

# Developing Well Functioning Canada Bond and Bill Markets

## A Review and Assessment of Debt Management Policies of the Government of Canada

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## Executive Summary

During the past ten years, the Government of Canada introduced a number of initiatives designed to improve the management of the Government of Canada bond and bill markets. While a number of rationales has been advanced for this activity, our focus is on initiatives designed to improve liquidity in Government of Canada secondary bond and bill markets. Liquidity is an important issue in all security markets since poor liquidity is manifest in higher yields on financial instruments. In the Government of Canada bond and bill markets there are many reasons to improve liquidity. These include the use of these securities as a benchmark to determine interest rates on non-default free securities; their use in derivative transactions; reduced transactions costs for investors who need to change their portfolio composition; reduced costs of capital facing corporations; and lowered Government of Canada debt servicing costs.

To this end the Government of Canada introduced the following initiatives:

- Changes in auction procedures
- Altering the proportion of long and short term government securities
- Increasing benchmark bond sizes
- Changes to facilitate stripping and reconstitution
- Buyback of illiquid bonds (reverse auctions)

In order to assess the impact of these initiatives two approaches were undertaken. The first entailed interviews of bond dealers, a pension fund manager and the chief economist of a regulatory body. The second approach utilized bond related data and used both turnover ratios and bid-ask spreads to assess whether an initiative had an impact on liquidity. For certain initiatives only the results of the interviews could be used since either data were not available or the initiatives were not amenable to empirical testing.

Overall we conclude from both empirical analyses and interviews that the initiatives were successful in improving liquidity. The empirical work sheds light on the stripping and reconstitution, reverse auctions, changing the frequency of 30-year bond auctions and altering the ratio of bills to coupon bonds. The interviews were broadly consistent with the empirical analysis. Interview results were used to assess other initiatives.

One interesting finding is that the departure of US dealers from the Canadian bill and bond markets appeared to have a detrimental impact on liquidity as observed in an increasing bid-ask spread on longer term debt and a reduction in turnover. The latter was not statistically significant. However, another interpretation of the increased bid-ask spread relates to changes in competition.

We were unable to identify new initiatives that the Government of Canada can undertake to improve liquidity, that they are not already considering. For example, bond dealers suggested that the reverse auction process be changed and that a Dutch auction process be considered for regular auctions. The Government of Canada has been considering these issues and in fact will try a new process for reverse auctions. Another example is the use of Automated Trading Systems for bonds in order to improve liquidity. The Bank of Canada made a submission on proposed rules governing these systems.

# Table of Contents

- 1. Introduction**
  - 2. What is liquidity and how is it measured?**
  - 3. Forces impacting liquidity**
  - 4. Analysis of specific tactics used by the Government of Canada**
    - a. Methodological problems**
    - b. Initiatives undertaken**
  - 5. Suggestions to improve liquidity**
  - 6. Conclusions**
- Appendix 1: Interviews**

## **1. Introduction**

Over the past ten years, the Government of Canada introduced a number of initiatives designed to improve the management of the Government of Canada bond and bill markets. While a number of rationales has been advanced for this activity, our focus is on initiatives designed to improve liquidity in Government of Canada secondary bond and bill markets. Liquidity is an important issue in all security markets since poor liquidity is manifest in higher yields on financial instruments. With liquid financial securities, investors have the option to trade the security at any time and ideally in any quantity without any impact on the prevailing market price. This is a valuable option and the purchaser effectively pays for it through a lower yield (higher price) on the security. When liquidity is not present, the yield on the security is higher (price is lower) to compensate the investor.

Why is liquidity in Government of Canada bonds sufficiently important to warrant policies to maintain or improve it? First, Government of Canada bonds are used as a benchmark to determine interest rates on non-default free securities. Yields on the latter are quoted as a Government of Canada bond yield for a specific maturity plus a default or risk premium. Having a liquid market provides the correct basis on which to price risky debt. Second, Government of Canada securities are used in derivative transactions and there must be sufficient liquidity to permit the necessary trades. Third, investors in bond markets may want to change their portfolio positions. If it is costly to do this or it takes time to construct a trade to meet their requirements, investors are worse off since they are forced to hold a non-optimal position for a longer than expected period of time. Finally, since improved liquidity lowers yields on bonds, yields paid by the Government of Canada are lower and debt servicing costs are reduced. The lower yields also improve economic efficiency since the cost of capital for corporations is lower thereby increasing investments in real assets. The issue of liquidity is particularly important now with the reduction in the amount of new Government of Canada issues.

In order to evaluate the debt management initiatives introduced by the Government of Canada, we use a combination of approaches. First, we interviewed three major investment dealers who are involved in the auction and secondary Government of Canada bond and bill markets, a fixed income manager of OMERS, a large pension fund, and the chief economist of the Ontario Securities Commission who has a good knowledge of bond and bill markets and current regulations. Their insights on the effectiveness of the initiatives is very important since they have first hand information on the liquidity of the secondary markets and how the initiatives affect the markets. The second approach uses statistical analysis, where possible, to measure the impact of the initiatives on market liquidity. As noted in a subsequent section, identifying the impact of any one initiative may be difficult. Also data is not available in sufficient detail or frequency to undertake some analyses. Therefore market participants' perspectives take on added importance.

The initiatives we investigate in the report are the following:

- Changes in auction procedures/IDA National Policy #5
- Altering the proportion of long and short term government securities
- Increasing benchmark size
- Changes to facilitate stripping and reconstitution
- Buyback of illiquid bonds (reverse auctions)

## **2. What is Liquidity and how is it measured?**

In order to measure the impact of various initiatives on liquidity we must first define it. Liquidity has many definitions and they can be specific to the party providing the definition. The standard textbook definition is that a security is liquid if a transaction can occur immediately with no impact on price. Thus a liquid market will allow an investor to sell their current holdings, regardless of size, with no impact on price and without the necessity of breaking up the position into smaller more easily digestible pieces. When the transaction needs to be subdivided, transactions costs are higher and it can take a substantial amount of time to sell out the position. Both of these impacts increase the cost of the transaction and reduce the effective yield on the investment.

One of the bond dealers interviewed defined liquidity in a similar fashion. Liquidity is a trade of a block size in and out of the yield curve or a transaction between dealers and clients without any impact on the market price. This individual was somewhat vague as to the identity of the size variable but noted that very large transactions could not be undertaken immediately without an impact on the prevailing market price. He noted that smaller trades are much easier to undertake and have good liquidity. Another dealer defined liquidity as the number of transactions needed to clear a trade of a substantial size.

As can be observed in these definitions, there is a common theme of immediacy, no impact on market price (price neutrality) and transaction size.<sup>1</sup>

An important issue is the measurement of liquidity. From the definitions, there is no obvious measure. What would be required is an assessment of each transaction to determine if the market had sufficient liquidity based on the concepts of immediacy, price neutrality and transaction size. Unfortunately, this data is not available. Speaking to bond dealers provides their assessment of the liquidity of the trades they undertake. However, these results are hard to generalize to a liquidity definition and measurement. Another method is to use available data that provides an indication of the liquidity of the market.

