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IV. The Information Content of Real Return Bonds[1]

1. ***Fiscal surpluses in Canada have raised new challenges for debt management.*** Since 1997, the government's commitment to prudent fiscal policy has led to a decline of $47 billion in the total outstanding market debt, about 10 percent of the total stock. With reduced financing needs expected over the medium term, Canadian authorities face the challenge of maintaining liquidity in nominal benchmark bonds, especially for longer-dated securities, without reducing the depth of other segments of its debt program.[2]

2. ***These considerations have led the government to initiate a review of its Real Return Bond (RRB) program.***[3] The objective of the review is to assess the value and demand of the program, its cost effectiveness, and its effects on investor diversification and financial market deepening. Given the original goals of the program, some observers have also drawn attention to its usefulness as a signal to the market of the government's anti-inflation stance, and as an instrument setting a market indicator of real returns and long-term inflation expectations.

3. ***Against this background, this chapter reviews the extent to which Canada's RRB program has provided useful information regarding inflation expectations and the transmission of domestic and international monetary shocks.*** Section A briefly describes the main features of Canada's RRB program and the development of the global market for sovereign real return bonds. Section B considers whether Canadian RRB yields provide useful proxies for market expectations of real returns and inflation expectations. Section C reviews the relationship between sovereign RRB yields and monetary policy for a sample of industrial countries, and section D analyses the responsiveness of monetary policy to changes in inflation expectations as measured by break-even inflation (BI) spreads.

A. Canada's Real Return Bond Program

4. ***Canada's RRB program began with the issue of 30-year bonds in December 1991***. Since then, the authorities have issued three new 30-year bonds at four-year intervals, and have reopened each of the existing issues several times. As of December 2003, total RRBs outstanding amounted to C$17 billion, or 4¼ percent of total marketable debt. RRBs are issued according to the

Table 1. RRB Gross Issuance 1/

Maturity date	Amount (in C$ M)	Coupon Rate (in percent)
Dec. 2021	5,175	4.25
Dec. 2026	5,250	4.25
Dec. 2031	5,800	4.00
Dec. 2036	800	3.00
Total	17,025	

Source: Bank of Canada.

1/ Excluding CPI adjustment.

[1] Prepared by Rodolfo Luzio.

[2] In addition to the drop in total net issue amounts, the February 2003 Budget announced that the target of the fixed-rate share of the debt would be reduced from two-thirds to 60 percent over the next five years.

[3] See the Government of Canada's Summer 2003 Consultation Document (Bank of Canada, 2003a).

government's quarterly funding schedule, with issue amounts of about C$300 million.

5. ***The design of Canada's RRBs is similar to those in other countries.*** RRBs are constructed in a manner that provides certainty regarding real returns at purchase, and all cash flows, both coupon and principal, are adjusted to accumulated consumer price inflation between the date of issuance and the date of payment. This structure allows the coupon and principal payments to be stripped as individual zero-coupon RRBs.

6. ***Canadian RRBs have been innovative in indexing bond returns to inflation.*** A key feature of Canadian instruments has been the use of an Index Ratio to adjust both principal and coupon to inflation for a given settlement date. This methodology simplifies the valuation of the instrument and the comparison of RRB and conventional yields. This approach has since been adopted by other countries, including Sweden, the United States, and France.

7. ***Traditionally, demand for RRBs has been largely concentrated among institutional investors such as pension funds and insurance companies***. The interest of these investors has reflected their need for a long-term inflation hedge, given that their liabilities typically are of a long-term nature and are linked to inflation. Since the annual inflation accretion on RRBs is treated as taxable income in the year it accrues, RRBs are also favored by tax-deferred investment plans.

8. ***More recently, interest in RRBs appears to have grown.*** The bid-coverage ratio for RRBs has recently been higher than for long-term nominal bonds, and the consistent decline of RRB yields following auctions has also suggested increased investor demand. Most of this interest appears to be concentrated in individual investors; the share of dealers' winnings at RRB auctions has been significantly lower than in nominal bond auctions, with investors winning about half of bids at RRB auctions. Part of the recent increase in the demand of RRBs is due to the trend of pension fund plan sponsors to recommend holding RRBs. There has been some additional increase in demand due to tactical trading, often from international participants. Strategic demand for RRBs is expected to continue growing as pension funds and other long-term funds increasingly use RRBs in order to match their long–term liabilities.

