An Examination of Property & Casualty Insurer Solvency in Canada

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Abstract: This paper provides both a qualitative and empirical analysis of insolvency experience in the Canadian property and casualty insurance industry. First, we provide a qualitative analysis of the differences between Canada and the U.S. that may help to explain the lower incidence of insolvency experience in Canada. These include differences in regulation and monitoring, such as the presence of a federal regulator and higher capital requirements, and differences in the environment, such as lower legal liability risk and less exposure to catastrophic risk. Second, we use logistic regression methodology and variables commonly used in U.S. studies of insurer insolvency prediction to test whether such models are able to predict insolvency for Canadian insurers. We include variables that attempt to capture some of the important differences between the Canadian and U.S. markets. The results suggest that only the profitability measure, return on assets, is found to be a statistically significant predictor of insolvency, and that result holds only one year prior to insolvency. This relationship is consistent with many previous studies on U.S. property and casualty insurer insolvency. [Key words: property and casualty insurance, regulation, insolvency]

INTRODUCTION

The solvency of property and casualty (P&C) insurers is of critical importance to many different stakeholders. In addition to policyholders and the regulatory bodies charged with monitoring their financial

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performance on their behalf, interested parties also include the stockholders of these firms as well as industry competitors who may be asked to contribute to guaranty funds that will be called upon to pay for claims on insolvent firms. While there is a great deal of literature related to insolvency prediction in the United States, there is little research on these issues for Canada, with the majority being of a non-academic nature.

Although there are many similarities between the P&C insurance markets in Canada and the U.S., there are also some significant differences. The Canadian market is dominated by auto insurance, which makes up over half of all premiums written. Private workers' compensation insurance, a major commercial line in the U.S., does not exist in the Canadian market. The domestic insurance industry in Canada is relatively smaller, and about two-thirds of the premiums in the Canadian market are written by foreign insurers. Finally, the regulatory structure is also significantly different, with insurers being allowed to choose between a federal or provincial charter, which determines which level of government monitors solvency.

The purpose of this paper is to examine whether these differences are important in terms of insolvency prediction and insolvency experience using two types of analyses. First, we provide a qualitative analysis of the differences in regulation, underwriting risk, and economic factors that have resulted in fewer insolvencies in Canada than in the U.S. Second, using a common methodology for predicting insolvency (e.g., Carson and Hoyt, 1995; Lee and Urrutia, 1996; Pottier and Sommer, 2002) we incorporate variables that capture the differences between the two markets and test the ability of the model to predict insolvency in Canada. We find that only return on assets, a measure of profitability, is a statistically significant predictor one year prior to insolvency.

The paper is organized as follows. The next section provides an analysis of certain factors that explain differences in solvency experience in the U.S. and Canada. This is followed by a brief review of related literature on insolvency prediction followed by a description of insolvency experience in the Canadian P&C market. Next, the variables that are used for predicting insolvency are discussed and then data, methodology, and results are presented. Finally a discussion of the limitations and implications of the study along with ideas for future research are presented.

SOLVENCY EXPERIENCE: U.S. VERSUS CANADA

Comparing the frequency of insolvency in the U.S. and Canada, we see in Figure 1 that the average frequency of involuntary exit for Canada (0.25

percent), indicated by the OSFI (Office of the Superintendent of Insurance) bar, is less than a third of that for the U.S. insurance industry. Further, if "involuntary exit" via liquidity risks[4] is excluded, the Canadian frequency is less than one-quarter of that of the U.S. (Dibra and Leadbetter, 2007). In general, the difference may be attributed to two broad factors: differences in regulation and monitoring and differences in the environment.

Regulation and Monitoring

Regulator: P&C insurers operating in Canada choose whether to be chartered at either the provincial or federal level. In 2004 there were 194 federally chartered insurers and 158 provincial insurers, with the majority of provincial insurers being in Ontario and Quebec.[5] For insurers that are provincially chartered, their solvency is monitored by provincial authorities, normally in the form of Superintendents of Insurance. Federally chartered insurers are monitored at the federal level by OSFI. OSFI-supervised insurers represent 80.1 percent of NPW, while provincially supervised insurers represent the remaining 19.9 percent.[6]

Although OSFI monitors solvency for all federally-chartered insurers, it does not have a market conduct mandate, resulting in rate regulation for all insurers being performed at the provincial level. Given that rate regulation and solvency are closely linked, the separation of these two regulatory functions may create problems if rates are inadequate.

Differences between federal and provincial supervision exist with respect to minimum capital requirements, as shown in Table 1. Other differences exist with respect to supervisory approach as well as resources dedicated to solvency surveillance. Twelve of the thirty-five insurers that have become insolvent since 1960 were provincial insurers. Newfoundland

[4]In Canada, the term involuntary exit is used rather than insolvency in order to be precise. Involuntary exit is precipitated by a winding-up order issued by the appropriate supervisory authority. Insurance companies may be wound-up when they become either an insolvency risk or a liquidity risk. An insolvency risk occurs when assets become insufficient for an insurance company to meet its contractual and other financial obligations. A liquidity risk occurs when a company has sufficient assets to cover its obligations but there is a high level of risk that those assets could disappear, usually to another jurisdiction. Appendix A lists involuntary exits in Canada and contains both insolvency and liquidity risks. In all cases, a winding-up order was issued. However, there was not always a liquidation associated with each winding-up order. In a few cases, it was possible to transfer the liabilities or sell off some or all of the involuntary exit.

[5]In addition, there are four Crown corporations that are government-run monopolies for the mandatory auto insurance product sold by province.

[6]Information obtained from the Property and Casualty Insurance Compensation Corporation (PACICC), based on data from Superintendent of Insurance and MSA Research Inc.