The most commonly used liquidity measure is the bid-ask spread on Government of Canada bonds and bills. The bid-ask spread is not a direct measure of liquidity but an indicator. Bond dealers must hold an inventory of bonds in order to make a market and provide liquidity to the market. Holding an inventory is costly and compensation is obtained through the bid-ask spread. If secondary markets are liquid, investment dealers

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<sup>1</sup> Gravelle defines liquidity in four dimensions: immediacy which refers to the speed with which a trade of a given size is completed; depth which refers to the maximum transaction size for a given bid ask-spread; width which refers to the cost of providing liquidity; and resiliency which refers to the speed with which prices revert to pre-transaction level after a large transaction. See T. Gravelle (1998) "Liquidity of the government of Canada securities market: stylized facts and some market microstructure comparisons to the United States treasury market", Financial Markets Division, Bank of Canada

need not hold as large an inventory and they can undertake the transaction quickly with no impact on price. Hence the bid-ask spread will be narrower compared to the situation where secondary markets are not liquid. Therefore one indicator of liquidity in the market is the size of the bid-ask spread.

Using a time series of bid-ask spreads for a given maturity category will give an indication of changes in liquidity. However, the degree of competition among bond dealers will also impact the bid-ask spread. Thus an increase in competition may reduce spreads even without any improvement in liquidity. The difficulty in assessing liquidity changes through bid-ask spreads is compounded when initiatives to improve liquidity are introduced at the same time as a change in competition due perhaps to changes in the number of dealers in the market.

Another indicator of liquidity is the turnover ratio. This ratio is defined as the volume of transactions divided by the amount of bonds outstanding over a specific time period. The larger this ratio the more liquid is the market. Unfortunately this ratio does not distinguish between a small number of large transactions and a large number of small transactions. If data were available, this distinction could be made. We have turnover data for various bond categories and will use this measure to assess any impact of Government of Canada initiatives.

### **3. Forces impacting liquidity**

As noted in the previous discussion, liquidity depends upon issue size, number of participants in the market at any time and amounts of debt outstanding. The individuals interviewed unanimously concluded that liquidity in the Canadian bond market has declined over time. One person noted that while in the past it took one half a day to unwind a large position, it currently takes 2 to 3 days, unless the dealer is willing to accept a lower price. They also stressed that declining liquidity is not just a Canadian capital market issue.

These dealers attribute the declining liquidity to a number of factors. First, there is a declining stock of Government bonds due to reduced debt origination by the Government of Canada. This issue is also a consideration for the U.S., which faces the same scenario although the US is paying down its debt much more rapidly than Canada.<sup>2</sup> Second, activity levels of aggressive portfolio managers have decreased and day traders have all but disappeared. In the past, portfolio managers were active traders in terms of duration strategies, adjusting the duration of their portfolios in line with their expectations of future interest rates. Many of these managers found it difficult to beat the benchmarks identified by pension fund committees and moved to index strategies. Even ‘active’ bond managers are ‘closet’ indexers. With the decline in active management, which started in 1997, bond managers have shifted their interest to corporate bonds and issues of credit quality. This shift mirrors the increase in corporate bond issuance in line with the reduction in gross government bond issuance and the increased importance of corporate debt in the bond index (benchmark). Finally, there are now fewer foreign participants in the auction and secondary bond and bill markets. Morgan Stanley, Goldman Sachs and Solomon all left the Canadian bond and bill markets during the first half of 2001 since they considered their activities were not sufficiently profitable.

Interviewed participants had different views on the impact of this reduction in the number of players. One dealer believed that the industry was over-brokered prior to their departure and while the larger number of participants led to improved liquidity, there was inconsistent behaviour in trading and auctions. Another dealer suggested that the reduced number of participants led to an increase in liquidity. Of course, there is also the possibility that with the reduced number of participants there could be an increase in spreads due to reduced competition. On the bills side, one dealer argued there has been a significant reduction in liquidity with the departure of the US dealers who used to provide liquidity from their 'arb' desk. Thus an increase in bid-ask spreads after the departure of the U.S. dealers could be consistent with a reduction in liquidity, no change in liquidity

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<sup>2</sup> See, for example, “Enhancing the Liquidity of U.S. Treasury Securities in a Era of Surpluses”, by P. Bennett, K. Garbade, and J. Kambhu, FRBNY Economic Policy Review, 2000.

but an increase due to reduced competition or a combination of the two. In a subsequent section we investigate the impact, if any, of the departure of foreign dealers on liquidity.

Liquidity also seems to have a pattern. One dealer noted that liquidity was greatest around the bond auction and dried up between auctions. This dearth of liquidity was most pronounced for long bonds.

We begin our analysis of liquidity by looking at the annual averages of bid-ask spreads (measured in basis points). We use daily bid-ask data on treasury bills of 3 month, 6 month, 12 month maturities, and benchmark bonds with maturities of 2, 5, 10 and 30-year bonds over the period January 2, 1991 to November 30, 2001. The Bank of Canada provided us with the data. The data are end-of-day quotes; they are not transactions based but are indicative of market bid-ask spreads and will provide a good indication of any changes in underlying liquidity. The results of this analysis are presented in Table 1.

Year	3 months	6 months	12 months	2 years	5 years	10 years	30 years
1991	1.31	1.51	1.68	3.55	6.09	6.12	5.60
1992	1.42	1.59	1.88	2.61	4.84	4.62	4.03
1993	1.16	1.39	1.44	2.64	5.58	5.27	4.05
1994	1.19	1.21	1.38	3.39	4.79	5.32	5.27
1995	1.55	1.60	1.50	2.87	3.33	4.15	4.57
1996	1.22	1.37	1.27	2.26	2.81	4.14	5.14
1997	1.45	1.75	2.03	2.21	2.89	3.47	5.42
1998	2.22	2.20	2.14	1.67	3.63	4.92	9.51
1999	1.66	1.64	1.53	0.99	2.30	3.45	7.34
2000	1.43	1.31	1.35	1.26	2.34	3.11	5.85
2001	1.53	1.55	1.48	1.61	3.20	7.04	7.43

In the above table there are some interesting observations. First, for every year in the sample, the bid-ask spread increases with maturity category. This reflects not only the greater impact of unanticipated interest rate changes on price but also the relative

liquidity of the bonds and bills. Prior to 1995, bid-ask spreads for 30-year bonds were less than spreads for 10-year bonds. Second, 1998 is anomalous with a one time only large increase in bid-ask spread for all maturity classes. During most of this year there was unusual economic activity—the Asian currency crisis, the Russian debt default crisis and the Long Term Capital Management (LTCM) crisis.<sup>3</sup> Apart from this anomalous year, it appeared that over the 10-year period, bid-ask spreads increased for the 3-month bill categories, decreased for 1, 2, and 5-year categories and increased for the 10 and 30-year categories.

With the departure of the foreign dealers in the first half of 2001, the bid-ask spreads increased compared to 2000 for all maturity categories with the 10 and 30 year bonds showing a very large increase. However, we cannot discern from this analysis if the increases were statistically significant. We investigate the impact of the departure of foreign dealers in more depth in a subsequent section and determine if other influence over the same period are responsible for the increase in bid-ask spreads on the longer bond maturity categories.

We consider next the secular impact of liquidity observed in Table 1. This evaluation was based on fitting the following regression over the period January 2, 1991 to November 30, 2001 to daily bid-ask prices:

$$b_t = a_0 + a_1t + \varepsilon_t$$

where  $b_t$  is the average daily bid-ask spread for week  $t$  expressed in basis points and  $t$  is the time trend. This regression provides an estimate of the trend in the bid-ask spread over the period through the estimate of the regression coefficient,  $a_1$ . If  $a_1$  is greater than zero, the bid-ask spread has increased and hence there is a reduction in liquidity in the market, holding competition constant. The results of the regression analysis are presented in Table 2 below.

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<sup>3</sup> In a subsequent section we investigate the impact of these crises on liquidity.

