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Abstract:

This paper investigates strategic brinksmanship between regulated property-liability insurance firms and their regulators. Prior research suggests that firms increase their financial leverage, and thus their probability of bankruptcy and expected bankruptcy costs, in order to mitigate the severity of binding price ceilings. Although financial leverage can be altered by changing capital structure, it can also be altered by increasing other liabilities, as analyzed in this paper. This paper uses an instrumental variable for price regulation with a maximum-likelihood Heckman estimation method over panel data for Canadian property-liability insurers to extract the impact that price regulation has on the financial leverage of insurers as well as the probability of bankruptcy, the non-selection probability.

Introduction

According to Modigliani and Miller (1958), the market value of any firm is based on its productive capacity and not its capital structure. Several studies, however, suggest how regulated firms can alter their capital structure to increase their probability of bankruptcy and improve their bargaining position with the regulator.[2] With an increased probability of bankruptcy, the regulator cannot cut prices as much as it otherwise might have.[3] If this theory is true, firms may alter their capital structure in order to thwart the intentions of a regulator. Empirical research has demonstrated that firms do increase their financial leverage when they are faced with price regulation of their product.[4]

Klein, Phillips, and Shiu (2002) use US property-liability insurer cross-sectional data and find that insurers subject to more stringent price regulation have higher financial leverage ratios. Klein *et al.* use an instrumental variable for the stringency of price regulation that is replicated in this paper. This paper extends the work of Klein *et al.* by using panel data and a maximum likelihood Heckman estimation method that allows the impact of price regulation on both the financial leverage and the probability of non-selection (probability of bankruptcy) to be estimated jointly. This paper finds similar results to Klein *et al.* but does not consider the worker's compensation markets in Canada as they are provincially monopolized; only price regulation of the automobile insurance market is considered.[5] The automobile insurance market is serviced by property-liability insurers.[6]

Modigliani and Miller (1958) found that the value of a firm is independent of its capital structure; a firm can fund its activities by using any combination of debt and equity without changing the underlying productive value of the firm. The probability of bankruptcy for a firm, however, generally increases with more financial leverage as the debt usually requires fixed repayments and most firms have earnings which are not fixed, but volatile. As financial leverage increases and the fixed debt repayments increase, the probability that the

[2] Spiegel and Spulber (1994), Dasgupta and Nanda (1993), Taggart (1981)

[3] Dasgupta and Nanda (1993)

[4] Klein, Phillips, and Shiu (2002), Hagerman and Ratchford (1978), Taggart (1985), and Dasgupta and Nanda (1993).

[5] Note that although the worker's compensation market has been excluded from observation because it is completely monopolized, the automobile insurance markets in Canada have not been excluded as they are not completely monopolized, even in the provinces of British Columbia, Saskatchewan, and Manitoba. In those provinces, competitive insurers can still compete with the crown corporations in the non-monopolized section of the market. The automobile insurance market segments monopolized by the crown corporations are the minimum, mandatory coverages, while the optional, extended coverages are not monopolized. Optional, extended coverages include higher third-party liability limits and lower deductibles.

[6] Property-liability insurance companies, also known as property-casualty companies are companies that do not write life insurance, living health benefits, or health insurance. Property-liability insurers insure property and provide coverage to individuals, businesses and other organizations for liability exposure. Typical property-liability insurance policies include personal automobile, personal home, apartment, condominium, commercial automobile, commercial business, motor-homes, personal property, cottages, personal-liability umbrella, etc.

firm will not have sufficient earnings to pay the debt payments in a given time period increases.[7] In Canada, a failure to meet liabilities as they become due is an act of bankruptcy upon which creditors can seize the assets of the company in order to recover their investment.[8] This paper assumes that the process of bankruptcy itself is costly.[9] As the probability of bankruptcy increases, the expected bankruptcy cost increases.

