

Too Much Capital? An Examination of Capital Requirements for Canadian Property / Casualty Insurers

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Introduction

Popular analyses of the property / casualty¹ insurance market conjecture that firms are, in general, over capitalized (for example Bodenmann, Franceschetti, Hoefter and Lyso (2000) and Doherty and Phillips (2000)).

Bodenmann et al (2000) state that insurance companies carry from 50 to 100 percent more equity than they use. If insurance companies realistically assess the genuine risk their business units carry, most of them will probably find that they have surplus capital reserves. These reserves could be managed better to produce higher returns for the firm.

Doherty and Phillips (2000) ask whether property / casualty insurers have built up equity over the past decade relative to some sensible reference value and, if so, why? Capital holdings of American property / casualty insurers have increased relative to premium and liability levels over the past decade. They show that insurers have increased capital holdings in response to an increased stringency in rating requirements with the highest ranked firms increasing capital at the greatest rate. The authors conclude that the cost of losing a good financial rating must be extremely high given the high cost of holding excess capital.

Over-capitalization is expensive. The standard costs of over capitalization include: shareholders do not receive the return on equity that they deserve; firms do not receive the optimal level of tax breaks; and managers act inefficiently. In particular, industry risk managers² have conjectured that weak underwriting results occur when a firm is over capitalized. Premium levels are not raised quickly enough in response to increasing claims costs if a firm can rely on excess surplus to cover any short fall.

Deregulation, merger and acquisition activities, tougher competition, and eroding margins make it increasingly important to ensure that shareholders earn competitive returns. To survive, property / casualty insurers need to estimate the capital they need, and then effectively manage their capital to maximize the company's value and shareholder returns.

First and foremost, capital levels are driven by regulatory requirements. Considerable debate is happening worldwide regarding the measurement of capital adequacy. How should capital requirements be mandated to ensure both solvency and profitability? The purpose of this study is not to add to this debate. Instead we wish to explore the capital holdings of Canadian

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¹ *Although the term property / liability is growing in popularity in many jurisdictions, property / casualty is the term most commonly used in Canada and which most accurately describes the industry's biggest markets.*

² *Private conversations with various risk managers.*

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property / casualty insurers, taking regulatory requirements as given. In particular, we will address the following issues.

- Are firms in fact over capitalized with respect to mandated capital adequacy thresholds? We wish to compare the actual asset holdings of firms to the minimum that they need to hold to pass regulatory capital tests.
- Do higher capital holdings translate into lower ROEs for firms? If there is no relationship between a firm's surplus levels and its ROE, what are the major determinants of a firm's ROE?
- Is there a relationship between Best's Ratings and a firm's capital holdings, as shown to be in the United States? Industry observers in Canada believe that, due to the lack of institutional investors, Best's Ratings are not as important in Canada. We would like to verify this belief.
- Which firm characteristics are important in determining capital holdings? In particular, do smaller, less diversified firms hold relatively more capital than larger more diversified firms or more than firms with significant international backing?

Using A.M. Best WinTrac data for 2000, we found overall that firms were not excessively overcapitalized in that the median excess capitalization, as measured by the proportion of assets held in excess of statutory levels, was 23%. Insurers held roughly one-quarter more capital than they needed by law. Firms that with greater overcapitalizations tended to be smaller firms.

There was no support that higher capital levels produced lower returns on equity for firms. More important predictors of a firm's ROE were its operating results. Firms with higher ROEs, not surprisingly, had lower underwriting ratios and higher investment yields.

As expected, greater capitalization levels (with respect to a firm's NPW) are not a predictor of a firm's Best's ranking. The key indicators of ratings were firm size and return on equity.

With respect to why some insurers hold more capital than others, our results are inconclusive at best. There is some support that the investment risk ratio of a firm reveals a firm's risk preference in that firms that hold more of their assets in stock also hold less capital. Firms with greater loss reserves (standardized to net written premiums) also hold more capital. But it is clear that our model does not capture the forces of over-capitalization.

What we have primarily determined is that the excess capitalization puzzle will not be an easy one to solve. We hope that our initial survey will lead to a continued dialogue on capital holdings for property / casualty insurers in Canada.

Property / Casualty Insurance in Canada

In Canada, the property / casualty insurance market is very competitive with some 230 active companies which are highly regulated both at the provincial (with respect to practices) and federal (with respect to solvency) levels. Canada's property / casualty insurance industry is the least concentrated of the financial services industries in Canada. Market share of the 10 leading property / casualty insurers in Canada is just under 50% in 2000, much less than the level of concentration in the banking industry, where the six leading firms account for more than 95% of that industry's assets.

