Real Return Bonds: Monetary Policy Credibility and Short-Term Inflation Forecasting

Christopher Reid and Frédéric Dion, Financial Markets Department, and Ian Christensen, Department of Monetary and Financial Analysis

- *By comparing the yields on conventional and Real Return Bonds, it is possible to calculate the break-even inflation rate, or BEIR, which is the average rate of inflation that equates the expected returns on these two bonds. The question then becomes, does the BEIR contain useful information about long-run inflation expectations?*
- *The BEIR has been higher, on average, and more variable than survey measures of expected inflation over the past 12 years. The difference between survey measures and the BEIR measure of inflation expectations may be explained by a number of market-based premiums and distortions that affect the BEIR.*
- *As a result of the potential distortions and the difficulties in accounting for them, the BEIR should not be given a large weight as a measure of inflation expectations at this time.*
- *The continued development of the Real Return Bond market should eventually result in the BEIR becoming a more useful indicator.*
- *The BEIR demonstrates no clear advantage in forecasting near-term inflation. Over all horizons examined, survey measures and even past inflation rates yield smaller forecasting errors than the BEIR.*

The difference between the yields on long-term Government of Canada conventional bonds and Real Return Bonds (RRBs), which is commonly referred to as the break-even inflation rate (BEIR), has long held out the potential of providing a unique, real-time, market-based measure of inflation expectations. Since Canada issues RRBs with 30-year maturities, the BEIR is constructed from yields on long-term bonds and indicates the expected average inflation over a 25- to 30-year horizon. In a study on the BEIR, Côté et al. (1996) concluded that this measure needs to be interpreted with caution, owing to the presence of a premium for inflation uncertainty and other distortions resulting from the small size of the RRB market. The authors maintained that "the differential over time may nonetheless be a good indicator of movements in long-run inflation expectations." With the BEIR breaching three per cent in 2004, the top of the inflation target band, there has been renewed interest in the importance of such premiums and distortions. Furthermore, since RRBs were first issued in Canada in December 1991, almost 13 years of data are now available to reassess the usefulness of this measure of inflation expectations.

The worth of the BEIR as a measure of inflation expectations can be examined from two perspectives: its usefulness as a measure of monetary policy credibility and as an aid to forecasting inflation.

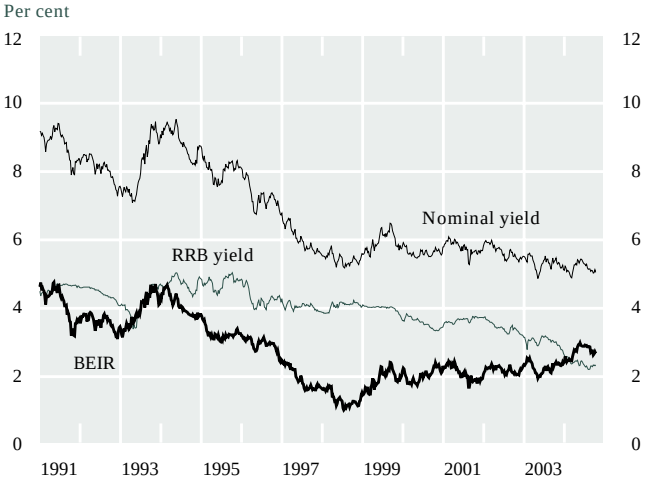
The worth of the BEIR as a measure of inflation expectations can be examined from two perspectives: its usefulness as a measure of monetary policy credibility and as an aid to forecasting inflation. It follows that if the BEIR captures inflation expectations accurately, its position relative to the midpoint of the inflation target band should be a good measure of credibility. To ascertain the BEIR's accuracy, the historical experience of this measure was examined in relation to alternative measures of the behaviour of long-run inflation expectations. While the broad trends in the BEIR conform with those of other measures of inflation expectations, the BEIR is more volatile and at times deviates significantly from other measures. The purpose of this article is to consider whether these movements can be attributed to changes in risk premiums and other distortions affecting the BEIR rather than to changes in inflation expectations. In addition, the BEIR's forecasting performance at short horizons is compared with that of survey measures of expectations and other simple models.

The Interest Rate Differential and Inflation Expectations

For conventional bonds, the nominal value of the cash flow is set in advance, while the real purchasing power of these cash flows deteriorates with inflation over the term to maturity. Therefore, to preserve the real purchasing power of these cash flows, the price of the conventional bonds must reflect the required compensation for expected inflation over the term of the bond as well as a real rate of return. In contrast, as the name implies, RRBs guarantee their holder a real return, protecting them from lower returns resulting from inflation. To do so, the coupon payment and the principal repaid at maturity of RRBs are adjusted to include compensation for inflation that has occurred since the issuance of the bond.[1] Assuming that the quoted real yield on the RRBs is equivalent to the expected real return on a conventional bond, and that both markets are efficient, the Fisher relationship[2] says that, in the absence of premiums and distortions, the difference between nominal and real yields should be equivalent to the average expected rate of inflation over the term of the bonds.

Chart 1

The BEIR, Nominal and Real Yields



The Historical Experience (1991 to 2003Q4)

The Government of Canada first issued RRBs in December 1991. Chart 1 shows the RRB yield, the yield from a 30-year nominal Government of Canada bond, and the BEIR calculated from these two yields.