Assuming that the debt holders of an insolvent firm restructure the firm and re-enter the market, it could be months before the restructuring process is complete.[10] It is assumed in this paper that the regulator places a high value on keeping its regulated firms solvent. The regulator must ensure that the participation-constraint[11] of the insurer is met and does so by allowing a price which allows the firm to make non-negative profit.[12] Following Spiegel and Spulber (1994), the regulator maximizes a utilitarian welfare function given by

$$W(p,k,D) = CS(p) + b\Pi(p,k,D) \tag{1}$$

Note however that in Canada, property-liability insurance companies are restricted in their ability to choose their own capital structure. In Canada, property-liability insurers are not allowed to have any more than two percent of their capital from debt obligations.[13] Ignoring the debt obligations of the company, the utilitarian welfare function can then be written as

$$W(p,k) = CS(p) + b\Pi(p,k) \tag{2}$$

where $CS(p) = \int_p^\infty Q(p)dp$ is consumer surplus and b is a weight on profits which generally is assumed to satisfy $0 < b < 1$. The profit function is assumed to be normally behaved, increasing in p. The price that the regulator chooses, as a function of capital $p^*(k)$, corresponds to an allowed rate of return $\Pi(p^*(k),k)/k$.

Although the Spiegel and Spulber (1994) paper does not consider the possibility of increasing the probability of bankruptcy by means other than an increase in debt obligations, this paper considers it. Although the regulated property-liability insurer in Canada is restricted

[7] Assuming the volatility of earnings increases or stays constant.
[8] Bankruptcy and Insolvency Act, S.C.1992 s.42(1), as amended by S.C. 1997 c.12 s.26, 2004, c. 25, s. 27
[9] Klein *et al*. (2002), Dasgupta and Nanda (1993), Spiegel and Spulber (1994), Taggart (1981), Spiegel (1994), Brander and Lewis (1988), Taggart (1985), Choi *et al*. (2002) also assume this.
[10] Willes and Willes, 2001, 'Contemporary Canadian Business Law, Principles and Cases, Sixth Edition,' p.579-584
[11] The participation constraint is a non-negative profit condition, not a zero profit condition.
[12] Owen and Braeutigam (1978) say that "One of the worst fears of a regulatory agency is the bankruptcy of the firm it supervises." Referenced in Taggart (1981), p.388-9
[13] Insurance Companies Act, Section 476; Property and Casualty Companies Borrowing Regulations, Section 7.

in the level of debt that can be issued, it can increase its probability of bankruptcy by increasing its other liabilities including unpaid claims, unpaid premiums, general accounts payable, and other liabilities in it's financial accounts. By increasing liabilities in general, the insurer increases its probability of bankruptcy.

Without price regulation, the insurer would choose an optimal level of liabilities such that the opportunity cost of capital is equal to the negative of the decrease in the expected profits because of the increase in the probability of bankruptcy from having higher liabilities. With the introduction of price regulation, the insurer has a new incentive, the incentive to increase the probability of bankruptcy above this equilibrium level so that the regulator who places a sufficiently-high value on the solvency of insurers does not cut prices so much that the probability of bankruptcy exceeds some probability of insolvency rate that is acceptable to the regulator.

With the expectation on the part of the insurer that the regulator will not cut prices so much that the probability of insolvency exceeds some acceptable level, the stage is set for a two stage bargaining game in which sub-game perfect equilibrium can be used as the solution concept for determining the optimal liability level of the insurer in order to maximize profits.

In the first stage of the game, the price regulated insurer chooses the level of financial leverage. In the second stage of the game, the regulator sets the regulated price so as to maximize the utilitarian welfare function. Using sub-game perfect equilibrium as the solution concept, the regulator sets prices such that the insurers remain solvent . In the first stage of the game, the insurer chooses leverage in order to maximize profits. Note that the expected profit function contains the expected bankruptcy costs.

Literature Review

Klein, Phillips, and Shiu (2002) investigate whether price regulation impacts the capital structure of property-liability insurers in the US and find evidence consistent with the theory of Spiegel and Spulber (1994). Klein *et al.* use an instrumental variable for the stringency of regulation and another for the extent of regulation.[14] Klein *et al.* did not estimate the degree to which financial leverage impacts the probability of insolvency.

Klein *et al.* (2002) use the size of the residual automobile insurance markets in each state and the size of the residual worker's compensation insurance markets in each state, weighted by an insurer's exposure to that market segment, as an instrumental variable for the stringency of price regulation.

[14] Klein *et al.* (2002) p. 84, s.4.2. The stringency variable is replicated in this paper.