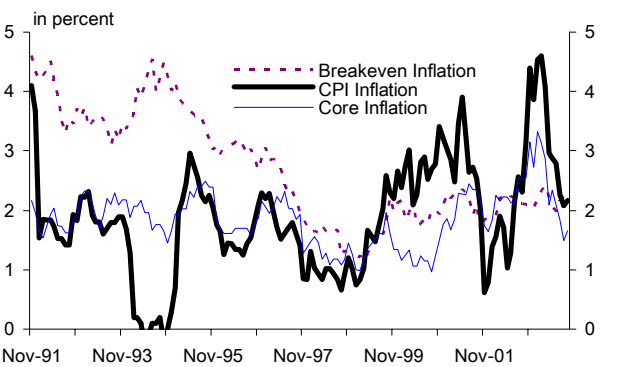
9. ***Secondary market activity has remained limited.*** The lower liquidity of RRBs is a result of the large share of buyers that hold RRBs to match long–term liabilities and the difficulty investment dealers face in hedging RRBs. Since the mid–1990s, secondary trading in RRBs has increased, although RRB turnover has modestly declined compared with nominal bonds.

10. ***RRBs have provided a cost-effective source of government funding***. From the inception of the program to the mid-1990s, actual inflation was significantly lower than the break-even inflation rate implied by nominal and RRB yields (Figure 1), implying that the nominal yield paid on these instruments was lower than on conventional bonds. The Bank of

Canada has estimated that the RRB program resulted in debt service savings of C$1.5 billion.[4] However, with the increased credibility of the authorities' inflation target, the break-even inflation rate implied by RRB yields has begun to closely match actual inflation, and the Bank of Canada estimates that RRBs would remain only marginally cost-effective relative to nominal bonds if future inflation remains close to the mid-point of the inflation target range.

Canadian RRB yields in the international context

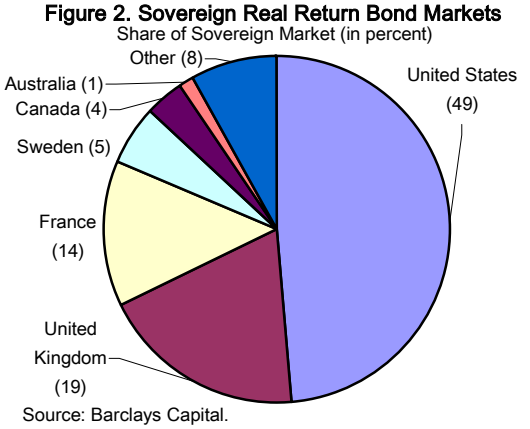
Figure 1. Breakeven Inflation and Actual Inflation



Source: Haver Analytics.

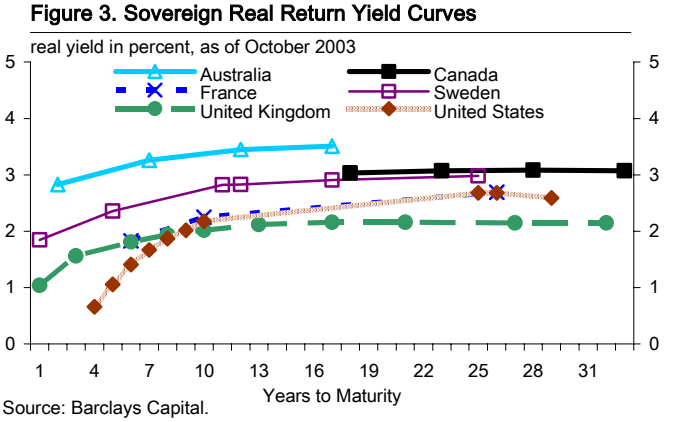
11. ***In the past decade, sovereign issuances of inflation-indexed bonds have experienced remarkable growth.*** Following the lead of the United Kingdom (1981), Australia (1985), Canada (1991) and Sweden (1994), new markets in developed economies have been established in the United States (1997), France (1998), and most recently Italy (2003). As a result, the total value outstanding surpassed $450 billion in 2003, nearly four times its size in 1997. The United States and United Kingdom are the two main issuers accounting for 68 percent of the market, with a large presence in the medium- and long-term range of the market (Figures 2 and 3). Because many major countries have very young markets and will continue to expand their market for inflation-indexed bonds toward a higher target, inflation-indexed bonds as a global asset class will continue to grow at a rapid pace for the next several years.[5]

Figure 2. Sovereign Real Return Bond Markets



Source: Barclays Capital.

Figure 3. Sovereign Real Return Yield Curves



Source: Barclays Capital.

[4] See Bank of Canada (2003a).

[5] The current size of the sovereign inflation-indexed bond market is about twice that of emerging market debt, and roughly equal size of global high yield, and European corporate bonds.

12. ***The growth of inflation-indexed instruments has enhanced the scope for diversification.*** The correlation of inflation-indexed returns with those of conventional bonds and equities are low or negative in most markets, enabling investors to improve the efficiency of their portfolios.[6] Also, inflation-indexed bonds are more correlated across markets than to domestic nominal bonds. With the rapid growth of sovereign inflation-indexed bond market, these bonds are increasingly considered as a separate and global asset class, and a separately designated part of the portfolios of global investors.