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The Office of the Superintendent of Financial Institutions (OSFI) oversees the solvency of federally regulated insurers. The key test of surplus adequacy or insolvency risk is the minimum asset test (MAT) for Canadian insurers and the deposit adequacy test (DAT) for foreign insurers.³ A detailed description of the MAT test is given in Appendix 1. Briefly, the MAT / DAT compares a firm's allowable assets with what it needs to cover all its liabilities by a preset safety margin. The test statistic reports the excess between allowable and required capital holdings divided by required capital levels. Firms need to achieve a statistic of 0% to pass the test.

In 2000, the median MAT result for Canadian companies was 26.55% higher than the regulatory minimum of 0%. Foreign insurers' DAT test results were 36.96% higher than required. At the company level, there are large variations in the minimum asset test result. Among the 30 largest insurers (excluding public insurers), the capital adequacy test ranged between 6% and 55%. On an industry-wide basis, Canadian insurers carried 19% more capital than necessary, and foreign insurers, 25% more capital than necessary.

Two other tests used by regulators to measure an insurer's capitalization are the loss reserves-to-surplus test and the NPW to surplus ratio⁴. The loss reserves-to-surplus test is a leverage ratio calculated by dividing a company's net provision for unpaid claims by its capital and surplus. A loss reserve-to-surplus ratio that is above two-and-a-half times is a red flag to insurance regulators. At the company level, the average ratio in 2000 was 1.05, and the median was 0.66. Over the recent years, the loss reserve-to-surplus ratio for the industry has been ranging between 1.3 and 1.5.⁵

The ratio of net written premiums to surplus levels, or the insurance risk ratio, is a measure of the company's ability to absorb financial shocks. OSFI allows for up to a 3 to 1 ratio. Best's defines this ratio as the company's ability to absorb financial shocks. The higher the ratio of premiums to surplus, the greater is the potential risk borne by the company in relation to the surplus available to absorb loss variations and the greater its leverage of available capital.

The data used in this study are financial results reported to A.M. Best via WinTrac for all insurers licensed in Canada in year 2000. From this set, we removed all insurers who have no direct written premiums for the year 2000, but who act as reinsurers only. We conjectured that reinsurers would face different pressures on capital holdings and, as such, not fit into this framework.

Description statistics of these 174 insurers are given in Table 1. We defined Canadian insurers without additional capital resources as those insurance companies that are not part of an international insurer, like ING, nor are they owned by a bank, like RBC Insurance, nor are they part of a larger financial conglomerate, like Kingsway Financial. Both average and median values are shown because of a significant number of outliers for some variables.

³ This test is being replaced with the Minimum Capital Test in 2003. The key difference between the MAT and the MCT is that the MCT calculates margins for both assets and liabilities at risk, whereas the MAT focuses on liabilities.

⁴ In addition, firms are also rated by AM Best Company. Key tests relating to surplus are the above tests plus a test of receivables (excess receivables to surplus ratio).

⁵ Insurance Bureau of Canada. (June 2000) Perspectives.

Table 1 – Summary Statistics of Insurer Data

<i>Number of Canadian insurers without additional capital resources</i>	65	
<i># Insurers failing the MAT / DAT test</i>	3	
	<i>Average</i>	<i>Median</i>
<i>Surplus to NPW ratio</i>	3.0	0.93
<i>2 year ROE</i>	9.6%	10.5%
<i>2 year underwriting ratio</i>	109.7%	103.8%
<i>MAT / DAT ratio</i>	61.26	26.55
<i>NPW (Cdn \$1000)</i>	112,341	24,713
<i>Best's rating (for those firms that are rated)</i>	A-	A-

The surplus to NPW ratio is the inverse of the insurance risk ratio used by OSFI; as such the minimum requirement on this test would be 0.33. We use this variable as one measure of capital adequacy. This is more intuitive measure for capitalization than the insurance risk ratio since larger ratios signify greater capital holdings.

Are Firms Over Capitalized?