The residual market in each US state/ Canadian province or territory/ business line is the market of last-resort for consumers who cannot find insurance coverage in the regular market. *Ceteris paribus*, as price regulation becomes more stringent, more automobile insureds will be placed into the residual markets given the desire by insurers not to insure consumers at a price which is sufficiently low. [15]

Hagerman and Ratchford (1978) investigate the impact that economic and political variables have on the allowed rate-of-return for electric utility companies. Using data from seventy-nine US electric utility companies in thirty-three states, Hagerman and Ratchford find that the financial leverage of electric utility companies (measured by debt/ equity) has a significant and positive impact on the allowed rate-of-return. Klein *et al.* (2002) and Spiegel and Spulber (1994) argue that price control regulation causes firms to increase their financial leverage and that the increased financial leverage causes regulators not to lower the regulated price as much as they otherwise could have. Klein *et al.* find evidence of the first half of that argument, that price regulation causes insurers to increase their financial leverage. Hagerman and Ratchford (1978) find evidence for the second half of that argument, that financial leverage ratios which are high result in higher allowed rates-of-return (through higher prices) from the regulator for the regulated firm.

Taggart (1981) argued that rate-of-return regulation can create incentives for firms to alter their capital structure. Taggart (1985) found evidence that rate regulation impacts the financing decisions of utility companies. He found that "the establishment of regulation is associated with a discernible increase in utility debt proportions." However, Taggart could not rule out the possibility that the debt increased as a result of decreased business risk. If a regulated firm is more stable than an unregulated firm owing to some governmental protection and/ or guarantee to earn some pre-determined rate, it is plausible that a firm might use more leverage as the increased leverage/ bankruptcy risk may be offset by the decreased business/ competitive risk. In the case of property-liability insurance, most states and provinces have multiple companies operating, suggesting that there is not any lowered business or competition risk because of price regulation and regulation in general. However, the strategic bargaining game outlined by Spiegel and Spulber (1994) requires that the regulator values the

[15] Whether a provincial regulator has an "all-comers-rule" or not is not the key; the key is the existence or non-existence or degree of price regulation. An "all-comer's rule" is a rule which requires all insurers to provide insurance to any and all consumers who the insurer may not wish to insure at a binding price-control-ceiling rate. The risk-sharing-pools enable insurers who are subject to an "all-comers-rule" to pool their risks so that they all receive the same loss from that group of policies. In the absence of an "all-comers-rule," the risk-sharing-pools still exist when the regulator allows higher-risk consumers to get automobile insurance through carrier-insurers (insurers who write on-behalf of the pool). In that situation, the carrier-insurers write on behalf of the pool and the overall loss is then apportioned in some manner to either the government or all of the insurers themselves. Whether the government subsidizes those high-risk consumers or the insurers subsidize them themselves is unimportant as the instrumental variable for the stringency of price regulation is the size of the risk sharing market/ pool(s) for the province in the given year, not who subsidizes them.

firm's solvency; if there are multiple competitors, the regulator may allow some insurers to go bankrupt as others will presumably service the market share the bankrupt firm leaves behind.

Dasgupta and Nanda (1993) find evidence that regulated US electric utilities companies in the period 1972-1983 increased their financial leverage when they were subject to more hostile regulatory environments. Dasgupta and Nanda argue that firms increase their debt in order to increase their bargaining power with the regulator.

As already discussed, Spiegel and Spulber (1994) argue that a firm's capital structure has a significant effect on the regulated price that the firm receives. Spiegel and Spulber find that firms increase their financial leverage because of price regulation. Furthermore, Spiegel (1994) argues that the regulated price is an increasing function of a firm's debt. Spiegel also argues that when regulators attempt to limit the ability of a firm to raise capital, the firm may reduce overall investment which can actually harm consumers. Whether a regulated firm increases overall investment or not is not directly considered in the current paper.

While there appears to be agreement across the previous non-insurance market studies that regulated firms are more financially leveraged than unregulated firms, the study by Klein *et al.* did not estimate the impact of price regulation on the probability of insolvency. Further, the use of the panel data set in this paper allows fixed-effects to be held constant at the firm level, producing more efficient estimators of the impact of price regulation on the financial leverage of insurers.