13. ***The structure and mechanics of inflation-indexed bonds is similar across countries, facilitating investors' understanding and pricing of these instruments across markets.*** The similarity in the structure of inflation-linked bonds reflects the fact that the real rate of return of these instruments must be known and fixed in advance. This feature makes this type of bonds the only instrument whose income flows are truly cost-of-living adjusted.

14. Nonetheless, differences do occur across markets:

- *Deflation protection*: Australia, France, and the United States offer a floor protection at par for the principal, whereas Canada and other markets do not.

- *Inflation lag*: All bond programs are linked to inflation with a lag, allowing time for the compilation of inflation statistics. In Canada, France, and the United States, this lag is three months, while the lag is eight months in the United Kingdom.

- *Inflation index*: Canada, the United States, and the United Kingdom use a non-seasonally-adjusted headline CPI for inflation adjustment, while France uses a CPI excluding tobacco prices.

- *Taxation*: Coupon income and principal appreciation are taxed as interest for most of the major issuing countries including Canada, either on an accrual or cash-flow basis. For the United Kingdom, however, coupons are taxed after adjusting for inflation. In France, principal appreciation is taxed as interest on an actuarial, smoothed basis.

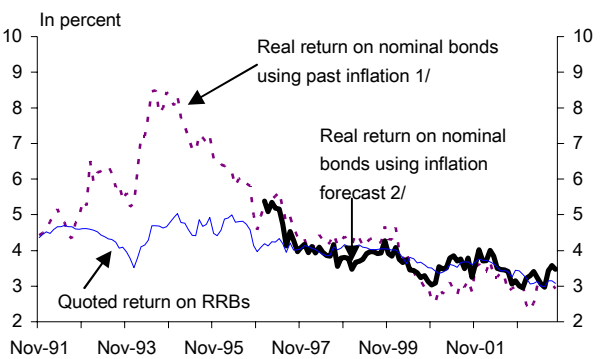
- *Coupon frequency*: Canada, the United States, and the United Kingdom pay coupons on a semi-annual basis, while Australia and France do so on a quarterly and annual basis, respectively.

[6] See Bridgewater (2002) for an efficient frontier analysis showing the degree to which inflation-linked (IL) bonds merit inclusion and that they tend to displace nominal bonds within a typical portfolio. Bodie (1990) shows how the introduction of IL bonds can improve portfolio efficiency, and why these instruments are the only hedge against long-run inflation risk.

B. The Information Content of Canadian RRBs

15. ***Canadian RRB yields have recently moved closely with proxies for real yields on conventional bonds*** (Figure 4). Prior to 1996, deviations were significant, possibly reflecting the evolving depth and liquidity in the RRB market and an inflation risk premium that may still have been attached to nominal bonds. Since this period, however, the real yield on nominal bonds—whether constructed by deflating by recent inflation or consensus forecasts for future inflation—has closely tracked RRB yields.

Figure 4. Real Bond Yields



Sources: Haver Analytics; and Fund staff calculations.
1/ Calculated as quoted nominal yield on benchmark 10-year bond less annualized inflation over past two years.
2/ Calculated as quoted nominal yield on benchmark 10-year bond less consensus forecast for inflation.

16. ***Several technical factors, however, may reduce the extent to which the quoted "real yield" on RRBs provides a market measure of real returns and inflation expectations***.[7]

- *Inflation-risk premiums*: Yields on nominal bonds may be driven upward by an inflation risk premium that is not required on RRBs, implying that spreads between nominal bonds and RRBs may provide an upwardly biased proxy for inflation expectations.[8]

- *Liquidity premium:* Conversely, if investors require a higher RRB yield to compensate for the relatively low liquidity of RRBs, the spread may be biased downward.[9]

- *Differences in duration:* Since coupon payments on RRBs rise with inflation, the cash-flow profile of RRBs and nominal bonds with the same maturity would differ.[10]

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[7] See for instance, Craig (2003), Sack (2002), Shen and Corning (2001), Emmons (2000), and Côté, Nelmes, and Whittingham (1996).

[8] Campbell and Shiller (1996) estimate that the risk-aversion premium is about ½ - 1 percentage point for the United Kingdom.

[9] Sack (2000) suggests using off-the-run long-term nominal securities which would have liquidity levels closer to inflation-indexed securities. On-the-run securities maintain high liquidity owing to their extensive use as hedging and other trading intensive investment activities.

[10] Sack (2000) derives a measure of inflation compensation based on a portfolio of zero-coupon securities constructed to match the back-loaded payments of inflation-linked securities. However, as demonstrated in that paper, the resulting measure differs only modestly from simple BI spreads.

- *Market segmentation:* Since RRBs are especially attractive to a particular class of investor with a stronger aversion to inflation uncertainty and possibly higher inflation expectations than the average market participant, RRB yields may be lower than otherwise, raising the BI spread and the implied inflation expectation.

