THE EFFECTS OF INTEREST RATE CHANGES ON BANK STOCK RETURNS AND PROFITABILITY

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ABSTRACT

We empirically investigate the sensitivity of Canadian commercial bank stock returns and profitability to changes in interest rates. We find a statistically significant negative relationship between bank stock returns and changes in interest rates over the period 1995-2006, while the relationship is not significant over the past five years. Furthermore, banks' profitability appears not to be significantly affected by changes in interest rates over our sample period. Our results suggest that Canadian Banks are relatively well immunized against interest rate risk. This may be due to an appropriate matching between the duration of assets and liabilities (on balance sheet risk management) and/or an efficient use of interest rate derivatives (off balance sheet management).

Keywords: Interest Rate; Bank; Stock Return; Profitability

我们将此文献给我们的父亲、母亲和我们的两个小天使——新新和团团.

We dedicate this paper to our parents and our two angels, Stephen and Derek.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Interest rate is assumed to be one of the most important factors that affect the bank stock returns and the profitability of banks. Interest income is a key source of income for commercial banks. For example, during the past 10 years, 51% of total revenues of Canadian banks came from interest income (See Table 1.1). Hence, interest rate risk is a major source of risk to which commercial banks are exposed. Intuitively, changes in interest rates can affect a bank's profitability by increasing its cost of funding, reducing its returns from assets, and lowering the value of equity in a bank. Moreover, recent decades have ushered in a period of volatile interest rates, confronting the investors with more unpredictable environment to work in.

Table 1.1 The Ratio of Net Interest Income to Total Revenue*

Bank/Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
Royal Bank of Canada	0.64	0.62	0.54	0.50	0.48	0.44	0.44	0.46	0.38	0.37	0.35	0.48
Toronto Dominion Bank	0.65	0.60	0.48	0.44	0.36	0.33	0.35	0.33	0.55	0.56	0.50	0.47
Bank of Nova Scotia	0.62	0.64	0.58	0.57	0.56	0.55	0.54	0.54	0.57	0.56	0.56	0.57
Bank of Montreal	0.63	0.61	0.56	0.56	0.53	0.47	0.46	0.51	0.51	0.53	0.48	0.53
Canadian Imperial Bank of Commerce	0.65	0.63	0.53	0.47	0.44	0.35	0.41	0.50	0.49	0.45	0.40	0.48
National Bank of Canada	0.22	0.19	0.56	0.53	0.50	0.40	0.43	0.48	0.39	0.39	0.39	0.41
Laurentian Bank of Canada	0.77	0.71	0.60	0.60	0.52	0.57	0.58	0.58	0.55	0.58	0.65	0.61
Average	0.60	0.57	0.55	0.53	0.48	0.45	0.46	0.48	0.49	0.49	0.47	0.51

Notes: Net interest income is defined as the difference between interest income and interest expense. Total revenue is defined as the sum of net interest income and non-interest income. Average is equally weighted average and in grey. Data Source: www.mergentonline.com

Consequently, investor's primary concern is the impact of interest rates on commercial bank revenues, costs, and profitability. On the one hand, the notion that commercial banks "lend long and borrow short" implies that bank profit may decrease in case of an increase in short-term interest rate and a decrease in long-term interest rate; On the other hand, a bank will benefit from a decrease in short-term interest rate and an increase in long-term interest rate. As a result, provided that markets are efficient, we expect negative effects of short-term interest rates on bank stock returns and profitability. Meanwhile, we assume positive impacts of long-term interest rate changes on bank stock returns and profitability.

During past years, several studies have analysed the effects of fluctuations of interest rates on the stock returns of commercial banks in the U.S.. Most studies find that bank returns exhibit a negative correlation with the changes of interest rates, while others find no significant association between the movements of the interest rates and the returns of the commercial banks. Less evidence exists regarding the factors that explain the interest sensitivity of bank stock returns across firms and through time.

In this paper, we examine the interest rate sensitivity of common stock returns and profitability of Canadian commercial banks. Actual and unanticipated changes in interest rates are considered from January 1995 to May 2006. During this period, the interest rates varied substantially and were globally decreasing through time from 9% in 1995 to 4% in 2006. In order to investigate the effect of different maturity classification on stock returns, short-, intermediate-, and long-term interest rate indices are employed separately (in addition to the market return) in a two-factor model. Furthermore, a three-factor model is constructed by adding the changes in the US interest rate.

Furthermore, we also study the asset-liability management of the banks. In the last decades, banks employ a wide variety of interest rate hedging techniques. The most popular among these techniques are interest sensitive GAP management and duration management. With these tools, a bank balances the interest sensitivity and maturity of its assets with the interest rate sensitivity and maturity of its liabilities. In addition to the on balance sheet management, a bank might also use an off balance sheet hedging approach—futures, swaps and options to hedge interest rate risk.

A bank's interest rate risk is assumed to be conditioned on the following three bank specific characteristics: change of net interest income, change of net income, and notional amounts of interest rate derivatives. These factors are observable and can be easily measured. They are useful indicators for investors to anticipate how sensitive a bank's performance to interest rate risk. If a bank successfully controls its interest rate risk, its net interest income and net income should be immunized against interest rate fluctuations. Therefore, we investigate whether the interest rate risk is related to these observable financial measures. In addition, as banks are increasingly employing derivatives to hedge their financial risks, the national amount of interest rate derivatives for the purpose of non-trading is also analysed.

The remainder of this study is organized as follows. Section 2 provides an overview of the literature on this topic. Section 3 describes the methodology and data used to answer our research questions. Section 4 presents the empirical results. Conclusions are presented in Section 5.

2 LITERATURE REVIEW

The exposure of financial institutions to fluctuations of interest rates has been the subject of much empirical research. Most of the researches employ two-factor model and focus on two aspects: The association between the bank stock returns and the interest rate changes, and how to measure the banks' exposure to interest rate risk.

Stone (1974) proposes the two-factor model as an extension of the capital asset pricing model. He suggests a model involving a "debt market factor" and an "equity market factor". He justifies the model by arguing that individual equity securities have different levels of interest rate sensitivities and it is a useful framework quantifying systematic interest rate risk. He indicates that incorporating an index for the returns in a debt market might increase the explanatory power for the stock returns that exhibit considerably sensitivity to interest rate, such as the stock returns of banks, gold, public utilities, etc.

The evidence on the relationship between bank stock returns and interest rate changes is mixed. Most studies find that bank stock returns are negatively related to the changes in interest rate while others find no significant relationship between these two variables. Lynge and Zumwalt (1980) test the interest rate sensitivity of bank stock returns by estimating several multi-index models containing short- and long-term debt return indices. In their sample covering 1969-1975, 61% of the 57 commercial banks exhibit significant interest coefficients for short-term index and 75% have significant coefficients for the long-term index. Booth and Officer (1985) and Boe (1990) test the effect of current and unanticipated changes in interest rate. Fraser, Madura and Weigand (2002) examine the effect of unanticipated interest rate changes. All these studies lend strong support for a negative effect of both current and unanticipated interest changes on bank stock returns. Booth and Officer also find that this phenomenon is not present in the non-financial portfolio.

In contrast, Lloyd and Shick (1977) and Chance and Lane (1980) find no incremental explanatory power for interest rate changes. Some authors contribute to the debate by proposing some methodological refinements. For instance, Chen and Chan (1989) find some asymmetrical interest rate sensitivity during various phases of the interest rate cycle.

For the issue of how to assess the interest rate risk in a specific bank, Flannery and James (1984) find that the cross section difference in a bank stock's interest rate sensitivity are related to its balance sheet maturity composition. If the bank's maturity profile is changing over time, then the interest rate coefficient will change too. Mitchell (1989) argues that banks can control their interest rate risk by matching the interest sensitivity asset and liability. Kwan (1991) develops and tests a random two-factor model. His study provides evidence that the sensitivity of bank stock returns positively related to the maturity mismatch between the bank's assets and liabilities. Flannery (1981) develops a model and measures the average asset and liability maturities of a sample of commercial banks to determine whether bank's performances are exposed to interest rate risk. He finds that intraperiod rate variability has no significant effect on large banks' cost and revenue eventually because the intermediately effects have offset one another and because the rate is mean reverting.

More recently, Fraser, Madura and Weigand (2002) find that the sensitivity of bank stock returns to changes in interest rates is significantly affected by four financial characteristics: equity to assets, non-interest income to total revenue, demand deposits to total deposits, and loans to assets.

To date, all previous studies have focused on the US stock market. There is, to the best of our knowledge, no evidence about the relationship between Canadian banks stock returns and/or profitability and Canadian interest rate fluctuations. Moreover, all the previous studies focus on the period before 1996. None of them focus over the post 2000 period in which interest rates declined substantially.

3 METHODOLOGY AND DATA

3.1 Methodology

Several studies argue that as long as banks' assets and liabilities have different maturities, unanticipated movements in interest rate will negatively affect their market value. However, as argued by Bae (1990, p.72) that "if a large portion of current changes corresponds to unanticipated changes, even the current interest rate changes should induce a similar impact on the market value of a bank with a maturity imbalance". In this regard, we employ both actual and unexpected interest rate changes in this paper. In addition, we employ a single market-index model in order to check whether the two-factor model suggested by Stone (1974) indeed increase the explanatory power to bank stock returns.

3.1.1 Estimation of the Effect of Market-Index on Bank stock Returns

In the market index model, the return-generating process of return on a bank is given by:

$$\mathbf{R_t = \alpha + \gamma R_{mt} + \varepsilon_t} \qquad \textbf{(1)}$$

where R_t is the dividend adjusted returns of the individual public traded banks and two portfolios in the TSX market in week t, computed by $(P_t - P_{t-1}) / P_{t-1}$ where P_t is the stock price of the individual bank in week t. R_{mt} is the weekly returns of S&P/TSX Composite Price Index. It is calculated by $(P_{mt} - P_{mt-1})/P_{mt-1}$, where P_{mt} is the index price in week t.

This model has been widely used and the parameter γ is a measure of systematic risk. Stone (1974) claims that constructing a two-factor model by adding a debt market factor may help to reach a more precise return-generating process for common stocks with considerably sensitivity to interest rate changes.