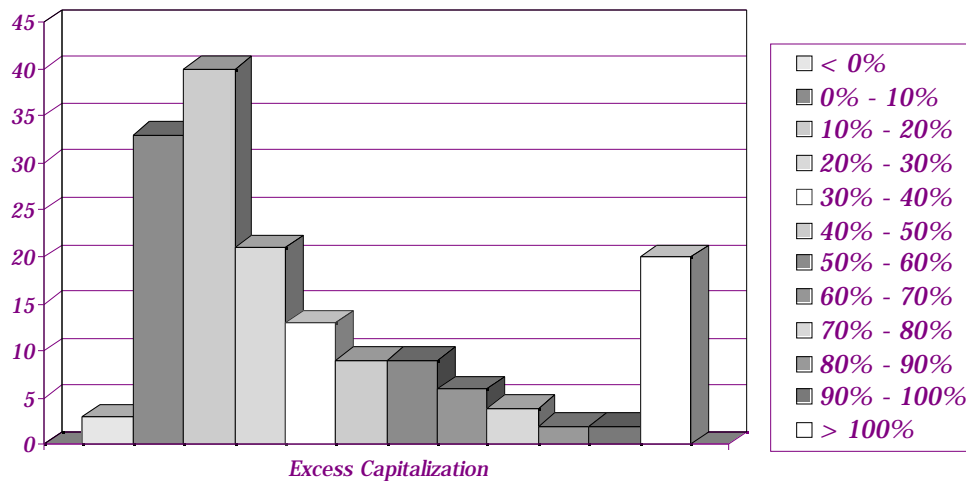
To measure whether firms were overcapitalized, we calculated the book value Minimum Total Capital (MTC)⁶ that the firm needs to hold to pass the MAT test. We then compared the MTC to total asset holdings of the firm, calculating a firm's excess capitalization as:

$$\frac{\text{MTC} - \text{Total Asset Holdings}}{\text{Total Asset Holdings}}$$

For this analysis, firms which are licensed only in Quebec and do not report MAT statistics were eliminated. This left 162 companies in the data set. Of the remaining firms, excess capitalization (EC) was 55% and the median EC was 23%. A histogram of excess capitalization is given in Figure 1. This figure displays the number of firms with excess capitalization less than 0 % (under-capitalized), 0% – 10% overcapitalized, 10% – 20% overcapitalized and onward to the last category of greater than 100%. Of those firms that are overcapitalized, 73, 46% of firms, of them carry less than twenty percent excess capital and 94, or 59% of firms, carry less than 30% excess capital. Those firms that were greatly over-capitalized (ratios greater than 30%) had significantly lower required asset levels than firms not excessively over-capitalized: \$75.8 million compared to \$430.8 million. Average calendar year asset holdings for these two categories were \$118.5 million and \$478.7 million respectively. Greatly over-capitalized firms also wrote less business: \$36 million versus \$176 million in net premiums written in 2000.

⁶ The calculation for the MTC is described in Appendix 1.

Figure 1 – Histogram of Excess Capitalization



Therefore, although several firms appear to be excessively over-capitalized, at first glance these firms tend to be smaller firms. Thus we find no strong support for the accepted opinion that property / casualty insurers in the Canadian market are over capitalized. This does not preclude the fact that MAT requirements may be excessive, but, as stated earlier, that is beyond the scope of this survey.

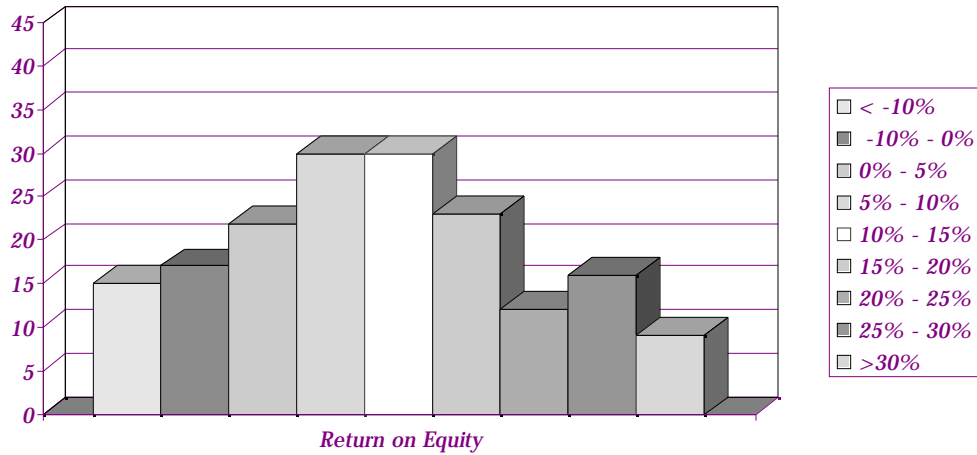
Do Higher Capital Holdings Reduce Firm Profitability?

Industry participants comment that one reason property / casualty insurance insurers are performing so poorly – 3.2% industry wide ROE in 2001, 6.2% in 2000 and 5.4% in 1999 - is because of onerous capital requirements. If this is true, then we expect that firms with high capital holdings should have lower rates of return on equity.

ROE numbers for 1999 and 2000 were significantly higher than that for 2001, mainly due to higher investment income. The distribution of 2 year (1999 and 2000) pre-tax ROE results for the industry is given in Figure 2.