Methodology

The official regulatory financial definitions of surplus and equity differ from Canada to the USA and from Klein, Phillips, and Shiu (2002) to this paper. The Office of the Superintendent of Financial Institution's (Canada's federal-government agency solvency regulator for insurance companies) definition of surplus changed in 2003 — the data point was not consistent over the time-period analyzed.[16] For that reason, the data source utilized in this paper (MSA Research Inc.) did not have the surplus variable available past the year 2003. Instead of using surplus, this paper has used equity to calculate the main financial leverage ratios.[17]

Klein *et al.* (2002) claim that their analysis using cross sectional data helps them overcome possible confounding effects that can be caused when other regulations are

[16] According to MSA Research Inc., "statutory surplus" was defined as: [Assets- Liabilities- Reserves required] prior to 2003 when it was discontinued and replaced with "adjusted equity" defined as: [Total Equity - Capital Required for Catastrophes and Reinsurance Ceded to Unregistered Insurers.]

[17] The differences between surplus and equity are not expected to alter the results. Prior to 2003, surplus was defined as [assets-liabilities-reserves required], and so it represented excess equity that the firm had. In the main analyses in this paper, equity is used instead of surplus.

introduced at the same time as price regulation.[18] The instrumental variable for price regulation employed by Klein *et al.* and in this paper is an efficient estimator. It is more efficient than the actual observed price chosen by the regulator because it varies with changes in the cost of the insurance product itself. Whereas the actual observed price chosen by the regulator does not necessarily change with changes in the cost of the product, the instrumental variable does. The cost of the insurance product is determined, in part, by the evolution of tort law and changes in the cost of fixing vehicles. The instrumental variable is efficient because an increase in the cost of the product will force more consumers into the residual market, an effect that would not be captured by using only the regulated price observed. Furthermore, the regulated price suffers from endogeneity issues as the regulator sets prices in order to lower financial leverage and the probability of insolvency. The instrumental variable, although it may also suffer from the same endogeneity issue, would be more efficient than the regulated price variable since the tort system and the cost of fixing vehicles is exogenous to the insurer's choice of financial leverage.

Data

The main source of data for this analysis comes from MSA Research Inc., a private Canadian company engaged in collecting, organizing, and selling data from the Canadian insurance industry. The data set is similar to that used by Klein *et al.* (2002).[19] MSA Research Inc. collects data both indirectly and directly from insurance companies.[20] This data set was chosen because it is the most comprehensive source for Canadian property-liability insurance company financial information.[21] The data from MSA Research Inc. was supplemented with data from the Facility Association that provided information on the size of the residual insurance markets and risk-sharing-pools in every province for every year of observation.[22]

[18] Klein *et al*. (2002), p.80. For example, other changes (minor-injury benefit ceiling, two new risk-sharing pools on top of the already existent residual market pool) were introduced in 2003 and 2004 to the Alberta personal automobile insurance market in addition to price regulation. The effects of other changes in regulation alongside price regulation are discussed in the data section on page 20.

[19] In Klein *et al*. (2002), the authors used data from both the automobile insurance industry and the worker's compensation industry as they are the most heavily regulated insurance sectors in the US (Klein *et al*. (2002), pp.84, 85). In Canada, worker's compensation insurance is monopolized by government at the provincial level and, as such, is not useful for the analysis of this paper. This paper investigates only the automobile insurance industry in Canada relative to the rest of the Canadian property-liability insurance industry.

[20] See MSA Research Inc.'s website for more information, http://www.msaresearch.com/, accessed July 16, 2007.

[21] See MSA Research Inc.'s usage rates: http://www.msaresearch.com/products_msaresearcherPC.php

[22] The residual/ risk-sharing-pool market data from the Facility Association was calculated by the Facility Association using the written count basis, not the written premium basis.

The Facility Association is an unincorporated Canadian body that administers the residual markets and risk-sharing-pools in Canada.[23]

Three-hundred fifteen (315) property-liability insurance companies operated in Canada during the years 1997-2006 inclusive. This includes all property-liability insurers in the MSA Research Inc. data set whether they sold automobile insurance or not. Some of the companies exited the industry during this time period and some entered after 1997, in addition to that, some companies may have become licensed one year (observed in the MSA Research Inc. data), but did not start operating until the next year or a later year. Given the hypothesis that price regulation causes an increase in financial leverage and bankruptcy, it would not be surprising to find that an insurer's decision to be in the market or not is correlated with the degree of price regulation. A Heckman two-step estimation method is used to account for this problem.