3.1.2 Estimation of the Effect of Actual Interest Rate Changes on Bank Stock Returns

Should correlation exist between variables in a two-factor model, most of the previous studies choose to orthogonalize one of the factors to eliminate correlation, which can result in damaging collinearity and unstable regression coefficients. We examine the correlation between our two factors and find that the correlations between each of the three interest rate indices, 1 year treasury bill, 5 year selected government of Canada benchmark bond yields and 10 year selected government of Canada benchmark bond yields, and the TSX market factor are 0.06, 0.08, and 0.07 respectively. Since the correlation is not very significant, we then choose not to orthogonalize TSX market variable.

We retrieve stock price for seven banks and compute the percentage change in the prices every week as stock returns in that specific week. The sample comprises seven Schedule 1 Banks publicly traded at Toronto Stock Exchange (TSX). Schedule 1 Banks are banks that are allowed to accept deposit under the Canada Bank Act and are not a subsidiary of a foreign bank. Table 3.1 shows descriptive statistics regarding size and profit of these banks on year-end 2005. In addition, two portfolios are constructed. One portfolio is the value weighted average return portfolio with market capitalization measured at 31 December 2005 as the weights. The other portfolio is the equally weighted average return portfolio.

Table 3.1 Descriptive Statistics for Size and Profit of Canadian Banks

Bank	Total Assets	Net Income	Net Interest Income	Non Interest Income
Royal Bank of Canada	469,521	3,387	6,770	12,445
Toronto Dominion Bank	365,210	2,229	6,008	5,889
Bank of Nova Scotia	314,025	3,209	5,871	4,529
Bank of Montreal	297,532	2,400	4,787	5,052
Canadian Imperial Bank of Commerce	280,370	-32	1,437	7,536
National Bank of Canada	107,598	855	1,437	2,266
Laurentian Bank of Canada	16,507	65	326	176

Notes: All data are as of 31 October 2005 and are in millions of CAD.

Similar to Stone (1974), the following model is estimated to measure the impact of actual interest rate changes on bank stocks returns:

$$\mathbf{R_t = \alpha + \beta \Delta AI_t + \gamma R_{mt} + \varepsilon_t} \qquad (2)$$

where R_t is the dividend adjusted returns of the individual public traded banks and two portfolios in the TSX market in week t. ΔAI_t is the actual interest rate changes of the Canadian benchmark government bond (bill) yield in week t. ΔAI_t is calculated for each series of three interest rate indices by $(Y_t - Y_{t-1}) / Y_t$, where Y_t is Canada benchmark bond yields or treasury bill yield in week t. R_{mt} is the weekly returns of S&P/TSX Composite Price Index in week t.

Furthermore, considering the close economic relationship between Canada and U.S. and the fact that most of the Canadian commercial banks are publicly traded at Toronto Stock Exchange and New York Stock Exchange simultaneously, we also investigate the association of Canadian bank stock returns with the changes of interest rates in the US market. As such, we construct a three-factor model to estimate the effects. It includes in addition to domestic variables, the changes in the US interest rates.

Since the correlations between the interest rate changes of Canada and the U.S. are 0.52, 0.69, and 0.77 for 1 year, 5 year and 10 year T bond yield, respectively. We decide to orthogonalize the US interest rate changes in a preliminary step. The US interest rate changes are regressed on the corresponding Canadian interest rate changes using OLS. The residuals from these regressions are used as the orthogonalized US interest rate changes in the three-factor models.

$$\mathbf{R_t = \alpha + \beta_1 \Delta AI_t + \beta_2 \Delta AI_{ut} + \gamma R_{mt} + \varepsilon_t} \qquad (3)$$

where ΔAI_{ut} is the orthogonalized actual interest rate changes of the U.S.. All other notations have the same meanings as those of equation (1).

3.1.3 Estimation of the Effect of Unanticipated Interest Rate Changes on Bank Stock Returns

Intuitively, in an efficient market, the expected interest rate changes should be already embedded in the stock price. The actual changes include expected and unexpected interest rate and hence only reflect partly the impact of the unexpected changes in interest rates. Therefore, in order to conduct a thorough study of the impact of interest rate changes, it is necessary to estimate the effect of unexpected interest rate changes on stock returns.

We use a 2-step process to investigate the effect of unanticipated interest rate changes:

(1) Generate three series of unexpected interest rate changes.

An interest rate expectation equation is identified. We employ a rolling window of 12 weeks to forecast the one-week ahead change in interest rate. For example, to obtain the expected rate in January 18, 1995, we use the previous 12-week rates from 19 January 1994 to 11 January 1995.

$$\mathbf{EI_t = (AI_{t-1} + AI_{t-2} \ldots + AI_{t-12}) / 12} \quad (4)$$

where EI_t is the forecasted interest rate in week t and AI_t is the actual Canadian bond yield at week t. The forecasted interest is then subtracted from the actual bond yield for each week, generating three series of unanticipated interest rate changes.

$$\mathbf{\Delta UI_t = (AI_t - EI_t) / EI_t} \quad (5)$$

where $\mathbf{\Delta UI_t}$ is the unexpected Canadian interest rate change in week t. AI_t is the actual Canadian bond yield at week t.

Interest rate sensitivity is estimated by employing the unexpected interest rate as the interest rate factor in the following two-factor model:

$$\mathbf{R_t = \alpha + \beta \Delta UI_t + \gamma R_{mt} + \varepsilon_t} \quad (6)$$

$$R_t = \alpha + \beta \Delta UI_t + \gamma R_{mt} + \varepsilon_t \quad (6)$$

Again, a related variable, the orthogonalized interest rate changes in the U.S. is employed to construct a three-factor model.

$$R_t = \alpha + \beta_1 \Delta UI_t + \beta_2 \Delta UI_{ut} + \gamma R_{mt} + \varepsilon_t \quad (7)$$

where ΔUI_{ut} is the unexpected interest rate changes of the U.S..

3.1.4 Estimation of the Effect of Interest Rate Changes on the Banks' Profitability

To identify the readily observable bank characteristics that explain the variation in interest rate risk is relevant to the investors who wish to evaluate the impact of interest rate movements on bank stock returns.

For the purpose of investigating the relationship between bank profitability and interest rate changes, two key profitability factors, the quarterly change of net income and the quarterly change of net interest income are examined against the fluctuations of the three interest rate changes indices. The regression equations are:

$$\Delta NII_t = \alpha + \beta \Delta I_t + \varepsilon_t \quad (8)$$

where ΔNII_t is the change of net interest income for a bank in quarter t, computed by $(NII_t - NII_{t-1}) / NII_{t-1}$, ΔI_t is the change of the Canadian Treasury Bill (Bond) yield in quarter t.

$$\Delta NI_t = \alpha + \beta \Delta I_t + \varepsilon_t \quad (9)$$

where ΔNI_t is the change of net income for a bank in quarter t, computed by $(NI_t - NI_{t-1}) / NI_{t-1}$, ΔI_t is the change of the Canadian Treasury Bill (Bond) yield in quarter t.

It indicates how capable the management of the bank has been converting the bank's assets into net earnings.

ROA = Net income /Total assets

The net interest margin measures how large a spread between interest revenues and interest costs management can be achieved by closely controlling over the bank's earning assets and the pursuit of the cheapest sources of funding. Earning assets are those generating interest or fee income, principally the loans and security investments the bank has made.

NIM= (Interest income-Interest expense)/Total earning assets

= Net interest income/Total earning assets

where Total earning assets are the sum of total securities and total loans.

In addition, as the banks employ derivatives to hedge their financial risks, the national amount of interest rate derivatives for the purpose of non-trading is also analysed. Notional amount of derivatives is the notional amount of interest rate derivatives using by the banks to hedge their exposure to the interest rate risk. The notional amount is a factor indicating the gap between interest sensitive assets and liabilities for a specific bank at a specific time. In order to make it more comparable across firms and through time, the notional amount is scaled by total asset.

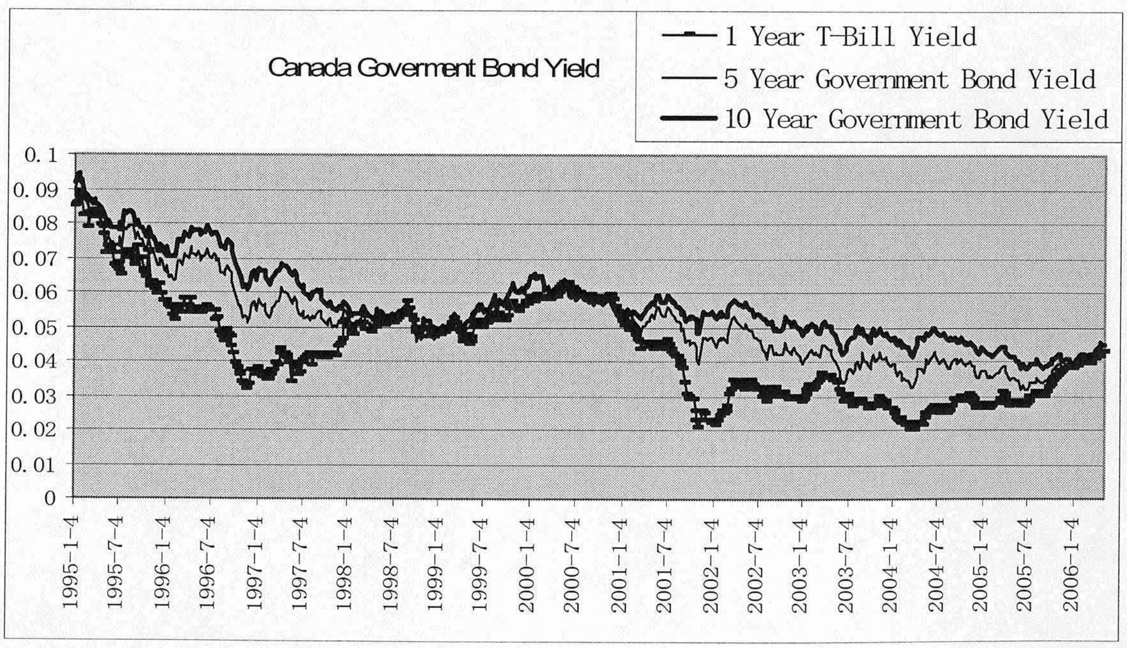
3.2 Data

Our sample consists of all banks that have stock price continuously available over the period January 1995 to May 2006. Weekly individual company stock price data are obtained from www.finance.Yahoo.com. Close prices with dividend adjusted were retrieved. S&P/TSX composite index prices are obtained from CFMRC TSE database as a measure of market return index. We do not employ the monthly data because we believe that weekly data will output more statistically precise results with more observations.