Table 1 shows the means and measures of the variability of the nominal and real yields as well as the BEIR.[3] The drop in the mean and variability of the BEIR in the latter half of the sample coincides with a drop in the mean and variability of the nominal yield. This is consistent with inflation expectations and inflation uncertainty falling over the sample. The real yield also dropped

Table 1

Full and Subsample Statistics

	Mean			Standard deviation		
	1992–2003	1992–1997	1998–2003	1992–2003	1992–1997	1998–2003
Nominal	6.83	8.02	5.64	1.35	0.86	0.26
RRB	4.06	4.45	3.66	0.53	0.33	0.37
BEIR	2.74	3.52	1.96	0.95	0.66	0.36

1. See "Canada—Real Return Bonds" on the Bank of Canada's Web site (http://www.bankofcanada.ca/en/notices_fmd/market_consult03.htm).

2. Fisher relationship: $(1+i) = (1+r)(1+\pi^{\varepsilon}) \Rightarrow \pi^{\varepsilon} = \frac{1+i}{1+r} - 1$

3. The sample includes quarterly data from 1991 to 2003Q4

Chart 2

Four Measures of Inflation Expectations

on average in the latter half of the sample, but its variability was relatively unchanged. Formal inflation targets were adopted in Canada in February 1991, and since December 1995 have been set to the current target of 2 per cent. Chart 2 shows that the BEIR was above the inflation target in the early- to mid-1990s, temporarily below it from late 1997 to mid-1999, and very close to target to the end of 2003. Longworth (2002) and others cite the falling level of the BEIR between 1992 and 1997 as evidence of monetary policy becoming more credible.

Also shown in Chart 2 are the three survey measures of expected inflation: the median expected inflation rate 4 to 14 years ahead from an annual survey of forecasters conducted by Watson Wyatt; the semi-annual survey by Consensus Economics of forecasters' inflation expectations 6 to 10 years ahead; and expectations 2 years ahead from the Conference Board of Canada's quarterly *Survey of Forecasters*.[4] The BEIR is higher than the other measures of expectations for the first half of the sample—at times by more than 150 basis points. It registers both the highest reading (4.9 per cent in March 1992) and the lowest (about 1.0 per cent in late 1998). It also took longer to move to the target range for inflation. However, over the past four years, until the beginning of 2004, the BEIR was very close to 2 per cent, the Bank of Canada's target for inflation, along with the other measures of inflation expectations. From 2000 to 2003, taking surveys as the appropriate benchmark, any distortions in the level of the BEIR were, on average, either small or offsetting.

Even if all of these series were perfect measures of inflation expectations, their levels would be expected to differ because they capture expectations over different horizons. The measures of inflation expectations are in fact quite different. The mean level of the BEIR over the 1992 to 2002 sample is 2.8 per cent, above that of the 4- to 14-year expectations (2.5 per cent), the 6- to 10-year (2.1 per cent), and the 2-year (2.0 per cent). Thus, over this period, the longer the horizon over which the expectation applies, the higher the average expectation of inflation. This is consistent with a slow increase in the long-term credibility of monetary policy, which led expectations over longer horizons to fall gradually.

While it is too early to judge, the recent movement of the BEIR in 2004 may represent the beginning of a third significant deviation between this measure and survey measures of inflation expectations.

The BEIR is the most variable measure of longer-term inflation expectations, showing an average annual absolute change of 0.56 percentage points, at least double that of the survey measures over any horizon. The first differences in the latter measures, taken at the frequencies of the respective surveys, show little correlation with changes in the BEIR, suggesting that changes in one (or both) of these measures reflect some phenomenon other than changes in inflation expectations (Table 2). Historically, the higher peaks and lower troughs of the BEIR are mainly linked to two episodes: 1993–95, when the BEIR increased rapidly as other measures stabilized or fell; and 1997–99, when the BEIR dropped sharply while other measures fell only modestly or flattened. As of October 2004, the BEIR was approximately 2.8 per cent, well above its range over the preceding four years. While it is too early to judge, the recent movement of the BEIR in 2004 may represent the beginning of a third significant deviation between this measure and survey measures of inflation expectations.

4. Inflation two years ahead is the expected inflation rate for the following calendar year rather than over the next 12 months. The other survey measures are similarly defined.

Table 2

Correlations between Changes in the BEIR and Other Measures of Inflation Expectations

Survey measures	1992–2003	1992–1997	1998–2003
2 years ahead (quarterly)	0.17	0.11	0.20
6-10 years ahead (semi-annual)	0.08	0.08	-0.36
4-14 years ahead (annual)	0.31	-	-

Differences between survey measures and the BEIR may reflect flaws in either measure. In this article, we focus on the potential distortions affecting the BEIR, including cash-flow mismatches, term-varying inflation expectations, inflation- and liquidity-risk premiums, and market segmentation.

Embedded Premiums and Distortions: How Important Are They?

