A RETURN Enhancement Strategy FOR CANADIAN FIXED INCOME PORTFOLIOS

An update on earlier research examines the predictability of duration-constrained returns for default-free bond portfolios.

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There is now widespread agreement that asset returns embody a predictable component. One interpretation is that risk premia are time-varying, not surprising when one remembers that such premia are merely prices of the risk attached to the underlying assets, and the ability of assets to hedge various sources of economy-wide risk need not be time-invariant (Merton [1973]). However, to a great extent attention has shifted to the factors driving premia. In the context of U.S. capital markets, Keim and Stambaugh (1986) and Fama and French (1989) have detected the presence of conditioning variables which have a predictive component in both equity and bond markets. The former paper, for example, finds that risk premia are partially explained by default spreads, lagged detrended stock returns, a small firm effect, and a January effect.

Our focus is on default-free fixed income markets. The issue at hand is what drives term premia, which we define to be the differences between the expected returns on multi-period bonds net of the short rate of interest. Most previous work on term premium determinants has been undertaken using U.S. data; however, a major previous study of Canadian bond market predictability has been conducted by Deaves (1997). Using Government of Canada securities across the maturity spectrum during 1960-94, he demonstrates that fixed income returns net of the short rate of interest were predictable using lagged aggregate stock market returns and the slope of the term structure. Other variables, while considered, proved to be essentially inconsequential.

One criticism often levied at empirical exercises in this vein is data mining. It is always possible *ex post* to come up with a set of conditioning variables that embody a 'predictive' component. There are several ways to parry such critiques: first, the variables considered must make economic sense. Additionally, out-of-sample simulations are often useful to convince sceptics; for example, Deaves (1997) concluded that dynamic simulations conditioning on the detected correlations meant that bond portfolio managers could enhance return in an economically significant fashion. Still, such a finding can be questioned since the choice of variables (as opposed to their values) used in the out-of-sample simulations is still subject to model mining, meaning the conditioning variables are usually selected using all the data, even if the regression coefficients are sequentially re-estimated using only information truly available at the time.

The purpose of this article is to remedy this deficiency. We explore the extent to which scope for return enhancement has continued to exist in the Canadian fixed income marketplace. To counteract the critique of model mining, we use the exact same conditioning variables, namely lagged aggregate stock market returns and the slope of the term structure, that Deaves (1997)

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TABLE 1: OLS REGRESSION ANALYSIS OF EXCESS BOND RETURNS FOR ONE-MONTH HOLDING PERIOD

	Constant	Slope	ISMR	R-sq (adj. R-sq)	Constant	Slope	ISMR	R-sq (adj. R-sq)
	2-year bonds				7-year bonds			
Full sample	-0.0093*	0.1330*	0.0106**	0.069	-0.0120	0.1973#	0.0135	0.033
	(2.067)	(1.687)	(2.389)	(0.050)	(1.028)	(1.433)	(1.151)	(0.013)
1995:1-1999:3	-0.0252**	0.2093*	0.0279**	0.141	-0.0874**	0.5039*	0.0924**	0.166
	(2.396)	(1.870)	(2.522)	(0.105)	(2.728)	(2.297)	(2.836)	(0.131)
1999:4-2003:5	-0.0078*	0.0934	0.0088*	0.069	-0.0075	0.1226	0.0082	0.023
	(1.887)	(0.794)	(1.744)	(0.029)	(0.571)	(0.589)	(0.602)	(-0.018)
	3-year bonds				10-year bonds			
Full sample	-0.0113*	0.1301#	0.0131*	0.052	-0.0103	0.2179#	0.0115	0.026
	(1.754)	(1.323)	(2.072)	(0.032)	(0.709)	(1.401)	(0.785)	(0.006)
1995:1-1999:3	-0.0429**	0.2707*	0.0470**	0.173	-0.1027**	0.5377*	0.1083**	0.144
	(2.812)	(1.918)	(2.974)	(0.138)	(2.529)	(2.113)	(2.632)	(0.108)
1999:4-2003:5	-0.0080	0.0726	0.0095#	0.041	-0.0038	0.2031	0.0028	0.022
	(1.053)	(0.501)	(1.313)	(0.000)	(0.224)	(0.822)	(0.155)	(-0.020)
	5-year bonds				30-year bonds			
Full sample	-0.0136#	0.1605#	0.0154#	0.040	-0.0090	0.2974#	0.0082	0.020
	(1.416)	(1.304)	(1.614)	(0.020)	(0.391)	(1.337)	(0.349)	(0.000)
1995:1-1999:3	-0.0790**	0.4433**	0.0841**	0.209	-0.0968#	0.5391	0.1008#	0.046
	(3.217)	(2.405)	(3.342)	(0.175)	(1.285)	(1.257)	(1.336)	(0.00)
1999:4-2003:5	-0.0084	0.0876	0.0095	0.026	-0.0015	0.3525	-0.0028	0.031
	(0.768)	(0.470)	(0.863)	(-0.015)	(0.059)	(1.039)	(0.099)	(-0.010)