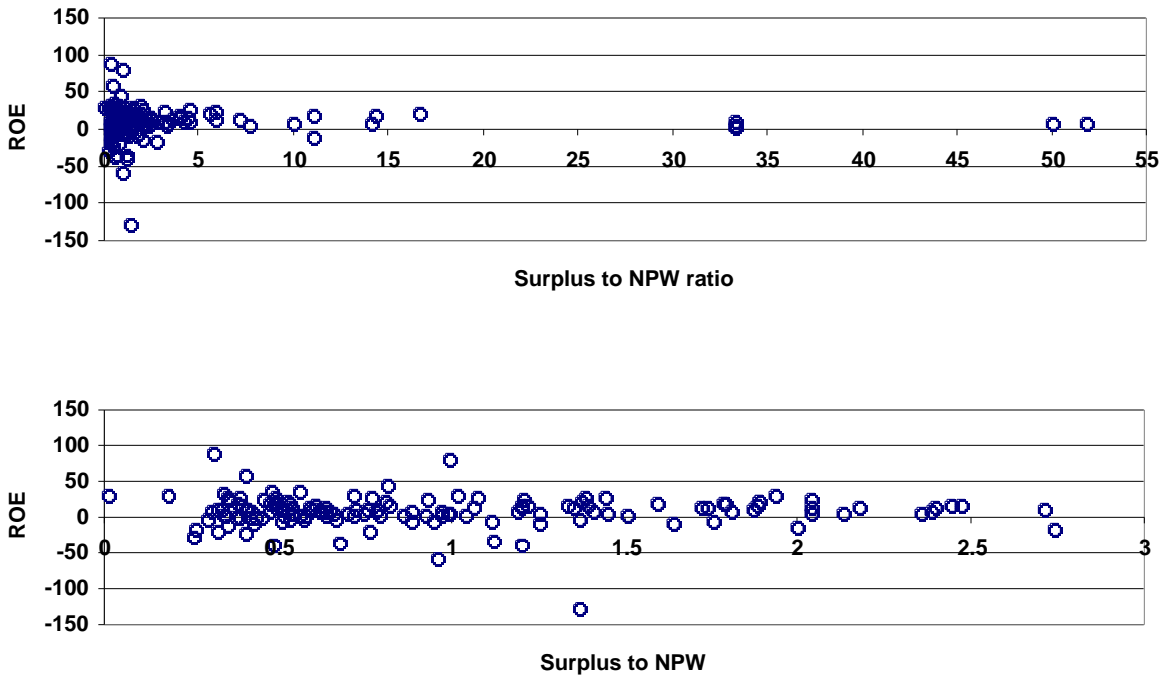
To test the hypothesis that excess capital requirements are weighing down the industry, we need to define what we mean by high capital holdings. If we were concerned with capital holdings in excess of regulatory requirements then the excess capital (EC) ratio, developed in the previous section, would be a reasonable variable. However, if one believes that regulatory requirements are excessive, a calculation based on total surplus holdings is more suitable. In this section, we will look at total surplus requirements, using the surplus to NPW ratio, as discussed previously. Since we are not using MAT data, we added back to the dataset those firms that did not report MAT statistics.

Figure 2 – Histogram of 2 Year Pre-tax ROE



We find no statistical relationship between the surplus to NPW ratio, in itself, and the firm's 2 year ROE. The two graphs in Figure 3 illustrate this lack of relationship. The top chart graphs each insurer's 2 year ROE versus surplus to NPW ratio. The second graph replicates the first; removing those companies with surplus to NPW ratio greater than three to better illustrate the (lack of) relationship for firms with smaller surplus to NPW ratios

Figure 3 – Surplus to NPW versus 2 Year Pre-tax ROE



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It is possible that the relationship between excess surplus and ROE is not linear, but that firms with high ROEs had lower capitalization levels. To test this hypothesis, we divided the data set into two groups: those with ROEs less than 15%, and those with ROEs greater than 15%. Capitalization was higher in the first group; the average surplus to NPW ratio for firms with ROE less than 15% is 3.54, compared with 2.02 for firms with ROEs greater than 15%. However these results are not statistically significant.⁷

What therefore are the determinants of a firm's ROE? To answer this question, we examined the following explanatory variables:

- *2 year underwriting ratio.* This relationship, if it is significant, should be negative. Firms that have better underwriting results should have higher ROEs.
- *Investment yield.* Investment yield should be positively related to ROE. Firms that earn higher yields on their portfolio of assets, ceteris paribus, should produce higher returns for their shareholders.
- *Surplus to NPW ratio.* Although we have shown that by itself, this ratio does not explain variability in firm profitability, it may be significant in combination with other firm characteristics. If it is significant, we expect the relationship to be negative.
- *Total auto concentration.* Given the poor outcomes in the auto insurance markets of Ontario, Atlantic and Alberta, we conjecture that firms who are heavily concentrated in these three markets will have poorer profitability. Our measure of concentration is direct premiums written in these markets divided by the firm's total direct premiums written.
- *Adjusted loss reserves to NPW.*⁸ Firms which have longer tailed lines will be able to earn larger returns on premiums than firms which pay out premium dollars quickly. If significant, we expect a positive relationship between the relative size of loss reserves and a firm's ROE.