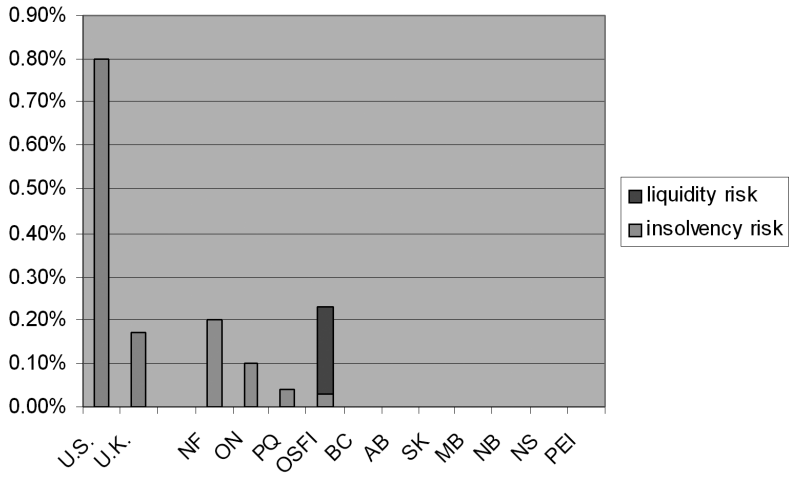

Fig. 1. Insolvency rate as a percentage of total insurers.

has the highest frequency of provincial P&C insolvency in Canada, followed by Ontario and Quebec. If only insolvency risks are considered (not liquidity risks), the federal frequency falls by 88 percent (see Figure 2). The number of company involuntary exits supervised by provincial regulators nearly doubled from four in the thirty-year period before 1990 to seven in the fifteen-year period after 1990 (Dibra and Leadbetter, 2007).

One practice that influences the frequency of involuntary exits is regulatory forbearance. Unlike in the U.S., in Canada receivership is almost never used and has not been for well over a decade. Regulators may place a company under interim control but that is usually a measure to preserve the assets while the winding-up order is before the courts. Similarly, Canadian regulators do not issue conservation orders, although they will "stage" a company. All P&C insurance companies are staged by OSFI, which is the process of assigning them to one of six stages, where 0 represents normal operations and stage 5 indicates that the company is not viable and insolvency is imminent. Neither the regulator nor the company is permitted to release information on its staging, even if the company is stage 0 (normal operations).

The low frequency of insolvencies in Canada provides some evidence of the efficacy of solvency monitoring by the OSFI. In comparison to the U.S., where solvency is monitored at the state level, Canada's experience may provide relevant input to the discussion regarding the advantages and disadvantages of a single federal regulator.[7]

Table 1. Minimum Capital Requirements

Regulatory authority	Capital requirement	Description of risk-based requirements
British Columbia	Risk based	MCT (100% minimum)
Alberta	Risk based	MCT (100% minimum)
Saskatchewan	Assets > liabilities	
Manitoba	$4 million with $1 million unimpaired	
Ontario	Risk based	MCT (150% minimum + 50% supervisory target + company target)
Quebec	Risk based	MCT (100% minimum + company target)
New Brunswick	$3 million with $250,000 unimpaired	
PEI	$3 million with $750,000 unimpaired	
Newfoundland	$3 million	
OSFI	Risk based	MCT (100% minimum + 50% supervisory target + company target)

Source: Provincial insurance statutes and regulations.

Capital Requirements: Similar to what has occurred in other countries, OSFI instituted risk-based capital requirements to better reflect the risk of insurers' assets and liabilities.[8] The current test, introduced in 2003, is called the Minimum Capital Test (MCT) for Canadian insurers and the Branch Adequacy of Assets Test (BAAT) for foreign insurers.[9] There is evidence that minimum capital requirements in Canada are substantially higher than in other countries (KPMG, 2003), which may contribute to the low

[7]Although in the U.S. the NAIC's cooperative efforts result in what could be described as "national regulation" for large insurers, particularly as it relates to solvency, this does not apply to smaller insurers, which account for a majority of insolvencies in the U.S.

[8]In 1992 the National Association of Insurance Commissioners (NAIC) adopted model minimum risk based capital standards in the U.S.

[9]These replaced the Minimum Asset Test (MAT) and the Deposit Adequacy Test (DAT), which compared an insurer's allowable asset level under statutory accounting rules to what the insurer needs to cover all its liabilities by a preset safety margin.

frequency of insolvencies. Minimum capital requirements are nearly double what they are for U.S. insurers, and more than double what they are for the U.K., Germany, France, and Japan. Carayannopoulos and Kelly (2004) find that the characteristics that explain variations in capital levels for U.S. insurers cannot be used to explain variation for Canadian insurers. Canadian insurers typically hold capital levels that are above the required levels, and the authors suggest that one explanation for their results are that firms choose to operate at a predetermined margin above the regulatory threshold and that the regulatory regime is the major determinant of capital holdings.

Another explanation for why insurers hold more capital may be that it avoids regulatory attention due to reductions in capital, even though capital levels are adequate based on the MCT. Higher capital requirements serve to increase the cost of entry into the market, which tends to limit choice and competition for consumers. In contrast, lower costs of entry result in higher firm turnover rates as companies exit and enter the market more frequently (Hopenhayn, 1992). There is a trade-off between the benefits of increased choice and competition (with lower capital requirements) and the costs of increased insolvencies. Munch and Smallwood (1980) find no evidence that capital requirements have an independent deterrent effect on the number of insolvencies over and above the effect on the number of companies. Thus, although the solvency experience in Canada has been good in terms of the frequency of insolvency, the consequential costs for consumers in terms of a more limited range of products available and potentially higher prices due to less competition may outweigh the benefits.

