DO FIRM'S EQUITY RETURN REFLECT THE RISK OF ITS PENSION PLAN?

A CANADIAN EMPIRICAL STUDY

by

Mo, Wenna

B.A. in Economics, University of Victoria, 2006

Xiang, Chris

B.A. in Economics, Hangzhou Dianzi University, 2008

Approval

Name: **Wenna Mo and Chris Xiang**

Degree: **Master of Business Administration**

Title of Project: **Do firm's equity return reflect the risk of its pension plan?**

                             A Canadian empirical study

Supervisory Committee:

_____

Christina Atanasova

Senior Supervisor

Assistant Professor, Finance

_____

Evan Gatev

Second Reader

Assistant Professor, Finance

Date Approved: August 6th, 2010

Dedication

We wish to dedicate this paper to our dearest families and friends for their continuous support, not only during this past year, but also throughout our lives. Without their support, we would never have made it this far.

Acknowledgements

We would like to thank our senior supervisor Dr. Christina Atanasova for her comments and encouragements in the writing of this thesis project. We also would like to thank Dr. Evan Gatev for his comments and suggestions on extending our research.

Warm Thanks to our fellow classmates for their encouragements, suggestions and editing services.

Abstract

This paper examines whether systematic equity risk of Canadian firms as measured by beta from Capital Asset Pricing Model, reflects the risk of firm's defined benefit pension plan. The foremost reason for this study is due to the opaque set of accounting report for pension asset, liability and expenses. Pension asset and liability are kept off balance sheet and are regarded as a separate entity from the rest of the firm. As the equity market and long term interest rate deteriorates, and longevity of people increases in past decade, the risk of pension can be detrimental to the company's financial health as a whole. Panel based models are used in testing the relationship between the firm risk and pension risk The empirical finding in this paper highlighted a direct relationship between the two. It also shows implication for corporate finance practise in the determination of the cost of capital. The standard procedure of measure of cost of capital or for operating assets tend to overestimate the cost of capital which put upward pressure on the discount rate for capital budgeting.

Keywords: Defined benefit pension plan; pension risk; equity risk; pension accounting; cost of capital

_____

Table of Content

1. Introduction

In this paper, we examine the empirical question of whether real-world equity return reflects the risk of corporate pension plans. We focus on the systemic risk of firms and use beta from capital asset pricing model (CAPM) as the measure of the risk. Since 2001 downturn in global equity market and a decline in long term interest rate have negatively affected pension asset and liability. The value of pension assets went down and the amount of liability increase as the discount rate declines. The pension liability grows even faster when the workforce substantially ages for baby boomers and longevity of people improved. Therefore, it is critical for corporate decision makers and regulators to incorporate the pension risk into equity risk. With the expansion of pension plan and accounting standards, plan sponsors must make well informed decision on asset allocation and funding target by correctly estimating pension risk on both asset and liability sides. Numerous empirical studies have been done on the relationship between pension risk and firm risk in UK and US. Their empirical finding supports direct relationship between the two.

However, the question of whether pension risk and pension value in Canada are reflected in the equity risk of Canadian firms has never been examined. The uniqueness about this paper is that we break down the time period from 2000 to 2005 and from 2006 to 2008. The two time periods characterize different economic condition. 2000-2005 is characterized by perfect storm highlighted by low asset return and long term interest rates. During 2006-2008, the credit crunch caused big crash in

the equity market and volatility in the stock market is aggravated. By looking at financial crisis along, the paper provides recommendation for policy makers how to regulate in this environment in terms of pension risk management. Therefore, we are motivated to write the paper with a focus on Canadian firms in order to give empirical support to our argument.

The plan of the paper is as follows. Section 2 discusses the relating literatures and provides overview of the Canadian DB pension plan and trends, and pension accounting risk exposures. Section 3 presents data source, control variables and statistical summary. In Section 4, we derive the company's operating beta from the firm's equity risk as measured by beta from the capital asset pricing model, pension asset beta and pension liability beta. Section 5 shows empirical evidence on the relation between pension risk and firm risk from panel data, cross-sectional regression and Fama Macbeth regression and interpretation of the results. In Section 6, we present our summary on the results, analysis and our suggestion on further development in this area for Canadian firms.