17. ***Despite these technical factors, a simple regression analysis confirms that RRB yields appear to be reasonable proxies for the underlying real yield expectation in the nominal bond market.*** Table 2 summarizes regressions relating proxies for the real return on nominal bonds to RRB returns during the 1997–2003 period. Regardless of whether the real yield proxy is derived using actual past inflation or consensus inflation forecasts, the coefficient on the contemporaneous RRB yield is found to be significant and close to unity.[11]

Table 2. Canada: Regression of Inflation-Adjusted Nominal Bond Yields on RRB Yields

	Real Return on Nominal Bonds Using Consensus Inflation forecast 1/			Real Return on Nominal Bonds Using Past Inflation 2/		
	Coefficient		t-statistic	Coefficient		t-statistic
Constant	-1.10		-0.66	-0.94		-1.10
RRB Yield	1.16	**	3.61	1.33	*	2.38
Lagged RRB Yield 3/	-0.53		-0.57	-0.84		-1.46
Lagged Dependent Variable 3/	0.65		1.11	0.75	**	7.79
AR correction	0.62		0.85	-0.48		-1.34
MA correction	-0.36		-1.12	0.67	*	2.36
Adjusted R-squared	0.89			0.83		
Durbin-Watson stat	2.07			2.04		

Note: The Sample period is from January 1997 to November 2003. (*) denotes significance at the 5 % level and (**) at the 1 % level. ADF and Phillip-Peron unit root tests indicate that RRB and real yields are stationary. AR and MA corrections included to reduce the possibility of spurious correlation.

Source: Fund staff estimates.

1/ Calculated as quoted nominal yield on benchmark 10 year bond less annualized inflation over past two years.

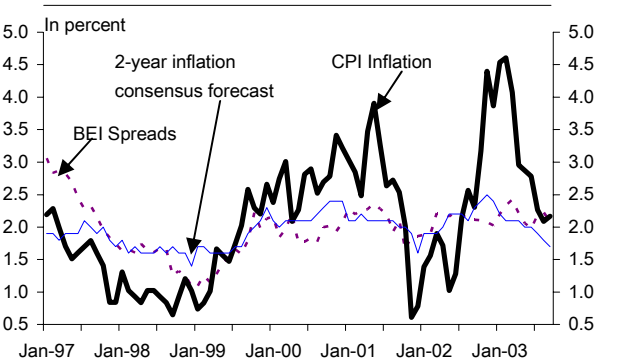
2/ Calculated as quoted nominal yield on benchmark 10 year bond less consensus forecast for inflation.

3/ Other lagged variables are not significant, and so not included.

[11] Interestingly, the results of regressions using real return proxies calculated with two year inflation forecasts suggest that lagged RRB yields are also significant but show an opposite sign.

18. ***Break-even inflation (BI) rates (implied by spreads between RRB and nominal yields) have tracked inflation forecasts more closely than actual CPI inflation*** (Figure 5.)[12] BI spreads have remained within the Bank of Canada's target range since 1997, with significantly lower volatility than inflation. Nonetheless, BI spreads have tended to be less stable than the two-year ahead consensus inflation forecast. The higher volatility of the BI spread would seem inconsistent with the 10-30 year maturity of the underlying instrument and the fact that the BI spread should reflect expectations of inflation over a longer horizon.

Figure 5. Breakeven Inflation Spreads and Inflation Expectations



Sources: Haver Analytics; and Fund staff calculations.

19. ***Despite a lack of correlation with actual inflation, BI rates appear to reflect forward looking inflation expectations.*** Using consensus forecasts as a proxy for inflation expectations, the first equation in Table 3 shows the results from a regression of changes in inflation expectations on changes in BI rates and past inflation. The coefficient on current and 3-month lagged changes in BI rates is significant with a positive sign, suggesting that a positive change in BI rates would translate in increasing inflation expectations. Similarly, the second equation in Table 3 uses the one-year ahead inflation forecast derived from monthly rolling regressions based on an AR inflation model over the period from January 1983 to November 2003, with the rolling forecast period starting in January 1997. BI rates with a one-period lag show again a positive and significant coefficient, indicating that BI rates would be a valuable instrument in gauging forward-looking expectations of inflation.

[12] Changes in BI rates show little useful information about actual inflation or inflation dynamics. A simple inflation AR model shows that BI rate add no information to inflation dynamics. Similarly, in the period from 1992 to November 2003, the presence of unit root for inflation can be rejected using both Phillips-Perron and Augmented Dickey-Fuller tests at a 5 percent confidence level, suggesting that long-term inflation is not significantly affected by short-term fluctuation in inflation.