The interpretation of a value such as 0.000112 for  $a_1$  (for the 3-month maturity) is that, on average, the bid-ask spread for 3-month treasury bills increased at the rate of 0.000112 basis points per week during the 1991-2001 period. The interpretation of the value  $a_0$  is the value of the bid-ask spread, in basis points, at the beginning of the period, as given by the trend line. The negative values for the 3-month and 30-year maturities suggest that the assumption that the bid-ask spread changes uniformly over time is unrealistic.<sup>4</sup> The impact of other events on the bid-ask spread is explored in section 4.

**Table 2: Trend in liquidity from 1991 to 2001**

Maturity	Estimate of $a_0$	Estimate of $a_1$
3 months	-0.0240	0.000112**
6 months	0.83*	0.000055*
1 year	1.83**	-0.000017
2 years	10.65**	-0.00063**
5 years	16.20**	-0.00093**
10 years	7.46**	-0.00021**
30 years	-6.47**	0.000921**
* significant at the 5% or less level, ** significant at the 1% or less level		

From this table we observe a statistically significant increase in liquidity for the 2, 5 and 10-year maturities. The longest bond had a significant decrease in liquidity over the period, as did the 3 and 6-month bills. The observations for the 3 and 6-month bills and the 30-year bond are consistent with market participants' perceptions of reduced liquidity, while the 2, 5 and 10-year benchmark bond results differ from their perceptions. However, this analysis is an overview of the liquidity issue and does not consider the

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<sup>4</sup> One possible scenario that generates the negative intercept is a fairly constant bid-ask spread followed by a sharply increasing spread.

possibility that while liquidity has increased over time for the 2, 5 and 10-year bonds, the more recent history may demonstrate a reduction in liquidity.

We next investigate turnover statistics as another indicator of liquidity in Table 3. The data are provided by the Bank of Canada for four debt maturity categories—T-bills, under 3-years, 3 to 10-years and greater than 10-years. Unfortunately this grouping of maturities can hide some important relationships for bills compared to coupon rate debt in the first maturity category or different maturities in the second category. The turnover statistics reported in Table 3 were computed from weekly volume and month end outstanding amounts as the total of the weekly volume divided by an estimated outstanding amount. The weekly volume is the total of sales and purchases. The estimated amount outstanding at week-end was computed using linear interpolation between the month-end amounts outstanding. The annual turnover ratios are obtained as weekly values averaged over the year. The reported amounts include both benchmark and non-benchmark bonds, for the period January 1, 1994 to September 30, 2001.

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**Table 3: Average Weekly Turnover Ratios, by maturity**

Year	T-bills	Less than 3 years	3 years to 10years	Greater than 10 years
1994	0.527	0.295	0.270	0.213
1995	0.553	0.280	0.278	0.180
1996	0.521	0.382	0.318	0.247
1997	0.416	0.410	0.319	0.215
1998	0.326	0.297	0.302	0.192
1999	0.255	0.210	0.224	0.148
2000	0.247	0.218	0.214	0.118
2001	0.231	0.284	0.236	0.111

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This table reports a general decline in turnover for all debt instruments for the 1997 to 2001 period. For bills and for the longest maturity bonds, the turnover observed in 2001 was less than half that observed for 1996. For the first two maturity categories of bonds, turnover increased until 1997 and then decreased until 2000 (1999 for the less than 3 year category) and then increased in 2001. For the shortest maturity bond category, turnover

was slightly higher in 2001 than in 1995 whereas for the 3 to 10-year category turnover in 2001 is less than in 1995. For the longest maturity category, turnover peaked in 1996 and diminished dramatically thereafter, while for the Treasury bills, the decline in turnover was almost monotonic between 1994 and 2001.

This pattern of turnover suggests a greater reduction in trading activity in Treasury bills and in long term bonds, than in other bonds. It is tempting to attribute this trend in Treasury bills to the government initiatives to increase the amount of the fixed rate debt relative to the Treasury bill debt during the period. However, the decreasing turnover for bills means that the volume of trading in bills decreased faster than amount of bills outstanding, so that simply decreasing the amount of financing by Treasury bills does not explain the trend.

From both the bid-ask and turnover results, we cannot determine if the changes in liquidity indicators were due to initiatives undertaken by the Government of Canada or for unrelated reasons. Further, we will identify important control variables that have changed over the time period and thereby eliminate the time trend variable from the analysis. We turn to these issues in the next section.

#### **4. Analysis of Specific Initiatives implemented by the Government of Canada:**

Over the period 1991 to 2001 the Government of Canada introduced a number of changes intended to improve the functioning of the Canada bond and bill markets. Our interest is in assessing the impact of these changes on liquidity in the markets. We will describe the changes that were introduced and analyze their impact.

##### **a. Methodological issues**

As noted in section 2, it is difficult to obtain an unambiguous measure of liquidity and in some situations we rely on market participant perceptions of liquidity. For the empirical

analysis we analyze bid-ask spreads and turnover liquidity indicators. However, even if there was an unambiguous measure, determining the impact of a particular policy decision on liquidity is difficult for a number of reasons.

First, in the ideal situation, the impact of a policy change can be assessed by measuring liquidity both before and after the change. However, this approach requires the identification of a specific date on which the new policy comes into affect. If there is not a specific date but a series of dates or a slow implementation, assessing the impact using the before and after approach will not lead to clean inferences.

Second, to the extent that the policy decision is anticipated, even if there is a unique announcement date, the impact will be observed in a time period before the policy is actually implemented.

Third, there are a number of policy changes that occurred over a long time period. Trying to assess the impact of any one of them by looking at liquidity after the introduction of the policy will be confused by a new policy change. This problem arises in our analysis when looking at the number of changes that occurred in the 1998 to 2001 period. A more sophisticated statistical analysis will be undertaken to address this problem.

## **b. Initiatives**

### **i. Change in Auction procedures**

In October 1998, the Government of Canada introduced new auction procedures intended to reduce the probability that there would be a squeeze in the auction. These changes are refinements on changes introduced in 1996 with a similar purpose. With the possibility of a squeeze, auction bidders are concerned that they may lose a significant amount of money as they purchase auctioned securities in the secondary market to cover short

positions taken before the auction. By eliminating the potential of a squeeze, liquidity will improve, as participants are more willing to take short positions. Also there were changes to improve the operation of the auction. One example is shortening the period for the results of the auction to be made public to 15 minutes. This shortened time period reduces risk for the bidders.

All interviewed bond dealers were supportive of these changes and felt that they improved the auction process. One bond dealer suggested that the process should be a Dutch auction. He stated that under the current process the street has an option to wait and see if the auction is good or not. The market players will not participate in the auction but prefer to purchase after the auction at better prices.<sup>5</sup> Moving to a Dutch auction would solve this problem.

The Government of Canada is aware of the Dutch auction approach and the U.S. Treasury introduced this approach to the U.S. auction process after pilot projects. The Government of Canada has consulted market participants about a Dutch auction but they did not greet it with unanimity.

Another auction change occurred in April 1998 when the Government of Canada reduced the frequency of 30-year bond auctions to semi-annual from quarterly. Given the dealers observations that liquidity was greatest around auctions and dried up at other times, this change could have a negative impact on liquidity.