Note: T-statistics are provided in brackets below coefficient estimates. Coefficients marked with **, * and # are significant at 1%, 5% and 10% respectively.

concluded to be useful for predicting bond market returns in Canada. Additionally, the dataset employed begins exactly when the dataset used by Deaves (1997) ends; in other words, we use a dataset beginning in January 1995. There is another salient improvement over Deaves (1997): while the latter paper uses synthetic bond data, here we use actual traded bonds—specifically, highly liquid on-the-run bonds for a range of maturities spanning the yield curve.

The ability to identify factors that are useful for predicting excess bond market returns is a possibility that no fixed income market practitioner should view with indifference. We will briefly provide key background, consider whether obvious strategies utilizing the relevant explanatory variables could have brought about economically significant return enhancement, and finally offer our conclusion.

Background

Consider a default-free k-period coupon-paying bond. Its single-period return in excess of the short rate of interest is easily calculated as:

$$xr_{t+1,k} = \ln\left(\frac{P(k)_{t+1}}{P(k)_t}\right) - r_t$$

where $xr_{t+1,k}$ is the single-period holding period return in excess of the short rate of interest of a k-period default-free coupon-paying bond; r_t is the single-period spot interest rate at t; and $P(k)_t$ is the price (inclusive of accrued interest) at t of (the relevant) k-period coupon-paying bond.[1] It can be shown that these excess bond returns are functions of the term structure of term premia.[2]

End-of-month two-, three-, five-, seven-, 10- and 30-year benchmark Government of Canada bonds and

TABLE 2: PROFITABILITY AND SHARPE RATIOS FOR THE DYNAMIC TRADING STRATEGY

Strategy	Mean return	Std. dev.	Mean excess ret.	Mean net return	Success rate	Sharpe ratio
Full sample						
Static equal value-weighted portfolio of T-bills and Canada bonds (benchmark)	0.666	1.156	0.315**	-	-	0.272
Duration-constrained dynamic portfolio	0.726	1.201	0.375**	0.060	0.53	0.312
1995:1 – 1999:3						
Static equal value-weighted portfolio of T-bills and Canada bonds (benchmark)	0.822	1.308	0.439**	-	-	0.336
Duration-constrained dynamic portfolio	0.975	1.365	0.592**	0.153#	0.60	0.434#
1999:4 – 2003:5						
Static equal value-weighted portfolio of T-bills and Canada bonds (benchmark)	0.511	0.969	0.191#	-	-	0.197
Duration-constrained dynamic portfolio	0.478	0.961	0.157	-0.033	0.46	0.164

Note: All returns are one-month returns presented in per cent. Excess and net returns marked with **, * and # are significant at 1%, 5% and 10% respectively. Sharpe ratios, marked with **, * and # have been concluded to be significantly higher than those of the benchmark strategy (equal value-weighted portfolio) using a one-sided t-test.

Treasury bill yield data were obtained.[3] Note that to construct continuous series of roughly constant-maturity bond returns it was necessary to periodically switch from old benchmark bonds to new ones.[4] In our empirical analysis we focus on a one-month holding period.[5] In a straightforward fashion, we then calculate one-month excess bond returns (i.e., bond returns over and above the one-month T-bill rate) by subtracting the one-month T-bill rate from the gross holding period return on the bond.