2 Literature Review

A number of empirical studies include Oldfield (1977), Feldstein and Seligman (1981), Feldstein and Morck (1983), Gersovitz (1980) and Westerfield. These researches provided the empirical evidence about the market valuation of pension liabilities, in which they used the standard crossing–sectional valuation models and techniques. In a controversy, Modigliani-Cohn(1977), Summers (1981) and French,

Ruback and Schwert(1983) studied the effects of inflation on firm's nominal assets and liabilities. Feldstein and Morck(1982) also explored how firms' unfunded pension liabilities obligation affect the market value of firms. Jin and Merton (2006) examined the question of whether equity risk of US firm can reflect the risk of their pension plan with capital asset pricing model (CAPM). Their finding indicates that equity beta do appear to reflect both beta of firms' pension asset and liabilities accurately in US capital market.

2.1 Defined Benefit Pension Plan Profile

(Zvi Bodie, John B. Shoven, 1987) Defined benefit pension funds are segregated pools of capital that collateralize the future liabilities explicit (and perhaps implicit) in defined benefit plans. Viewed from traditional perspective, pension funds are entirely separate from the corporation and its shareholders and should be managed without regard to either corporate financial policy or the interests of the corporation and its shareholders. Recently, an alternative perspective regarding pension decision on overall corporate financial policy is that defined benefit liabilities are fixed financial liabilities of the firm. Pension assets on the other hand are the assets of the firm in that the surplus and deficit belong to the firm's shareholders.

2.2 Canadian DB Pension Plan Overview

Unlike other developed country such as United States and United Kingdom, Canada's Constitution has given authority over pension standards to sub national

jurisdiction(Gretchen Van Riesen,2009). Two levels of jurisdiction govern private pension plans – tax and minimum standards (Van Riesen2009). The federal level deals with tax deferral/tax shelter limits, while provincial jurisdictions establish minimum standards for design, funding and administration. Three pillars are in the system. CPP, a universal public retirement income plan, provides direct government subsidies to seniors for the purpose of securing a minimal standard of living including the federal Old Age Security (OAS) and Guaranteed Income Supplement (GIS) and other similar provincial programs. Private contribution-based savings plans are formal plans, such as Registered Retirement Savings Plan (RRSP) or some other financial products which is independently contributed by individuals or through their employers. Private defined-benefit pension is the third pillar that provides members with a regular financial benefit at retirement. Many large companies, as well as federal, provincial and municipal public services, offer such pension plans to their workers (Jay Makarenko, 2010).

2.3 Risk and DB Plan's Current Status

In recent years, many Canadian DB pension funds have become underfunded as due to a downturn in global equity market and a decline in long term interest rates. As the workforce substantially ages in Canada, pension liability growth kept pace. Consequently, the funded status of DB pension plans did not improve (Purcell, 2005). Not only has the estimated number of deficit DB plans not improved, but the magnitude of the aggregate deficit has swelled significantly (Rock Lefebvre, 2005).

Table 1 shows how pension funded status in Canada deteriorated over years and underfunded amounts have been increased from 2001 to 2007.

Table 1: Funded Status for Canadian Plans (2000-2007)

Aggregate Funded Status
in million Canadian dollars

| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
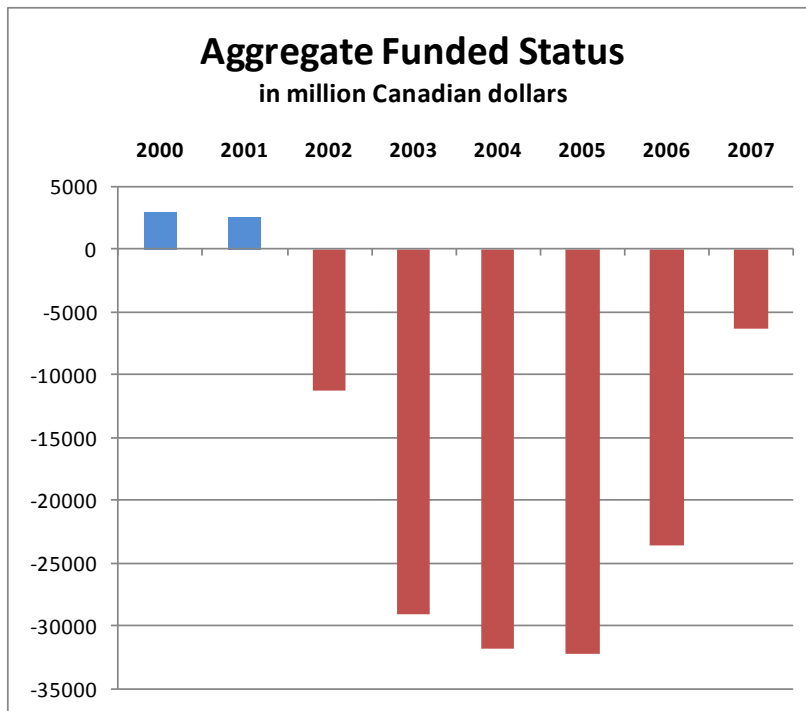
2.4 Accounting Risk exposure and trends

