944	0.441	0.861
Kruskal-Wallis test, *p*-value	0.894	0.974	0.554	0.109	0.225	0.037	0.040	0.198	0.745	0.442	0.106	0.711

Bid-ask spread: the average difference between the best bid and offer prices (in dollar terms) in each time interval. The Kruskal-Wallis test is used to examine whether there is a statistically significant difference between the means of each liquidity measure on announcement and non-announcement days.

without a news announcement. Both variables are statistically higher on announcement days during the five minutes before and the 25 minutes following the release of macroeconomic news. The latter reflects the processing of new information by market participants. Table 4 indicates that bid-ask spreads are statistically higher on announcement days for the five minutes before and after the release of macroeconomic news. The wider bid-ask spreads reflect dealer reluctance to make markets at a time when prices may adjust sharply. Kryzanowski and Nemiroff (1998, 2001) find that liquidity falls around trading halts on the Toronto and Montreal stock exchanges. Halts can be imposed by exchange officals to disclose alleged asymmetric information between investors.

Table 5 indicates that the price-impact coefficients of net trade volume and net number of trades have nearly identical characteristics. As for the magnitude of the price-impact coefficients, there is on average a price increase of 0.00632% for every $1 million in net trading volume and an increase of 0.00024% for every net trade for the two-year bond during the 30 minutes preceding an 8:30 a.m. release. Price-impact coefficients are significantly higher on announcement days in the second 30- to 60-minute interval following the release of macroeconomic news. Green (2004) also finds a significant increase in the informational role of trading following economic announcements, suggesting that the release of public information increases the level of information asymmetry in the government bond market. In the 60 to 90 minutes after the release of macroeconomic news, price-impact coefficients are significantly lower on announcement days, which suggests that once information is processed, uninformative trading occurs in the market as traders rebalance their portfolios in light of the newly discovered prices.

Conclusion

A two-stage adjustment process to public information is observed in the Government of Canada securities market which is consistent with theoretical predictions and U.S. empirical evidence. Spreads widen in the five-minute interval before and after an announcement. Price volatility, trading volumes, and trade activity increase to higher-than-normal levels following the macroeconomic news release, persisting for up to 25 minutes. Once the new information is impounded into prices, volatility declines. In general, we find that news is processed in an efficient and timely manner, which suggests that the quality of the government securities markets in Canada may be adequate. ▮

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TABLE 5: TWO-YEAR BENCHMARK, KYLE 1 AND KYLE 2

30 minutes ending at:	8:00		8:30		9:30		10:00	
	Kyle 1	Kyle 2	Kyle 1	Kyle 2	Kyle 1	Kyle 2	Kyle 1	Kyle 2
Announcement days, coef.	0.508	0.010	0.614	0.001	0.632	0.024	0.191	0.006
p-value	0.000	0.003	0.035	0.397	0.000	0.002	0.016	0.051
Non-announcement days, coef.	0.732	0.017	0.426	0.018	0.342	0.010	0.565	0.020
p-value	0.000	0.000	0.111	0.139	0.000	0.002	0.000	0.040
p-value, F-stat, diff. in slope	0.116	0.351	0.550	0.559	0.002	0.017	0.002	0.061

Price-impact coefficients (10^{-4}) are estimated by regressing log changes in price on either the volume of buyer-initiated trades minus the volume of seller-initiated trades (Kyle 1) or the number of buyer-initiated trades minus the number of seller-initiated trades (Kyle 2) over the interval. The time interval between 8:30 and 9:00 a.m. is not analysed due to comtemporaneous stage 1 and stage 2 effects.

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