## **ii. Altering the proportion of long and short term securities**

In 1990 the Government of Canada decided to alter its debt outstanding to have a greater emphasis on fixed-rate bonds (bonds with maturities in excess of one-year). In 1995, 55% of the Government debt had maturities greater than 1 year. A target was set such that this proportion would be 66%. This target could be attained only over time through a

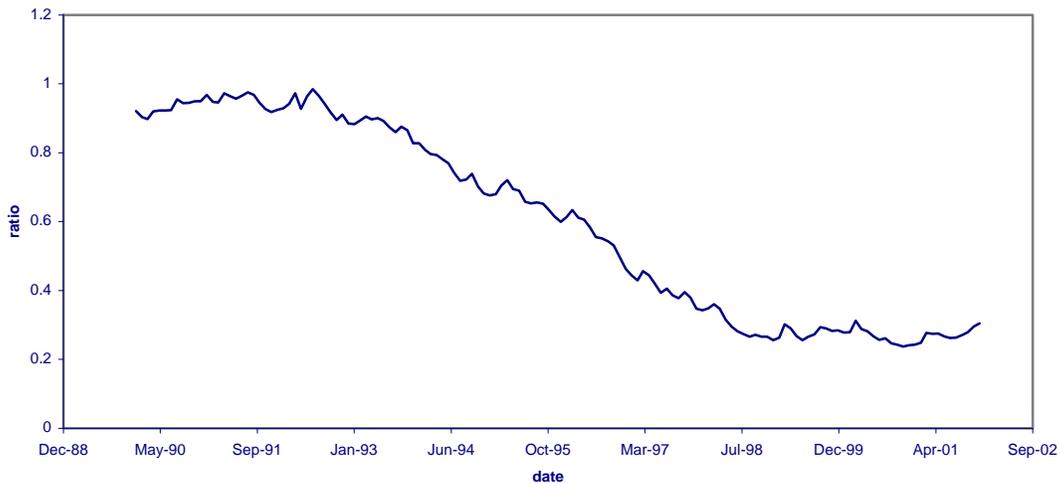
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<sup>5</sup> This bond dealer's perception seems to be inconsistent with the observed participants' behaviour at the auctions. While prices do decline prior to auctions, they rally as participants who go into the auction process in a short position, purchase bonds to cover their positions. This activity drives up prices.

change in issue sizes of long and short-term debt securities. Given the reduced use of debt with the elimination of the deficit, the achievement of the target would take a number of years. The target was reached in 1997-98, much sooner than expected through a significant reduction in the issuance of Treasury bills. This shift in maturity structure will increase the amount of fixed-rate debt outstanding and provided it was not held in portfolios and hence not traded, should have a positive impact on liquidity. This shift in maturity structure is superimposed on the temporal decrease in debt due to Government surpluses.

The chart below presents the ratio of the total amount of domestic Treasury bills outstanding divided by the sum of the amounts outstanding of all coupon bonds for each month ending December 2001. As can be observed in this chart, the ratio falls dramatically from the end of 1992 leveling off in July 1998. For example, in December 2001 the ratio of treasury bills to coupon debt is .3. This value translates to a proportion of treasury bills to total debt outstanding of 23%. Thus coupon debt is approximately 77% of the total. This is a dramatic increase from its value of 53% in 1990-91.

**Ratio of T-Bills Outstanding to Coupon Bonds Outstanding**



To assess the impact of this decision we looked at average bid-ask spreads on benchmark bill and bond maturities. Our first analysis divided the overall time period of 1991-2001 into two halves: January 1991-June 1996 and July 1996 to November 2001. Since the policy change was introduced in 1995 but did not reach its target until 1997 our mid-

point is roughly consistent with periods before and after the policy target was achieved. The results are presented in Table 4.

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**Table 4**  
Comparison of Average bid-ask spreads for two sub-periods  
Averages in basis points

Maturity	Period 1 average	Period 2 average
3 months	1.32**	1.62**
6 months	1.45**	1.67**
1 year	1.54	1.67
2 years	2.97**	1.61**
5 years	4.67**	2.85**
10 years	5.09**	3.73**
30 years	4.71**	6.91**

\*\* indicates statistical significance in the difference of the means at the 1% or less level

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As can be observed in this table, the bid-ask spread increased for the 3 and 6-month bills. For example, the average bid-ask spread in the first half of the data period was 1.32 basis points and in the second half, 1.62 basis points. For the 2, 5 and 10-year maturities there was a significant reduction in average bid-ask spreads. The results for bills and the three bond maturity classes are consistent with an increase in liquidity due to the change in maturity structure of the outstanding debt. The surprising result is for 30-year maturity bonds where the bid-ask spread actually increased. This result is inconsistent with improved liquidity. One possible explanation for this observation is the change in issuance in the 30 year bond from quarterly to semi-annually in 1998-99. The overall results are consistent with the trend analysis (reported in Table 1).

In assessing the impact of this change, we need to incorporate the fact that the change, although started in 1995 was not completed until 1997. Also as observed in Table 1, the anomalous results for 1998 should most likely be removed from the analysis. Therefore we subdivide the overall sample period into three sub-periods: 1991-1994, 1995-1998 and post 1998. The difference in average bid-ask spreads for the first and third sub-

period will provide an indication of the impact of this policy. The results are presented in Table 5, and reinforce those presented in Table 4.

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**Table 5**

Average Bid-Ask spreads January 1, 1991 to December 31, 1994 (Period 1) compared to January 1, 1999 to June 27, 2001 (Period 2), in basis points.

Maturity	Period 1 averages	Period 2 averages
3 months	1.27**	1.55**
6 months	1.43**	1.50**
1 year	1.60*	1.46*
2 years	3.05**	1.29**
5 years	5.35**	2.61**
10 years	5.33**	4.48**
30 years	4.73**	6.83**

\*\* indicates statistical significance in the difference of the means at the 1% or less level

\* indicates statistical significance in the difference of the means at the 5% or less level

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Of course, even if there is a reduction in the bid-ask spread post 1998 we do not know if it is due to the change in the maturities outstanding or to the other initiatives that were undertaken. We now investigate whether we can identify the impact of the other initiatives. Also there are other control variables that have to be included in the analysis, such as amounts outstanding in each maturity category, in order to isolate the impacts of the initiatives.<sup>6</sup>

**iii. Increasing benchmark size**

Benchmark bond issues are generally those with the largest amounts outstanding and with the greatest liquidity. If liquidity is to be improved, benchmarks must be larger thereby providing market participants with more securities to purchase and sell; in addition, there

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<sup>6</sup> See Gravelle, *op. cit.* who uses amounts outstanding as an explanatory variable in a bid-ask spread regression analysis.

should be fewer unique securities outstanding each with its own maturity date thereby concentrating outstanding bonds in benchmark maturities. Over the decade under consideration, the Government of Canada decided to increase the size of its fixed coupon bond auctions and the benchmark size. In 1996 the benchmark issues were 2, 3, 5, 10 and 30-year bonds along with a real return bond. For all bonds, auctions were quarterly. The Government of Canada also instituted an important innovation in its auction process—regularity and transparency. To this end the Government of Canada now announces the auction maturities in advance. Any initiatives that facilitate planning by market participants should improve the operation of the auction and the secondary market. By removing this element of uncertainty, market participants can engage in bond transactions that facilitate the auction and result in a wide dissemination of bonds at the auction. These ideas of transparency and regularity have been maintained by the Government of Canada and are highly regarded by investment dealers.

In 1997 the Government of Canada decided to eliminate the three year bond leaving the 2, 5, 10 and 30 year bonds with target sizes of \$7 to \$10 billion. The three year bond was eliminated with the downsizing of the bond program as government deficit financing was reduced. In 1998 the auction of 30-year bonds was reduced from quarterly to semi-annual frequency. This change was based on discussion with bond dealers.