Because companies make contributions to defined contribution plans as the expense arises, no liabilities accrue for that type of plan. However a liability from DB plan does accrue and thus must be measured and reported. (CGA 2003) The highly criticised accounting rule of expected return on plan assets and the various smoothing mechanism is that it leaves billions of dollars worth of pension deficits off-balance sheet. Because the firm report the expected return on plan assets, any difference between the actual return and expected return and gains and losses in the DB plan can be pushed off balance sheet and amortized only when the unrecognized gains or loss

grows larger than 10% of the plan assets (The magic of pension accounting). Pension accounting is complex and it has been long debated. Regulators and analysts advocate a transparent method that funded status of pension plan can be truly reflected in the company's balance sheet. But fear that excessive pension liability booked on the balance sheet will affect company's real economic decision and push down company's stock price. Due to all the inappropriateness in the pension accounting rules, it makes apparent that the DB pension plan sponsored company's financial statement and conditions can be misrepresented.

3. Data and measurement of variables

In This section, we discuss our sample and the construction of variables. Table 2 shows a list of control variables and detailed procedure to construct them, and the procedure to estimate pension asset betas is presented in the appendix.

Table 2

List of control variables

Variable	Calculation
Market share by value	share price* number of outstanding shares
Book to market ratio	book value of firm/market value of firm
Return on investment	Net income/total assets

The data are downloaded from COMPUSTAT and Bloomberg for 140 Canadian firms from 2000 to 2008. Because of lack of uniformity in minimum standards in Canadian pension plan, pension legislations and provisions are different across provinces. We focuses on DB pension plan reported in COMPUSTAT. Majority of firms are from Ontario province, some firms are from other provinces but all the plans

have to comply with reporting standard. COMPUSTAT reports two different measures of pension liability: the Accumulated Benefit Obligation (ABO) and Projected Benefit Obligation (PBO). We use ABO as a measure to Canadian pension liability since ABO contains more data for Canadian firms. If ABO is not available, we use PBO multiply by 0.9565, which is the sample mean ratio of ABO/PBO.

Table 3
Summary statistics
Equity beta is downloaded from Bloomberg and it is daily adjusted return. Beta for pension asset 0.576 is estimated by weighted average of aggregate pension assets on each asset category from 1996 to 2008. The firm risk is $\beta_{E+D} = \beta_E \frac{E}{E+D} + \beta_D \frac{D}{E+D}$, and pension risk is $\beta_{pension} = \beta_{PA} \frac{PA}{E+D} - \beta_{PL} \frac{PL}{E+D}$ where β_{PL} is assumed to be equal to 0.175.

Variable	Number of observation	Mean	Standard deviation	Quantile1	Median	Quantile3
Equity beta	7280	0.609	0.6705	0.4615	0.7182	0.98
Firm risk	7280	0.5997	0.3168	0.3199	0.5152	0.7253
Pension risk	7280	0.0525	0.072	0.0016	0.0819	0.0608

The summary of statistics of our sample is reported in Table 3. It shows large variation in the equity beta. Pension risk (pension asset risk minus pension liability risk) demonstrates very low standard deviation.

4. Background and Methodology

4.1 Background

In Canada, when a company sponsors a defined-benefit pension plan, the plan's assets and liability, although segregated, are assets and liability of the company. To simply the method, we assume there are no tax and insurance effects. We follow Jin, Bodie and Merton (2006) to derive the relations between pension plan risk and firm

equity risk, and we discuss how the firm's operating assets risk con be correctly estimated from the pension plan risk and observed equity risk. We then derive the structure of estimation specification errors in measuring firm operating risk when pension risk is accounted for improperly. We analyze two circumstances: (1) that the entire pension plan, assets and liability is neglected in the estimation of operating asset risk and (2) that the values of pension assets and liabilities are correctly taken into account, but the risks of plan assets and liabilities are not.