Of the 315 companies that operated in Canada in the ten year time period observed, 93 entered after 1997, these companies were removed from the panel. After removing these 93 companies, 222 companies remained. These 222 companies were in business in Canada selling property-liability insurance on or before 1997. Of these 222 companies, only 182 survived until at least 2006. Therefore, the panel of 222 firms observed over ten years, 2220 observations, includes 40 firms that exited the industry at some point during the period of observation. Of these 40 firms that exited, it is reasonable to assume that price regulation may have played a role in their decision to leave the industry. Using Heckman's maximum likelihood estimation technique, it is possible to jointly solve for both the impact of price regulation on the financial leverage of insurers as well as the impact of price regulation on the probability of non-selection, that is, the probability of market exit/ insolvency.

The Facility Association provided data on the size of the residual market in each province. The only provinces in which the Facility Association does not operate are British Columbia (BC), Saskatchewan (SK), Manitoba (MB), and Quebec (QC). It does not operate in BC, SK, or MB because each of those provinces has a crown-corporation monopoly that provides mandatory (monopolized) and optional insurance (competitive) to all drivers including higher-risk drivers which the Facility Association normally insures or underwrites in other provincial jurisdictions.[24] In Quebec, there are no residual markets for higher-risk

[23] See: http://www.facilityassociation.com/, accessed July 16, 2007.

[24] Crown corporations have not been excluded from the data set. Nevertheless, the results do not change in significance or magnitude when they are excluded. It is the belief of this author that crown corporations should be included in this fixed-effects analysis. The fixed-effects regression essentially assigns a dummy variable to each and every company including the crown corporations. In addition to this, the perfect competition assumption implies that the firms will all earn zero profit, a result which may not be too different from the crown corporation which may have a non-profit condition on it as well. It is important to remember that even the capital used by a monopolized crown corporation has an opportunity cost which the crown corporation must recover over time in order to maintain solvency without subsidization or a tax-payer bailout (even though it may be able to ignore the opportunity cost of it's capital for an extended period of time).

drivers; if a driver cannot find insurance at a price he is willing to pay, he is not insured and cannot legally drive. In addition to the residual market pools, the Facility Association manages what are known as "risk-sharing-pools". The residual market pools and the risk-sharing-pools are essentially the same thing—a risk-sharing mechanism for the riskiest drivers to which all insurers participate.[25] This paper assumes that the residual markets and the risk-sharing-pools are the same. The residual markets and the risk-sharing-pools in each province have been added together, in this paper, for each year.

Table 1. Summary Statistics for all variables, 1997-2006

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Dependent Variables					
Total Liabilities to Equity	1820	1.964	1.908	-0.106	23.147
Total Liabilities to Liquid Assets	1820	59.068	36.364	-17	641.4
Unearned Premiums to Equity	1820	0.531	0.614	-0.626	3.971
Unpaid Claims to Equity	1820	1.209	1.230	0	12.622
Premiums / Equity	1820	0.955	3.922	-1.264	164.034
Regulatory Variables					
Regulatory Stringency	2220	0.006	0.013	-0.082	0.127
Control Variables					
ROA Before Taxes	1820	0.04	0.11	-1.897	1.369
Year	2220	-	-	1997	2006

The negative values of various variables are a result of accounting procedures and are still valid for the analysis.

Table 1 shows the summary statistics for all variables. Some of the minimum observations in the summary statistics table are negative. In the case of the financial leverage ratios, the negative minimum observations arose from only one company.[26] The negative value from the one company comes from contra-liability accounts in their accounting-

[25] In the case of the residual markets, the facility association essentially re-insures the consumer through a servicing insurance company. In the case of the risk-sharing-pool, insurance companies directly insure consumers and then report their qualifying policies to the Facility Association which then collects extra money or takes extra money from insurers depending on the performance of their pooled risks relative to the average pooled risk.

[26] Legacy General Insurance Co. had negative liabilities in the years 1997 and 2003. Legacy's negative values come from contra accounts. Other observations in the sample had negative unearned premiums also, but the net result (when considering all liabilities) for those were positive while for Legacy and Atrudius was negative. These observations have not been removed from the sample as they are still informative and accurate observations not containing any known errors.

recognition of earned premiums.[27] The negative minimum value for the "sum of exposure to regulatory stringency" arose from companies that had negative automobile insurance premiums from select provinces in select years (total of 16 observations).