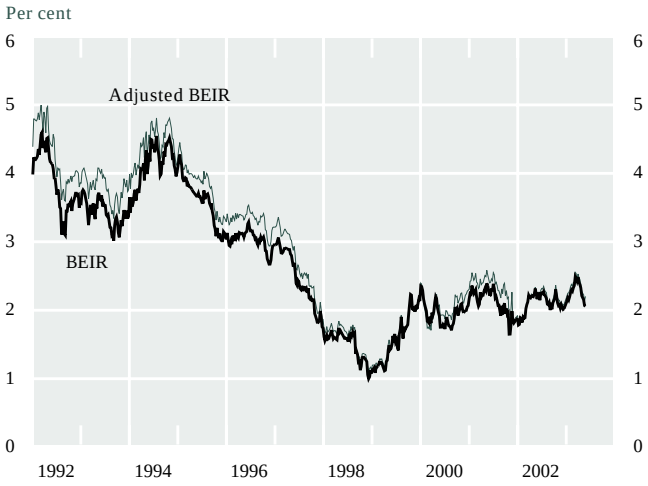
The use of the BEIR to capture inflation expectations depends on a number of fairly strong assumptions. Investors are assumed to demand the same real return from RRBs as from conventional Government of Canada bonds. In addition, the BEIR calculation is premised on well-functioning, efficient markets with cross-market arbitrage. Traditional bonds are also assumed to strictly adhere to the Fisher relationship, which stipulates that the only difference between a nominal interest rate and the real interest rate is in fact expected inflation. However, several factors may cause these assumptions to be violated and bias or distort the BEIR as a measure of inflation expectations. Furthermore, the calculation of the BEIR may introduce a bias, owing to the different structures of the component bonds.

Cash-flow mismatch

The RRB and the nominal bond that are used to construct the BEIR have approximately the same maturity. However, because the RRB's coupon payments rise with inflation while those of the nominal bond are constant, an investor will receive different cash flows for the two products. A greater portion of the cash flow for RRBs will tend to occur later in the maturity structure than for conventional bonds. Since the price of a bond is simply the sum of discounted future cash flows, the two bonds will have different sensitivities to the expected path of real interest rates and real interest rate risk. These differences will influence the yield spread between the securities for reasons unrelated to expected future inflation.

Chart 3

The Cash-Flow Adjusted and Unadjusted BEIR



Therefore, to adjust for the differences in cash flow in calculating the BEIR, the yield to maturity of the RRB should be compared not with that of a nominal bond, but with that of a synthetic nominal bond (created from a zero-coupon curve[5]) with exactly the same stream of cash flows as the RRB. Expressed differently, by discounting the inflation-adjusted cash flows with a zero-coupon curve, it is possible to solve iteratively for the constant inflation expectations that are consistent with the observed price (see Box).

Chart 3 illustrates both the BEIR and the cash-flow-adjusted BEIR. The two measures are reasonably close, but differ significantly on occasion (Chart 4), with an average bias of 20 basis points. The largest source of week-to-week volatility in this bias calculation is the issuance of a new benchmark bond, since the change in length of maturity will alter the sensitivity to interest rates of either component bond in the BEIR. Therefore, the level and variations of the BEIR reflect not only inflation expectations, but also the discrepancy in the interest exposure of each bond.

5. Results are based on the Merrill-Lynch-Spline exponential methodology to extract the yield curve (Brenner et al. 2001) as calculated by Bolder, Johnson, and Meltzer (forthcoming).

Box

"Adjusting" for Cash-Flow Mismatches

Discounting Using a Zero-Coupon Curve

The price of a bond is the present value of its cash flows. The price (P) therefore reflects how much money must be invested today, given a certain rate of return (yield to maturity), for n periods, to produce a specific flow of nominal payments. The specific future nominal cash flows of a conventional bond are known in advance. For example, a $100 par value semi-annual pay bond with a 5 per cent coupon and a maturity of 30 years will make 60 payments of $2.50 and $100 at maturity. To determine the present value of this bond, the cash flows (CF) are discounted using this formula:

$$P = \sum_{t-1}^{N} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{N} C/(1+i)^t + PL/(1+i)^n, \quad (1)$$

where C= coupon and PL = principal. This formula for calculating P assumes that the interest rate (i) or yield to maturity used to discount each cash flow is constant. However, it is more appropriate to discount each cash flow at the interest rate relevant to when it is received. Therefore, each cash flow should be considered separately; or, more technically, one should value a bond as a package of zero-coupon bonds, with each payment considered its own bond. To determine the present value of each zero-coupon bond, the future cash flow is discounted using the yield on a zero-coupon Government bond with the same maturity (m).

$$P = \sum_{m=1}^{N} CF_{t+m}/(1+i_m)^m. \quad (2)$$

However, such bonds do not exist for every maturity, and therefore theoretical foundations are used to derive a zero-coupon curve. This article relies on the Merrill-Lynch-Spline methodology to extract the yield curve as calculated by Bolder, Johnson, and Meltzer (forthcoming).

The Cash-Flow Adjustment

From equation (1) above, it follows that, for a given interest rate, the further out the cash flow, the lower the present value. Since a greater portion of the cash flows of RRBs typically occurs later in the maturity cycle than with conventional bonds, an adjustment for this difference in structure should be made.