4.2 The derivation of firm's operating asset risk

Define OA as the value of operating assets, E as the value of equity, D as the value of debt, PA as the value of pension assets, PL as the value of pension liabilities, PS = PA −PL as the pension surplus, and L = D/E as the leverage ratio. Therefore,

Assets = OA + PA = E + D + PL = Liabilities.

We examine three cases:

Correct Case: calculation of operating asset risk correctly incorporates both the value and the risk characteristic of the pension plan.

$$\beta_{OA} = \frac{E}{OA}\beta_E + \frac{D}{OA}\beta_D - \left[\frac{PA}{OA}\beta_{PA} - \frac{PL}{OA}\beta_{PL}\right]$$

$$= \frac{E}{OA}(\beta_E + \beta_D) + \frac{D-E}{OA}\beta_D - \frac{PA}{OA}(\beta_{PA} - \beta_{PL}) - \frac{S}{OA}\beta_{PL}$$

Error case 1: calculation of operating asset risk ignores the pension plan's value and risk altogether.

$$\hat{\beta}_{OA} = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E$$

Error case 2: calculation of risk includes the pension surplus, S, but neglects difference between β_{PA} and β_{PL}

$$\hat{\hat{\beta}}_{OA} = \beta_E \frac{E}{OA} + \beta_D \frac{D-S}{OA}$$

The risk level of pension liability is similar to firm debt for firms with normal leverage ratio. The beta of debt can be quite low since debts of the firms are not often traded. Risk level of pension asset on the other hand has higher beta risk than the firm debt as the portion of pension assets are invested in equities. In this paper, we assume the beta for both pension liability and firm's debt to be 0.175 and the overall beta for pension assets is estimated to be 0.567[1].

---

[1] The pension asset beta 0.567 is estimated by weighted average of aggregate pension assets for each asset category from 1996 to 2008(see appendix 1.2). The assumed beta in calculation is 1 for equity, 0.175 for bonds, 0.006 for cash and 0.15 for real estate (JFE, 2006).

Table 4
Selected company balance sheet information for 2008
Pension asset and pension liability are from Compustat. Market cap of equity and Book value of debt are obtained from Bloomberg.
Figures are in million of dolloars

Company	Pension asset	Pension liability	Pension Surplus (shortfall)	Market Cap of equity	Book value of debt	Operating asset (E+D-PA+PL)
Bank of Nova Scotia	5537	4414	1123	33040.86	18166	50083.8552
Thomson Reuters	3698	4175	-477	29451.17	6630	36,558
Canadian Imperial Bank	3794	3641	153	19454.98	42246	61547.98004
Canadian National Railway	13611	12326	1285	20966	7598	27278.996
Telus	5654.00	5243.00	411	11807.03	6348	17744.0282

Five big Canadian firms sorted by market capitalization are used in estimating the pension risks. By inspection of Table 4, 4 of the firms' plans are overfunded and Thomas Reuters has a small pension deficit and pension liability is small relative to market capitalization.

Table 5
Estimated equity and operating asste betas for 2008
Beta of equity are estimated using CAPM, using data on five-year monthly stock return obtained from CRSP and the return on TSX index as proxy for market. Beta of debt is assumed to be 0.175 through out the paper. Operating asset beta correct is the operation asset beta when correctly accounting for pension value and risk, Operating asset beta error 1 is the operating asset beta ignoring pension plan altogether, and Operating asset beta error 2 is the operating asset beta counting pension value but misrepresenting pension risk.