In 2000-2001 there was a decision to increase the benchmark sizes for 5, 10 and 30 year bonds. The sizes increased from \$7 to \$10 billion to \$9 to \$12 billion. The two-year bond size remained unchanged at \$9 to \$10 billion. For 2001-2002 the Government of Canada intends to continue its liquidity enhancements by maintaining large benchmarks. For example for the 10 and 30-year bonds, the target benchmarks increased to \$12 to \$15 billion at the start of 2001. The increase was undertaken through a reopening of an outstanding issue. The original issue may be smaller than benchmark size, but with reopenings the issue will be built up to benchmark size.

Applying an empirical methodology to assess the success of increasing benchmark sizes on liquidity in the secondary market is very difficult since there is no unique point in time

when the benchmark size increased. The impact would be due to the continuing operation of the market with increasing benchmark sizes.

Alternatively, discussions with bond dealers suggest that the Department's decision to increase benchmark size combined with transparency and regularity have improved liquidity. However, this conclusion is tempered by what they perceive as a reduction over time in overall liquidity. One dealer suggested that the reduction in the frequency of the 30-year bond auction had a negative effect on liquidity in this maturity category. Thus the Government of Canada's actions have tempered the temporal reduction in liquidity.

#### **iv. Stripping and Reconstitution**

The efficient functioning of markets requires market participants to enter markets in situations in which prices are not in equilibrium and drive these prices to equilibrium. This is usually undertaken by arbitrage activities in which market participants can construct portfolios of over and undervalued securities such that they generate a return without risk. The ability to construct a perfect substitute to an outstanding mispriced bond by building a portfolio of strips became possible in 1993 with changes in the clearing system and the use of generic CUSIPs. One research paper noted that the bid-ask spread on bonds narrowed dramatically not just when the generic CUSIP was introduced but when it was announced.<sup>7</sup> The latter result arose as bond participants began to purchase bonds to be in a position to undertake the arbitrage.

However, the amount of debt that could be created by reconstitution of stripped bonds was limited by the original issue size of the bond—i.e. the book entry at CDS. Following a request by the IDA in June 1999, the Government of Canada introduced new rules related to stripping and reconstitution in June 2000. These rules were intended to improve the liquidity of the secondary market by allowing stripped bonds to be reconstituted such that there would be more of a particular bond outstanding than in the

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<sup>7</sup> See "A Note on Market Efficiency, Institutional Practice, and Economic Constraints in the Experience of the Canadian Bond Market", P.J. Halpern and J.D. Rumsey, *Journal of Banking and Finance*, Vol. 21, No.1, 113-123, (1997).

original issue. This flexibility would improve liquidity in benchmarks since the size of the benchmark could actually increase above the initial size. Also, it would reduce the likelihood of a squeeze in a particular auction. This change would improve arbitrage activities and increase the size of benchmark bonds outstanding since a non-benchmark bond could be replicated by a set of stripped bonds. With this introduction there should be an improvement of liquidity.

Practitioners were unanimous in their positive reaction to the new stripping and reconstitution provisions. They believe that these provisions increase liquidity in bonds primarily when it was needed most. In addition, arbitrage transactions are made easier. Since these provisions are most likely to be of benefit to certain events such as auctions and mispriced bonds, there may not be a general improvement in liquidity.

We will consider the empirical evidence when we investigate the simultaneous impact of the introduction of a number of initiatives and the loss of foreign investment dealers during the period.

#### **v. Buyback of Illiquid Bonds**

There are many outstanding Government of Canada bonds that do not trade and due to this illiquidity have very low prices or high yields. With a large number of these bonds outstanding, bond dealers, who make a market, will hold inventories of these bonds purchased from clients. This inventory investment is expensive and the dealers will have a large bid-ask spread on the illiquid bonds to compensate for this cost. In 1998-99 the Government of Canada undertook a pilot project to repurchase illiquid bonds by having a reverse auction for certain specified bonds. At this time the government did not increase the size of the normal auction to finance the transaction. However, the program permitted the government to maintain the existing auction size. If not for the buyback program, the auction size would have been decreased. The pilot project was successful and bond buybacks were implemented on an ongoing basis in 2000/01. Under this program the government pays for the illiquid bonds by issuing new benchmark bonds of approximately the same maturity as the illiquid bond and uses the cash to purchase the

illiquid bonds. The net result of this transaction is the reduction in the amount outstanding of the number of different bonds outstanding and the replacement of illiquid bonds with liquid benchmark bonds. This transaction should improve the liquidity of the bond market, as more benchmark bonds are available for trading. Up to this point in time, there has not been a buyback in the 30-year bond category.

Bond dealers are unanimous in their support for the Government of Canada purchase of illiquid bonds. Upon the announcement of the pilot program and for subsequent auctions, bond dealers predicted the bonds that would be subject to the buyback program and purchased them from institutional clients for inventory. If the purchased bonds were subject to the buyback, the bond dealer would most likely make a profit on the transaction. However, if the bonds are not subject to buyback or if the bond dealer paid too high a price for the bonds, the dealers can lose on the transaction or be forced to hold the bonds in inventory. The bonds they chose to purchase in anticipation of the reverse auction are identified as those they believed were priced off the yield curve. A similar approach would be used by the Government of Canada to determine which illiquid bonds to purchase.

The bond dealers interviewed believed that the initial announcement of the program had an impact on the liquidity of both on and off the run bonds. However, they had no view on the continuing impact of the buyback program on liquidity in the secondary market.

All bond dealers agreed that the buyback program introduced some additional risk although they differed in whether this was a serious problem. One dealer argued that while risk was increased, they priced the risk and thus were not concerned. The risk they were concerned about related to the lag between the time between the submission of the offer to sell by the dealers and the decision. Currently the time period is 30 minutes. Over that time period the market can shift and the sellers can be hurt. In effect the Government of Canada has an option to delay and during which time period, the market may move in its favour. Shortening the lag between the submission of the offer in the auction and the purchase of the bonds would reduce this risk.

Another solution to this problem is to use a ‘switch’ approach where the dealer receives the new bond directly instead of cash. In October 2001, the Government of Canada announced its intention to use switches in future ‘reverse’ auctions.

From discussions with the pension fund representative it was clear that he was not interested in participating in the buyback program for two reasons. First, he was content to hold the illiquid bonds, which generally had a higher coupon, for its yield. Second, in an auction the fund would be exposed to the market risk due to the time lag and the fund cannot easily build in compensation for this risk. To offset this risk, the fund would prefer the switch method to the cash approach. However, the yield argument may dominate and even when the switch method is introduced, institutional investors may still prefer to hold the high coupon rate illiquid bonds.

In the following section we assess the impact of the buyback program on the liquidity of the secondary market.

## **vi. Empirical tests**

In this section we investigate the simultaneous impact of the introduction of strip reconstitution and buyback of illiquid bonds while holding constant other influences on liquidity including the departure of the US bond dealers. We also investigate the impact of the change in the auction timing for 30-year bonds. The analysis is undertaken using both bid-ask spreads and turnover measures of liquidity. We discuss first the bid-ask spread results and then turnover.

### **Bid-ask Spreads**

The dependent variable is the weekly average of the bid-ask spread for each maturity category measured in terms of basis points. The time period for the analysis is January 1,

1994 to September 30, 2001. We choose this start date, rather than the January 1, 1991 because the changes in strip trading rules caused a sharp decline in bid-ask spreads after May 1993. In addition, turnover data exist only for the January 1, 1994 to September 30, 2001 and we wanted to have comparable periods.