Environment

Financial Markets and Investments: A 2004 A.M. Best study that examined the causes of insolvency for U.S. P&C insurers found that the rate of financial impairment and changes in capital exhibited strong relationships with equity markets. In Canada the relationship is weaker due to insurers' more limited exposure to equity markets. The view in Canada has always been that the bulk of the portfolio should be in high-quality bonds,[10] whereas in the U.S. it was common practice to have the investment in equities be roughly equal to the insurer's capital base (i.e., the shareholders' funds are invested in equities).[11] The Canadian insurance industry, between 1990 and 2005, on average invested only 12.1 percent of their assets in equities, with over 40 percent of their assets in fixed income securities. Recently, the equity portion of U.S. insurers' portfolios was over 16 percent while in Canada equities represented less than 9 percent (Dibra and Leadbetter, 2007). The larger equity component for U.S. insurers

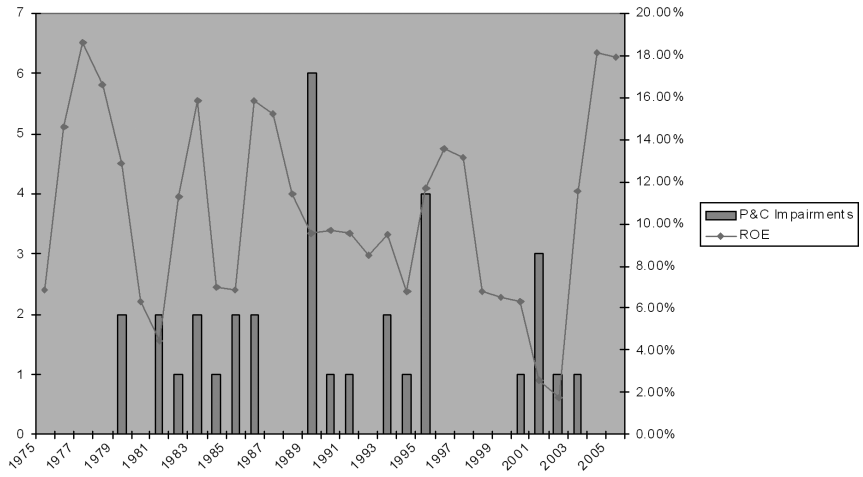

Fig. 2. Comparison of insolvency experience and insurance industry profitability. *Source:* Property and Casualty Insurance Compensation Corporation (PACICC), with data from the Insurance Bureau of Canada and General Registrar.

makes them more vulnerable to equity market volatility than Canadian insurers.

Underwriting Cycle, Profitability, and Catastrophes: The link between profitability and insolvency varies across time and across jurisdictions. Figure 2 shows that periods of poor profitability are followed by an increase in insurer involuntary exits. A. M. Best (2004) finds a high correlation (60 percent) between the underwriting cycle and insolvency. The correlation is only about half that in Canada (Dibra and Leadbetter, 2007), in part because of the greater presence of foreign insurers in Canada. Figure 3 shows the combined ratio for U.S. and Canadian insurers from 1980 through 2004. With the exception of the early 1980s, the peaks of the underwriting cycle in terms of poor underwriting performance are worse

[10]Up until the early 1990s there was a rule stating that equities could not make up more than 25 percent of assets, yet Canadian insurers were generally well below that. The more conservative practices of Canadian insurers may go back to the depression, when Sun Life, the largest insurer at the time, would have been insolvent on a market value basis. The company was heavily invested in equities, as well as farm mortgages, and the value of these assets plunged. The government allowed Sun Life to use what they called "authorized values," which were neither market nor book, but were determined in such a way as to enable the company to still appear to be solvent.

[11]In the U.S. most states require insurers' investments to be diversified, and many place limits on low-quality bonds and high-risk assets.

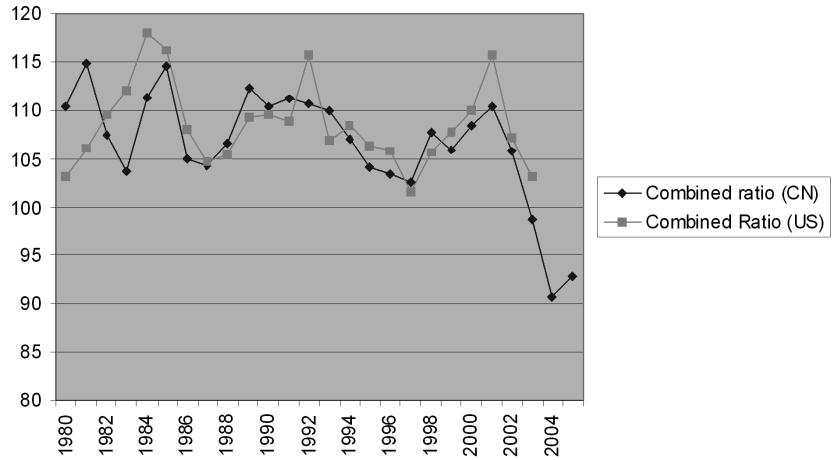

Fig. 3. Combined Ratios for the U.S. and Canadian P&C Insurance Industry 1980–2004.

in the U.S. When the combined ratio exceeded 115 in 1992 and 2001, insolvency rates increased significantly in the year following and there were more insolvencies than any other year since 1990.[12]

Another factor that affects profitability is catastrophe exposure, which is significantly higher in the U.S. than in Canada. The main difference is the higher wind exposure in the U.S. due to hurricanes in the Gulf of Mexico and the Atlantic. The impact of insured catastrophe losses on insurers' financial health is much greater in the U.S. than in Canada. Over the period 1987–2005, the increase in combined ratios due to catastrophe losses in Canada was about half that of the U.S. (Dibra and Leadbetter, 2007). Between 1969 and 2005, 6.5 percent of insurer impairments in the U.S. were due to catastrophe losses. This increased to 8.6 percent for the period 2003–2005. For the period 1960–2005, catastrophe losses were identified as the proximate cause of involuntary exit in Canada for only one insurer. For the catastrophe-laden period of 1995–2005, no involuntary exits in Canada were caused by catastrophe losses.