Company	Equity beta	OA beta correct	OA beta error 1	Percent overestimate for error 1	OA beta error 2	Percent overestimate for error 2
Bank of Nova Scotia	0.527	0.374	0.412	10.17	0.417	11.594
Thomson Reuters	0.427	0.338	0.381	12.51	0.378	11.719
Canadian Imperial Bank	0.504	0.255	0.279	9.39	0.279	9.487
Canadian National Railway	0.504	0.233	0.417	79.19	0.428	84.091
Telus	0.616	0.344	0.462	34.41	0.469	36.345

According to Table 5, the correct estimates of operating asset beta for these five firms are 0.374, 0.338, 0.255, 0.233 and 0.344, respectively. When commit error 1 is made, a flawed procedure ignores the pension plan altogether, we obtain the operating asset beta 0.412 0.381, 0.279, 0.417 and 0.462 respectively. The largest estimation error is for Canadian National Railway overestimated by 79%. The operating asset betas for the rest of the firms are overstated by between 10% and 35%. Error 2 is

present when pension value but not pension risk is incorporated in the calculation and

the resulting betas are still significantly different from their correct value.

Table 6
Estimated costs of capital for 2008
The cost of capital is estimated using the capital asset pricing model to estimate equity cost of capital, assuming a risk free rate of 3.67%/year and a market risk premium of 7.13%/year.

Company	Correct cost of capital estimate (%)	Cost of capital estimate error 1 (%)	Percent overestimate error1	Cost of capital estimate error 2 (%)	Percent overestimate error 2
Bank of Nova Scotia	6.335	6.606	4.280	6.644	4.546
Thomson Reuters	6.082	6.384	4.963	6.365	4.298
Canadian Imperial Bank	5.486	5.656	3.107	5.658	2.840
Canadian National Railway	5.328	6.642	24.648	6.723	24.123
Telus	6.120	6.964	13.777	7.011	13.620

The cost of capital can be overestimated if operating asset risk and pension plan

risk are not recognized. Because the cost of capital is used as discount rate for

operating projects, overestimating the cost of capital leads to overstated discount rate.

We use 3.67% as risk free rate and 7.13 as market risk premium.[2] (Table 6) For

Canadian National Railway, the two error measurements of cost of capital yield an

overestimate of about 25%. The correct cost of capital is 6.34%, 6.08%, 5.49% and

6.12% for Bank of Nova Scotia, Thomson Reuters, Canadian imperial Bank and Telus

respectively, while the standard approach yields 6.61%, 6.38%, 5.66% and 6.96

respectively, for an over estimated range from 3% to 25%.

---

[2]Risk free rate of 3.67% is calculated by taking the expected return of 10 year Canadian bond in 2008. 7.13% is estimated by taking the expected return of the difference between TSX/SP index return and risk free rate.

4.3 The derivation of firm's risk and pension risk

In subsection 4.2, we demonstrated the extent of overestimation when pension risk and pension plan are not fully recognized by standard measure of the firm's risk. In this subsection, we explore the question to the extent how strong the risk relation between pension risk and firm risk holds in practice. We incorporate company's pension funding status into the risk of its equity. We test the hypothesis that a higher pension plan risk lead to a higher overall firm market risk and measure the magnitude of the relation between pension risk and firm risk.

Define the capital risk, the firm risk is estimated as

$$\beta_{E+D} = \beta_E \frac{E}{E+D} + \beta_D \frac{D}{E+D}$$

The net pension risk is measured as

$$\beta_{pension} = \beta_{PA} \frac{PA}{E+D} - \beta_{PL} \frac{PL}{E+D}$$

We fit the simple regression as follows:

$$\beta_{E+D} = a + b\beta_{pension} + \varepsilon$$

The data is split into two periods: from 2000 to 2005 and from 2006 to 2008 for panel A and panel B respectively. Because the pension data for Canadian firms is fairly small, we run three different regressions in order to show the consistency of the results across different tests: (1) that uses Fama Macbeth regression (2) that use panel

data with fixed effects (3) that runs pooled cross sectional regression with industry dummies.

The regression coefficients and their t-statistics are reported in Panel A and Panel B below. Panel A represents period of 2000 to 2005 and Panel B is for period of 2006 to 2008. The pension liability beta is set to be 0.175 and 0.30 respectively.