Using the previous division of firms, we find that, with the exception of the surplus to NPW ratio, all these performance measures differ significantly (at the 5% level) between the two groups. The results are detailed in Table 2

Table 2 – Firm Characteristics based on 2 Year Pre-Tax ROE

Variable	Firms with ROE < 15%	Firms with ROE > 15%
Average 2 year underwriting ratio	118.56	93.22
Average investment yield	7.27%	8.41%
Average total auto concentration	31.23%	13.87%
Average adjusted loss reserves to NPW	7.28	8.41

⁷ If insurers are classified by a threshold of 20% ROE, then the surplus to NPW ratio was significantly different between the two groups.

⁸ A.M. Best adjusts a firm's loss reserves to reflect the insurer's past accuracy in reserve estimation.

What factors are the best determinants of ROE? Table 3 lists the potential covariates, their expected relationship and the fitted regression model. A firm's underwriting ratio is the most significant measure in explaining a firm's ROE. Capital holdings are not relevant at all. The R^2 for this model is 51%

Table 3 – Determinants of ROE

Variable	Expected Relationship	Co-efficient
Intercept		38.005*
Two year underwriting ratio	-	-0.321*
Surplus to NPW ratio	-	-0.056
Auto concentration	-	-8.046*
Investment yield	+	1.078*
Adjusted loss reserve to NPW	+	0.280*

* Significant at 5% level

Therefore we find no strong support for the hypothesis that poor industry profitability is caused by excess capital holdings. A firm's underwriting ratio, the relative size of its private passenger auto market, its investment yield and the relative size of its loss reserves are more important predictors of ROE.

Do Firms with Higher Surplus Levels Have Higher Best's Ratings?

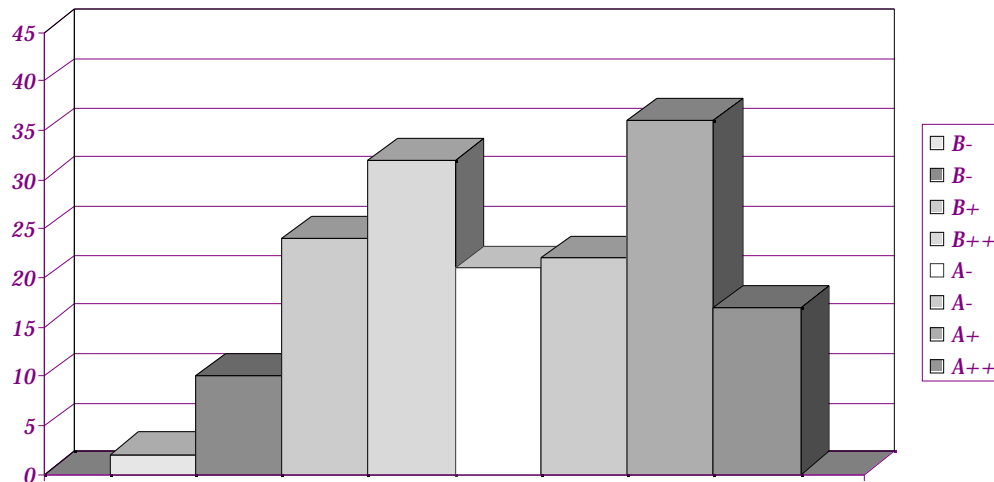
Doherty and Phillips (2000) find that in the United States, property / casualty insurers are under pressure to maintain ratings that have become more stringent over time. This pressure to maintain ratings is a plausible explanation for the build up of surplus in the American property / casualty insurance market. Best's ratings are extremely important in the United States, and less important in Canada, where there are fewer institutional investors. In particular, industry watchers in Canada feel that Best's ratings are relatively insignificant in Canada and therefore will not influence a firm's level of surplus.⁹

As in Doherty and Phillips, the correct test of changes in rating stringency would be to examine the changes in a firm's capital holdings with respect to its Best's ratings over time. As an exploratory measure, however, we are simply going to examine whether or not surplus holdings and Best's ratings are correlated. We do expect to find a slight positive correlation since A.M. Best stresses financial stability, and higher capital holdings would result in greater stability.

Overall, in 2000, Canadian firms have high Best's ratings, as seen in Figure 4. The average ranking is an A-.

⁹ Private discussions with Insurance Bureau of Canada.

Figure 4 – Best’s Ratings of Canadian Insurers for 2000.