Before exploring (in the next section) whether a dynamic trading strategy based on two conditioning variables—namely the slope of the term structure and inverse relative wealth—succeeds in generating return enhancement, it is first instructive to run regressions of excess bond returns of different maturities on these two independent variables, as in Equation 2:

$$xr_{t+1,k} = b_{0,k} + b_{1,k} \cdot Slope(k)_t + b_{2,k} \cdot ISMR_t + e_{t+1,k}$$

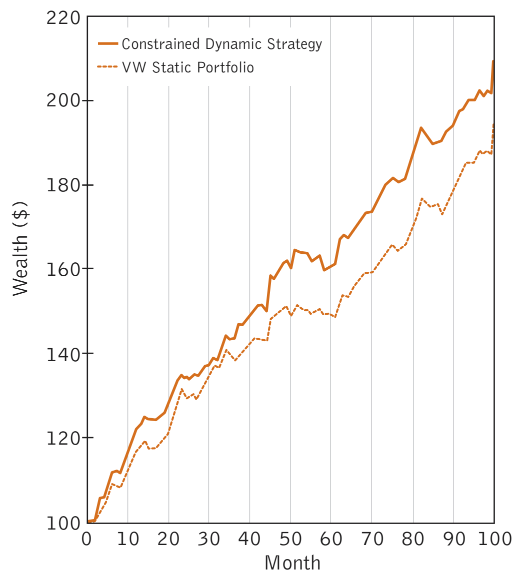
where $b_{i,k}$ ($i = 0$, 1 and 2) are coefficients to be estimated; $ISMR_t$ is the inverse stock market return at t; $Slope(k)_t$ is the slope of the term structure based on the k-period bond at t; and $e_{t+1,k}$ is the error term.[6]

Our sample period is from January 1995 to May 2003.[7] Table 1 provides the regression estimates. A cursory examination indicates that for the full sample these two conditioning variables continue to have predictive content for fixed income excess returns. The strongest results are for shorter maturities; for example, for the two-year maturity using the full sample, both coefficients are significant at least at 5% and have the correct sign. The subsample results suggest stronger explanatory power for the two independent variables during the first half of the sample period (1995:1–1999:3). Nevertheless for all maturities and subperiods the coefficient signs are always as expected.[8]

Testing a dynamic trading strategy

Several dynamic trading strategies, designed to investigate the economic significance of the predictability of excess bond returns as implied by the above regression analysis, suggest themselves. First, similar to Deaves (1997), one can consider a trading strategy where a portfolio is entirely invested in either a particular maturity bond or in short-term T-bills. The choice—between one-month T-bills and the bond with the relevant maturity—could be made monthly

FIGURE 1: WEALTH ACCUMULATION



by observing the fitted value from the excess bond return regressions. At the beginning of each period, one observes or calculates the explanatory variables in Equation 2 in order to predict the excess return of the relevant bond. When the fitted value is positive, the choice is to put 100% of the portfolio in the bond. On the other hand, when the fitted value is negative, the choice is to put 100% of the portfolio in the short-term Treasury bill.[9] Of course, there is no reason to restrict oneself to a single maturity beyond the short rate. More realistically, one can consider bonds with different maturities. Similar to the first strategy, at the beginning of each month we could make use of predictions of coming-month excess returns, but instead all bond predictions would be utilized. The strategy entails investing all wealth in the Canada bond with the highest predicted excess return, or conversely in one-month T-bills, if all predicted excess returns are negative.

In practice very few managers are in a position to allow their portfolio durations to whipsaw as dramatically as these first two strategies suggest. To account for this, we could make a further refinement and consider a duration-constrained version of the previous dynamic strategy. Here, investment weights are chosen to maximize the predicted portfolio return under the constraint of maintaining the duration of the portfolio to be within +/- 50% of the duration of a portfolio with equal (value) weights in each of the seven maturities.[10] This portfolio we call the equal value-weighted portfolio, and it serves as a natural benchmark. In this article, we focus attention on this particular dynamic strategy since we believe it to be most relevant for fixed income managers.

In Table 2 we present full-sample profitability and risk metrics for the latter dynamic strategy. Excess returns are the returns on the strategies in question over and above those of one-month T-bills, while net returns are for the tested strategy versus the equal value-weighted benchmark. The success rate is defined as the proportion of the time the dynamic strategy in question provides a higher return than the static benchmark.[11]

The results are mixed. For the full sample, while the dynamic strategy has excess returns that are positive and statistically significant, their superiority relative to the equal value-weighted portfolio, while present in the data, is insignificantly different from zero. Still, Figure 1 illustrates the clear gap in wealth accumulation for the duration-constrained strategy versus its benchmark. Also reported in Table 2 are the corresponding Sharpe ratios. With a duration-constrained strategy, the Sharpe ratio is higher than for its benchmark. During the first subperiod it is significantly higher, again attesting to the benefits in risk reduction achieved by occasionally going short. Additionally, mean net returns are significantly positive during the first subperiod. On the downside, the second subperiod witnesses insignificant results.