Panel A (2000-2005)

Regression test	Fama Macbeth		Time dummy		Tme and industry dummies	
	Beta_PL=0.175	Beta_PL=0.3	Beta_PL=0.175	Beta_PL=0.3	Beta_PL=0.175	Beta_PL=0.3
Intercept	0.47798	0.48419	0.37380	0.38472	0.33514	0.32541
	(−13.570)	(13.340)	(7.610)	(7.830)	(1.480)	(1.430)
Pension risk	0.18729	0.03776	0.14157	0.01340	0.44136	0.63547
	(1.040)	(0.140)	(0.760)	(0.050)	(1.820)	(1.890)
R-squared	0.02300	0.02190	0.04990	0.04850	0.39550	0.39600
Intercept	0.46696	0.46950	0.41626	0.42705	0.55398	0.54662
	(9.550)	(9.400)	(7.890)	(8.110)	(2.270)	(2.240)
Pension risk	0.12278	−0.01061	0.15892	0.04523	0.47308	0.69537
	(0.760)	(−0.050)	(0.840)	(0.170)	(1.920)	(2.050)
Marketsharbysales	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000
	(4.030)	(4.100)	(−0.320)	(−0.310)	(0.400)	(0.380)
Booktomark ratio	−0.05860	−0.05581	−0.04828	−0.04825	−0.04407	−0.04485
	(−2.330)	(−2.350)	(−2.900)	(−2.890)	(−2.600)	(−2.650)
Return on investment	0.04183	0.05486	−0.03297	−0.03857	0.08457	0.08961
	(0.180)	(0.230)	(−0.260)	(−0.300)	(0.690)	(0.730)
R-square	0.29320	0.29190	0.07070	0.06900	0.41530	0.41620
obs	390	390	390	390	390	390

Panel B (2006-2008)

| Regression test	Fama Macbeth		Time dummy		Tme and industry dummies	
	Beta_PL=0.175	Beta_PL=0.3	Beta_PL=0.175	Beta_PL=0.3	Beta_PL=0.175	Beta_PL=0.3
Intercept	0.638	0.635	0.601	0.600	0.558	0.557
	(28.380)	(32.210)	(14.340)	(14.280)	(2.620)	(2.620)
Pension risk	−0.648	−0.906	−0.643	−0.864	−0.111	0.017
	(−2.440)	(−2.520)	(−2.110)	(−2.030)	(−0.420)	(0.050)
R-squared	0.020	0.021	0.022	0.021	0.706	0.705
Intercept	0.588	0.584	0.536	0.536	0.534	0.528
	(5.230)	(5.180)	(9.030)	(9.020)	(3.360)	(3.330)
Pension risk	−0.637	−0.919	−0.751	−1.032	−0.050	0.064
	(−3.610)	(−3.340)	(−2.520)	(−2.490)	(−0.190)	(0.170)
Marketsharbysales	0.000	0.000	0.000	0.000	0.000	0.000
	(2.440)	(2.480)	(2.620)	(2.630)	(0.080)	(0.040)
Booktomark ratio	−0.095	−0.094	0.026	0.025	−0.048	−0.048
	(−0.620)	(−0.620)	(0.820)	(0.810)	(−2.370)	(−2.380)
Return on investment	0.813	0.823	0.665	0.668	0.347	0.349
	(1.380)	(1.380)	(3.710)	(3.730)	(2.700)	(2.710)
R-square	0.182	0.183	0.103	0.103	0.722	0.722
obs	258	258	258	258	258	258

5. Estimation Results

In Panel A, when we run overall regression between pension risk and firm risk pension liability beta is assumed to be 0.175, the estimated coefficients are 0.19, 0.14 and 0.44 respectively for Fama Macbeth model, regression on time dummy and regression on both time and industry dummies. T-stat values are presented in the bracket under the coefficients. The coefficient on pension risk is only slightly different between FM and panel regression using fixed effects and not statistically significant. However, when we include industry dummies and estimate pooled cross section regression, the statistical significance increased substantially within 95% confidence level for both levels of assumed pension liability beta. When control variables are added into the regressions, the R-square has increased significantly. The

pension risk coefficient remains positive sign and it is statistically significant for regression test with time and industry classification dummies. Thus, for the period of 2000 to 2005 at the expansion of pension and accounting regulation, when the equity return and long term interest rate are low, pension risk is positively correlated with firm risk: one unit increase in pension risk increases the firm risk by 0.44 to 0.64 units. The magnitude of the firm risk increase as a result of pension risk is determined by the assumed pension liability beta. The higher the assumed pension liability beta, the higher the firm risk when holding pension liability at the same level across companies.