There are several equivalent ways to approach the cash-flow adjustment. If expected future inflation is known and constant over the term of the RRB, then the stream of nominal payments from an RRB is also known (the fixed coupon and principal are adjusted for inflation). The necessary portfolio of zero-coupon bonds to replicate those cash flows exactly can then be constructed. The present value of this portfolio is determined by summing each cash flow that has been discounted using the zero-coupon curve.

$$P = \sum_{m=1}^{N} \frac{RCF_{t+m}(1+\pi)^m}{(1+i_m)^m} =$$

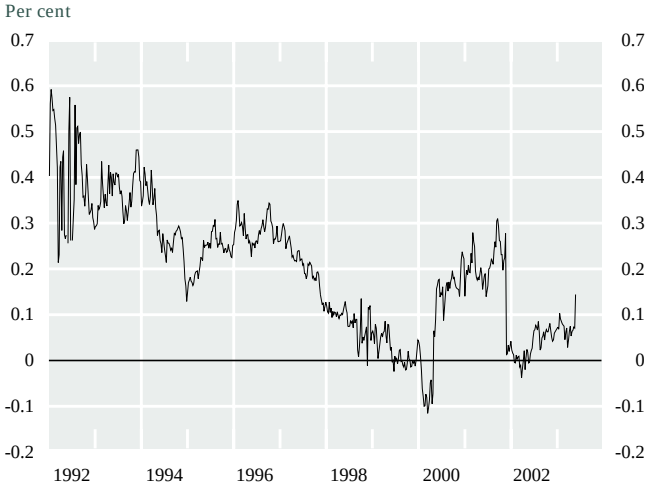
$$\sum_{m=1}^{N} \frac{RC_{t+m}(1+\pi)^m}{(1+i_m)^m} + \frac{RP(1+\pi)^n}{(1+i_n)^n}, \quad (3)$$

where RCF = real cash flow, RC = real coupon, and RP = real principal. Of course, expected inflation is not known, but since the current market price of the RRB contains an implicit valuation of expected inflation (the BEIR), this measure can now be calculated by solving iteratively for the constant inflation rate that equates the market value of the RRB with the calculated value of the synthetic portfolio of zero-coupon bonds. By matching the cash flows of the RRB with a portfolio of zero-coupon bonds, the differences in the timing of the cash flows are accounted for. A slightly different but equivalent approach consists of maintaining the constant inflation assumption but altering the level of inflation until the resulting present value of the inflation-adjusted cash flows (discounted by the zero-coupon curve) is equivalent to the observed market price of the RRB.

Chart 4

Bias Resulting from Differences in Cash Flow

(BEIR – adjusted BEIR)



The bias will also be a function of the slope of the yield curve, and accounting for it will further improve the measure of inflation expectations from RRBs. In October 1996, for example, the yield curve was particularly steep, which caused the BEIR to understate inflation expectations by 31 basis points. Conversely, in March 2000, the yield curve was flat to inverted,[6] and inflation expectations would have been overstated by 10 basis points.

Term structure of inflation expectations

The BEIR is not a forward rate,[7] in the sense that it doesn't refer to a future rate of inflation, but rather, is more closely aligned with the average of inflation over the maturity of the bonds. For example, if inflation is expected to be high for some period of time and then to return to 2 per cent, the BEIR will be above 2 per cent, even though it is a long-term measure. Thus, in order for the BEIR to be a good measure of average inflation expectations, the term structure of inflation expectations must be relatively constant. When this assumption fails, a bias is introduced into the BEIR measurement. As a result, term-varying inflation expectations will alter the level of the BEIR, adding to its variability even when long-run expected inflation is unchanged. In this section, we explore the extent to which the current reading of the consumer price index (CPI) and short-term inflation expectations can affect the BEIR.

In order for the BEIR to be a good measure of average inflation expectations, the term structure of inflation expectations must be relatively constant.

Table 3 shows the results of a sensitivity test of the BEIR obtained under different levels of short-term inflation expectations that last for varying lengths of time before reverting to the inflation target of 2 per cent. For example, if inflation is expected to be 3 per cent for the next six months and 2 per cent for the remainder of the 30 years to maturity, we should observe a BEIR of 2.03 per cent (while average inflation is 2.02 per cent).[8] Clearly, a large and persistent deviation of inflation expectations is required to create a significant bias. The bias owing to the term structure of inflation expectations is typically no larger than 3 to 4 basis points (Christensen, Dion, and Reid 2004). However, the bias will most likely be at its maximum (approximately 10 basis points, based on our sample) at criti-

Table 3

BEIR under Different Structures for Inflation

Period of high expected inflation before returning to the target (2%)	3% expected inflation		4% expected inflation		5% expected inflation	
	BEIR (%)	Average inflation (%)	BEIR (%)	Average inflation (%)	BEIR (%)	Average inflation (%)
6 months	2.03	2.02	2.05	2.03	-	-
1 year	2.05	2.03	2.11	2.07	2.16	2.10
2 years	2.10	2.07	2.21	2.13	2.31	2.20
5 years	2.25	2.17	2.50	2.33	2.76	2.49
10 years	2.47	2.33	2.94	2.66	3.42	2.99
15 years	2.65	2.50	3.30	3.00	3.97	3.49
30 years	3.00	3.00	4.00	4.00	5.00	5.00