As our measure of capitalization, we will once again use the surplus to NPW ratio. We will use Best’s numeric rating score as the rating variable. The mapping between numeric rating scores and letter grades is given in Table 4. In this data set, we retained the Quebec firms that did not report MAT scores, but we removed all firms that did not report a Best’s rating. This left 165 firms in the dataset.

Table 4 – Relationship Between Best’s Ratings and Numeric Rating Scores

Rating	NRS	Rating	NRS	Rating	NRS	Rating	NRS	Rating	NRS
A++	15	A-	12	B	9	C+	6	D	3
A+	14	B++	11	B-	8	C	5	E	2
A	13	B+	10	C++	7	C-	4	F	1

In case Surplus to NPW is acting as a proxy for other performance variables, we ran a regression for Best’s numeric rating scores, using the following firm characteristics:

- *U.S. based.* A dummy variable that equals 1 if the insurance company is U.S. based or if a Canadian company has a U.S. parent. Because of the importance of Best’s ratings in the US, we expected this relationship to be positive. U.S. based firms would have higher Best’s rating scores.
- *Surplus to NPW.* If a significant relationship exists, we would expect this relationship to be positive. Firms with greater capital holdings will have higher Best’s ratings because they will appear more stable.

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- *2 year underwriting ratio. This variable should be positively related to Best' ratings. Firms that perform the core business of insurance better should be rated more highly.*
- *Investment yield. We do not expect this variable to be significant because a high investment yield doesn't necessarily reflect financial stability. But, all else equal, a firm with higher investment returns should have a higher Best's ranking.*
- *2 year pre-tax ROE: Best's rankings reward financial stability over profitability and at first glance, this variable may not be important. However, from the previous section, a high ROE arises from superior underwriting and investment performance. Therefore, this variable might be significant in place of both the underwriting ratio and the investment yield.*
- *Firm size. Measured by Best's financial size categories given in Table 5. A.M. Best assigns each company a Financial Size Category (FSC) based on reported capital and surplus (or head office account) in millions of U.S. dollars. We expect this to be the most significant variable – larger firms (in Canada) are inherently more stable.*

Table 5 –Firm Size based on Reported Capital and Surplus.

Size \$US	FSC	Size \$US	FSC	Size \$US	FSC	Size \$US	FSC	Size \$US	FSC
> 2000 M	15	1000 – 1250 M	12	250 – 500 M	9	5 – 10 M	6	2 – 5 M	3
1500 – 2000 M	14	750 – 1000 M	11	100 – 250 M	8	10 – 25 M	5	1 – 2 M	2
1250 – 1500 M	13	500 – 750 M	10	50 – 100 M	7	25 – 50 M	4	< 1M	1

Table 6 lists the potential covariates, their expected relationship and the fitted regression model. As expected, FSC is the most important predictor of Best's ranking. The only other variable significant is the two year pre-tax ROE, which we conjecture measures the firm achievement. Firms that perform better have higher ROEs and higher Best's ratings. This model fits with a R^2 of 66%.

Table 6 – Determinants of Best’s Ratings

<i>Variable</i>	<i>Expected Relationship</i>	<i>Co-efficient</i>
<i>Intercept</i>		<i>9.666*</i>
<i>US based</i>	<i>+</i>	<i>0.041</i>
<i>Surplus to NPW</i>	<i>+</i>	<i>0.010</i>
<i>Two Year underwriting ratio</i>	<i>-</i>	<i>-0.003</i>
<i>Investment yield</i>	<i>+</i>	<i>-.030</i>
<i>Two year pre-tax ROE</i>	<i>+</i>	<i>0.025*</i>
<i>FSC</i>	<i>+</i>	<i>0.350*</i>

** Significant at 5% level*

Determinants of Capitalization

Can we define determinants of capital holdings? In particular, do smaller, less diversified firms hold relatively more capital than larger more diversified firms or more than firms with significant international backing? We will examine capital holdings in two manners: using the EC measure developed earlier in the paper, and the Surplus to NPW ratio.

The variables that we will use to capture measures of a firm’s size and potential riskiness are as follows:

- Canadian firm – This dummy variable is 1 if the firm is Canadian owned and not backed by another large corporation. It captures Canadian firms whose major business is property / casualty insurance. We expect that Canadian firms will rationally hold more capital because they are less diversified than their international counter parts.*
- Investment risk ratio - This measures how much of the insurer’s portfolio of assets is held in stocks. One might expect the relationship to be positive – insurers with riskier portfolios (higher investment risk ratios) should rationally have higher capital levels. However we believe that this variable is an indication of the risk tolerance of the firm. A higher investment risk ratio implies that the firm is willing to accept more risk. Risk tolerant firms will hold lower capital levels, ceteris paribus, and therefore we expect this relationship to be negative.*
- Adjusted loss reserves to NPW - This is a measure of the outstanding claims of an insurer, standardized by the insurer’s size. The ratio is adjusted upwards if the company has historically under reserved, and it is adjusted downwards, if the company has had a history of favorable loss development. We expect the relationship between this ratio and the insurance risk ratio to be positive. Firms that have significant claims to be paid in the future should hold higher surplus.*
- Test of surplus relief - This test measures a company’s dependence on reinsurance by examining premiums ceded as a percentage of gross written premiums. The higher the*

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ratio, the higher a company's dependence on reinsurance. We expect the relationship to be negative, companies that reinsure more risk should hold less capital.