We define the following independent variables:

- $D_{\text{BUYBACK}}$ : The dummy variable reflects the introduction of the buyback program and takes on a value of 1 for dates 5 November 1998 and later and zero otherwise.
- $D_{\text{STRIP}}$ : The dummy variable identifies the introduction of the strip/reconstitution change and takes on a value 1 for dates 1 June 2000 and later, zero otherwise
- $D_{\text{DEALER}}$ : The dummy variable identifies the impact of the departure of the US dealers and takes on a value of 1 for dates 1 July 2001 and later after the departure of the dealers and zero otherwise.
- *Volatility*: a measure of the volatility of the yield. For each date, the variance of the yield for the date and the yields of the previous 22 yields (approximately the previous month's data) was estimated. These variances were averaged weekly. The weekly volatility was estimated as the square root of the weekly average of the variances. Changes in volatility can induce changes in the bid-ask spread as dealers attempt to obtain compensation for added risk.
- *Short/long*: the ratio of treasury bills to total coupon debt outstanding.
- *Turnover*: an estimate of the weekly turnover for bills and bonds of a given maturity<sup>8</sup>. Since the bid-ask spread reflects compensation for risk to the dealers for holding inventories the greater the turnover, the lower should be the spreads.
- *Outstanding*: The amount outstanding in the specific maturity category for the period. Since data is measured at month end, we approximated weekly amounts by linear interpolation. We expect a negative sign since larger amounts outstanding should reduce the bid-ask spread

We then ran seven regressions, one for each (benchmark) maturity:

$$b_t = a_0 + a_1 D_{\text{BUYBACK}} + a_2 D_{\text{STRIP}} + a_3 D_{\text{DEALER}} + a_4 \text{Volatility} + a_5 \text{Short/long} + a_6 \text{Turnover} + a_7 \text{Outstanding} + \varepsilon_t$$

where  $b_t$  is the bid-ask spread in basis points for week  $t$ . Since there is the possibility of multicollinearity when all of the variables are introduced into the regression, we present a

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<sup>8</sup> Due to the data, the same turnover ratio was used for 3,6 and 12-month maturities. Also turnover is available only in three categories—0-3-year maturity, 3-10-year maturity and over 10-year. Thus the turnover ratio for coupon bonds with maturities below 3-years was used for the 2-year maturity category; turnover for maturities between 3 and 10-years was used for the 5 and 10-year maturities; and turnover for maturities greater than 10-years was used for the 30-year maturity. Since the volume data was weekly, and the amount outstanding was at month-end, weekly turnover ratios were estimated by linear interpolation of amounts outstanding. Similar interpolation was used to estimate weekly short/long ratios.

subset of the regression estimate. The estimated coefficients in the regressions measure the impact on the bid-ask spread, in basis points, of the introduction of the buyback program, the changes in strip bond reconstitution (where applicable), the influence of the departure of the U.S. dealers, the volatility of bond yields, the ratio of short to long debt, turnover and amounts outstanding respectively. Since Treasury bills cannot be used to reconstitute bonds, we did not include the strip dummy variable for the 3, 6 and 12-month maturities.

The regression equation noted above includes both turnover and amount outstanding separately. We cannot introduce both of these variables in the regression since they are highly correlated--turnover is calculated by using the amount outstanding. Thus the regression that we report is based on:

$$b_t = a_0 + a_1 D_{\text{BUYBACK}} + a_2 D_{\text{STRIP}} + a_3 D_{\text{DEALER}} + a_4 \text{Volatility} + a_5 \text{Short/long} + a_7 \text{Outstanding} + \varepsilon_t$$

The results of this analysis are presented in Table 6. The *p*-values in () are used to assess statistical significance. Values of 0.01 or less indicate significance at the 1% or smaller level.

**Table 6: Impact of Government of Canada initiatives, estimated using data between January 1, 1994 and September 30, 2001**

**Slope coefficients with p-values in ()**

Maturity	buyback dummy	strip dummy	US dealer dummy	volatility	short to long ratio	amount outstanding
3 months	-0.61 (0.0001)		0.23 (0.02)	0.89 (0.0001)	0.44 (0.32)	-0.015 (0.0001)
6 months	-0.68 (0.0001)		0.16 (0.24)	1.23 (0.04)	-1.27 (0.04)	-0.0057 (0.12)
12 months	-0.91 (0.0001)		-0.095 (0.62)	1.12 (0.01)	0.35 (0.67)	-0.017 (0.0009)
2 years	-0.56 (0.0001)	0.42 (0.003)	-.063 (0.78)	-0.12 (0.81)	5.00 (0.0001)	0.016 (0.10)
5 years	-0.96 (0.0001)	0.53 (0.0005)	0.94 (0.0005)	2.15 (0.005)	-3.32 (0.0001)	-0.076 (0.0001)
10 years	-0.98 (0.002)	0.83 (0.0001)	5.41 (0.0001)	4.71 (0.0003)	-4.29 (0.0001)	-0.072 0.0001
30 years	-0.82	-0.87	1.59	0.12	-12.62	-0.11

	(0.02)	(0.02)	(0.02)	(0.97)	(0.0001)	(0.0002)
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First, the introduction of the buyback program consistently reduced bid-ask spreads across all maturity classes. The reduction in spreads was statistically significant for all maturity classes. The reduction in spreads could reflect the increased transactions in certain bonds or the increase in the size of the benchmark issues to finance the bond buybacks.

Second, the changes in the reconstitution of strips reduced bid-ask spreads for the 30-year bond. This impact was statistically significant. For the 2, 5 and 10-year bonds the results show an increase in bid-ask spread that is statistically significant. The positive results are counter intuitive.

Third, the departure of the U.S. dealers was accompanied by an increase in bid-ask spreads that was significant for the 3 -month bill and 5, 10 and 30-year bonds. For example, for the 10-year bond the departure was associated with an increase in the bid-ask spread of approximately 5.4 basis points. Whether this increase in the spreads is associated with a reduction in liquidity or a decrease in competition or a combination is hard to determine.<sup>9</sup>

To this end, we obtained data from the Bank of Canada on turnover statistics for bonds and bills broken down by foreign versus non-foreign dealers over the period January 5 1994 to June 27, 2001 when the dealers left. Some summary measures are presented below:

Turnover by Foreign dealers as a percentage of total turnover		
	Bills	Bonds
Mean	3.15	10.6
Standard deviation	2.53	4.85

<sup>9</sup> Instead of the dummy variable, we also used the fraction of trades by non-U.S. dealers in each maturity category. The results were similar.

High	15.13	22.85
Low	0	0

From this table it is clear that foreign dealers were more active in the bond area although the absolute amounts were not large. The high value of relative turnover was 22.85% for bonds and 15.13% for bills. At the margin, this activity would improve liquidity although it is hard to argue that it is a driving factor. Whether the removal of this liquidity at the margin is sufficient to explain the increase in bid-ask spreads remains an open question.

Fourth, volatility had a positive and statistically significant impact on the bid-ask spread for all maturity categories except the 2-year bond and the 30-year bond where although statistically insignificant, the bid-ask spread falls for the former. With increases in volatility, uncertainty increases and the bid-ask spread widens.