Our interest rate data consist of three series of bond yield of Canada obtained from CANSIM ∏ @CHASS data centre—1 year treasury bill, 5 year selected government of Canada benchmark bond yields and 10 year selected government of Canada benchmark bond yields. In order to test the sensitivity of Canadian bank returns to the changes of interest rate in the U.S., we also retrieve weekly quotes of three series of bond yield from Federal Reserve Bank of St. Louis—1year, 5 year and 10-year treasury constant maturity rate. Figure 3.1 charts the three Canadian government bond yield from Jan 1995 to May 2006.

The data of net interest income, net income, NIM, ROA and national amount of hedging derivative employed by Canadian banks are obtained from annual/quarterly reports of the banks during the sample period.

Figure 3.1 Canada Government Bond yield (1995-2006)



Notes: Data Source: CANSIM II @CHASS data centre (www.dc2.chass.utoronto.ca)

4 EMPIRICAL RESULTS

For brevity's sake, tickers of banks are used in all the tables and analysis hereafter and are explained as follows:

RY: Royal Bank of Canada;

TD: Toronto Dominion Bank;

BNS: Bank of Nova Scotia

CM: Canadian Imperial Bank of Commerce;

BMO: Bank of Montreal;

LB: Laurentian Bank of Canada;

NA: National Bank of Canada.

4.1 Empirical Results for Market Index Model

Panel A, Panel B and Panel C of Table 4.1 report the sensitivity of common stock returns of seven Canadian banks and two portfolios to the market index in the period 1995 - 2006, 1995 - 2000 and 2000 - 2006 respectively. All parameter γs for the S&P/TSX Composite Index are statistically different from zero at 0.05 level. Obviously, all bank stock returns are significantly sensitive to the market index. Meanwhile, the sensitivity is obvious less significant during post-2000 period than that during pre-2000 period.

Table 4.1 Effect of Market Index on Bank Stock Returns

Regression equation: $R_t = \alpha + \gamma R_{mt} + \varepsilon_t$

R_t is the dividend-adjusted returns of the individual public traded banks/portfolios in the TSX market at week t, R_{mt} is the weekly returns of S&P/TSX Composite Price Index at week t.

Panel A: January 1995 - May 2006 (591 observations)									
Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
α	0.003	0.003	0.004	0.003	0.003	0.001	0.003	0.003	0.003
tstat	(2.758)*	(2.083)*	(2.754)*	(2.114)*	(2.313)*	(1.035)	(2.559)*	(2.961)*	(2.897)*
γ	0.389	0.647	0.428	0.569	0.444	0.382	0.452	0.461	0.473
tstat	(5.923)*	(8.461)*	(5.949)*	(7.204)*	(6.115)*	(5.215)*	(6.616)*	(7.712)*	(8.532)*
R^2	0.056	0.108	0.057	0.081	0.060	0.044	0.069	0.092	0.110
Panel B: January 1995 - September 2000 (295 observations)									
Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
α	0.004	0.005	0.005	0.004	0.004	0.001	0.003	0.004	0.004
tstat	(2.126)*	(2.065)*	(2.134)*	(1.771)*	(1.707)*	(0.597)	(1.579)	(2.277)*	(2.161)*
γ	0.187	0.360	0.190	0.299	0.275	0.397	0.261	0.240	0.281
tstat	(1.517)	(2.463)*	(1.404)	(1.949)*	(1.988)*	(2.938)*	(2.046)*	(2.045)*	(2.591)*
R^2	0.008	0.020	0.007	0.013	0.013	0.029	0.014	0.014	0.022
Panel C: September 2000 - May 2006 (296 observations)									
Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
α	0.003	0.002	0.003	0.002	0.003	0.002	0.004	0.003	0.003
tstat	(2.049)*	(1.038)	(2.057)*	(1.495)	(1.804)*	(0.894)	(2.421)*	(2.329)*	(2.355)*
γ	0.505	0.809	0.566	0.723	0.541	0.373	0.565	0.587	0.583
Tstat	(7.349)*	(10.574)*	(7.519)*	(9.442)*	(7.280)*	(4.661)*	(7.802)*	(10.410)*	(11.043)*
R^2	0.155	0.276	0.161	0.233	0.153	0.069	0.172	0.269	0.293

Notes: Value Weighted Average is the value-weighted portfolio with market capitalization of the banks on year-end 2005 as the weights. Equally Weighted Average is the equally weighted portfolio.
t-statistics are in parentheses.
** Indicates statistical significance at the 0.05 level.*

4.2 Effect of Actual Interest Rate Changes on Stock Returns

Table 4.2 shows the impact of actual interest rate changes on common stock returns of seven Canadian banks and two portfolios. Comparing these results to those of market index model, we observe that R^2s in the two-factor model are higher, indicating that, as Stone (1974) claims, incorporating an index for the returns in a debt market indeed increase the explanatory power for bank stock returns.

Panel A of Table 4.2 reports the effect of actual interest rate changes on stock returns of seven Canadian banks and two portfolios in period 1995 - 2006. For the three interest rate indices, almost all the estimates βs have negative signs and significantly different form zero at the 0.05 level. This result indicates that actual interest rate changes adversely affect stock returns of the banks as a whole.

Panel B and Panel C of Table 4.2 report the effect of actual interest rate changes on stock returns of the seven Canadian banks and two portfolios over two equal sub sample periods. Over January 1995 to September 2000, the stock returns are much more sensitive to actual interest rate changes than that over September 2000 to May 2006. For the later period, some bank stock returns even exhibit positive correlation with the changes of interest rate.

Moreover, for the same period, the magnitude of parameter β increases with the length of maturity of the interest rate indices. That is, the magnitude of β for 1year interest rate is smaller than that of 5-year interest rate and the magnitude of β for 5-year interest rate is smaller than that of 10-year interest rate.

Actual interest changes include expected and unexpected interest rate changes. In an efficient market, the expected changes of interest rate should be already embedded in the stock price. Consequently, only the unexpected interest rate changes should have significant impact on the stock price (Bae 1990). The above results imply that most of the actual interest changes are interpreted by the market as the unexpected changes and hence have a significant negative impact on the stock price. This is the case especially over the period of 1995 to 2000.

Table 4.2 Effect of Actual Interest Rate Changes on Common Stock Returns of Canadian Commercial Banks.

Regression equation: $R_t = \alpha + \beta \Delta AI_t + \gamma R_{mt} + \varepsilon_t$

R_t is the dividend adjusted returns of the individual public traded banks in the TSX market at week t, ΔAI_t is the actual changes of the Canadian benchmark government bond (bill) yield in week t. R_{mt} is the weekly returns of S&P/TSX Composite Price Index.

Panel A: January 1995 - May 2006 (591 observations)										
Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
1 Year T-Bill	β	-0.058	-0.088	-0.088	-0.074	-0.087	-0.032	-0.096	-0.074	-0.075
	tstat	(-1.676)*	(-2.206)*	(-2.336)*	(-1.786)*	(-2.289)*	(-0.827)	(-2.704)*	(-2.380)*	(-2.580)*
	γ	0.395	0.657	0.438	0.577	0.454	0.385	0.463	0.469	0.482
	tstat	(6.023)*	(8.607)*	(6.103)*	(7.313)*	(6.265)*	(5.254)*	(6.803)*	(7.873)*	(8.714)*
	R^2	0.061	0.116	0.065	0.086	0.068	0.045	0.081	0.100	0.120
5 Year Bond	β	-0.106	-0.106	-0.096	-0.086	-0.111	-0.008	-0.139	-0.104	-0.093
	tstat	(-2.350)*	(-1.997)*	(-1.931)*	(-1.576)	(-2.217)*	(-0.153)	(-2.958)*	(-2.537)*	(-2.436)*
	γ	0.402	0.660	0.440	0.579	0.457	0.383	0.469	0.473	0.484
	tstat	(6.122)*	(8.621)*	(6.105)*	(7.320)*	(6.301)*	(5.205)*	(6.885)*	(7.934)*	(8.743)*
	R^2	0.065	0.114	0.063	0.085	0.068	0.044	0.083	0.102	0.119
10 Year Bond	β	-0.157	-0.143	-0.091	-0.106	-0.130	-0.049	-0.181	-0.136	-0.122
	tstat	(-2.722)*	(-2.125)*	(-1.429)	(-1.532)	(-2.041)*	(-0.759)	(-3.031)*	(-2.600)*	(-2.517)*
	γ	0.401	0.659	0.436	0.577	0.455	0.386	0.467	0.472	0.483
	tstat	(6.136)*	(8.618)*	(6.043)*	(7.304)*	(6.264)*	(5.254)*	(6.864)*	(7.918)*	(8.730)*
	R^2	0.068	0.115	0.060	0.085	0.066	0.045	0.084	0.102	0.120

Panel B: January 1995 - September 2000 (296 observations)										
Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
1 Year T-Bill	β	-0.191	-0.161	-0.186	-0.193	-0.213	-0.162	-0.215	-0.189	-0.189
	tstat	(-3.393)*	(-2.399)*	(-3.011)*	(-2.735)*	(-3.374)*	(-2.605)*	(-3.716)*	(-3.554)*	(-3.832)*
	γ	0.182	0.356	0.185	0.294	0.269	0.393	0.255	0.235	0.276
	tstat	(1.501)	(2.452)*	(1.385)	(1.935)*	(1.980)*	(2.934)*	(2.043)*	(2.040)*	(2.602)*
	R^2	0.045	0.039	0.037	0.037	0.050	0.051	0.059	0.055	0.069
5 Year Bond	β	-0.293	-0.168	-0.224	-0.196	-0.250	-0.196	-0.325	-0.249	-0.236
	tstat	(-3.827)*	(-1.815)*	(-2.631)*	(-2.023)*	(-2.884)*	(-2.294)*	(-4.124)*	(-3.400)*	(-3.486)*
	γ	0.187	0.360	0.190	0.299	0.275	0.397	0.261	0.240	0.281
	tstat	(1.552)	(2.473)*	(1.419)	(1.959)*	(2.013)*	(2.959)*	(2.102)*	(2.082)*	(2.640)*
	R^2	0.055	0.031	0.030	0.026	0.041	0.046	0.068	0.052	0.062
10 Year Bond	β	-0.366	-0.234	-0.224	-0.232	-0.282	-0.241	-0.407	-0.300	-0.284
	tstat	(-4.020)*	(-2.124)*	(-2.203)*	(-2.007)*	(-2.721)*	(-2.374)*	(-4.344)*	(-3.440)*	(-3.517)*
	γ	0.176	0.354	0.183	0.293	0.267	0.390	0.249	0.231	0.273
	tstat	(1.468)	(2.431)*	(1.365)	(1.915)*	(1.950)*	(2.909)*	(2.012)*	(2.007)*	(2.564)*
	R^2	0.060	0.035	0.023	0.026	0.038	0.047	0.074	0.053	0.062