Liability Risk: Inadequate pricing and deficient loss reserves were found to be the proximate cause of insolvency 40 percent of the time in Canada during 1995–2005 (Dibra and Leadbetter, 2007). In the U.S. this has become a more important cause of insolvency, accounting for 62.8 percent

[12]Browne and Hoyt (1995) find that the underwriting cycle and combined ratio are related to insurer insolvency.

of insolvencies from 2003 to 2005. The risk associated with insurers' liability portfolios is greater in the U.S. for two reasons. First, in the U.S. a larger proportion of NPW is in long-tail lines (workers' compensation, other liability, product liability, and medical malpractice). U.S. insurers have about 21.5 percent in long-tail lines, whereas Canadian insurers have about 13 percent (liability, not including auto, but including homeowners).[13] Second, the U.S. is considered the most litigious nation in the world. In 2005 the U.S. tort system cost $261 billion, which translates to $880 per person (Tillinghast Towers Perrin, 2006). This represents two percent of gross domestic product, which is more than double the average in much of Western Europe, Canada, and Japan (Dobbs, 2005). In comparison to the U.S., Canada has a number of mechanisms that limit the liability of defendants. First, civil jury trials are rare. Judges make decisions rather than potentially sympathetic juries, and judges typically award less money to winning plaintiffs than juries. Second, awards for non-economic damages are lower in Canada, and punitive damages are awarded very infrequently. Third, a form of loser pays ("double costs awards") acts as a disincentive to filing questionable lawsuits. As well, class action suits have been far less of an issue in Canada than the U.S., and are a relatively recent phenomenon.[14] Finally, universal healthcare in Canada results in lower average awards for personal injury since medically necessary care is covered by provincial healthcare programs. All of these imply that liability risks are greater in the U.S., which is consistent with the fact that inadequate pricing and deficient loss reserves make up almost two-thirds of insolvencies in the U.S.

LITERATURE REVIEW

The early literature examining P&C insurer insolvency prediction can be differentiated on the basis of three major areas of interest: methodology, time period during which insolvencies occurred, and data used for deter-

[13]In Canada, half of premiums written are for auto insurance, and the remaining half represents commercial property (14.4 percent), personal property (14.2 percent), liability (13 percent), other (5.4 percent, Aircraft, boiler & machinery, credit, credit protection, fidelity, marine, hail, legal expense, mortgage, surety, title), and accident/sickness (2.8 percent).

[14]The main cause of rising medical costs and insurance rates in the U.S. are the extreme cases involving large class-action suits. Cases like asbestos settlements, which are responsible for the largest tort settlements and the most expensive litigation in U.S. history, are the biggest single reason tort costs have increased so much in recent years. Companies have paid out an estimated $70 billion on more than 700,000 asbestos personal injury claims through the end of 2002, according to the RAND Institute for Civil Justice (Dobbs, 2005).

mining variable sets. The majority of early studies used Univariate or Multiple Discriminant Analysis and focused on individual company-level data (see BarNiv and McDonald, 1992 for a review of this early literature). As well, many of these pre-1990s studies used matched-pair samples. In the 1990s, logit analysis became the more commonly accepted methodology. Carson and Hoyt (1995) and Lee and Urrutia (1996) provide evidence that logit models work as well as, if not better than, techniques used previously. Additionally, the use of the entire population of insurers in prediction became more common practice (e.g., Carson and Hoyt, 1995). Numerous other methodologies have been utilized, including neural networks (Brockett et al., 2006), cash flow simulation (Cummins, Grace, and Phillips, 1999), and ruin approach (Barth, 2000), with varying results.[15]

Studies also differ with respect to the period of time over which insolvencies occurred. The majority of the literature analyzes insolvencies occurring over a short time period, usually three to five years (e.g., Trieschmann and Pinches, 1973; Carson and Hoyt, 1995; Grace, Harrington, and Klein, 1998; Pottier and Sommer, 2002). A few studies have utilized one year's insolvency experience in their models due to the large experience in a given year, typically in the U.S. (e.g., Pottier and Sommer, 2007). While the sample sizes are large enough to be statistically sound, from a macroeconomic viewpoint the shorter time periods hold a number of industry and macroeconomic factors constant, not accounting for the fact that they may increase or decrease the probability of insolvency. Relatively fewer studies (e.g., Ambrose and Seward, 1988; Browne and Hoyt, 1995; Lee and Urrutia, 1996) have utilized longer time periods to allow for changes in these variables over time.

As mentioned above, the majority of studies use company-level data in variable selection. However, macroeconomic industry-wide data (Browne and Hoyt, 1995) and, more recently, group-level data have also been utilized in insolvency prediction. Pottier and Sommer (2007) compare the use of group-level data to company-level data and find that group-level data is better in predicting insolvency. Various rating tools have been investigated including ratings from external parties (Pottier and Sommer, 2002), Financial Analysis Solvency Tools (FAST) scores (Grace, Harrington, and Klein, 1998), and Risk-Based Capital measures (Cummins, Harrington, and Klein, 1995). The results from these studies suggest that private

[15]While the majority of approaches utilized did not provide substantially different results from the more typical logistic methodology studies, Brockett et al. (2006) find that neural network methodologies outperform logistic methodologies. See Chen and Wong (2004) for a more complete listing of the different methodologies utilized in prior insolvency studies.

measures are better at predicting insolvencies than regulator-driven (public) measures.[16]

A review of the previous literature (e.g., Trieschmann and Pinches, 1973; Ambrose and Seward, 1988; BarNiv and Raveh, 1989; BarNiv and McDonald, 1992; Pottier and Sommer, 2007) reveals that researchers have used many different variables in developing models to predict insolvency. While some standard measures are used in most of the studies, such as net premiums written (NPW) divided by surplus, there are also significant differences across studies in terms of how variables such as profitability and underwriting performance are measured. Further, many of these studies have utilized a stepwise regression methodology to identify the variables to include in the model. Because of the differing time periods and the different set of initial variables considered for inclusion, no two variable sets are ever the same. As a result, there is not strong evidence to imply that a given set of variables is superior in predicting P&C insurer insolvency.

OVERVIEW OF CANADIAN PROPERTY & CASUALTY SOLVENCY EXPERIENCE

The frequency of P&C insurer failures in Canada is low, as illustrated in Figure 4. Since 1960, there have been only thirty-five "involuntary exits" (see Appendix A for a complete list) and since 1996 there have been only five failures, all of them occurring between 1999 and 2002. Over the twelve-year period from 1992 to 2003, the Canadian industry paid out about $100 million for insolvencies,[17] with the cost of P&C insurance failures less than 0.1 percent as a share of industry premiums. In contrast, the U.S. insurance industry paid out $1.2 billion to cover bankruptcies in 2003 alone (Harris, 2004). Given the obvious differences in the incidence of insolvency between the two countries, and the differences outlined previously, a model for predicting insolvency in Canada needs to account for these important

[16]It should be acknowledged that the role of the regulator is not necessarily to predict insolvency but is more accurately described as solvency monitoring in order to prevent insolvency. As such, these models are meant to achieve a different purpose—early alert to problems. This awareness may allow the regulator to assist a troubled firm in finding a suitable merger partner as an alternative to impending insolvency. BarNiv and Hathorn (1997) suggest that nearly half of insurer mergers occurred as an alternative to insolvency.