Five different definitions for leverage (dependent variables) are used for otherwise identical specifications. The most straightforward and comprehensive definition used is "total liabilities to equity." Three of the other dependent variables simply analyze components of "total liabilities" relative to equity or assets to see which components the insurer altered to increase financial leverage.[28] The fifth definition of financial leverage is one that is particular to the insurance industry itself, "premiums over equity". "Premiums over equity" is a rough measure of an insurer's capitalization relative to its premiums. If the ratio of premiums to equity is higher than it is for another company or for another year, it can be said that the insurer is likely more leveraged. This assumes that premiums are an accurate measurement of the total risk that the insurer has insured and that the amount of risk per premium collected does not vary from company to company. The higher the ratio of premiums to equity, the more premiums (and by assumption, risk) the insurer has relative to its ability to pay for losses, equity.

All provinces and territories with price control regulation in Canada have a residual market and/or risk-sharing-pool for the pooling (and subsidization) of risks for when the binding price control regulation is below the market price.[29]

Klein *et al.* (2002) use six different measurements for the stringency of regulation. Only one of the six variables from Klein *et al.* is directly replicated in this paper. [30]

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[27] A contra account is an accounting term for an account which offsets another account but is placed in the same section of the balance sheet (assets, liabilities, or shareholders equity) as the account it offsets.

[28] Standard accounting definitions would have likely been used to determine which items the companies placed under assets, under liabilities, and under equity. In Canada, insurance companies must use Statutory Accounting Procedures (SAP) instead of Generally Accepted Accounting Procedures (GAAP). SAP is assumed by this author to be more rigorous and standardized than GAAP, contributing to standardized data points from one company to the next. For the uninformed reader, the standard accounting equation is [assets=liabilities + equity]. For each one dollar in assets that a company has, it is matched by either one dollar in equity or one dollar in liabilities or some combination of the two to equal one dollar.

[29] Another argument for the pooling of risks into residual markets and/ or risk sharing pools is that the highest risk consumers are too risky and that it is fairer to insurers if they all share in the losses for the highest-risk consumers.

[30] The remaining four regulation variables used by Klein *et al*. were not available for Canada. Two were based on US-specific research from *Conning and Company* known as the *External Climate Index*. The remaining two regulatory variables used by Klein *et al*. were based on information from the *US National Council on Compensation Insurance*. Conning and Company has information for the US on the regulatory stringency of a regulator and bases its analysis, for example, on the size of the regulator's budget to the total market size and the number of people on the regulator's payroll to the size of the market. The information from the *US National Council on Compensation Insurance* is based, for example, on the ratio of the number of rate-increase

Equation (3) is the formula for the instrumental variable for the severity of price regulation on each observation— each *i* insurer in a given *t* year. The severity of regulatory stringency is an efficient instrumental variable; consider the alternative: the actual price controls introduced for each level of risk for each year for each province. In order to understand the severity of a price control, we need to know the market price of the product. In the case of automobile insurance, that task is very difficult since the product varies tremendously from province to province and year to year, with different tort, legal and regulatory regimes that are constantly evolving. Suppose, for example, that a price control is in place but that the tort system changed. With such a change, the severity of price regulation would also change, but it would be unnoticed if the variable for price severity was simply the price regulation itself. By using this instrument, equation (3), fluctuations in the severity of price regulation will be captured. Furthermore, it is also likely that using the price controls themselves would create an endogeneity issue in that the regulator could set prices after observing insurer's financial leverages. For that reason as well, the instrumental variable, equation (3), is efficient because the tort system likely varies in response to greater societal issues relating to the law than just insurer's financial positions.

The instrument is calculated through the summation of an insurer's automobile insurance premiums in a j province or territory (the three territories were combined into one) in a given year, $\text{AutomobilePremiums}_{ijt}$, over total premiums from all lines of business for that year, $\text{TotalPremiums}_{it}$, multiplied by the relative size of the province's residual market in that year, $RSIZE_{jt}$. The Facility Association provided data on RSIZE_{jt}, the size of each province's residual market relative to the province's total automobile insurance market size in each year. As the severity of price regulation increases, the RSIZE_{jt} variable increases. As an insurer's exposure to a province increases, the ratio of $\frac{\text{AutomobilePremiums}_{ijt}}{\text{TotalPremiums}_{it}}$ increases.

$$\text{RegStringency}_{it} = \sum_{j-1}^{11}\left(\frac{\text{AutomobilePremiums}_{ijt}}{\text{TotalPremiums}_{it}} \times \text{RSIZE}_{jt}\right) \tag{3}$$

The harsher and more severe the price regulation (the farther it is below market prices) the higher the $\text{RegulatoryStringency}_{it}$ instrument will be.