Panel C: September 2000 - May 2006 (295 observations)										
Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
1 Year T-Bill	β	0.053	-0.035	-0.011	0.021	0.018	0.085	0.001	0.019	0.019
	tstat	(1.335)	(-0.796)	(-0.244)	(0.469)	(0.425)	(1.862)	(0.021)	(0.589)	(0.620)
	γ	0.494	0.816	0.568	0.719	0.538	0.356	0.565	0.584	0.580
	tstat	(7.157)*	(10.589)*	(7.485)*	(9.313)*	(7.173)*	(4.436)*	(7.735)*	(10.262)*	(10.888)*
	R^2	0.160	0.277	0.161	0.233	0.153	0.080	0.172	0.270	0.294
5 Year Bond	β	0.027	-0.073	-0.011	-0.016	-0.013	0.140	-0.007	-0.005	0.007
	tstat	(0.532)	(-1.306)	(-0.198)	(-0.288)	(-0.236)	(2.400)*	(-0.124)	(-0.125)	(0.172)
	γ	0.499	0.824	0.568	0.727	0.544	0.345	0.567	0.588	0.582
	tstat	(7.189)*	(10.665)*	(7.458)*	(9.372)*	(7.228)*	(4.309)*	(7.728)*	(10.304)*	(10.888)*
	R^2	0.156	0.280	0.161	0.233	0.153	0.087	0.172	0.269	0.293
10 Year Bond	β	0.032	-0.079	0.019	-0.008	0.004	0.145	0.023	0.005	0.019
	tstat	(0.469)	(-1.042)	(0.252)	(-0.100)	(0.053)	(1.829)	(0.316)	(0.093)	(0.369)
	γ	0.500	0.821	0.563	0.725	0.541	0.351	0.562	0.587	0.580
	tstat	(7.190)*	(10.614)*	(7.388)*	(9.338)*	(7.181)*	(4.360)*	(7.660)*	(10.266)*	(10.853)*
	R^2	0.156	0.278	0.162	0.233	0.153	0.079	0.172	0.269	0.294

Notes: Value Weighted Average is the value-weighted portfolio with market capitalization of the banks on year-end 2005 as the weights. Equally Weighted Average is the equally weighted portfolio.

t-statistics are in parentheses.

** Indicates statistical significance at the 0.05 level.*

In order to test the robustness of the effect of Canadian interest changes, another economic factor is taken into account. As the close economic relation between Canada and the U.S., and the fact that several Canadian banks are also publicly traded at New York Stock Exchange and have business in the U.S., we expect that the interest rate changes in the U.S. should have some effect on the Canadian bank stock returns too. As the correlation between the Canadian and US interest rate indices are significant, the US interest rate changes are orthogonalized.

Table 4.3 reports the results of the three-factor model which implements the actual US interest rate changes. Comparing to the results of two-factor model, the magnitude and t-statistics of the coefficient in Canadian interest rate indices do not change dramatically. This analysis reinforces previous findings of this study that stock returns of Canadian banks are significant negatively related to actual changes in all the three Canadian interest rate indices. Surprisingly, the returns of CM exhibit significant positive correlation with the three US interest rate indices. The returns of BMO, Bank of Nova Scotia and Laurentian Bank also have significant positive correlation with one or two of the US interest rate indices. The remaining stock returns, although not significant, also have positive signs of the coefficient without exception. When the interest rate changes of the U.S. are used as the only interest rate factor in a two-factor model, all bank returns exhibit slightly negative sensitivities. The results are not reported here for brevity's sake. Comparing the dramatic change of the effect of the US interest changes in two and three-factor models, we conclude that Canadian bank stock returns have no significant correlation to US interest rate changes.

Table 4.3 Simultaneous Effect of Actual CA and US Interest Rate Indices

Regression equation: $R_t = \alpha + \beta_1 \Delta AI_t + \beta_2 \Delta AI_{ut} + \gamma R_{mt} + \varepsilon_t$

R_t is the dividend adjusted returns of the individual public traded banks in the TSX market at week t, ΔAI_t is the actual changes of the Canadian benchmark government bond (bill) yield in week t. ΔAI_{ut} is the actual changes of the US treasury bond (bill) yield in week t, R_{mt} is the weekly returns of S&P/TSX Composite Price Index.

January 1995 to May 2006 (591 observations)

Interest Rate Index	Bank	RY	TD	BNS	CIBC	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
1 year T-bill	β_1	-0.057	-0.088	-0.088	-0.073	-0.086	-0.031	-0.096	-0.074	-0.074
	tstat	(-1.666)*	(-2.194)*	(-2.325)*	(-1.766)*	(-2.273)*	(-0.806)	(-2.693)*	(-2.366)*	(-2.564)*
	β_2	0.048	0.070	0.056	0.163	0.095	0.120	0.049	0.069	0.086
	tstat	(0.961)	(1.205)	(1.022)	(2.720)*	(1.715)*	(2.146)*	(0.944)	(1.526)	(2.040)*
	γ	0.384	0.641	0.425	0.539	0.432	0.357	0.452	0.453	0.461
	tstat	(5.755)*	(8.259)*	(5.824)*	(6.751)*	(5.870)*	(4.804)*	(6.526)*	(7.485)*	(8.235)*
	·	0.062	0.118	0.067	0.097	0.073	0.053	0.082	0.104	0.126
5 year bond	β_1	-0.106	-0.104	-0.095	-0.083	-0.110	-0.007	-0.139	-0.103	-0.092
	tstat	(-2.332)*	(-1.975)*	(-1.907)*	(-1.537)	(-2.193)*	(-0.133)	(-2.948)*	(-2.512)*	(-2.409)*
	β_2	0.066	0.100	0.102	0.215	0.102	0.081	0.028	0.093	0.099
	tstat	(1.086)	(1.404)	(1.517)	(2.937)*	(1.512)	(1.186)	(0.438)	(1.685)*	(1.927)*
	γ	0.387	0.638	0.418	0.533	0.436	0.365	0.463	0.453	0.463
	tstat	(5.792)*	(8.187)*	(5.697)*	(6.650)*	(5.890)*	(4.874)*	(6.662)*	(7.463)*	(8.216)*
	·	0.067	0.117	0.066	0.098	0.071	0.047	0.083	0.106	0.124
10 year bond	β_1	-0.156	-0.142	-0.089	-0.104	-0.129	-0.047	-0.181	-0.135	-0.121
	tstat	(-2.709)*	(-2.115)*	(-1.406)	(-1.504)	(-2.025)*	(-0.736)	(-3.029)*	(-2.582)*	(-2.497)*
	β_2	0.077	0.072	0.174	0.265	0.122	0.170	-0.003	0.112	0.125
	tstat	(0.870)	(0.694)	(1.785)*	(2.485)*	(1.243)	(1.718)*	(-0.029)	(1.385)	(1.677)*
	γ	0.390	0.648	0.411	0.539	0.437	0.361	0.467	0.456	0.465
	tstat	(5.855)*	(8.322)*	(5.600)*	(6.725)*	(5.912)*	(4.837)*	(6.737)*	(7.512)*	(8.261)*
	·	0.069	0.116	0.065	0.094	0.069	0.050	0.084	0.105	0.124

Notes: Value Weighted Average is the value-weighted portfolio with market capital of the banks on year-end 2005 as the weights; Equally Weighted Average is the equally weighted portfolio.
t-statistics are in parentheses.
** Indicates statistical significance at the 0.05 level*

4.3 Effect of Unexpected Interest Rate Changes on Stock Returns

Table 4.4 presents stock returns sensitivity to unexpected interest rate changes as well as to the market. Comparing the results to those of market-index model, R^2s for two-factor model are higher, implying that incorporating unexpected interest rate changes as a factor can increase the explanatory power to bank stock returns too.

Panel A of Table 4.4 presents stock returns sensitivity to unexpected interest rate changes in period 1995 – 2006. In terms of statistical significance, almost all bank returns are very sensitive to unexpected long-term interest rate changes while not sensitive to short-term interest rate changes. The magnitude of parameter β and the sensitivity is found to increase for a longer-maturity interest rate index. However, compare to the effect of actual change of interest, the effect of unexpected interest changes are less significant, either for the magnitude or the t-statistics of β. This might attribute to the reason that weekly data is able to catch the instantaneous market reaction to the actual changes of rates. As to the sub samples, Panel B and Panel C shows that over the period January 1995 to September 2000, the bank stock returns are much more sensitive to unexpected interest rate changes than the returns over the period September 2000 to May 2006. This phenomenon also presents in the analysis on the effect of actual changes of interest rate.

Table 4.4 Effect of Unexpected Canadian Interest Rate Changes on Common Stock Returns of Canadian Commercial Banks.

Regression equation: $R_t = \alpha + \beta\Delta UI_t + \gamma R_{mt} + \varepsilon_t$

R_t is the dividend adjusted returns of the individual public traded banks in the TSX market at week t, ΔUI_t is the unexpected changes of the Canadian benchmark government bond (bill) yield in week t. R_{mt} is the weekly returns of S&P/TSX Composite Price Index.

Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
Panel A: January 1995 - May 2006 (591 observations)										
1 Year T-Bill	β	-0.012	-0.022	-0.021	-0.024	-0.001	-0.025	-0.015	-0.015	-0.017
	tstat	(-0.817)	(-1.293)	(-1.289)	(-1.354)	(-0.083)	(-1.542)	(-0.962)	(-1.092)	(-1.384)
	γ	0.388	0.646	0.427	0.567	0.444	0.380	0.451	0.460	0.472
	tstat	(5.910)*	(8.449)*	(5.936)*	(7.192)*	(6.109)*	(5.201)*	(6.603)*	(7.699)*	(8.521)*
	R^2	0.057	0.111	0.059	0.084	0.060	0.048	0.071	0.094	0.113
5 Year Bond	β	-0.043	-0.037	-0.050	-0.042	-0.034	-0.025	-0.036	-0.042	-0.038
	tstat	(-1.970)*	(-1.446)	(-2.089)*	(-1.588)	(-1.386)	(-1.009)	(-1.571)	(-2.085)*	(-2.058)*
	γ	0.393	0.651	0.433	0.573	0.447	0.384	0.456	0.465	0.477
	tstat	(6.002)*	(8.514)*	(6.035)*	(7.264)*	(6.165)*	(5.247)*	(6.675)*	(7.801)*	(8.621)*
	R^2	0.062	0.112	0.064	0.085	0.063	0.046	0.073	0.098	0.116
10 Year Bond	β	-0.076	-0.063	-0.068	-0.063	-0.063	-0.044	-0.067	-0.069	-0.063
	tstat	(-2.596)*	(-1.861)*	(-2.133)*	(-1.781)*	(-1.963)*	(-1.344)	(-2.220)*	(-2.613)*	(-2.581)*
	γ	0.394	0.652	0.433	0.573	0.448	0.385	0.457	0.466	0.477
	tstat	(6.032)*	(8.535)*	(6.033)*	(7.271)*	(6.190)*	(5.259)*	(6.706)*	(7.830)*	(8.652)*
	R^2	0.067	0.114	0.064	0.086	0.066	0.047	0.077	0.102	0.120
Panel B: January 1995 - September 2000 (296 observations)										
Interest Rate Index	**Bank**	**RY**	**TD**	**BNS**	**CM**	**BMO**	**LB**	**NA**	**Value Weighted Average**	**Equally Weighted Average**
1 Year T-Bill	β	-0.069	-0.043	-0.071	-0.058	-0.038	-0.075	-0.048	-0.059	-0.058
	tstat	(-2.388)*	(-1.247)	(-2.239)*	(-1.618)	(-1.175)	(-2.368)*	(-1.606)	(-2.152)*	(-2.261)*
	γ	0.183	0.358	0.186	0.296	0.273	0.393	0.258	0.236	0.278
	tstat	(1.496)	(2.448)*	(1.383)	(1.932)*	(1.973)*	(2.928)*	(2.029)*	(2.028)*	(2.577)*
	R^2	0.027	0.026	0.024	0.022	0.018	0.047	0.023	0.030	0.039
5 Year Bond	β	-0.141	-0.065	-0.120	-0.078	-0.096	-0.124	-0.089	-0.112	-0.102
	tstat	(-3.634)*	(-1.380)	(-2.798)*	(-1.599)	(-2.181)*	(-2.888)*	(-2.193)*	(-3.017)*	(-2.962)*
	γ	0.197	0.365	0.199	0.305	0.282	0.406	0.267	0.248	0.289
	tstat	(1.632)	(2.498)*	(1.485)	(1.991)*	(2.051)*	(3.041)*	(2.110)*	(2.143)*	(2.693)*
	R^2	0.051	0.027	0.033	0.021	0.029	0.056	0.030	0.044	0.051
10 Year Bond	β	-0.174	-0.092	-0.126	-0.094	-0.125	-0.138	-0.115	-0.137	-0.123
	tstat	(-3.771)*	(-1.637)	(-2.454)*	(-1.594)	(-2.367)*	(-2.688)*	(-2.379)*	(-3.100)*	(-3.003)*
	γ	0.199	0.367	0.199	0.306	0.284	0.407	0.269	0.250	0.290
	tstat	(1.653)*	(2.514)*	(1.483)	(1.997)*	(2.067)*	(3.041)*	(2.126)*	(2.159)*	(2.707)*
	R^2	0.054	0.029	0.027	0.021	0.032	0.052	0.033	0.046	0.052

Panel C: September 2000 to May 2006 (295 observations)										
Interest Rate Index	**Bank**	**RY**	**TD**	**BNS**	**CM**	**BMO**	**LB**	**NA**	**Value Weighted Average**	**Equally Weighted Average**
1 Year T-Bill	β	0.016	-0.012	0.004	-0.007	0.017	-0.001	0.002	0.007	0.003
	tstat	(1.068)	(-0.711)	(0.236)	(-0.418)	(1.040)	(-0.049)	(0.106)	(0.594)	(0.232)
	γ	0.506	0.809	0.566	0.723	0.542	0.373	0.565	0.588	0.583
	tstat	(7.362)*	(10.556)*	(7.509)*	(9.423)*	(7.292)*	(4.652)*	(7.790)*	(10.405)*	(11.027)*
	R^2	0.159	0.277	0.161	0.233	0.156	0.069	0.172	0.270	0.293
5 Year Bond	β	0.022	-0.019	-0.004	-0.018	0.008	0.042	-0.001	0.006	0.005
	tstat	(0.940)	(-0.708)	(-0.146)	(-0.678)	(0.315)	(1.535)	(-0.038)	(0.279)	(0.245)
	γ	0.502	0.812	0.566	0.726	0.540	0.368	0.565	0.587	0.583
	tstat	(7.300)*	(10.586)*	(7.506)*	(9.453)*	(7.248)*	(4.601)*	(7.784)*	(10.372)*	(11.004)*
	R^2	0.158	0.277	0.161	0.234	0.153	0.076	0.172	0.270	0.293
10 Year Bond	β	0.023	-0.033	-0.011	-0.031	-0.003	0.049	-0.021	-0.001	-0.004
	tstat	(0.663)	(-0.864)	(-0.279)	(-0.808)	(-0.067)	(1.231)	(-0.588)	(-0.036)	(-0.143)
	γ	0.503	0.812	0.567	0.726	0.542	0.369	0.567	0.588	0.584
	tstat	(7.309)*	(10.596)*	(7.512)*	(9.461)*	(7.264)*	(4.611)*	(7.811)*	(10.385)*	(11.021)*
	R^2	0.156	0.277	0.162	0.234	0.153	0.074	0.173	0.269	0.293

Notes: Value weighted average is the value-weighted portfolio with market capitalization of the banks on year-end 2005 as the weights, equally weighted average is the equally weighted portfolio.
t-statistics are in parentheses.
** Indicates statistical significance at the 0.05 level.*

Again, we test the effect of the unexpected changes of US interest rate on Canadian bank stock returns. Since the unexpected Canadian and US interest rate indices are highly correlated (0.58, 0.73 and 0.82 respectively), we orthogonalize the US interest rate changes.

Table 4.5 reports the results for the three-factor model incorporating the unexpected interest rate changes in U.S.. This analysis reinforces the results in previous step that the bank stock returns have negative correlation with long-term unexpected Canadian interest indices. For the US interest indices, the coefficients again have positive signs, but the sensitivity level is much less significant than that of Canadian interest rates, implying that no significant effect of the unexpected change US interest rate on Canadian bank stock returns

Table 4.5 **Simultaneous Effect of Unexpected CAD and US Interest Rate Changes on The Common Stock Returns of Canadian Banks**

Regression equation: $R_t = \alpha + \beta_1 \Delta UI_t + \beta_2 \Delta UI_{ut} + \gamma R_{mt} + \varepsilon_t$

R_t is the dividend adjusted returns of the individual public traded banks in the TSX market at week t, ΔUI_t is the unexpected changes of the Canadian benchmark government bond (bill) yield in week t. ΔUI_{ut} is the unexpected changes of the US treasury bond (bill) yield. R_{mt} is the weekly returns of S&P/TSX Composite Price Index.

January 1995 to May 2006 (591 observations)

Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA	Value Weighted Average	Equally Weighted Average
1 Year T-Bill	β_1	-0.012	-0.022	-0.021	-0.024	-0.001	-0.025	-0.015	-0.015	-0.017
	tstat	(-0.816)	(-1.293)	(-1.288)	(-1.354)	(-0.083)	(-1.542)	(-0.961)	(-1.092)	(-1.383)
	β_2	0.001	0.009	-0.007	0.011	-0.010	0.013	-0.008	0.000	0.001
	tstat	(0.059)	(0.444)	(-0.339)	(0.522)	(-0.501)	(0.630)	(-0.434)	(0.001)	(0.089)
	γ	0.388	0.642	0.430	0.563	0.447	0.376	0.454	0.460	0.471
	tstat	(5.871)*	(8.359)*	(5.936)*	(7.101)*	(6.125)*	(5.112)*	(6.609)*	(7.655)*	(8.464)*
	R^2	0.057	0.111	0.060	0.084	0.060	0.049	0.071	0.094	0.113
5 Year Bond	β_1	-0.043	-0.037	-0.050	-0.042	-0.034	-0.025	-0.036	-0.042	-0.038
	tstat	(-1.967)*	(-1.443)	(-2.086)*	(-1.585)	(-1.385)	(-1.006)	(-1.572)	(-2.082)*	(-2.055)*
	β_2	0.013	0.028	0.015	0.041	-0.002	0.019	-0.013	0.015	0.014
	tstat	(0.547)	(0.980)	(0.548)	(1.398)	(-0.090)	(0.677)	(-0.515)	(0.670)	(0.693)
	γ	0.390	0.644	0.430	0.563	0.448	0.380	0.459	0.461	0.473
	tstat	(5.923)*	(8.389)*	(5.956)*	(7.112)*	(6.142)*	(5.161)*	(6.690)*	(7.704)*	(8.519)*
	R^2	0.063	0.113	0.064	0.088	0.063	0.047	0.074	0.099	0.117
10 Year Bond	β_1	-0.075	-0.063	-0.068	-0.062	-0.063	-0.044	-0.067	-0.069	-0.063
	tstat	(-2.592)*	(-1.858)*	(-2.130)*	(-1.779)*	(-1.960)*	(-1.341)	(-2.217)*	(-2.610)*	(-2.579)*
	β_2	0.045	0.052	0.051	0.098	0.034	0.066	0.014	0.049	0.052
	tstat	(1.156)	(1.151)	(1.192)	(2.105)*	(0.794)	(1.516)	(0.349)	(1.382)	(1.572)
	γ	0.386	0.642	0.424	0.556	0.442	0.373	0.454	0.457	0.468
	tstat	(5.883)*	(8.373)*	(5.881)*	(7.037)*	(6.074)*	(5.081)*	(6.630)*	(7.653)*	(8.455)*
	R^2	0.069	0.116	0.066	0.093	0.067	0.051	0.077	0.105	0.124

Notes: Value weighted average is the value-weighted portfolio with market capital of the banks on year-end 2005 as the weight, equally weighted average is the equally weighted portfolio.
t-statistics are in parentheses.
** Indicates statistical significance a t the 0.05 level*

4.4 Effect of US Interest Rate Changes on US Bank Returns

For comparison purpose, we collect monthly returns data of US bank from CRSP and divide the banks into two portfolios based on the SIC code - State Commercial Bank (6022) and National Commercial Bank (6021). We only retrieve data that are available over the period Jan 1995 to Dec 2005. Two portfolios are constructed: one is equally weighted average portfolio of the State Commercial Banks; the other is equally weighted average portfolio of the National

Commercial Banks. We choose the S&P500 index as our market proxy for the two-factor model. The methodology is the same as the one we employed for Canadian banks.