[17]In addition, an extra $53 million was paid out in order to cover claim costs for insolvent insurers.

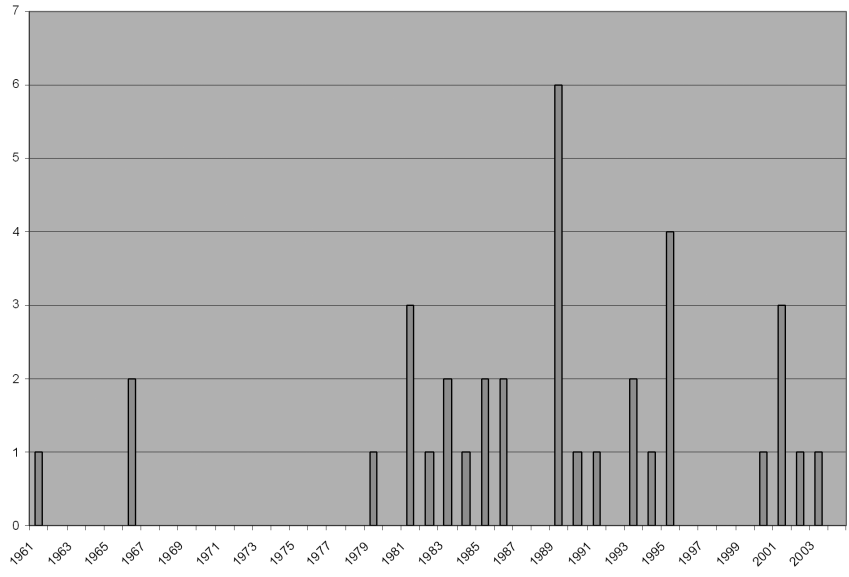

Fig. 4. P&C insurer insolvencies in Canada, 1961–2004. *Source:* Property and Casualty Insurance Compensation Corporation (PACICC).

differences. We incorporate these differences to the extent possible and describe the expected effect.

Variables Used to Predict P&C Insurer Insolvency

As discussed above, previous studies on insolvency prediction have used many different variables that are expected to be related to insolvency. The types of variables used can be categorized under the following headings: capitalization, profitability, diversification, ownership, leverage, liability risk, and growth. In this study we use variables commonly used in other P&C insolvency prediction studies and note where our ability to use certain variables is limited by what is reported. A summary of the variables and their predicted signs appears in Table 2.

Leverage: Underwriting leverage is a variable closely monitored by regulators and expected to be related to solvency (e.g., Trieschmann and Pinches, 1973; Ambrose and Seward, 1988; Lee and Urrutia, 1996). A high ratio represents a high level of potential liabilities relative to capital: the greater an insurer's capital relative to its liabilities, the better its ability to absorb unexpected shocks. We measure underwriting leverage as net

premiums written (NPW) divided by total capital and expect a positive relationship with the risk of insolvency.

Profitability: A measure that is often found to be a predictor of insolvency is profitability (e.g., BarNiv and McDonald, 1992; Lee and Urrutia, 1996; Pottier and Sommer, 2007). Insurers that demonstrate higher profitability are expected to have a lower risk of insolvency. To measure profitability we use return on assets, measured as net income divided by total assets.

Liability Risk: The Canadian P&C market is dominated by auto insurance: total auto premiums written account for over half of the market. Insurers that concentrate heavily in auto may have a higher probability of insolvency for two reasons. First, auto insurance is highly regulated. Theoretical and empirical research suggests that rate regulation increases volatility of underwriting results (Harrington, 2002). Greater volatility of underwriting results together with restrictions on the ability to change rates may contribute to a higher probability of insolvency. Second, the auto insurance market is highly competitive and historically has been a difficult line of insurance to make a profit on, with loss ratios generally higher than those for other lines of business. However, given the smaller market in Canada, it may be more difficult for insurers to achieve the minimum efficient scale without writing a significant portion of business in auto insurance, especially given that it is considered a competitive market.[18] Therefore, having a higher proportion of DPW in auto may reduce the probability of insolvency if it reduces average costs. To test for these effects, we include a variable equal to the percent of business written in auto (direct premiums written (DPW) in auto divided by total DPW) and note that the expected sign is ambiguous.[19]

Canadian Incorporated: Two-thirds of the Canadian P&C insurance industry is foreign owned. The impact of foreign ownership on insolvency is ambiguous. Two of the last three windups of Canadian companies were due to the failure of parent companies in the U.S. In contrast, for U.S. insurers A.M. Best (2004) did not identify foreign risks as a source of failure for U.S. companies. Insurers that are foreign-owned may benefit from contributions of capital from their parent, yet they may also be negatively

[18]The Canadian P&C industry is small in comparison to the U.S. In 2004 NPW for the industry amounted to $32.8 billion, about one-tenth of U.S. NPW. From a competition standpoint, the top ten insurers have 54.23 percent of the market share (based on total NPW), while in the U.S. the top 10 insurers have about 40 percent of the market. Browne and Hoyt (1995) find that the number of insurers (competition) is related to insurer insolvency.

[19]DPW is used instead of NPW because of data restrictions in the later years of the data. As well, by-line premium data are not available for 1981–1982, making it impossible to use a different measure of liability risk that would be comparable to U.S. studies.

affected by poor results of the parent.[20] A dummy variable is included that takes the value of 1 for Canadian incorporated companies and 0 for foreign-owned branches.