Conclusion

To conclude, the bond market relationships established in Deaves (1997) have held up—though rather more weakly. Practitioners are put on notice that one must seek consistency of results before banking too much on any strategy. Still, a dynamic strategy that allows fixed income managers to choose any bond maturity while at the same time constraining over-zealous duration adjustment proves effective, especially when one focuses on risk-adjusted returns. ∎

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Notes

1. It is convenient to use continuously compounded returns. When coupon interest is received on the bond during the holding period, the numerator must include a term which is the product of the coupon and $exp(rt,1(t+1-s))$. Doing so includes the accumulated income from reinvesting the coupon C at the prevailing one-month T-bill rate over the remaining holding period from s to $t+1$, where $t<s<t+1$.
2. See Deaves (1997) and Deaves and Miu (2004) for more details. These papers provide a theoretical exposition of the term structure which relates holding period term premia to forward rate term premia.
3. The bond data were obtained from Bloomberg. According to Bloomberg, the two-, five-, 10- and 30-year benchmark bonds are current on-the-run as dictated by when swap traders make the change, while the three- and seven-year benchmarks are selected by Bloomberg's staff based on maturity and outstanding dollar value (i.e., liquidity).
4. For example, the 6% 6/1/2008 Canada bond was the benchmark seven-year bond in early 2002 up to the beginning of March. Starting from the end of March, the 5.5% 6/1/2009 bond became the new seven-year benchmark. Note that to obtain the time series of holding period returns, besides knowing the yields (or prices) of the current benchmark bonds, we also need to keep track of the yields of those that were benchmarks during the last period but which had just become non-benchmarks out-of-run in the current period. A robustness test performed on the 30-year bond suggests that the results are insensitive to the timing of the switching of the benchmarks. Specifically, by keeping the non-benchmark bond as the benchmark for three more months after the switching produces essentially the same results.
5. We also performed estimation for a three-month holding period. The results (available from the authors) were quite similar, though somewhat weaker because of a dearth of non-overlapping observations.
6. More specifically, note that inverse stock market returns are (after Ilmanen [1995]) calculated as the ratio of the exponentially smoothed (over 36 months) past level of the real level of Canadian equity prices (where we use the TSX100 index level divided by the Canadian CPI at time t for the real stock price at t) to its current level; and that the term structure slope is specific to each maturity and is the difference between the continuously compounded yield-to-maturity of the relevant Canada bond and the yield of the one-month T-bill at time t.
7. We choose January 1995 because the sample period of Deaves (1997) ends at the close of December 1994.
8. See Deaves and Miu (2004) for a discussion of diagnostics for these regressions.
9. Note that to screen out noise, a particular explanatory variable had to be significant based on data up to that point in time, and, second, when going to T-bills, borderline signals were discounted. See Deaves and Miu (2004) for more details.
10. To decide on the bond portfolio to be invested in at the beginning of each month, investment weights are obtained by maximizing the predicted portfolio return under the constraint of maintaining the duration of the portfolio to be within +/- 50% of the equal value-weighted portfolio's duration. It becomes a linear programming problem, of which both the objective function and the constraints are linear functions of the weights. An additional constraint is imposed to ensure that all weights are non-zero (i.e., short-selling is not allowed). For example, let us consider this dynamic strategy over the month of December in 1997 using our sample data. At the beginning of that month, predictions on the excess returns on the six bonds are made using the calibrated regression models. It turns out that the 30-year bond is predicted to provide a monthly excess return of 1.38%, which is the highest among the bonds. An unconstrained strategy (second dynamic strategy) will therefore call for investing 100% in the 30-year bond. At the end of the month, it turns out that the realized return from this bond is –11.44%. However, under the duration-constrained strategy, investing 100% in the 30-year bond (with a duration of 13.09 years) violates the requirement of having a portfolio duration within 50% of the equal value-weighted portfolio's duration of 4.77 years. By solving the linear programming, the optimal portfolio satisfying this constraint consists of 96.88% invested in the 10-year bond and 3.12% in the 30-year bond. The resultant portfolio duration becomes 7.15 years, which just satisfies the duration requirement. The predicted portfolio excess return is now only 0.95%, which is lower than the unconstrained predicted return of 1.38%. Nevertheless, it turns out—fortuitously in this case—that the constrained strategy provides a higher realized monthly return of 0.10%.
11. A robustness test is conducted by using Government of Canada bond indices rather than individual bonds. We consider three different indices (one- to five-year, five- to 10-year and 10+ year) compiled by Bloomberg and repeat the dynamic strategy analysis. The results suggest that the conclusions drawn in this article apply to both individual bonds and indices.