Table 4.6 and Table 4.7 show the effect of US interest rate changes on the stock returns of US banks. Overall, the stock returns of US banks exhibit negative correlation with both actual changes and unexpected changes of US interest rates. The returns of the US banks are not significantly sensitive to the actual changes of interest rate while significantly sensitive to the unexpected changes of interest rate. Comparing the effect of interest rate changes on the two portfolios, the unexpected changes of all the three interest rate indices have obvious negative impact on the State Commercial Bank returns while have no significant adverse impact on National Commercial Bank returns. In the US stock market, the bank stock returns show more sensitivity to the interest rate changes over the pre-2000 period than that over the post-2000 period. This phenomenon is similar to what we observe in the Canadian stock market.

Table 4.6 Effect of Actual US Interest Rate Changes on Common Stock Returns of US Commercial Banks.

Regression equation: $R_{ut} = \alpha + \beta \Delta AI_{ut} + \gamma R_{mt} + \varepsilon_t$

R_{ut} is the dividend adjusted returns of the public traded banks in the US stock market in month t, ΔAI_{ut} is the actual interest rate changes of the US Treasury bond (bill) yield in month t. R_{mt} is the monthly returns of S&P 500 Index.

Interest Rate Index	US Bank	State Commercial Bank	National Commercial Bank	Equally Weighted Average
Panel A: January 1995 – December 2005				
1 Year T-Bill	β	-0.050	-0.025	-0.038
	tstat	(-1.214)	(-0.499)	(-0.868)
	R^2	0.373	0.437	0.434
5 Year Bond	β	-0.037	-0.019	-0.028
	tstat	(-0.831)	(-0.357)	(-0.603)
	R^2	0.370	0.436	0.433
10 Year Bond	β	-0.050	-0.018	-0.034
	tstat	(-0.868)	(-0.258)	(-0.564)
	R^2	0.370	0.436	0.432
Panel B: January 1995 - December 2000				
Interest Rate Index	**US Bank**	**State Commercial Bank**	**National Commercial Bank**	**Equally Weighted Average**
1 Year T-Bill	β	-0.216	-0.178	-0.197
	tstat	(-2.040)*	(-1.236)	(-1.650)*
	R^2	0.388	0.434	0.436
5 Year Bond	β	-0.181	-0.099	-0.140
	tstat	(-2.042)*	(-0.817)	(-1.393)
	R^2	0.388	0.427	0.429
10 Year Bond	β	-0.207	-0.074	-0.141
	tstat	(-2.058)*	(-0.537)	(-1.228)
	R^2	0.388	0.424	0.426
Panel C: January 2001 – December 2005				
Interest Rate Index	**US Bank**	**State Commercial Bank**	**National Commercial Bank**	**Equally Weighted Average**
1 Year T-Bill	β	-0.014	0.025	0.005
	tstat	(-0.346)	(0.671)	(0.140)
	R^2	0.403	0.527	0.491
5 Year Bond	β	0.024	0.046	0.035
	tstat	(0.487)	(1.051)	(0.797)
	R^2	0.405	0.532	0.497
10 Year Bond	β	0.054	0.079	0.066
	tstat	(0.772)	(1.277)	(1.069)
	R^2	0.408	0.537	0.501

Notes: State Commercial Bank is equally weighted average portfolio of all sample State Commercial Banks. National Commercial Bank is equally weighted average portfolio of all sample National Commercial Banks. Equally Weighted Average is the equally weighted average portfolios of all sample US banks.

t-statistics are in parentheses.

**Indicates statistical significance at the 0.05 level*

Table 4.7 Effect of Unexpected US Interest Rate Changes on Common Stock Returns of US Commercial Banks.

Regression equation: $R_{ut} = \alpha + \beta \Delta UI_{ut} + \gamma R_{mt} + \varepsilon_t$

R_{ut} is the dividend adjusted returns of the public traded banks in the US stock market in month t, ΔAI_{ut} is the actual interest rate changes of the US Treasury bond (bill) yield in month t. R_{mt} is the monthly returns of S&P 500 Composite Price Index.

Interest Rate Index	US Bank	State Commercial Bank	National Commercial Bank	Equally Weighted Average
Panel A: January 1995 – December 2005				
1 Year T-Bill	β	-0.030	-0.020	-0.025
	tstat	(-2.587)*	(-1.454)	(-2.073)*
	R^2	0.397	0.445	0.449
5 Year Bond	β	(-0.053)	(-0.031)	(-0.042)
	tstat	(-2.566)*	(-1.193)	(-1.908)*
	R^2	0.397	0.442	0.447
10 Year Bond	β	-0.068	-0.040	-0.054
	tstat	(-2.368)*	(-1.127)	(-1.777)*
	R^2	0.393	0.441	0.445
Panel B: January 1995 – December 2000				
Interest Rate Index	**US Bank**	**State Commercial Bank**	**National Commercial Bank**	**Equally Weighted Average**
1 Year T-Bill	β	-0.089	-0.060	-0.075
	tstat	(-2.248)	(-1.093)	(-1.651)*
	R^2	0.395	0.431	0.436
5 Year Bond	β	-0.099	-0.074	-0.086
	tstat	(-2.808)*	(-1.505)	(-2.144)*
	R^2	0.418	0.440	0.450
10 Year Bond	β	-0.115	-0.086	-0.100
	tstat	(-2.902)*	(-1.558)	(-2.217)*
	R^2	0.422	0.441	0.452
Panel C: January 2001 – December 2005				
Interest Rate Index	**US Bank**	**State Commercial Bank**	**National Commercial Bank**	**Equally Weighted Average**
1 Year T-Bill	β	-0.023	-0.013	-0.018
	tstat	(-2.102)*	(-1.365)	(-1.859)*
	R^2	0.445	0.538	0.520
5 Year Bond	β	-0.021	0.008	-0.007
	tstat	(-0.840)	(0.340)	(-0.298)
	R^2	0.409	0.524	0.492
10 Year Bond	β	0.005	0.047	0.026
	tstat	(0.122)	(1.294)	(0.708)
	R^2	0.402	0.537	0.496

Notes: State Commercial Bank is equally weighted average portfolio of all sample State Commercial banks. National Commercial Bank is equally weighted average portfolio of all samples National Commercial Banks. Equally Weighted Average is the equally weighted average portfolios of all sample US banks.

t-statistics are in parentheses.

**Indicates statistical significance at the 0.05 level*

4.5 Effect of Interest Rate Changes on Bank Profitability

In order to measure the effect of interest rate changes on bank profitability, we employ three different approaches, quantitatively and qualitatively. First, we examine the sensitivities of net interest income and net income of banks to interest rate changes by running OLS. Furthermore, we compute the quarterly Net Interest Margin (NIM) and Return of Assets (ROA) as proxies of bank profitability and analyse their sensitivity to the changes of interest rate. We also explore the relationship between changes of notional amount of interest rate derivatives employed by these banks and interest rate changes, and evaluate the effectiveness of derivative hedging using NIM as a criterion.

The regression results are illustrated in Table 4.8 and Table 4.9. Table 4.8 shows that most signs of β in equation (8) are negative (18/21), implying that net interest rate income has negative correlation with interest rate changes. Table 4.9 reports that most signs of β in equation (9) are positive (14/21), implying that net income has positive correlation to interest rate changes. Meanwhile, in the two tables, most of the βs are not statistically significant (34/42). Thus, in general, net interest income and net income of these banks are not significantly sensitive to changes in interest rate. The impact of interest rate changes on bank profitability is small. Most banks' profitability is insulated from interest rate fluctuations.

Actually, interest rates changes will affect a bank's profitability unless it diversifies the risk by creating non-interest income sources, such as investment banking business, or hedges the risk by using financial instruments and/or dynamic rebalancing. Base on table 1.1, we observe that Canadian banks indeed successfully increase their ratio of non-interest income to total revenue from 40% to 53% in the last 10 years on average. This might be one reason for the small effect of interest rate changes to bank profitability. Furthermore, a bank usually employs on balance sheet and/or off balance sheet risk management, such as derivatives, to manage its interest rate risk. For the on balance sheet risk management, a bank intents to increase fixed rate liabilities and floating rate assets when it forecasts that the interest rate will go up. On the other hand, a bank intends to increase floating rate liabilities and fixed rate assets when it predicts that interest rate will decrease. Since on balance sheet management are often difficult or impossible to achieve, as complementary, derivatives such as futures, swaps and options are increasingly used to hedge interest rate risk. Some banks deal with interest rate risk focus on net interest income while other banks focus on net income. Regardless of methods used by a bank, the goal is to immunize its profitability from interest rates changes, or even benefit from interest rate changes.