Group: The impact of group membership on the probability of insolvency is also unclear.[21] Hazard models predict that subsidiary companies survive longer than new stand-alone companies (Klepper and Sleeper, 2001; Walsh, Kirchhoff, and Boylan, 1996). This is consistent with Cummins, Phillips, and Allen (1998), who explain that insurers that are members of a group may be rescued by the group in order to protect the reputation of the group. However, other arguments can be made that group membership may increase the probability of insolvency if there is a demand for investment capital by the parent company (Harrington, 1981). An A.M. Best study found that since 1990, twenty-one financial impairments (7.4 percent of all impairments) in the U.S. could be attributed to the financial distress of an affiliate, whereas prior to 1990 there were none attributable to the failure of an affiliate.[22] In Canada, 3 percent of insolvencies were due to the failure of an affiliate. We include a dummy variable for group membership to account for the potential impact of group affiliation on the probability of insolvency.[23]

Premium Growth: Rapid premium growth has been found to be associated with a higher probability of insolvency (Kim et al., 1995).[24] Insurers that are experiencing substantial increases in NPW on a one-year basis may be taking on substandard risks, thereby increasing their probability of

[20]Companies that are incorporated in Canada may be either foreign or Canadian owned. Canadian incorporated companies fail as a result of their operation and exposure to the Canadian economy and underwriting environment. However, foreign branch companies may fail because the home office company has failed due to the economic/underwriting environment in a foreign jurisdiction." (Dibra and Leadbetter, 2007). Since "foreign owned" as defined for U.S. studies may differ from non-Canadian incorporated as defined here, we also perform the analysis without this variable. The results are consistent with the results reported.

[21]Pottier and Sommer (2007) find that it is the overall strength of the group that ultimately affects the probability of insolvency. Affiliated insurers with better capitalization, that were more profitable, and that were members of more diversified groups have a lower probability of insolvency.

[22]See A.M. Best (2004).

[23]The data only allow for membership in a Canadian group. If a firm is owned by a foreign-based parent with numerous subsidiaries in a group in the foreign country, but the Canadian entity is the only subsidiary of that parent operating in Canada, it is considered not a group member for the purposes of our study. Analyses were run without this variable and are consistent with the results reported.

[24]Rapid growth was found to be the proximate cause of insolvency about 17 percent of the time in both the U.S. and Canada.

insolvency. The effect of growth is measured by the ratio of the one-year change in NPW relative to the prior year's NPW, which is utilized by OSFI as one of their Regulatory Early Warning Indicators. The expected sign on this variable is positive.

Capital Growth: Changes in capital represent changes in an insurer's ability to absorb unexpected losses. A decrease in capital reduces an insurer's buffer available to absorb shocks, increasing the probability of financial distress. This is measured by the ratio of the one-year change in capital relative to the prior-year's capital, a variable utilized by OSFI as a Regulatory Early Warning Indicator. A negative relationship is expected.[25]

Loss Ratio: Prior studies (e.g., Ambrose and Seward, 1988) have used the loss ratio as a proxy for the quality of underwriting rigour a firm undertakes. Firms that have higher losses and higher costs associated with settling claims per dollar of premium are more likely to experience financial difficulties. The loss ratio is also an indicator of price adequacy. Loss ratios near or above 100 percent provide some evidence of inadequate prices, one of the major causes of insolvency. The loss ratio is equal to total incurred losses plus loss adjustment expenses divided by premiums earned. We expect a positive relationship between the loss ratio and the probability of insolvency.

Size: A number of studies find that smaller insurers are more likely to become insolvent, in part because regulators are less likely to liquidate large insurers (BarNiv and Hershbarger, 1990; Cummins, Harrington, and Klein, 1995). In addition, size may serve as a proxy for age (Thompson, 2005), and older insurers are less likely to exit the market involuntarily. To measure the effect of size on the risk of insolvency we use the natural log of total assets and expect that larger insurers have a lower probability of insolvency.

Other variables that have been included in previous studies include organizational form and adequacy of loss reserves. Unfortunately, we are unable to include organizational form in this study since all of the insolvencies in our sample are mutual companies. As well, the detail of our data does not allow us to measure reserve deficiency.

DATA AND METHODOLOGY

Individual company-level data from 1980 to 2004 are used for the analysis. Data for 1980 through 1988 was collected from the Report of the

[25]Although excessive increases in capital may also be a warning indicator, we expect this to be uncommon.

Table 2. Explanatory Variables and Predicted Signs

Variable	Predicted sign
Underwriting leverage (NPW/total capital)	+
Profitability (net income/total assets)	–
Liability risk (percentage of DPW written in auto lines)	+/–
Canadian incorporated (equal to 1 if owned by Canadian firm, 0 otherwise)	+/–
Premium growth (one-year rate of change in NPW)	+
Group membership (equal to 1 if a member of a Canadian group, 0 otherwise)	+/–
Capital growth (one-year rate of change in capital and surplus)	–
Loss ratio (loss and loss adjustment expenses/NPE)	+
Size (natural log of total assets)	–

Superintendent of Financial Institutions and data for 1989 was collected from TRAC reports. Data was obtained from MSA Research Inc. for the years 1990 to 2004. Table 3 provides a list of the insurer insolvencies used in the analysis. Ideally, our insolvency prediction tests would include both provincial and federal insurers; however, the data for provincial insurers was not available and hence they are not included in the sample. In addition, some federal insurers had incomplete data and therefore were not included. Some U.S. studies are able to include "financially troubled" insurers, which also serves to increase the sample of insolvent insurers. However, due to the process that OSFI uses to issue a winding-up order, we are unable to identify any insurers that are financially troubled but never become "involuntary exits."