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applications that are accepted to the number of rate-increase applications made (by the insurance companies to the regulator).

The written-premium-method was used to calculate $RSIZE_{jt}$. Only fourteen observations had negative stringency variables resulting from negative written premiums, this paper has assumed that this is not a problem.[31]

The size of the residual market, $RSIZE_{jt}$, in each of the provinces of British Columbia, Saskatchewan, and Manitoba are zero—there are no residual markets or risk-sharing-pools in these provinces. Insurers are free to offer insurance products in the non-monopolized market segments of these provinces which are higher than the crown corporation's prices. The crown corporations monopolize the mandatory insurance requirement in each province, but compete with other insurers for the optional automobile insurance coverage market segment. For example, in the province of Saskatchewan, the government requires all automobile drivers to carry minimum third-party liability insurance coverage of $200,000 and minimum collision and comprehensive coverage with a deductible of $700. The insurance customer does not have a choice as to which company he can buy this mandatory coverage from—he must buy it from the Saskatchewan Government Insurance company. However, if the customer would like to buy more insurance coverage, at his option, he can buy coverage for higher third-party liability insurance coverage up to $2,000,000 or even higher and he can buy an insurance product with a lower deductible, perhaps as low as $50 or $100. The optional portion of insurance coverage above-and-beyond the mandatory minimum coverages can be purchased from any insurance company, not just the Saskatchewan Government Insurance company, although they do sell it. The customer can buy the optional insurance coverage from any company that sells it and no company is forced to sell the optional insurance coverage for any certain price or below some regulated price. For this reason, the provinces of British Columbia, Saskatchewan, and Manitoba are assumed to have zero price regulation (on the competitive insurers for the optional insurance market) as the competitive insurers who offer products in these markets are not required to do so at a price-controlled rate.

The variation in the price control variable may be caused by factors other than price regulation *per se*. Regulations that change the policy wording, claim benefits, and other costs in addition to the price can also impact the stringency of the regulation. If the product becomes more costly owing to a legislated increase in benefits and prices are restricted from reflecting the increased cost, the stringency of regulation will increase leading to an increased size of the residual market and the instrumental variable used in this paper.

[31] Negative written premiums can arise because consumers can start and stop their policies at any point in a calendar year, whereas the data from MSA Research Inc. used in this paper is based on the calendar year. The written premium method aggregates all premiums written in the calendar year whereas the earned premiums method accounts for all premiums actually earned in the year (irrespective of when the policy began/ ended/ was written).

The profitability of an insurance company has been used as a control variable as it is assumed that an insurer's profits vary over time and that this could affect financial leverage. The profitability of an insurer (relative to assets) varies from company to company and year to year. The variable used is: "return-on-assets before taxes and extraordinary items". Insurers that have high profitability are assumed to have more retained earnings and, therefore, lower leverage. Insurers who are more profitable than others are also assumed to have higher growth opportunities and be more likely to hold on to capital in order to reduce the agency costs of acquiring external capital. It is expected that this variable be negatively correlated with leverage. It is assumed that this variable and the regulatory stringency variable are independent. While the panel data with fixed effects at the firm-level will account for most of the variation from one company to the next, the return-on-assets variable adds explanatory power to the model. Firms with similar profitability may have similar behavior, something not captured by the fixed-effects regression which essentially assigns a dummy variable to each firm over time.

Empirical Analysis

With four-hundred censored observations, it is important that we correct the coefficient on the regulatory stringency variable to account for natural attrition that would have occurred in the absence of price regulation in Canada. The Heckman maximum likelihood method allows us to do this. Not only does the Heckman maximum likelihood method allow us to separate out the natural attrition rate from the attrition caused by price regulation, but the estimated probit on the probability of attrition caused by price regulation can be interpreted as a probability of bankruptcy measure. In this way, the theory of Spiegel and Spulber (1994) is brought to life: not only do we estimate the effect of price regulation on the financial leverage of insurers, but we also estimate the effect of price regulation on the probability of insolvency.

Table 2, Heckman Maximum Likelihood Estimation of Regulatory Stringency on the Financial Leverage of Canadian Property-Liability Insurers, fixed-effects at the firm level, panel data 1997-2006 inclusive, 1820 uncensored observations, 400 censored observations, standard errors have been clustered by firm, fixed effects omitted to save space.