Table 3. Inflation Forecast and Breakeven Inflation

	Inflation Consensus Forecast 1/			Inflation Forecast Using AR Model 2/	
Variables	Coefficient	t-statistic	**Variables**	Coefficient	t-statistic
Breakeven Inflation (-1) 3/	0.05	0.39	Breakeven Inflation (-1) 3/	0.22 **	2.21
Breakeven Inflation (-2)	-0.07	-0.61	Breakeven Inflation (-2)	-0.10	-0.84
Breakeven Inflation (-3)	0.47 **	4.31	Breakeven Inflation (-3)	0.01	0.15
Inflation (-1) 4/	-0.01	-0.25	Dependent Variable (-1)	1.04 **	9.48
Inflation (-2)	0.22 **	5.42	Dependent Variable (-2)	-0.56 **	-3.70
Inflation (-3)	0.13 **	2.98	Dependent Variable (-3)	0.39 **	3.72
MA Correction	0.17	1.41	MA Correction	-0.99 **	-77.33
Adj.R-squared	0.49		Adj.R-squared	0.29	
DW statistic	2.00		DW statistic	2.04	

Note : The sample period is from January 1997 to November 2003. All variables in the regressions are specified as first differences. ADF and Phillip-Peron unit root tests on the first differences of all variables indicate stationarity over the sample period. (*) denotes significance at the 5 % level and (**) at the 1 % level. (-1) means one-period lag

Source: Fund staff estimates.

1/ The dependent variable is calculated using 1-year ahead inflation consensus forecast.

2/ The dependent variable corresponds to the one-year ahead inflation forecast based on a AR inflation model over the period from January 1983 to November 2003. The inflation forecast is derived from rolling regressions over the sample period. The model uses 12-month price differences of the non-seasonally adjusted CPI.

3/ Breakeven inflation rates are caculated as the difference of the long-term benchmark nominal bond yields and RRB yields.

4/ The inflation rate corresponds to the 12- month difference of non-seasonally adjusted CPI.

C. What Effect Does Monetary Policy Have on Real Yields?

20. ***Economic theory is ambiguous regarding the extent to which monetary policy affects long-term real interest rates.*** At one extreme, some models argue that monetary policy is "super neutral" and has no impact on real activity or real interest rates. However, models that allow for frictions or incomplete markets show the effects of monetary policy through its effects on real interest rates. Empirical evidence has confirmed at least a short-run response of macro-economic variables to monetary policy shocks using vector autoregressive (VAR) models and data of many countries and across varied monetary regimes.[13]

21. ***This paper uses a simple VAR specification to model the response of RRB yields to short-term nominal rates for a sample of developed economies.***[14] The specification is similar to that used by Kahn, Kandel, and Sorig (2002) and consistent with the standard

[13] See Bagliano and Favero (1998) for an example.

[14] The econometric analysis below does not take into account the pricing implications of the structural differences across markets described in section A; neither does it make adjustments to account for the technical factors described in section B.

reference model used in the analysis of the monetary transmission mechanism. The model specification is as follows.

$$x_t = A(L)x_{t-1} + u_t$$

where x_t is a vector which includes the first difference of (i) log real GDP, (ii) log CPI, (iii) RRB yields, and (iv) short-term nominal rates, which are used as a proxy to monetary policy conditions; $A(L)$ is the standard lag operator; $u_t = Ce_t$ is the vector of residuals and C is the unique lower triangular decomposition of the covariance matrix of u_t.[15] A key identifying assumption is that the short-term nominal rates have no contemporaneous effect on other variables. Correspondingly, a triangular factorization of the residual matrix is imposed to be consistent with the assumption above.

22. ***The results indicate limited interaction between short-term rates and real yields, at least in the short run (Table 4).*** The estimated impact of short-term interest rates on RRB yields is not significant for any country in the sample, except for Australia (where the one-period lag is significant at the 10% level). Conversely, the coefficients in the short-term rate regression are found to be significant for Sweden, the United Kingdom, and the United States, suggesting that changes in short-term rates reflect changes in RRB rates.[16] Nonetheless, Granger causality tests show that neither RRB yields nor short-term rates can be treated as exogenous variables, indicating the absence of one-directional causality between real yields and short-term rates.

[15] We use various measures of short-term rates including central bank interest rate target rates, one-month and three-month sovereign bonds, but found no material differences on the results.

[16] It remains difficult to explain what type of information RRB yields would contain that would affect short-term rates after controlling for inflation and output growth, given the little dynamic interaction between RRB yields and inflation and output growth in the short run