Consistent with recent literature in insurer insolvency (e.g., Pottier and Sommer, 2002; Pottier and Sommer, 2007), logistic regression is used for the analysis. The dependent variable in the models is equal to 1 if the insurer became insolvent in one of the two years following the data year for that company (depending on the model). That is, if an insurer became insolvent in 1993, the dependent variable is 1 in 1992 for the one-year prior analysis or in 1991 for the two-year prior analysis, but 0 in all other years of data for that firm. As well, the approximate jackknife procedure was utilized to control for the bias introduced by using the same sample for estimation and prediction.[26] For any given year of firm data, the firm must have positive assets, positive net premiums written, and positive capital to be

Table 3. Insolvent Companies Included in Logistic Regression

Company	Year wound-up
Advocate General Insurance Company	1989
Alta Surety Company	2001
American Mutual Liability Insurance	1989
Century Insurance Company of Canada (The)	1989
Eaton Bay Insurance Company	1989
English & American Insurance Company	1993
Northumberland Insurance Company	1985
Phoenix Assurance Company of Canada	1989
Reliance Insurance Company	2001
The following insurers were included in the 2-year prior analysis	
Ideal Mutual Insurance Company	1985
Midland Insurance Company	1986
Orion Insurance Company PLC	1995

included in the sample. In addition, the percent of auto written had to be greater than or equal to 0 and less than or equal to 1. Companies with negative loss ratios were also excluded. This leaves a sample of 3986 observations including nine insolvencies.[27]

Results

Univariate Analysis

Table 4 presents means for the variables included in the analysis.[28] Means are reported for solvent and insolvent firms and asterisks indicate significant differences based on t-tests for equality of means. One year prior to insolvency, insolvent companies are less profitable, write less auto insurance, and have lower (negative) premium growth than solvent companies. Two years prior, in addition to the results in the one year prior analysis, insolvent firms are smaller, experiencing lower (negative) capital

[26]See Pregibon (1981) for further details.

[27]Depending on the variables included in a given model, the sample size will fluctuate due to missing data.

[28]Spearman correlation coefficients are reported in Appendix B.

Table 4. Variable Means

Variable	One-year prior		Two-years prior	
	Solvent	Insolvent	Solvent	Insolvent
Natural log of assets	17.40077	16.80074	17.40257	16.36395**
Return on assets	0.0272193	–0.0268917*	0.0272015	–0.0075776*
NPW/surplus	1.384555	2.027295	1.384397	1.918129
Capital/assets	0.4234435	0.4192404	0.4231762	0.5072263
Loss ratio	92.00777	87.54399	92.02894	81.77554
Percentage auto	0.7698463	0.2332069***	0.7703396	0.2220551***
Change in capital	0.2267057	0.0104308	0.2270494	–0.0447552**
Change in NPW	0.33665154	–0.19448**	0.3639971	0.7622914**
Canadian parent	0.5558695	0.5555556	0.5562982	0.4166667
Group membership	0.3952143	0.2222222	0.3955263	0.1666667**
Sample size	3905	9	3902	12

T-test comparisons for means were utilized to test for significant differences between solvent and insolvent insurers.
*** significant at 1%; ** significant at 5%; * significant at 10%

growth, and are less likely to be group members than their solvent counterparts.

Logistic Models

Tables 5 and 6 present the results for the logistic regression models. For both one-year prior and two-year prior analyses, two models were run. The secondary model eliminates certain variables in order to incorporate one additional insolvency. Model 1 includes all nine of the variables listed in Table 2, resulting in eight (eleven in the two-year prior analysis) insolvencies being included. Model 2 eliminates the Premium Growth variables, which results in one additional insolvency being added in both analyses.

While many variables were of the expected sign, the only variable that is significant is return on assets. Although the sample of insolvent insurers is small, the evidence suggests that insurers with lower profitability in the year prior have a higher probability of insolvency. This result is consistent with expectations. This result is less strong for the two-year prior analysis, suggesting that profitability may decline rapidly, and two years prior there may be not be an indication of a problem. The fact that most of the variables

are not significant is most likely due to the small number of insolvent insurers.

In addition to the small sample size, another potential explanation for the lack of predictive ability in the model relates to the relatively high capital requirements in Canada. If insurers hold capital levels well in excess of what is required, and what would be held by U.S. insurers, variables that help to identify firms worth monitoring more closely may not have the same predictive power for Canadian insurers.

Classification error rates are presented at the bottom of Tables 5 and 6. Given the small number of insolvencies in this study, and the varying number of insolvencies depending on the model, classification error rates are reported differently than in most studies.[29] The overall ability of the models to correctly classify insurers is weak. Misclassification rates are high for all models, and while the full model, one-year prior analysis does have a 5 percent Type II error rate with four Type I errors, it should be noted that the total number of insolvencies is eight for that model.[30]

CONCLUSION AND FUTURE WORK

This paper presents an analysis of insolvency prediction and experience in the Canadian P&C insurance market. Given the small number of insolvencies and the limitations on the data available, the ability of the model to predict insolvencies is not very good. However, the noticeably different frequency of insolvency in the U.S. and Canada provides an interesting comparison between the factors that may explain the lower incidence of insolvencies in Canada, including a single federal regulator, higher capital requirements, and lower underwriting risk. These issues are important factors to consider in the ongoing debate regarding a single federal regulator in the U.S.

For Canada, the experience of provincially-regulated insurers suggests that there is a need for more consistent reporting of insurer financial information to aid in the monitoring of insurer performance. Harmonization of solvency regulation and financial reporting will allow for better

[29]Normally, Type I error rates are calculated for different Type II error rates. The Type I error rate is the percentage of insurers that subsequently became insolvent that are incorrectly predicted to remain solvent. The Type II error rate is the percentage of solvent firms that are incorrectly predicted to become insolvent. This study reports the number of Type I errors, rather than the percentage, and the corresponding Type II error rate.

[30]These results are comparable to those of Pottier and Sommer (2007) based on using individual company data alone without incorporating group data, which is found to significantly improve classification results.