Fifth, as the ratio of short to long increases, this implies there are relatively more bills to coupon bonds and the bid-ask spread for bills should fall. This is reflected in the negative sign for the bills maturity categories for only the 6-month maturity. However, when considering the longer maturities, an increase in the ratio implies a relative reduction in the coupon debt and this should lead to an increase in spreads for bonds. This is consistent with the positive and significant estimates for only the 2-year bond. All other bonds have an unexpected negative and significant impact. The 30-year bond, once again displays an anomalous result with a large reduction in the spread as the proportion of bills increases. This variable suggests that the shift in maturity structure did not affect liquidity in the expected direction.

The final variable is the amount outstanding. The expectation is that as the amount outstanding increases there is more activity in the bonds and spreads will fall. The impact is as expected and statistically significant in all maturity categories except for the 2-year bond where the sign is positive (and marginally significant) and the 6 month bill where the impact is not statistically significant.

The behaviour of the short to long ratio is counter-intuitive. We note that when turnover is used in the regression instead of the amount outstanding, the short to long ratio takes on the expected signs and is significant. We suspect there is a multicollinearity problem with the short to long ratio and amount outstanding variables.

In one set of regressions we dropped the amount outstanding variable and observed the expected relationship of bid-ask spread and the short to long variable. The impact of the other variables on bid-ask spreads was unaffected.

We also dropped the short to long ratio and included only the amount outstanding variable. The results for this regression are presented in table 7 below.

**Table 7: Impact of Government of Canada initiatives**  
slope coefficients with p-values in ()

Maturity	buyback dummy	strip dummy	US dealer dummy	volatility	amount outstanding
3 months	-0.59 (0.0001)		0.23 (0.02)	0.94 (0.0001)	-0.012 (0.0001)
6 months	-0.74 (0.0001)		0.15 (0.27)	1.04 (0.0002)	-0.013 (0.0001)
12 months	-0.89 (0.0001)		-0.093 (0.63)	1.18 (0.005)	-0.015 (0.0001)
2 years	-0.74 (0.0001)	0.12 (0.32)	-0.25 (0.25)	0.04 (0.93)	-0.025 (0.0001)
5 years	-0.56 (0.0001)	0.52 (0.0007)	0.82 (0.003)	1.62 (0.04)	-0.042 (0.0001)
10 years	-0.46 (0.01)	0.82 (0.0002)	5.25 (0.0001)	5.57 (0.006)	-0.028 (0.0001)
30 years	-0.01 (0.97)	-1.36 (0.0007)	2.95 (0.0001)	-5.34 (0.05)	0.097 (0.0001)

In general there is little change in the relationships. The results are the same for the strip dummy variable and the US dealer dummy variable. For the volatility measure, only the 30-year bond result is different with a statistically significant decrease in bid-ask spread with an increase in volatility. In the buyback dummy variable, the results are basically

unchanged with the 30-year bond now having a negative but statistically insignificant impact. This is consistent with the fact that the 30-year bond has not yet been bought back under the program although the expectation is that it will have to occur.

Finally, the amount outstanding variable now is negative and statistically significant for all maturity categories except the 30-year bond.

One initiative that was not considered in the above analysis was the shift in April 1998 from quarterly to semi-annual auctions for the 30-year bond. We introduced a new dummy variable into the 30-year bond regression to reflect the shift in auction frequency. Whether the short to long ratio or amount outstanding variables were used along with the other variables we found that the bid-ask spread increased significantly when the auction became semi-annual.<sup>10</sup> This change reduced liquidity.

### **Turnover analysis:**

As noted previously, turnover is another measure of liquidity and should be affected by similar variables as the bid-ask spread. One difference is that the bid-ask spread is affected by variables that reflect the inventory costs of the bond dealers whereas turnover is not affected by these variables. From the empirical perspective, a major difference is that turnover data are based on all bonds outstanding whereas the data for bid-ask spreads reflect only benchmark bonds, which are the most liquid.

In the following regressions we introduce the same explanatory variables over the same time period—January 1, 1994 to September 30, 2001. In addition we introduce the bid-ask spread as a dependent variable. The spread is the cost of transacting and we would expect that an increase in the bid-ask spread would reduce turnover. Thus we anticipate a negative coefficient.<sup>11</sup>

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<sup>10</sup> The regression coefficients on the dummy variable ranged from 4.82 to 5.40 with a p-value of 0.0001.

<sup>11</sup> In addition, we recognize that net new issuance has changed during the sample period and this may have an independent impact on turnover. Therefore, we also introduce a net issue variable. The data for this variable was collected by the Bank of Canada and is equal to monthly amount issued less the monthly amount retired. Additionally, net issue of bills was distinguished from net issue of bonds. We do not

The results using turnover as a dependent variable are presented in Table 8 below.

The important observations from this table are as follows:

First, the buyback dummy variable is consistently negative and statistically significant over all maturity categories. This result suggests that the buyback activity actually reduces turnover/liquidity and is counter-intuitive and inconsistent with the bid-ask analysis. One possible explanation is that because of the buyback bond dealers purchase illiquid bonds and hold them in inventory in anticipation of the auction. It is important to remember that unlike the bid-ask data, turnover data covers trading in all issues not just benchmarks. This explanation, however, ignores the fact that new benchmark bonds are issued to pay for the repurchase of illiquid bonds.

**Table 8: Turnover: slope coefficients with p-values in ()**

Bond Type	$D_{\text{BUYBACK}}$	$D_{\text{STRIP}}$	$D_{\text{DEALER}}$	Volatility	Short to Long Ratio	Bid-Ask Spread
T-Bills	-0.098 (0.0001)		-0.045 (0.05)	0.00086 (0.08)	0.40 (0.0001)	-0.0051 (0.51)
0 to 3 yr maturity	-0.18 (0.0001)	0.051 (0.002)	-0.021 (0.47)	0.0032 (0.0001)	-0.21 (0.0001)	-0.0080 (0.10)
3 to 10yr maturity	-0.11 (0.0001)	0.014 (0.22)	-0.037 (0.09)	0.0029 (0.0001)	-0.16 (0.0001)	-0.0027 (0.12)
More than 10-yr maturity	-0.076 (0.0001)	-0.011 (0.33)	-0.027 (0.18)	0.0057 (0.0001)	-0.060 (0.03)	-0.00005 (0.98)

Second, the strip dummy variable is statistically significant only for the 1 to 3-year maturity category. The positive sign indicates that the change in the terms of the strip

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present regressions using this variable since it was not significant and its inclusion did not affect the values of any other variables.

reconstitution increased turnover. This is the expected result and is consistent with the bid-ask analysis.

Third, the US dealer variable is negative for all maturity categories and marginally statistically significant for Treasury Bills and the 3 to 10-year maturity categories. Consistent with the bid-ask spread analysis this variable suggests that the greater the non-U.S. dealer trading activity, the smaller the turnover. Thus the departure of the U.S. dealers would result in a reduction in turnover.

Fourth, volatility is consistently positive and statistically significant for all but the T-Bill category where it is marginally significant. The increase in volatility leads investors to restructure portfolios and take new positions as a result of their changed expectations.

Fifth, the short term to coupon paying debt variable should have a positive sign for the T-Bill category and a negative sign for longer maturities if this variable reflects the quantity of the debt outstanding. In fact the results are consistent with expectations for all maturity categories except the greater than 10-year maturity category.

Finally, the bid-ask variable has the expected sign but is marginally significant only in the 1 to 3 -year maturity category.

We did not use the amount outstanding as an explanatory variable in the regression with turnover as the dependent variable because of the multicollinearity in the two variables.