Table 4.8 Effect of Interest Rate changes on Bank Net Interest Income Changes

Regression equation: $\Delta NII_t = \alpha + \beta \Delta I_t + \varepsilon_t$

where ΔNII_t is the percentage change of net interest income of a bank in quarter t, ΔI_t is the percentage change of the Canadian T bill (bond) yield in quarter t.

Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA
1 Year T-Bill	β	-0.033	-0.027	-0.081	-0.151	-0.074	0.025	-0.007
	tstat	(-0.457)	(-0.288)	(-2.174)*	(-2.730)*	(-0.224)	(0.384)	(-0.048)
5 Year Bond	β	-0.038	-0.108	-0.069	-0.130	-0.479	-0.054	0.385
	tstat	(-0.293)	(-0.637)	(-0.892)	(-1.147)	(-0.810)	(-0.446)	(1.400)
10 Year Bond	β	-0.079	-0.110	-0.025	-0.126	-0.901	-0.159	0.793
	tstat	(-0.422)	(-0.431)	(-0.199)	(-0.618)	(-1.054)	(-0.840)	(1.880)*

Notes: RY has 41 observations (January 1996 – January 2006). TD has 30 observations (January 1998 – April 2006). BNS has 22 observations (January2001 – April 2006). CM has 36 observations (July 1998 – April 2006). BMO has 41 observations (January 1996 – January 2006). LB has 22 observations (January 2001 – April 2006) and NA has 22 observations (January 2001 – April 2006)

** Indicates statistical significance at the 0.05 level.*

Table 4.9 Effect of Interest Rate changes on Bank Net Income Changes

Regression equation: $\Delta NI_t = \alpha + \beta \Delta I_t + \varepsilon_t$

Where ΔNI_t is the percentage change of net interest income for a bank in quarter t, ΔI_t is the percentage change of the Canadian T bill (bond) yield in quarter t.

Interest Rate Index	Bank	RY	TD	BNS	CM	BMO	LB	NA
1 Year T-Bill	β	-0.034	0.812	1.620	3.243	2.151	-1.388	7.061
	tstat	(-0.091)	(8.199)*	(3.137)*	(1.036)	(1.738)*	(-1.473)	(3.355)*
5 Year Bond	β	-0.160	0.837	1.078	0.787	-0.239	0.303	5.326
	tstat	(-0.238)	(13.118)*	(0.922)	(0.139)	(-0.103)	(0.162)	(1.101)
10 Year Bond	β	-0.510	0.892	1.548	0.472	-1.362	1.048	6.897
	tstat	(-0.525)	(0.865)	(0.829)	(0.056)	(-0.406)	(0.353)	(0.887)

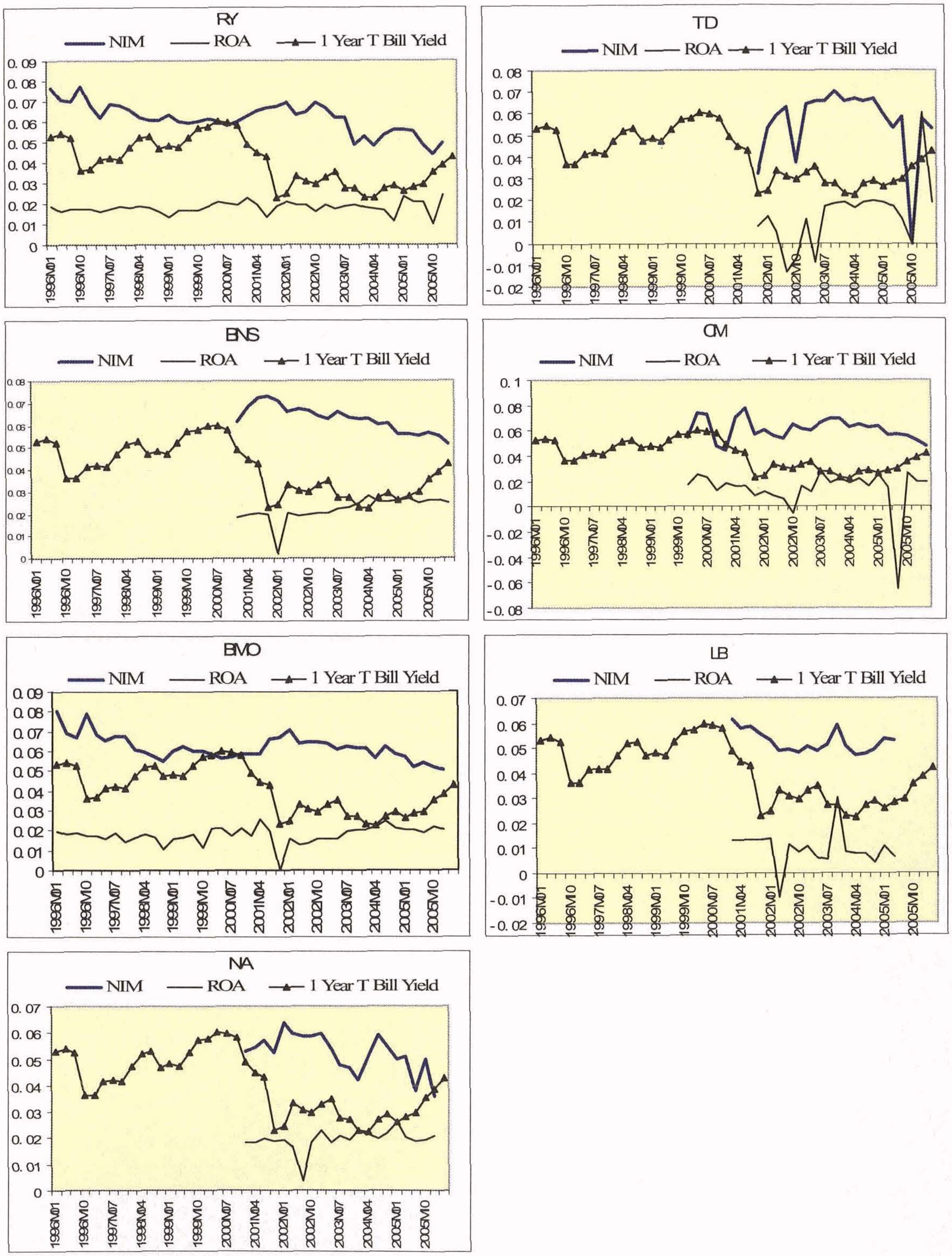
Notes: RY has 41 observations (January 1996 – January 2006). TD has 30 observations (January 1998 – April 2006). BNS has 22 observations (January2001 – April 2006). CM has 36 observations (July 1998 – April 2006). BMO has 41 observations (January 1996 – January 2006). LB has 22 observations (January 2001 – April 2006) and NA has 22 observations (January 2001 – April 2006).

** Indicates statistical significance at the 0.05 level*

For the purpose of further examination, two key profitability ratios in banking industry, net interest margin (NIM) and return on assets (ROA), are examined against the fluctuations of interest rate. The curves of the above two ratios of banks (provided with the availability of data) and the curve of interest rate over the period 1996-2006 are plotted in Figure 4.1.

For most of the banks, we observe that there are some big jumps in ROA around year 2002 and 2003. These jumps are mainly due to risks other than interest rate risk. According to their annual/quarterly report, the jumps around 2002 and 2003 mainly attribute to credit losses that are more likely triggered by a less robust economic environment. Besides, CIBC and RY record a huge credit loss due to the Enron event in 2005. In terms of NIM, the trends through last ten years are going down. We attribute the decrease in interest margin to the severe competition. Excluding the effect of other risks, the diagrams illustrate that the curves of both ROA and NIM are more flat than the curve of interest rate. The profitability of banks remains stable when the interest rate fluctuates violently through the whole period. The analysis of the bank profitability against interest rate changes has a number of implications for investors. The results can be interpreted as evidence that interest rate changes are not problematic given good risk management in place.

Figure 4.1 Quarterly Interest Rate against Net Interest Margin (NIM) and Return on Assets (ROA)



Notes: Net Interest Margin (NIM) = Net Interest Rate / Total Earning Assets, where Total Earning Asset = Total securities + Total Loans. Return on Asset (ROA) = Net Income / Total Assets. NIM and ROA sample periods: RY: Jan 1996 – Jan2006. TD: Oct 2001 – Apr 2006. BNS: Jan 2001 – Apr 2006. CIBC: Jan 2000 – Apr 2006. BMO: Jan 1996 – Apr 2006. LB: Jan 2001 – Apr 2005. NA: Jan 2001 – Apr 2006.

How these banks execute their interest rate risk management policy? Since the information of on-balance sheet risk management is not publicly available, the notional amount of hedging derivatives might be an aspect indicates the interest rate risk management activities for a specific bank at a specific time. We expect banks to use more derivatives when interest rate goes up and to use fewer derivatives when interest rate goes down. In order to understand the effect of derivative hedging on bank profitability, we use NIM as the criteria of performance since NIM represents the net interest income for each dollar earning asset investment.