The outcome for Panel B (2006-2008) shows a different picture. The coefficient for pension risk is negative for the first two tests with strong statistical significance. For beta of pension liability being 0.3, the overall pension risk is -0.91and -0.86, and the t value is -2.5 and -2.03 respectively. Strong t value implies that the reverse relation between pension risk and firm risk is robust during the second period. The result might be counter intuitive and partly might be contributed to the financial crisis during this period highlighted by crackdown in equity market. As seen in Table 7, the beta of the firm has significantly increased since 2006, but the beta of pension has remained constant over time. During the extreme volatility in the market, a flight to quality occurred as investors rush to less risky, more liquid investment, such as bonds or government. In the economic environment where everyone panics, people tend to behave irrationally, so the market valuation is not tied to the fundamentals. Beta as a

measure of equity risk from CAPM cannot fully reflect the equity risk at that particular economic environment. Thus, further investigation in the relation between firm risk and pension risk is suggested.

Table 7 mean of each beta

Mean of Betas 2000-2008
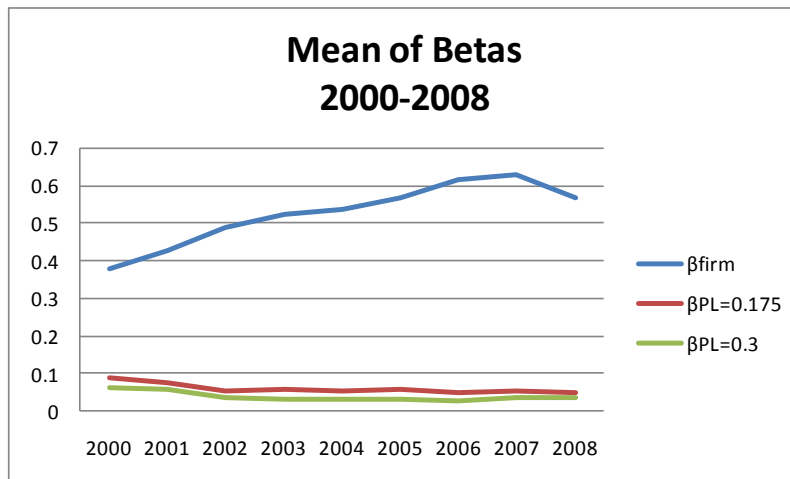
6. Conclusion and further improvements

This paper focuses on an important area where no Canadian pension literature has previously explored. It examined pension plan risk, as measured by pension asset risk minus pension liability risk, and its impact on the off balance sheet and non operating risk on equity risk measured beta from CAPM and the bias in estimation of the firm's cost of capital for capital budgeting for 140 Canadian companies over two sub period 2000-2005 and 2006-2008 respectively. The period of 2000-2005 has coincided with lower equity return and long term interest rate accompanied by tightening in pension accounting regulation. The majority of DB pension scheme of the companies in the sample have been under funded. Because of the low equity return, a trend has been

characterized by a marginal shift away from equities and towards bonds. By looking

at Panel A, the third regression test including time and industry dummies along, our

finding confirms the hypothesis that pension risk is positively related to firm's risk.

This suggests that pension risk does feed into firm equity and the market views the

assets and liabilities of the company pension scheme as part of the assets and liability

of the firm itself. However, the lack of robustness in the other two tests in Panel A

casts doubt on the original hypothesis. This might be explained by lack of availability

of Canadian pension data and number of firms in the sample are either inactive or

trade very infrequently. When more pension data become available in Canada, further

study can be improved by only considering frequently traded and active firm in the

sample. During the second period 2006-2008 characterised by meltdown in equity

market, market valuation tied to fundamentals could not fully reflect the picture

because the market is based on the irrational behaviour of investors. We suggest

further study on this particular period.