Table 4. Coefficient Estimates in Basic VAR Model Including RRB Yields

	Australia		Canada		Sweden		United Kingdom		United States	
	RRB Yield	ST Rate	RRB Yield	ST Rate	RRB Yield	ST Rate	RRB Yield	ST Rate	RRB Yield	ST Rate
GDP Growth (-1)	0.01	0.07	0.01	-0.01	0.01	-0.05	-0.11	0.02	0.02	0.05 *
	0.21	*1.14*	*0.30*	*-0.29*	*0.19*	*-0.66*	*-0.95*	*0.08*	*0.79*	*1.62*
GDP Growth (-2)	-0.07	-0.21 ***	0.02	0.05	-0.01	0.01	0.21	0.16	0.00	0.03
	-1.03	*-2.53*	*0.81*	*1.00*	*-0.13*	*0.04*	*1.12*	*0.44*	*-0.11*	*0.90*
GDP Growth (-3)	0.05	0.17 ***	-0.03 *	0.04	0.00	0.05	-0.06	-0.06	-0.02	0.07 **
	1.14	*3.40*	*-1.63*	*0.89*	*0.07*	*0.74*	*-0.51*	*-0.25*	*-0.91*	*1.98*
CPI Inflation (-1)	-0.06	0.12 **	-0.05 **	-0.04	0.01	-0.01	-0.02	0.12	-0.05	0.05
	-1.14	*1.84*	*-1.90*	*-0.74*	*1.13*	*-0.51*	*-0.45*	*1.18*	*-0.95*	*0.66*
CPI Inflation (-2)	0.16 **	0.02	0.01	0.05	-0.01 *	0.02 *	-0.03	-0.22 *	0.04	0.07
	1.73	*0.15*	*0.42*	*0.74*	*-1.35*	*1.41*	*-0.43*	*-1.54*	*0.45*	*0.59*
CPI Inflation (-3)	-0.11 **	-0.09 *	0.01	-0.07 *	0.00	0.02 *	0.08 *	0.05	-0.02	0.04
	-2.00	*-1.43*	*0.51*	*-1.38*	*0.51*	*1.65*	*1.34*	*0.41*	*-0.37*	*0.39*
RRB Yield (-1)	1.08 ***	0.10	0.97 ***	-0.27	1.41 ***	0.29 *	1.01 ***	0.49 **	0.97 ***	0.35 **
	8.51	*0.65*	*7.97*	*-0.95*	*9.56*	*1.48*	*7.88*	*1.96*	*6.74*	*1.70*
RRB Yield (-2)	-0.15	-0.12	-0.10	-0.10	-0.54 **	-0.55 **	-0.26 *	-0.65 **	-0.37 **	0.31
	-0.79	*-0.51*	*-0.60*	*-0.26*	*-2.26*	*-1.70*	*-1.48*	*-1.87*	*-1.82*	*1.07*
RRB Yield (-3)	-0.03	0.20	0.06	0.34	0.05	0.44 **	0.22 **	0.25	0.30 **	-0.06
	-0.21	*1.11*	*0.49*	*1.12*	*0.36*	*2.14*	*1.75*	*1.04*	*1.73*	*-0.23*
ST Rate (-1)	-0.15 *	1.19 ***	0.00	1.01 ***	0.06	1.24 ***	-0.01	1.06 ***	0.05	0.86 ***
	-1.48	*9.79*	*-0.04*	*8.00*	*0.63*	*9.77*	*-0.20*	*7.88*	*0.49*	*6.01*
ST Rate (-2)	0.11	-0.20	-0.02	0.04	-0.14	-0.37 **	0.03	0.05	0.00	-0.26 *
	0.69	*-1.01*	*-0.20*	*0.19*	*-0.92*	*-1.85*	*0.26*	*0.26*	*-0.02*	*-1.38*
ST Rate (-3)	0.01	-0.16 *	0.04	-0.13	0.03	0.11	-0.08	-0.16	0.00	0.16 *
	0.07	*-1.31*	*0.78*	*-1.13*	*0.29*	*0.90*	*-1.09*	*-1.17*	*-0.04*	*1.31*
Constant	0.58 *	-0.07	0.23	0.28	0.50 **	-0.70 **	0.26 ***	-0.14	0.30	-2.09 ***
	1.50	*-0.15*	*1.07*	*0.55*	*1.89*	*-2.00*	*2.72*	*-0.75*	*0.88*	*-4.36*
Adj. R-squared	0.91	0.96	0.95	0.97	0.91	0.93	0.97	0.97	0.94	0.99

Note: The estimates shown are of a fully recursive VAR model with the following variables: 12-month GDP growth; 12-month CPI inflation; RRB rate of return, 3-month treasury bill yields. The table omits the estimates for GDP growth and CPI inflation equations since they are not relevant to the analysis. (***) denotes significance at 1 percent level, (**) at the 5 percent, and (*) at the 10 percent. The sample period is from January 1997 to September 2003. (-1) denotes the lag of the variable. The numbers in italics are estimated t-statistics.

Source: Fund staff estimates.

23. ***Impulse response function estimates from the VAR system also show a weak response of real yields to short-term rates.*** For most countries in the sample, a one standard deviation increase in short-term rates leads to a small drop in RRB yields, but the effect remains insignificant. Hence, RRB yields appear to be largely invariant to current monetary conditions.