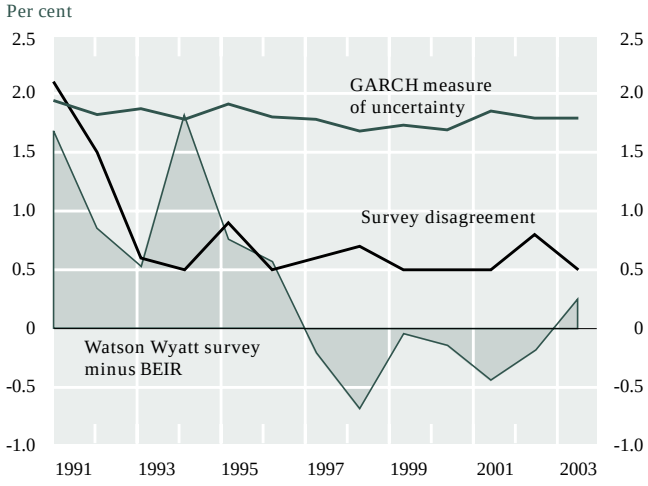
6. The yield to maturity on a 30-year conventional Government of Canada bond was significantly lower than that of a similar bond with 20 years to maturity.

7. A forward rate is an interest rate that is set today but has future start and stop dates.

8. The difference between the BEIR and average inflation is driven by the coupon structures of RRBs and nominal bonds.

Chart 5

Survey/BEIR Difference and Inflation Uncertainty



cal times, perhaps following a large relative price shock when monetary authorities will be looking for evidence that this shock is feeding into inflation expectations.

Inflation-risk premium

Inflation risk reflects the probability that the actual inflation rate will not match the expected rate. If inflation is significantly higher over the term of a conventional bond than was anticipated at the time of purchase, the realized real rate of return will be lower than the anticipated real rate of return. Investors in conventional bonds require compensation for this risk, resulting, other things being equal, in higher nominal yields. In contrast, RRB investors do not face inflation risk because RRBs compensate for realized inflation.[9] For this reason, the BEIR contains a positive inflation-risk premium, the magnitude of which is in turn dependent on the degree of uncertainty about future inflation and the degree of risk aversion.

Chart 5 shows two proxies of long-run inflation uncertainty. The first is a measure of the disagreement among forecasters who responded to the Watson Wyatt survey, calculated as the difference between the upper and lower quartiles of reported inflation expectations at the 4- to 14-year horizon. The second measure is inflation uncertainty over a 5-year forecast horizon derived from a GARCH model developed by Crawford and Kasumovich (1996).[10]

Côté et al. (1996) suggest that the increase in the BEIR in 1994, which was not accompanied by a similar move in survey measures, may reflect an increase in the inflation-risk premium. If changes in the premium for inflation uncertainty are an important factor in explaining movements in the BEIR, then sharp movements in these proxies should be associated with similar movements in the BEIR. Yet both measures fail to indicate a rise in inflation uncertainty in 1994 or a significant decline in 1997. Crawford and Kasumovich's measure of inflation uncertainty fell dramatically during the 1980s but has been relatively stable since 1992. Similarly, survey disagreement fell between 1991 and 1994 but was relatively stable afterwards. The simplest explanation is that deviations of the BEIR from survey measures of inflation expectations are the result of some phenomenon other than changes in uncertainty regarding inflation.

Liquidity-risk premium

Owing to the relatively small number of RRBs outstanding, investors may demand a higher yield on RRBs to compensate them for the risk that they will not be able to sell RRBs quickly or will have to sell at unfavourable prices. Other things being equal, this will result in a higher real yield and a lower BEIR. If this liquidity-risk premium is present, it should fall over time as more RRBs are issued and traded. In fact, there has been an improvement in liquidity since the beginning of the RRB program. The stock of RRBs outstanding increased from $4.1 billion at the end of 1994 to $17.3 billion at the end of 2003, rising from 9 per cent to 26 per cent of federal government marketable debt with a maturity of 10 years or greater.

However, even with a much greater stock outstanding, the liquidity premium may rise during periods when investors demonstrate a heightened preference for highly liquid assets. A dramatic deterioration in liquidity, if there were one, could explain the declining differential between the BEIR and survey measures of expected inflation between 1997 and 1999. During that period, global financial markets were heavily influenced by a series of shocks, chiefly the Asian crisis and the

9. In practice, there is some inflation risk, owing to the indexation lag and taxation.

10. Similar analyses were undertaken using implied volatility from long-term swaptions as a proxy for long-term inflation uncertainties in the sample 1997 to 2003. No positive relationship was identified. A swaption gives the holder the right (but not the obligation) to enter into an interest rate swap having a predetermined fixed rate at some later date.