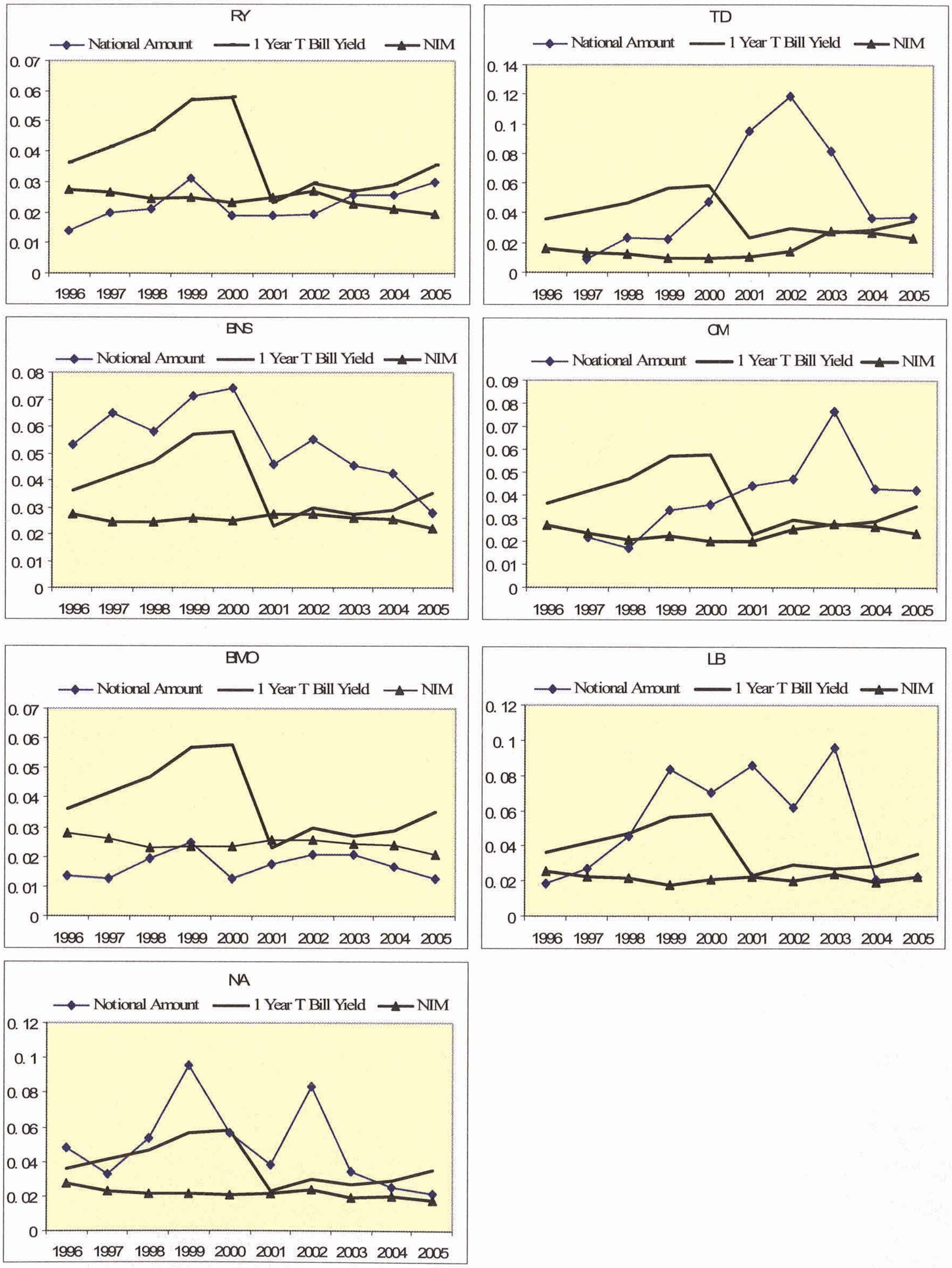
Therefore, annual notional amounts of non-trading interest rate derivatives, the 1-year T-bill yield and the NIM for each bank over the period 1996-2005 are retrieved. The notional amounts are scaled by total assets of corresponding bank and then multiplied by 10 to make the graphs easy for comparison. Figure 4.2 shows the trends for above 3 variables of each bank over the period 1996-2005. On one hand, although with some exceptions, we find that four banks - RY, BNS, BMO and CM employ the derivatives with almost the same trends as that of interest rate. In other words, they increase their use of derivatives when the interest rate is going up, and decrease their use of derivatives when the interest rate is going down. Table 4.10 shows that all individual NIMs are higher than the industry average NIM. On the other hand, TD employs derivatives mostly unrelated to the changes of interest rate, and its average NIM is only 0.016, which is much lower than the industry average level. This fact indicates that efficient usage of derivative can reinforce the profitability of banks. For the remaining two banks, NA and LB, no obvious relationship exists between the changes of interest rate and the changes of notional amount of derivatives. For a specific bank, the question of whether to use and how to use derivatives is based on the specific characters of its asset-liability structure, its desire risk and its assumption about future trends of rate. Given the available information, although it is premature to make a final judgment, it seems that some relationship exists between the changes of interest rate and the changes of notional amount of derivatives and this relationship lends some explanatory power to bank profitability.

Table 4.10 The Net Interest Margin (NIM) of Canadian Banks (1996 to 2005)

Date/Bank	RY	TD	BNS	CM	BMO	LB	NA	Average
10/31/1996	0.027	0.016	0.027	0.027	0.028	0.026	0.027	0.026
10/31/1997	0.026	0.014	0.024	0.024	0.026	0.022	0.023	0.023
10/31/1998	0.025	0.012	0.024	0.020	0.023	0.022	0.021	0.021
10/31/1999	0.025	0.010	0.026	0.023	0.024	0.018	0.021	0.021
10/31/2000	0.023	0.010	0.025	0.020	0.023	0.021	0.020	0.020
10/31/2001	0.025	0.011	0.027	0.020	0.026	0.022	0.022	0.022
10/31/2002	0.027	0.014	0.027	0.025	0.026	0.020	0.024	0.023
10/31/2003	0.023	0.028	0.026	0.028	0.024	0.024	0.019	0.025
10/31/2004	0.021	0.027	0.025	0.026	0.024	0.019	0.020	0.023
10/31/2005	0.019	0.023	0.022	0.024	0.021	0.022	0.018	0.021
Average	0.024	0.016	0.025	0.024	0.024	0.022	0.022	0.022

Notes: Average is equally weighted average and is in grey.

Figure 4.2 Notional Amounts of Interest Rate Derivatives, Interest Rate and Net Interest Margin (NIM)



Notes: Notional Amount is the notional amount of interest rate derivatives employed by banks for non-trading purpose scaled by total asset. Net Interest Margin (NIM) = Net Interest Income / Total Earning Assets, where Total Earning Assets = Total Securities + Total Loans

5 CONCLUSION

We empirically investigate the sensitivity of Canadian commercial bank stock returns and profitability to changes in interest rates. In general, over the period Jan 1995 to May 2006, both the actual and unexpected changes of three different time series of interest rate indices, the short-, intermediate- and long-term interest rates, have significant negative correlation with bank stock returns, while this correlation disappear over the past five years. Adding US interest rate changes as an additional variable reinforces these results.

The analysis of the bank profitability against interest rate changes is important for investors. To measure Canadian bank profitability against interest rate risk, we find that net interest income and net income of these banks are not significantly sensitive to changes of interest rate. Excluding effect of other risks on the profitability of banks, banks sustain stable profitability while the interest rates fluctuate considerable over the period. These results evidence that these banks' asset - liability management successfully control their interest rate risk at acceptable level. In addition, we also find that the notional amount has some relationship with interest rate changes and this relationship lends some explanatory power to the profitability of banks. The results can be interpreted as evidence that interest rate changes are not problematic given the good risk management in place.

For those who are interested in this field, the effects of spread between long-term and short-term interest rate on bank stock returns and profitability might be worth studying. Since many banks hold loan and securities (assets) with longer maturities than deposits and other funds sources (liabilities), it is better for banks when this spread is larger, while it is worse for banks when this spread is smaller, disappear or negative.

REFERENCE LIST

Bae,S. (1990). Interest rate changes and common stock returns of financial institutions revisited, *Journal of Financial Research* 13, pp71-79.

Benton E.Gup and James W. Kolari (2005). Commercial Banking-The Management of Risk. Hoboken, NJ: J. Wiley.

Booth, J. and D. Officer (1985). Expectations, interest rates, and commercial bank stocks, *Journal of Financial Research 8*, pp51-79

Bradley, M. and S. Lumpkin (1992). The Treasury yield curve as a cointegrated system, *Journal of Financial and Quantitative Analysis* 27, pp449-463

Chance, D. and W. Lane (1980). A re-examination of interest rate sensitivity and common stock of financial institutions, *Journal of Financial Research* 2, pp49-55

Chen, C. and A. Chan (1989). Interest rate sensitivity, asymmetry, and the stock returns of financial institutions, *Financial Review* 24, pp457-473

Deshmukh, S., S. I.Greenhaum, and G. Kanatas (1983). Interest rate uncertainty and the financial intermediary's choice of exposure, *Journal of Finance* 38, pp141-147

Flannery, M. (1981), Market interest rates and commercial bank profitability: An empirical investigation, *Journal of Finance* 20, pp1085-1101

Flannery, M. and D. James (1984). The effect of interest rate changes on the common stock returns of financial institutions, *Journal of Finance* 20, pp1151-1153

Fraser, D.R., Madura, J. and Weigand, R.A. (2002). Sources of Bank Interest Rate Risk, *The Financial Review* 37 (2002), pp351-368

Giliberto, M..(1985). Interest rate sensitivity in the common stocks of financial intermediaries: A methodological note, *Journal of Finance* 20, pp123-126

Judge, G.G., R. C. Hill, W. E Griffiths, H. Lutkepohl, and T. Lee (1985). *The theory and practice of econometrics*. Hoboken, NJ: J. Wiley.

Koch, T. W. (1992). *Bank Management*, Fort Worth, TX: Dryden Press

Kwan, S. H. (1991). Reexamination of interest rate sensitivity of commercial bank stock returns using a random coefficient model, *Journal of Financial Services Research* 5, pp61-76

Lloyd, W. and R. Shick (1977). A test of Sloane's two index model of returns, *Journal of Financial and Quantitative Analysis* 12, pp363-376

Lynge, W. and K. Zumwalt (1980). An empirical study of the interest rate sensitivity of commercial bank returns: A multiindex approach, *Journal of Financial and Quantitative analysis* 15, pp731-742

Madura, J. and E. Zarruk (1995). Bank exposure to interest rate risk: A global perspective, *Journal of Financial Research* 18, pp1-13

Madura, J. and O. Schnusenberg (2000). Effect of Federal Reserve Policies on bank equity returns, *Journal of Financial Research* 23, pp421-447

Mckown, J.R. (1999). The effects of inverted yield curves in asset returns, *The Financial Review* 34, pp109-126

Mitchell, K. (1989). Interest rate risk at commercial banks: An empirical examination, *The Financial Review* 24, pp431-455

Rose, P. S. (2002). *Commercial Bank Management.* Boston: McGraw-Hill/Irwin.

Stone, B.K. (1974). Systematic interest-rate risk in a two-index model of returns, *Journal of Financial and Quantitative Analysis* 9, pp709-721

Tarhan, V. (1987). Unanticipated interest rates, bank stock returns and the nominal contracting hypothesis, *Journal of Banking and Finance* 11, pp99-115