D. Do Break-Even Inflation Spreads Affect Short-Term Interest Rates?

24. ***Break-even inflation spreads are often used as a measure of inflation expectation by markets and policymakers.*** The analysis above illustrates that BI spreads provide a relatively weak predictor of inflation, but do offer a useful (if imperfect) signal of inflation expectations. Unsurprisingly, therefore, the Bank of Canada lists the spread between nominal and real return bonds as one of its indicators of inflation expectations, and these spreads are

often used for similar purposes in other countries. This raises the question of how central banks and short-term interest rates have responded to changes in BI spreads.

25. ***VAR analysis suggests that changes in BI spreads have had only a limited effect on short-term rates in most countries.***[17] The VAR specification is similar to the one described in the previous section and assumes that BI spreads have no contemporaneous effects on output or inflation. Table 5 shows only the coefficient estimates for the specification of BI spreads and short-term rates as dependent variables. Focusing on the effect on short-term rates, the coefficients on BI spreads are found significant at a 5 percent level only for Australia and the United Kingdom, both with positive lagged coefficients. The results suggest that BI spreads do not appear to contain information that could significantly impact policy-related interest rates. Conversely, however, short-term rates enter as significant and negatively in the equation explaining BI spreads in Canada, Sweden, and the United States with negative coefficients. This finding would indicate that changes in monetary conditions affect inflation expectations, as proxied by BI spreads, although the effect appears to be temporary and fully dissipates after few months.

26. ***Impulse response functions indicate a positive, but weakly significant and only temporary, reaction of short-term rates to BI spread innovations*** (Figure 6). The evidence is weakest for Canada, where the reaction of short-term rates to an innovation in BI spreads is muted. The dynamic responses for other countries are stronger, and appear to peak in the first quarter following the shock. The reaction of short-term rates is strongest for Sweden and the United Kingdom, where a 1 percentage change in BI spread would lead to about ½ and ¼ percentage change in short-term rates, respectively. Nonetheless, the effect of the innovations dies out within the second quarter for all countries.

E. Concluding Remarks

27. ***This chapter reviews the institutional aspects of Canada's RRB program draws three empirical conclusions.*** First, yields on RRBs appear to provide some useful information regarding market expectations of real yields and inflation. Second, RRB yields are largely invariant to current monetary conditions. Third, monetary policy makers do not appear to respond to BI spreads in setting short-term interest rates with short-term rates responding weakly and only temporarily to changes in BI spreads.

[17] This analysis supports findings by Sack (2000) and Kahn, Kandel, and Sarig (2002) on the effect of BI spreads on past policy actions and its implications for short-term rates.

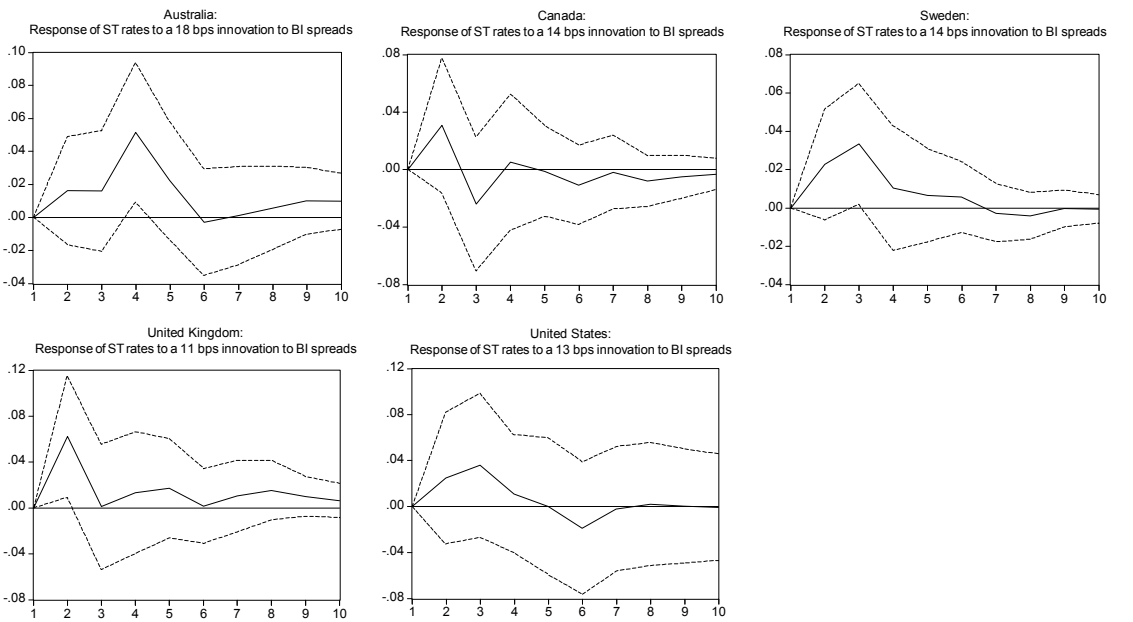
Table 5. Coefficient Estimates in Basic VAR Model Including BI Spreads