### **Conclusions from empirical analysis:**

The liquidity regressions are composed of two sets of independent or explanatory variables: those that are related to the Government of Canada initiatives i.e. buyback, strip reconstitution and the ratio of bills to coupon paying bonds and those that are used to control for other influences that were occurring over the sample period, e.g. U.S dealer

departure, amount outstanding and volatility and either turnover or bid-ask spread depending upon the dependent variable being used. For the purposes of this report, the first set of variables is important although the dealer variable is of interest. In addition there is one regression analysis looking at the impact of the shift in auction frequency for the 30-year bond.

For the bid-ask spread indicator of liquidity we observed, as expected, that the buyback improved liquidity. The bills to coupon bond variable results were consistent with an increase in the relative amounts of bills versus bonds reduced (increased) the liquidity for coupon bonds (bills) when turnover is used as a control variable instead of amount outstanding. The changes in the reconstitution of strip initiative had mixed results. It increased liquidity for the 30-year bond but had the opposite impact on the other maturity categories. This result for the 2, 5 and 10-year maturity categories is surprising given the comments of bond dealers.

For the turnover ratio liquidity indicator, the ratio of bills to coupon bonds variable behaved as expected. However, the strip variable had mixed results with the only significant maturity category being the 1 to 3-year group where the strip reconstitution leads to an increase in turnover, which is the expected direction. The most puzzling result is the impact of the buyback where there is a negative impact on liquidity. Clearly more analysis needs to be done on this to understand the impact. One possibility is that bonds that were once traded are now held in dealer inventories awaiting the auction.<sup>12</sup>

Finally, the impact of the departure of US dealers reduces turnover for all bonds but it is significant for T-Bills and the 3 to 10-year maturity bond. Also, bid-ask spreads are increased for all maturity categories although significant only in the longer maturities.

## **5. Suggestions to improve liquidity**

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<sup>12</sup> Dealers have given mixed messages about holding these bonds in inventory. In our interviews some of the dealers noted they held bonds in inventory in anticipation of the auction. The Government of Canada has informed us that dealers told them that they did not hold bonds in inventory while awaiting the auction.

From the analysis of the data and the reactions of interviewed market participants, a number of suggestions to improve liquidity were noted. By and large the dealers were supportive of the initiatives undertaken by the Government of Canada.

First, there has been an obvious decline in liquidity for the 30-year bond contrary to the increase in liquidity for other bonds greater than one year to maturity. One participant suggested that more frequent auctions, each with a smaller size, would improve liquidity. The obvious benefit is the improved liquidity around auction dates. This is consistent with our regression results investigating the impact of a change in auction frequency.

Second, in order to increase issue sizes one person suggested that CSBs be reduced in size or eliminated and any capacity generated be replaced with larger bond issues. It is not clear that CSB holders would view short to medium term bonds as alternatives, however.

Third, the most effective way to improve liquidity is the introduction of automated trading systems (ATS) that are accessible not only by the bond dealers but also by the institutional investor market. In the US bond market there has been a restructuring of dealer operations to trading strategies based on order flow information. The trading is facilitated by the use of an ATS such as TradeWeb. TradeWeb is, in effect, an automated version of the standard bond transaction procedure—specify an order size, request quotations from a specified number of dealers and complete the transaction. This system is more than a quotation information system such as CanPx since it not only generates quotes for various size transactions but also completes the transaction in a very short period of time. Note that the ATS approach is not the same as the fully automated trading networks found in the stock market where the automated system actually completes the transaction without the intermediation of a bond dealer. These systems are called Electronic Crossing Networks (ECN) and there are two such systems operational in the U.S.

Currently ATSs can be introduced in Ontario and they are under the regulatory control of a regulatory board to be determined. One possible problem could be the size of regulatory fees to be paid by ATSs as set by the self-regulatory board. An ATS need not be exclusively Canadian developed and based. The system will lead to order flow transactions by dealers and will increase liquidity and cut transactions costs. However, the use of these systems will have an important impact on the structure and operations of existing bond dealers.

Although the introduction of ATSs is not something that the Government of Canada can mandate, the Government recognizes that it is an important ingredient to an efficient market. To this end the Bank of Canada tendered its Submission on the Revised CSA Alternative Trading System (“ATS”) Proposal.

## **6. Conclusions**

The Government of Canada has undertaken a number of important initiatives to increase the efficiency of the Government of Canada bill and bond markets. In this report we have focused on the impact of these initiatives on the liquidity of the markets. To assess this liquidity we interviewed individuals who operate in these markets and also undertook empirical analyses of data. In some situations it is difficult either to obtain the relevant data or to devise an empirical test that will isolate the impact of one of more factors. In the latter situation, we have to rely on the interviews.

For each of the initiatives, we identify the impact on liquidity based on the relevant test.

- **Changes in auction procedures**

There was no empirical work undertaken on this issue but the market participants concluded that the changes are positive for the market since they reduce the potential for a squeeze and thus will increase the bidding activity.

The only aspect of the auction procedure we investigated was the change to semi-annual auctions for 30-year bonds. This shift increased the bid-ask spread. A return to more frequent auctions could improve liquidity in this maturity category.

- **Altering the proportion of long and short term government securities**

The results here are mixed although we believe that statistical problems may contribute to the unusual results for this variables in the bid-ask spread regressions. Looking at turnover, the results are as expected. The analysis demonstrates that by shifting the balance toward more coupon debt from treasury bills, the liquidity of the former has improved and the liquidity of the latter has decreased. There is indirect evidence that this impact is observed in the bid-ask relationships where the amount outstanding was associated with a reduction in the bid-ask spread.

- **Increasing benchmark size**

We did not undertake an empirical analysis of this issue since the changes occurred over a long period of time. Given the empirical results from the shift to long from short-term securities, it is expected that liquidity will improve as the size of the benchmark bonds increase. Even in an era of net reductions of debt, the focus on increasing benchmark sizes should improve liquidity. The dealers believe that in a time of a general decrease in liquidity, this initiative has helped ameliorate this decline.

- **Changes to facilitate stripping and reconstitution**

The dealers are very positive about this change and believe that it has improved liquidity. It permits arbitrage and the construction of benchmark bonds to eliminate any potential squeeze. The empirical evidence is mixed. For both the turnover ratio and the bid-ask spread the stripping initiative only improved liquidity on a subset of the bonds. However, from first principles we would expect that this initiative would improve liquidity.

- **Buyback of illiquid bonds (reverse auctions)**

The bond dealers are very supportive of this initiative. The reverse auction permits them to remove illiquid bonds from their inventory and as the buybacks are now structured,

benchmark bonds are issued to fund the buyback. When the bid-ask variable is used to measure liquidity, the buybacks unambiguously improve liquidity. However, when the turnover ratio is used, the buyback actually reduces liquidity. This latter may reflect the fact that bonds are now held in inventories awaiting the reverse auction.

Overall we conclude that the Government of Canada initiatives have improved the liquidity of the bond and bill markets.

## **Appendix 1: Interviews**

### **CIBC World Markets**

- David Leith, Managing Director, Head, Debt Origination, Debt Capital Markets
- Brian Thibideau, Managing Director- Canadian Liability Management, Debt Capital Markets

### **Scotia Capital**

- Andrew Branion, Director
- Mark Carrington, Head Canada Trader
- Andy Dickison, Managing Director, Interest rate Derivatives

### **RBC Dominion Securities**

- Michael Butler, Vice-President RBC DS Global Markets
- Richard Van Ness, Managing Director, Fixed Income Trading

### **OMERS**

- Peter Jarvis, Vice-President Fixed Income

### **Ontario Securities Commission**

- Randall Powley, Chief Economist