	ML Model 1		ML Model 2		ML Model 3		ML Model 4		ML Model 5	
	Total Liabilities to Equity	select	Liabilities to Liquid Assets	select	Unearned Premiums to Equity	select	Unpaid Claims to Equity	select	Total NPW/ Total Equity	select
RegStringency	28.95	60.862	87.107	59.838	8.972	67.281	18.145	53.758	-7.044	61.414
	(4.53)***	(5.42)***	(1.71)*	(4.25)***	(3.58)***	(6.60)***	(4.74)***	(4.27)***	(-0.67)	(4.36)***
ROA Btax	-0.966		-10.668		-0.208		-0.719		11.906	
	(-2.14)**		(-1.6)		(-2.67)***		(-2.02)**		(1.04)	
Yearline		-0.115		-0.208		-0.127		-0.101		-0.203
		(-4.96)***		(-33.02)***		(-6.03)***		(-4.10)***		(-33.95)***
Constant	3.858	1.337	91.263	2.043	0.966	1.454	2.386	1.217	0.694	2.009
	(53.02)***	(6.61)***	(186.58)**	(46.74)***	(20.31)***	(8.46)***	(37.88)***	(5.70)***	(1.72)	(49.68)***
Observations	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220

Robust z statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%
Yearline: (1997=1, 1998=2, … 2006=10)

Table 2 shows the empirical results of the five different specifications using Heckman's maximum likelihood method with fixed effects at the firm level and clustering for the standard errors.[32] Model 1 is the primary specification and shows strong support for the hypothesis that firms subject to stringent price control regulation increase financial leverage. While Models 1 through 4 are significant, the leverage variable in Model 5 is not, suggesting that there are likely differences between the US and Canadian solvency regimes that have not been accounted for.[33]

It is difficult to interpret the regulatory stringency variable, but it is informative to consider the effect that a one standard deviation increase in regulatory stringency has on the financial leverage of an insurer. From Table 1 we see that a one standard deviation in the regulatory stringency variable is 0.013; therefore, a one standard deviation increase in the stringency of regulation increases the probability of non-selection (insolvency/ exit from the industry) by 0.79 (79%). Furthermore, a one standard deviation increase in the severity of regulation increases the financial leverage of insurers by 0.3764; that is, a one standard deviation increase in the severity of price regulation increases the ratio of liabilities to equity by 38 cents for each dollar in equity.

Also note that the Model 2 coefficient on regulatory stringency is higher than it is in Model 1, which is as it should be given that liquid liabilities can adjust faster than total liabilities, adding more support for the theory. Also note that Models 3 and 4 show that one

[32] A *Hausman test* to compare the consistent fixed effects model with the more efficient random effects model returned a significant *p-value* confirming that the coefficients estimated by the random effects model were not the same as the ones estimated by the fixed effects model and confirming that the fixed effects model was required as the random effects model could not be used.
[33] More work is needed on this.

of the ways in which insurers increase their leverage ratios is by increasing the ratio of unearned premiums to equity and unpaid claims to equity. After confirming that total equities has not decreased with the severity of regulation or with time, it is safe to say that insurers who are subject to stringent price regulation increase the time they take to pay claims and increase the amount of premiums they collect ahead of time, suggesting that they may be providing lower service as a reaction to more stringent price regulation.

Conclusion

This paper investigated the impact of price regulation on the financial leverage and probability of insolvency/ exit from the insurance industry by property-liability insurance firms. Heckman Maximum Likelihood and Heckman Two-Step estimations with fixed-effects at the firm level and instrumental variables for the severity of price regulation were used. The findings are qualitatively similar to previous US research done by Klein, Phillips and Shiu (2002), but the quantitative effects of price regulation on financial quality are more severe in this report using Canadian panel data.

Regulators can unintentionally end-up lowering welfare by causing higher expected bankruptcy costs and lower profits which cannot be offset (owing to the increase in expected bankruptcy costs) by the increase in consumer surplus.[34]

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[34] Note that although an argument could be made that the lower insurance price enables more consumers to drive and that this is a social-welfare improvement, it is not a complete argument if the regulatory price is below the market price as the market price is assumed to be competitive and earn the insurer zero profits (assuming the price was equal to the cost). Therefore, the regulator's price-control regulations create a decrease in social-welfare because of the increased expected costs of bankruptcy.

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