	Australia		Canada		Sweden		United Kingdom		United States	
	ST Rate	BI Spread	ST Rate	BI Spread	ST Rate	BI Spread	ST Rate	BI Spread	ST Rate	BI Spread
GDP Growth (-1)	0.01	0.01	0.01	0.03	-0.01	-0.09 *	0.03	0.00	0.06 *	0.01
	0.34	*0.20*	*0.27*	*1.17*	*-0.10*	*-1.47*	*0.37*	*0.03*	*1.54*	*0.58*
GDP Growth (-2)	-0.12 ***	-0.03	0.06 *	0.01	0.07	0.06	0.04	-0.04	0.08 **	0.02
	-3.18	*-0.52*	*1.41*	*0.42*	*1.15*	*0.83*	*0.38*	*-0.79*	*2.00*	*0.72*
GDP Growth (-3)	0.13 ***	0.04	0.06 *	-0.01	0.00	-0.04	0.32 **	-0.01	0.13 ***	0.03 *
	2.80	*0.55*	*1.41*	*-0.43*	*-0.04*	*-0.52*	*1.85*	*-0.13*	*3.70*	*1.33*
CPI Inflation (-1)	0.10 *	0.06	-0.02	0.06 **	-0.01	-0.01	0.19 **	0.02	0.16 *	0.03
	1.54	*0.59*	*-0.28*	*1.71*	*-0.86*	*-0.50*	*1.95*	*0.38*	*1.55*	*0.35*
CPI Inflation (-2)	0.04	0.00	0.06	0.09 ***	0.00	0.01	-0.03	0.06	0.12 *	0.00
	0.48	*-0.03*	*1.20*	*2.68*	*-0.28*	*0.59*	*-0.30*	*1.09*	*1.29*	*-0.04*
CPI Inflation (-3)	-0.01	0.04	-0.01	0.05	0.01	0.02 **	-0.08	0.08 *	0.07	0.05
	-0.14	*0.39*	*-0.11*	*1.24*	*0.95*	*1.69*	*-0.75*	*1.46*	*0.68*	*0.61*
ST Rate (-1)	0.45 ***	0.05	0.23 **	-0.17 **	0.40 ***	-0.05	0.11	-0.09	0.24 **	-0.22 **
	3.54	*0.26*	*1.75*	*-2.01*	*3.09*	*-0.37*	*0.83*	*-1.28*	*1.74*	*-2.24*
ST Rate (-2)	0.02	0.08	0.34 ***	0.18	-0.03	0.09	0.22 *	-0.01	-0.04	0.09
	0.14	*0.44*	*2.49*	*0.20*	*-0.24*	*0.56*	*1.59*	*-0.10*	*-0.27*	*0.84*
ST Rate (-3)	-0.12	-0.29 **	-0.06	-0.19 **	0.00	-0.29 **	-0.01	-0.14 **	0.18	-0.01
	-0.96	*-1.67*	*-0.42*	*-2.11*	*-0.03*	*-2.02*	*-0.11*	*-1.95*	*1.25*	*-0.12*
BI Spread (-1)	0.09	0.20 *	0.25 *	0.08	0.17 *	0.20 **	0.55 ***	0.26 **	0.20	1.18
	0.99	*1.49*	*1.30*	*0.66*	*1.58*	*1.67*	*2.38*	*2.04*	*0.87*	*7.33*
BI Spread (-2)	0.02	-0.12	-0.26 *	-0.18 *	0.14 *	-0.21 **	-0.21	-0.27 **	-0.08	-0.31 *
	0.20	*-0.93*	*-1.44*	*-1.47*	*1.41*	*-1.86*	*-0.90*	*-2.11*	*-0.25*	*-1.33*
BI Spread (-3)	0.27 ***	0.19 *	0.07	0.25 **	-0.02	0.32 ***	0.25	0.19 *	-0.15	0.01
	2.88	*1.39*	*0.39*	*2.18*	*-0.22*	*2.77*	*1.13*	*1.57*	*-0.63*	*0.09*
Adj. R-squared	0.51	0.13	0.32	0.33	0.31	0.32	0.30	0.25	0.44	0.79

Note: The estimates shown are of a fully recursive VAR model with the following variables: 12-month GDP growth; 12-month CPI inflation; breakeven inflation spreads using long-term benchmark nominal bond yields and long-term inflation-linked bond yields, 3-month treasury bill yields. All variables in the VAR estimation are specified as first differences. The table omits the estimates for GDP growth and CPI inflation equations since they are not relevant to the analysis. (***) denotes significance at 1 percent level, (**) at the 5 percent, and (*) at the 10 percent. The sample period is from January 1997 to September 2003. (-1) denotes a one-period lag. The numbers in italics are estimated t-statistics.

Source: Fund staff estimates.

Figure 6. Impulse Response Functions to BI Spread Innovations



Source: Fund staff estimates.

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