Appendix

Pension asset categories	Assumed beta	2008 Average asset allocation	2008 Weighted allocation beta	2006 Average asset allocation	2006 Weighted allocation beta	2004 Average asset allocation	2004 Weighted allocation beta	2002 Average asset allocation	2002 Weighted allocation beta	2000 Average asset allocation	2000 Weighted allocation beta	1998 Average asset allocation	1998 Weighted allocation beta	1996 Average asset allocation	1996 Weighted allocation beta	1994 Average asset allocation	1994 Weighted allocation beta	1993 Average asset allocation	1993 Weighted allocation beta	1992 Average asset allocation	1992 Weighted allocation beta
Equity																					
CND common and preferred equity 1		0.036	0.036	0.223	0.223	0.262	0.262	0.251	0.251	0.305	0.305	0.311	0.311	0.364	0.364	0.310	0.310	0.299	0.299	0.276	0.276
Foreign common and preferred eq 1		0.064	0.064	0.273	0.273	0.213	0.213	0.192	0.192	0.166	0.166	0.158	0.158	0.131	0.131	0.117	0.117	0.109	0.109	0.104	0.104
Bond																					
Federal Bond	0.175	0.315	0.055	0.149	0.026	0.181	0.032	0.187	0.033	0.191	0.033	0.187	0.033	0.17	0.031	0.186	0.033	0.174	0.030	0.185	0.032
Provincial Bond	0.175	0.254	0.045	0.101	0.018	0.119	0.021	0.126	0.022	0.122	0.021	0.149	0.026	0.156	0.027	0.188	0.033	0.214	0.037	0.235	0.041
Municipal Bond	0.175	0.011	0.002	0.003	0.001	0.003	0.001	0.004	0.001	0.005	0.001	0.007	0.001	0.009	0.002	0.011	0.002	0.012	0.002	0.015	0.003
Other Canadian Bonds	0.175	0.121	0.021	0.072	0.013	0.069	0.012	0.077	0.013	0.076	0.013	0.060	0.011	0.050	0.009	0.054	0.009	0.060	0.011	0.059	0.010
Foreign Bond	0.175	0.042	0.007	0.055	0.010	0.016	0.003	0.013	0.002	0.019	0.003	0.022	0.004	0.006	0.001	0.006	0.001	0.005	0.001	0.005	0.001
Cash																					
Cash ST	0.006	0.112	0.001	0.038	0.000	0.063	0.000	0.073	0.000	0.061	0.000	0.065	0.000	0.067	0.000	0.078	0.000	0.085	0.001	0.074	0.000
Cash GIC	0.006	0.018	0.000	0.013	0.000	0.010	0.000	0.009	0.000	0.007	0.000	0.007	0.000	0.006	0.000	0.014	0.000	0.011	0.000	0.012	0.000
Real estate	0.15	0.026	0.004	0.073	0.011	0.064	0.010	0.069	0.010	0.048	0.007	0.034	0.005	0.032	0.005	0.037	0.006	0.031	0.005	0.037	0.005
Beta by year			**0.235**		**0.574**		**0.552**		**0.525**		**0.551**		**0.549**		**0.570**		**0.506**		**0.495**		**0.473**

References

Fama,E., MacBeth,J.1973.Risk,return,and equilibrium: empirical tests. Journal of Political Economy 81(3),607-636

Burlow,J.Morck,R.Summers,L.1987.How does the market value unfunded pension liabilities?

Lefebvre, Roack. 2005 The state of defined benefit pension plan in Canada,

Li Jin, Robert C. Merton, Zvi Bodie: Do a firm's equity returns reflect the risk of its pension plan? 2005

Carroll,T.,Niehaus,G.,1998. Pension plan funding and corporate debt rating. Journal of Risk and Insurance 65(3),427-443.

Laidler, David, and William B.P. Robson. 2007. Ill-Defined Benefits:
The Uncertain Present and Brighter Future of Employee Pensions in Canada. C.D. Howe Institute Commentary 250. Toronto.

Carrol,T.,Niehasu,G.,1998. Pension plan funding and corporate debt rating. Journal of Risk and Insurance 65(3),427-443

Fama,E. French,K.,1992. The cross-section of expected stock return, Journal of Finance 47(2),427-465

Famma,E., MacBeth,J. 1973.Risk, return and equilibrium: empirical tests. Journal of Political Economy 81(3),607-636

Scott, Jason. 2008. "The Longevity Annuity: An Annuity for
Everyone?" Financial Analysts Journal, January-February
2008. Vol. 64, No. 1.

Buchanan, James. 1969. "Cost and Choice: An Inquiry into Economic Theory." The Library of Economics and Liberty.

General Accountants' Association of Canada (CGA). 2004. "Addressing the Pensions Dilemma in Canada." Available on the Web at: http://
http://www.cga-canada.org/en-ca/ResearchReports/ca_rep_pensions.pdf

 Business Wire
http://www.allbusiness.com/labor-employment/human-resources-personnel-managem ent/5211734-1.html