Russian bond default. It is conceivable that, under these conditions of financial instability, the value investors placed on liquidity increased substantially. Shen and Corning (2001) find evidence of an increase in the liquidity-risk premium in the U.S. bond market from 1997 to 1999, using the yield spread between on-the-run and off-the-run conventional 10-year Treasury bonds as a proxy for the lower bound of the liquidity-risk premium in Treasury Inflation Protected Securities (TIPS), which are U.S. inflation-linked bonds. On-the-run bonds are the most recently issued bonds and are considered to be highly liquid. Conversely, off-the-run bonds are older securities that trade less often and are relatively less liquid. Therefore, by comparing the yield spread between the liquid on-the-run and the less liquid off-the-run bonds with similar maturities, the value of liquidity can be approximated.[11]

The relative lack of liquidity of RRBs compared with conventional bonds also discourages arbitrage, contributing to a less-efficient market. The resulting lack of efficiency in the RRB market could in turn lead to persistent mispricing. Lack of liquidity in the secondary market, for example, may make it difficult for market participants to complete a short RRB transaction (borrow and sell now, with the hope of purchasing the bonds more cheaply in the future). Participants' difficulty in borrowing RRBs to execute a short sale has been greatly alleviated by the evolution of security lending, as pension funds and other large accounts now regularly lend securities from their portfolios in return for a fee. However, the current strong demand for RRBs and the lack of depth in the secondary market could make it more difficult to purchase RRBs in order to return the borrowed securities (i.e., unwinding the short sale). A difficulty in covering a short RRB position limits participants' ability to take advantage of possible market mispricing. Specifically, if the BEIR were significantly higher than expected inflation, participants would normally buy conventional bonds and sell RRBs until this mispricing was eliminated. However, a difficulty with purchasing RRBs (once the price has fallen closer to fundamentals) in order to exit from a short RRB position would imply that RRBs can remain mispriced[12] over the short term. An increase in supply or the anticipation of greater supply should act to moderate this effect over time.

Market segmentation and supply constraints

Côté et al. (1996) and Mayer (1998) argue that the BEIR may reflect not the overall market view of inflation expectations, but the view of a non-representative subset of investors. The argument that the RRB market is segmented among investors with different degrees of risk aversion in regards to inflation requires the supply of RRBs to be relatively inelastic. In other words, if only a small amount of inflation-linked debt exists, it is likely to be owned by those with the highest inflation expectations or the biggest need for inflation protection, or by investors who have some tax advantage that allows them to accept a lower yield. As the amount of debt grows, however, inflation-linked debt should increasingly be held by investors who more accurately reflect the average expectation of, and sensitivity to, inflation. In the short run, it is reasonable to consider supply as being constrained (e.g., by rigid government funding policies or the high fixed costs faced by corporations implementing an inflation-linked borrowing program). To date, the supply of these types of securities has been relatively unresponsive to changes in price. In the long run, however, supply should also adjust eventually to take advantage of lower funding costs.

Using expectations survey data from Watson Wyatt, the maximum and upper quartile cutoff of responses, along with the BEIR, are plotted in Chart 6. Until 1996, the BEIR is usually inside the upper quartile of inflation expectations, consistent with RRB investors not representing the average investor.[13] Subsequently, the BEIR falls below this range. The break in this relationship in 1996 coincides with the announcement of the launch of the TIPS program. Not only did this mean more global supply and expected future supply through government issuance, it may have raised expectations regarding the development of the corporate inflation-linked securities market and led to more interest in, or acceptance of, Canadian RRBs. As a

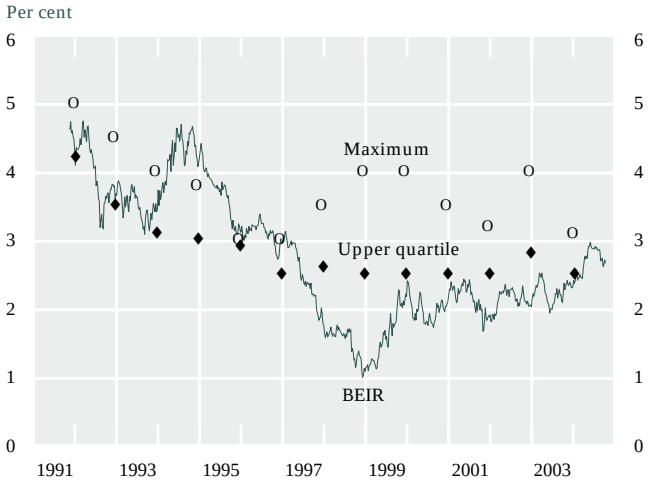
11. The high value of on-the-run U.S. Treasury bonds in the repurchase market may result in an upward bias in this measure of liquidity in the United States. Christensen, Dion, and Reid (2004) find little evidence of a liquidity-risk premium in Canada using a similar methodology. However, it is possible that this method of measuring liquidity is not particularly suited to the Canadian experience, since there is little difference in on-the-run and off-the-run securities.

12. The price distortion is in theory symmetrical and is dependent on demand conditions.

13. Note that the survey used for comparison may be subject to the same criticism, since respondents are drawn only from financial institutions and not from the whole population.

Chart 6

Upper Bound of Inflation Expectations



result, the degree of market segmentation may have diminished.