Table 5. Logistic Regression Results—One-Year Prior Analysis

	Model 1—Full model	Model 2—Excluding premium growth and capital growth variables
Intercept	–5.0512***	–4.9427***
	1.8991	1.6540
Natural log of assets	–0.0560	–0.0469
	0.1236	0.1097
Return on assets	–2.1988**	–2.0022*
	1.1175	1.0419
NPW/surplus	0.0267	0.0247
	0.0476	0.0487
Loss ratio	–0.00000787	–0.0000562
	0.0046	0.0053
Percentage auto	–0.02530	–0.4859
	1.2980	1.2268
Rate of change in capital	–0.0319	N/A
	0.0546	
Rate of change in NPW	–0.0034	N/A
	0.0041	
Canadian incorporated	0.5827	0.3469
	0.9585	0.8011
Group membership	–0.5467	–0.5985
	1.2259	1.1651
Logistic R^2	0.0292	0.0240

Jackknife standard errors are reported underneath each coefficient
*** significant at 1%, ** significant at 5%; * significant at 10%

# of Type I errors	Type II error %	
	Model 1	Model 2
1	64.7	98.6
2	43.2	95.9
3	31.4	92.9
4	5.0	75.5
5	1.5	62.6
6	1.1	59.5

Table 6. Logistic Regression Results—Two-Year Prior Analysis

	Model 1—Full model	Model 2—Excluding premium growth and capital growth variables
Intercept	–3.7349***	–3.4366***
	1.2594	1.1804
Natural log of assets	–0.0912	–0.0976
	0.0760	0.0692
Return on assets	–1.3491	–1.4749*
	0.9562	0.8728
NPW/surplus	0.0216	0.0224
	0.1559	0.2254
Loss ratio	–0.0001005	–0.000544
	0.0009	0.0019
Percentage auto	0.0383	–0.1068
	0.8146	0.7671
Rate of change in capital	–0.0413	N/A
	0.0476	
Rate of change in NPW	0.0009	N/A
	0.0045	
Canadian incorporated	–0.1420	–0.2746
	0.6617	0.6172
Group membership	–0.8206	–0.8375
	1.1380	1.1113
Logistic R^2	0.0258	0.0315

Jackknife standard errors are reported underneath each coefficient.
*** significant at 1%, ** significant at 5%; * significant at 10%

# of Type I errors	Type II error %	
	Model 1	Model 2
1	93.8	93.1
2	92.2	92.7
3	91.0	88.7
4	89.0	88.1
5	87.6	87.3
6	74.7	81.5
7	54.3	80.7
8	51.1	62.2

comparison across all Canadian insurers. This would allow regulatory agencies and customers to have a greater understanding of the potential risks associated with their insurers as well as allow for more complete research to be done on insurer financial distress. This is likely to provide greater advance warning of impending insolvencies. Models that predict insolvency only one year prior are arguably of little use.

Future research that would improve our understanding of insolvency in the Canadian P&C insurance market would examine the macro-economic and industry-wide variables that are related to insolvency. As well, given the high proportion of foreign-owned insurers in Canada, further analysis on ultimate parent financials may significantly contribute to the ability to assess the strength of Canadian insurers.

Lastly, as we have noted, our research has been constrained by the fact that we were unable to include "financially distressed" firms in our sample, and were only able to include those firms that received a winding up order. In order to better inform stakeholders on an ongoing basis regarding the financial status of an insurer, the revelation of information such as the risk stage assigned by OSFI would allow for greater levels of understanding by the academic community and to interested consumer-based groups.

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Appendix A. Involuntary Exits in Canada

Involuntary exit	Solvency supervisory	Wound-up	Type of exit
Abstainers Insurance Company	Ontario	1995	insolvency
Advocate General Insurance Company	Federal	1989	insolvency
Alta Surety Company	Federal	2001	insolvency
American Mutual Liability Insurance	Federal	1989	liquidity
American Reserve Insurance Company	Federal	1979	insolvency
Beothic General Insurance Company	Newfoundland	1993	insolvency
Canadian Great Lakes & Surety Company Ltd.	Ontario	1983	insolvency
Canadian Millers Mutual Insurance Company	Ontario	2001	insolvency
Canadian Universal Insurance Company	Newfoundland	1991	insolvency
Cardinal Insurance Company	Federal	1982	insolvency
Century Insurance Company of Canada (The)	Federal	1989	insolvency
Eaton Bay Insurance Company	Federal	1989	liquidity
English & American Insurance Company	Federal	1993	liquidity
Ensign Insurance Company	Federal	1961	insolvency
GISCO la Compagnie d'Assurance	Quebec	2000	insolvency
Hiland Insurance Company	Newfoundland	1994	insolvency
Home Insurance Company	Federal	2003	liquidity
Ideal Mutual Insurance Company	Federal	1985	liquidity
Kansa General International Insurance Co. Ltd	Federal	1995	liquidity
Maplex General Insurance	Ontario	1995	insolvency
Markham General Insurance Company	Ontario	2002	insolvency
Mennonite Mutual Hail Insurance Company	Saskatchewan	1984	insolvency
Midland Insurance Company	Federal	1986	liquidity
National Employers Mutual General Insurance Association Ltd.	Federal	1990	liquidity
North American General Insurance Company	Federal	1966	insolvency
Northern Union Insurance Company	Manitoba	1983	insolvency
Northumberland Insurance Company	Federal	1985	insolvency
Ontario General Insurance Company	Ontario	1989	insolvency
Orion Insurance Company PLC	Federal	1995	liquidity
Phoenix Assurance Company of Canada	Federal	1989	insolvency
Pitts Insurance Company	Federal	1981	insolvency
Reliance Insurance Commpany	Federal	2001	liquidity
Strathcona General Insurance Company	Federal	1981	insolvency
United General Insurance Company	Federal	1986	insolvency
Wentworth Insurance Company	Federal	1966	insolvency

Appendix B. Spearman Correlations

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Natural log of assets	1.0000									
(2) Return on assets	–0.1616	1.0000								
(3) NPW/surplus	0.3757	–0.3576	1.0000							
(4) Capital/assets	–0.5425	0.4680	–0.7864	1.0000						
(5) Loss ratio	0.1543	–0.5472	0.1651	0.2902	1.0000					
(6) Percentage auto	0.3842	–0.2338	0.4372	0.4504	0.3124	1.0000				
(7) Rate of change in capital	0.1258	0.2529	0.0174	0.0263	–0.1593	0.0316	1.0000			
(8) Canadian incorporated	0.3084	–0.1909	0.5133	0.4587	–0.0367	0.2904	0.0277	1.0000		
(9) Group membership	0.3879	–0.1231	0.3001	0.3917	0.1147	0.3773	0.0213	0.2487	1.0000	
(10) Rate of change in NPW	0.0064	–0.0666	0.1922	0.0389	0.0121	0.0379	0.0814	0.0216	–0.0047	1.0000