- *Maximum concentration* – This measures the maximum proportion of premium written for either property (commercial and property) or private passenger automobile coverage in a geographic region. We anticipate that this measure will be positively correlated to capital levels since less diversified firms should rationally hold more capital.
- *Size* – This relationship should be negative in that larger firms do not need to hold as much capital. We will measure size using the firm's NPW.
- *2 Year underwriting ratio* – If firms see poor past experience as a harbinger of poor future results (especially in jurisdictions where the ability to increase rates is restricted), then they might hold excess capital to protect against future solvency difficulties. We expect a firm's underwriting results to be positively related to capital levels.

Regressions for both Surplus to NPW and Excess capitalization showed non constant variance. This was corrected using a robust heteroskedasticity-consistent covariance estimator (see Davidson and McKinnon (1993) for details. A summary of both the regressions is found in Table 7.

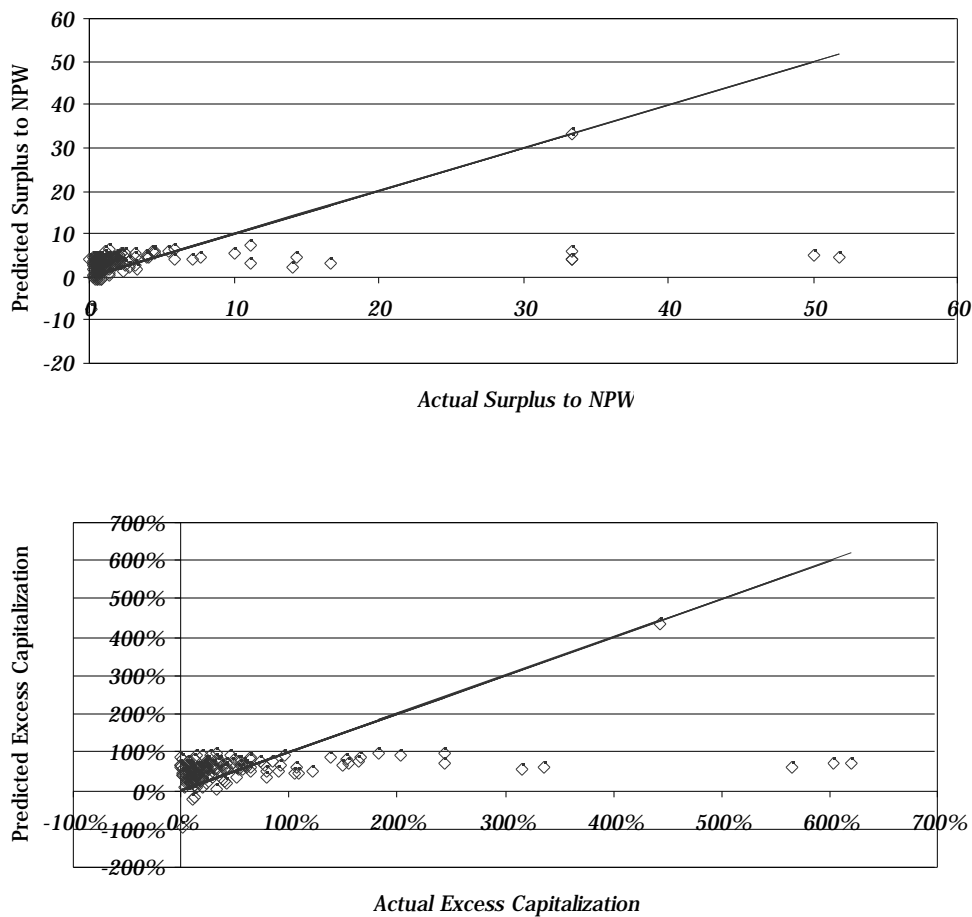
Table 7 – Summary of Explanatory Variables and Expected Relationship

Variable	Expected Relationship	Coefficient – excess capitalization	Co-efficient – surplus to NPW
Intercept		0.827*	4.425*
Canadian insurer	+	0.275	-0.091
Investment risk ratio	-	-0.005*	-0.039**
Adjusted loss reserves to NPW	+	0.013*	0.092*
Test of surplus relief	-	-0.003	0.023
Maximum concentration	+	0.125	-2.336
Size	-	-3.04x10 ⁻⁷	-9.606x10 ⁻⁷
2 year underwriting ratio	+	-.002	0.0004

* Significant at 5% level ** Significant at 10% level

The fit of both models is poor at best, with R² values of 16% and 15% for the excess capitalization and surplus to NPW models respectively. The fitted models do not capture the overcapitalization at all, as can be seen in Figure 5. For both models, the significant variables are the investment risk ratio, which we surmise reveals the risk preference of the organization, and the size of the loss reserves with respect to the firm's premium level.