The Importance of Distortions Today: An Open Question

The correct interpretation of the high level of the BEIR in October 2004 and in particular of its movement towards the upper band of the inflation target remains an open question. A rise in long-term inflation expectations reflected in the BEIR would suggest that market participants do not expect the Bank of Canada to conduct monetary policy so as to contain inflation (an erosion of credibility). The most recent survey data (as of October 2004), however, do not show a similar increase in expectations, suggesting that perhaps the recent value of the BEIR reflects temporary market distortions rather than increasing inflation expectations or heightened inflation uncertainty. Supporting this argument, some market participants argue that a re-evaluation of equity risk by investors after the sharp declines in equity markets between 2000 and 2002 is driving strong demand for alternative means to hedge inflation and increase portfolio diversification (Canada 2003). This strong demand and the relatively fixed short-run supply of index-linked debt may have driven the real yields on RRBs temporarily below the long-run expected real interest rate, resulting in a higher measure of the BEIR even if expected inflation were unchanged. Consistent with this argument, the real yield declined from approximately 3 per cent in November 2003 to about 2.3 per cent in October 2004 (Chart 1). The elevated level of the BEIR might therefore be the result of a portfolio shift and could indicate that the RRB market is still highly segmented.

The correct interpretation of the high level of the BEIR in October 2004 and in particular of its movement towards the upper band of the inflation target remains an open question.

The high level of the BEIR is the result not only of an earlier decline in the real rate, but also of an increase in the yields of conventional Government of Canada bonds. In addition, the relatively stimulative stance of monetary policy, a strengthening in the global economy, and rising oil prices could all be contributing to higher inflation expectations or inflation uncertainty. However, while an increase in expectations or uncertainty cannot be dismissed, it is highly probable that the recent increase in the BEIR significantly exaggerates any change in expectations and/or uncertainty.[14] It remains to be seen whether alternative measures of inflation expectations (such as surveys) will fail to confirm an increase in inflation expectations or heightened uncertainty, as has occurred in the past.

The BEIR as a Measure of Credibility

If the BEIR's movements reflect inflation expectations or an inflation-risk premium, they should be a good indicator of monetary policy credibility. When the BEIR is evaluated as a measure of the credibility of monetary policy, the existence of an inflation-risk premium is not a drawback, since uncertainty about future inflation must reflect investors' views about the central bank's willingness and ability to take action to control future inflation. Since inflation uncertainty is positively correlated with the level of inflation or inflation expectations, the BEIR will tend to move

14. For example, to get a BEIR near 2.7 per cent, according to Table 3, inflation expectations would have to be 3 per cent for the next 15 years before returning to 2 per cent.

more than one for one with an increase in expected inflation. Either a lower, or a less variable, inflation-risk premium would be a sign of increased credibility.

If the premiums and distortions discussed in this article are unable to account for the movements in the BEIR over history, there is a higher probability that the BEIR was reflecting long-term expected inflation. However, over the 1990s, it is likely that most of these premiums and distortions were present in some form. Given these findings, there is reason to doubt that the BEIR was a good measure of credibility over this time period. However, over the period 2000Q1 to 2003Q4, both the BEIR and survey measures of inflation expectations were relatively stable, near 2 per cent. More precisely, the mean of the BEIR was 2.2 per cent, and it was between 1.8 and 2.6 per cent 95 per cent of the time (although week to week it is not uncommon to see changes of up to 17 basis points in either direction). If surveys are an appropriate benchmark, this suggests that the premiums over this period were small relative to the past, and that the BEIR has improved as a measure of the expected average rate of inflation. However, more recent signs of distortion make it more difficult to draw inferences about credibility. The continued development of the RRB market should eventually result in the BEIR becoming a more reliable indicator of the credibility of monetary policy.

The continued development of the RRB market should eventually result in the BEIR becoming a more reliable indicator of the credibility of monetary policy.

Forecasting Power

A good gauge of credibility is not necessarily a good forecast of inflation outcomes, especially if monetary policy reacts to measures of inflation expectations. However, there is some evidence from the United Kingdom in favour of using interest rate measures for forecasting inflation. Scholtes (2002) finds that the forecast accuracy of the BEIR, constructed using index-linked gilts (U.K. inflation-linked bonds) with a 2-year maturity, outperforms survey measures of expected inflation at a 2-year horizon. Other measures of inflation expectations derived using index-linked gilts in the United Kingdom have also been shown to possess predictive power for inflation at the 1- to 4-year horizon (Breedon 1995; Barr and Campbell 1997).

In Canada, RRBs are issued only with long maturities, and thus, the relatively short span of RRB history does not permit a comparison of the BEIR with the realized average rate of inflation over a 30-year horizon. Yet the BEIR should be influenced by expected inflation over many different horizons and, as a result, may contain useful information about inflation (CPI excluding taxes and core inflation) over a short to medium horizon. The results of the BEIR's forecasting performance over a policy-relevant horizon are shown in Table 4 . Over the entire sample, the BEIR has the worst forecast performance for CPI excluding taxes in terms of root mean-squared errors (RMSEs). Survey measures and even past average inflation rates yield lower RMSEs than the BEIR at all horizons examined. The volatility in the BEIR caused by premiums and distortions in the first part of the sample is one potential explanation for

Table 4

Root Mean-Squared Forecast Errors of the BEIR and Other Measures of Inflation Expectations for Total CPI Inflation, Excluding Taxes

	Forecast Horizon					
	Sample starting 1992			Sample starting 1998		
	1 year	2 years	3 years	1 year	2 years	3 years
BEIR	1.67	1.82	1.80	1.02	1.15	0.97
Naïve measures						
Inflation over the past 12 months	1.16	1.07	1.06	1.46	1.40	1.27
Inflation over the past 24 months	1.01	1.00	1.02	1.24	1.23	1.23
Inflation over the past 36 months	0.97	0.98	1.08	1.12	1.17	1.28
Inflation target	0.89	0.85	0.81	0.89	0.94	1.00
Survey measures						
6 months ahead[a]	0.85	0.84	0.79	1.02	1.10	0.94
2 years ahead[b]	0.86	0.92	0.90	0.93	1.10	0.94
6-10 years ahead[c]	0.85	0.86	0.95	0.79	0.79	0.89[d]

a. Quarterly Business Confidence Survey: Conference Board
b. Quarterly *Survey of Forecasters*: Conference Board
c. Semi-annual: Consensus Economics
d. Limited number of observations (10 or less)

its poor near-term forecast performance. The 6- to 10-year survey expectations have RMSEs that are roughly half as large as the BEIR and were much closer to the inflation target for the whole sample. The best forecast performance is dependent on the horizon, but comes from either surveys of expectations or simply using the inflation target as a forecast for future inflation. These results are actually reassuring, in the sense that the BEIR does not simply reflect changes in short-term expected inflation.

Conclusions

The merit of the BEIR as a measure of long-term inflation expectations is dependent on the importance of risk premiums and distortions and our ability to account for these factors. Having set out to consider whether the differences between survey measures and the BEIR can be explained by these various premiums and distortions, we argue that neither cash-flow mismatches nor term-varying inflation expectations can account for the difference. In addition, proxies of inflation uncertainty suggest that, while this premium did change over the sample, the timing did not coincide with movements in the BEIR. Futhermore, the liquidity-risk premium may explain part of the decline in the BEIR over the 1997 to 1999 period. Finally, supply constraints in the RRB market appear to be a significant part of the explanation of why the BEIR tends to deviate from survey measures on occasion. Evidence suggests that these premiums and distortions were less prevalent in the period 2000 to the end of 2003, but may again be present so far in 2004. The variability of the BEIR also declined during this period, but week-to-week movements can still be substantial, making the BEIR difficult to interpret on a high-frequency basis.

Because of the potential distortions and the difficulty accounting for them, it is premature to consider the BEIR a reliable measure of long-run inflation expectations. Despite these findings, the BEIR should not be completely dismissed. If distortions and premiums can be ruled out, or better accounted for, the BEIR would be a useful measure of monetary policy credibility. It represents a more timely and market-based alternative to survey measures and should, along with the continued development of the RRB market, eventually become a more reliable indicator of long-term inflation expectations.

Literature Cited

Barr, D. and J. Campbell. 1997. "Inflation, Real Interest Rates, and the Bond Market: A Study of UK Nominal and Index-Linked Government Bond Prices." *Journal of Monetary Economics* 39: 361–83.

Bolder, D., G. Johnson, and A. Meltzer (forthcoming). Bank of Canada Working Paper.

Breedon, F. 1995. "Bond Prices and Market Expectations of Inflation." *Bank of England Quarterly Bulletin* (May): 160–65.

Brenner, R., E. DeWetering, G. Lucas, and A. Shapiro. 2001. "Merrill Lynch Exponential Spline Model." Merrill Lynch Working Paper.

Canada. 2004. "Debt-Management Strategy: Market Consultations on Real Return Bonds—Summary of Comments." Available on the Bank of Canada's Web site at <http://www.bankofcanada.ca/en/notices_fmd/market_consult03.htm>.

Christensen, I., F. Dion, and C. Reid. 2004. "Real Return Bonds, Inflation Expectations, and the Break-Even Rate." Bank of Canada Working Paper (forthcoming).

Conference Board of Canada. 2004a. *Survey of Forecasters* (Summer).

———. 2004b. *Index of Business Confidence:* (Autumn).

Consensus Economics. 2004. *Consensus Forecasts*. (July).

Côté, A., J. Jacob, J. Nelmes, and M. Whittingham. 1996. "Inflation Expectations and Real Return Bonds." *Bank of Canada Review (*Summer): 41–53.

Crawford, A. and M. Kasumovich. 1996. "Does Inflation Uncertainty Vary with the Level of Inflation?" Bank of Canada Working Paper No. 2003–32.

Literature Cited (cont'd)

Longworth, D. 2002. "Inflation and the Macroeconomy: Changes from the 1980s to the 1990s." *Bank of Canada Review (*Spring): 3–18.

Mayer, T. 1998. "Indexed Bonds and Heterogeneous Agents." *Contemporary Economic Policy* 16: 77–84.

Scholtes, C. 2002. "On Market-Based Measures of Inflation Expectations." *Bank of England Quarterly Bulletin* (Spring): 66–77.

Shen, P. and J. Corning. 2001. "Can TIPS Help Identify Long-Term Inflation Expectations?" Federal Reserve Bank of Kansas *Economic Review.* 86 (4): 61–87.

Watson Wyatt Worldwide. 2004. *Economic Expectations 2004-—23rd Annual Canadian Survey.* Vancouver: Watson Wyatt Worldwide.