Figure 5 – Regression Fits for Surplus to NPW and Excess Capitalization



Several explanations exist for this lack of fit. Perhaps we have missed some relevant variables in explaining a firm's capital choices. Even if we have captured variables of importance, different firms could weight the importance of these variables in different ways. Small firms could use one set of criteria in rationalizing capital requirements and large firms may use another. This would not be easily modeled in this framework.

Future Work and Conclusions

This study is a preliminary examination of the capital holdings of Canadian property / casualty insurance and is meant to promote further discussion on the capitalization of insurers. We examined four key areas of capital holdings and discovered the following.

Despite popular belief, in general Canadian insurers are not greatly overcapitalized with respect to statutory capital holdings. Those firms that seem to hold excessive levels of capital are small insurers.

There is no correlation between an insurer's capital holding and its ROE. More important predictors of a firm's ROE were its operating results. Firms with lower underwriting ratios and higher investment yields had higher returns.

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In Canada, there is no relationship between an insurer's capital holdings and its Best's ratings. Instead, ROE and firm size were the most important determinants of Best's ratings.

We had limited success in characterizing determinants of capital holdings and future work on this issue is required. There is some support that the investment risk ratio of a firm reveals a firm's risk preference in that firms that hold more of their assets in stock also hold less capital. Firms with greater loss reserves (standardized to net written premiums) also hold more capital. But it is clear that our model does not capture the forces of over-capitalization.

This study has many omissions that we will correct. Outlined below with respect to the four sections of the study are some areas of future work.

In the area of excess capitalization, we noted that smaller firms had greater excess capitalization, and that when we looked at determinants of capital holdings we could not predict the variability of excess capitalization. It is possible that we have created a biased measure of capitalization and that we would have more success predicting dollar values of excess capital holdings.

We also found no relationship between ROE and surplus holdings in the cross sectional model. But over time, what is the impact of the debt and stock market on ROE levels and the surplus held by property / casualty insurers. Surplus needs to be invested and a healthy market leads to greater investment income that in turns impacts ROE. Maybe a better way to assess the relationship is to investigate the changes in ROE and the change in surplus levels over time. We are currently collecting time series data to explore this relationship.

We have not collected data on how capital levels change over time. Doherty and Phillips (2000) find that capital holdings for U.S. property / casualty insurers have increased over the past decade. Is the same true of Canadian insurers? Is there increasing rating stringency in Canada?

As noted in the report, our models of excess capitalization and surplus to NPW fit poorly at best. It is clear that we need to explore different models and potential explanatory variables. The collection of cross sectional data as mentioned above may yield clues to the capitalization puzzle.

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Appendix 1 – MAT Test and MTC Calculations

The minimum asset test is calculated as _____ .

A firm must have a positive ratio to pass this test, which attempts to measure whether adjusted assets exceed the sum of adjusted liabilities and the largest margin?"

The assets available for test purposes are total assets held by firm plus the excess of market over book value less those non-admitted or otherwise not available. Non-admitted assets would include excess investment in real estate, deferred policy acquisition expenses (i.e. amortizing the cost of writing a policy over several years), amounts that should be recovered from other insurers but would not be if firm went bankrupt today.

Assets required for test purposes are calculated as total liabilities plus required margin less recoverables from reinsurance. The required margin is the largest of the three margins calculated below:

- A margin on liabilities equal to _____ .
- A margin on written premiums (GWP) equal to _____ .
- A margin on average gross incurred claims over the past three years (claims) equal to _____ .

where the reinsurance ratio is defined as _____ .

Starting with the assets available for test purposes, we added back the ineligible assets to derive the Minimum Total Capital (MTC). To back out the MTC from the required asset holdings, we assumed that the level of non-admitted and otherwise unavailable assets was held constant. For each firm we calculated the ratio of excess of market value over book value to total asset holdings. We then assumed that this percentage would remain constant regardless of the firm's total asset holdings. Thus we use this ratio to infer the proportion of assets required that arise from excess market value. Therefore (book value) MTC for each firm is calculated as _____ .