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Article abstract

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ABSTRACT

Previous studies using U.S. data have found that rate regulation reduces competition, availability of coverage and increases volatility of insurance premiums. This article extends the U.S. literature to the Canadian context to examine whether rate regulation increases premium volatility in the province of Ontario. Based on an empirical analysis using data covering six provinces over the 18–year period from 1984 to 2001 we find that rate regulation is significant in explaining the volatility in average insurance premiums, after accounting for claims related costs. This finding is consistent with results from other jurisdictions.

Keywords: Price regulation, auto insurance, price volatility.

JEL code: L510, G280, L500

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RÉSUMÉ

Des études antérieures effectuées à l'aide de données provenant des États-Unis ont révélé que la réglementation tarifaire diminue la concurrence, limite l'accès à l'assurance et augmente la volatilité des primes d'assurance. Cet article étend au contexte canadien la documentation réunie aux États-Unis en vue de déterminer si la réglementation tarifaire augmente la volatilité des primes dans la province de l'Ontario. Selon une analyse empirique menée à l'aide de données recueillies dans six provinces pour une période couvrant 18 ans de 1984 à 2001, la réglementation tarifaire est importante pour expliquer la volatilité des primes d'assurance moyennes, après avoir tenu compte des coûts reliés aux sinistres. Cette observation concorde avec les résultats d'autres territoires de compétence.

Mots clés : Réglementation tarifaire, assurance automobile, volatilité.

Code JEL : L510, G280, L500

1. INTRODUCTION

The effect of rate regulation on insurance premiums has been the subject of wide debate and numerous studies. Most empirical research on this question has been conducted in the United States, taking advantage of the rich heterogeneity of systems of rate regulation across fifty states. Considering that the Canadian insurance market and experience with rate regulation has been somewhat different from that of the United States, the objective of this study is to extend this literature to the Canadian context and examine whether rate regulation produces increased premium volatility.

For risk-averse consumers volatility in insurance prices would be important, as insurance can be an important household expenditure. According to data from Statistics Canada and the Insurance Information Division of the Insurance Bureau of Canada, the average Canadian spends between 3% - 4% of average disposable income for auto insurance, and unexpected changes in insurance prices would therefore be unwelcome.[1] The regulation of insurance pricing is one form of regulatory response to volatility in insurance pricing.

Intuitively, volatility conjures visions of "choppy" markets or wide price swings. Throughout this paper, we define volatility as a measure of the degree of price movement in insurance premiums. Unexplained volatility is defined as price movements not related to claims related costs. Historically, large swings in insurance prices (most commonly price increases, but downward volatility has also

generated solvency concerns) have generated consumer concern and has been a strong impetus for legislative and regulatory changes.

Rate regulation is a broad term that captures a range of practices. Stricter forms of rate or price regulation include prior approval and flex rating. Under these systems new rating structures and levels require regulatory approval before they can be used. In a flex rating system there may be an expedited process for approval if rate levels are within a predetermined range defined by the regulatory authority. Other forms of rate regulation, sometimes called competitive rating, include file-and-use and use-and-file. Under file-and-use, insurers file rates with the regulatory authority and after some defined period of time, rates are 'deemed' to be approved. In a use-and-file system, insurers file rate structures with the regulatory authority but may begin using the new rates immediately. Under both file-and-use and use-and-file, the regulatory authority generally has the authority to request more information or to order an insurer not to use the new rate structure and submit a new filing, perhaps with additional information.

The particular contribution of this paper lies in two areas. First, it adds to the contributions of Cummins and Outreville (1987), Lamm-Tennant and Weiss (1997) and Chen et al (1999) by using company and sub-national level data rather than national aggregate data. Secondly it extends a body of literature focused on the United States to another somewhat different set of jurisdictions, legal, political and economic contexts. The topic remains relevant as there is considerable national and regional discussion of pricing/tariff regulation outside of the United States. In many ways, the U.S. insurance industry is very different from that of other countries, differing markedly from the Canadian and other national industries. For many countries the ownership structure, distribution channels, capital structures and the dynamics of the market are quite different from that of the United States.

Such differences in the environment have the potential to generate different incentives for individual insurers in response to a market intervention such as rate/tariff regulation and these differences may result in outcomes that differ from that identified by the United States body of literature. Canada is perhaps an ideal candidate for extending the U.S. body of literature because while it has many similarities to the insurance market of the United States, it is also quite different in a number of areas that affect the insurance product environment and competitive dynamics.

First, Canada is a bijural country. In the area of private law (including insurance) the tort environment applies both common law and civil law traditions, particularly where the Supreme Court of Canada issues a ruling. There is an extensive finance and law literature that exposes the differences between common law and civil law (see Beck and Levine 2003 for a summary of this literature). This literature identifies the differences between the two traditions in corporate law and financial development. Further, Graff (2008) finds that while neither legal tradition is particularly better than the other in protecting creditors and investors, there are important differences in how each tradition shapes the body of corporate law. While bijuralism is not incorporated into these studies the mixing of the traditions would be expected to further complicate the legal environment. There are fifteen countries around the world with common/civil law bijuralism (Lavallée, 2001). Second, Canada has a universal public health care system. This system, rather than insurers, pay for "medically necessary" health services. While the insurance industry pays an annual lump sum amount ($181.6 million CDN in 2005) to government, all hospital and physician related costs are covered by the public sector.

In terms of competitive dynamics, the predominance of international insurance companies and the sensitivity to strategic priorities that may be determined offshore in the context of a global rather than national approach to product delivery and capital allocation is an important difference from the United States.

Further, there is the existence of a dominant market. The province of Ontario is the largest insurance market, accounting for half of all auto insurance premiums written. It is not possible in Canada to be a national insurer and not be in the Ontario auto insurance market. In contrast, even California – the largest auto insurance market in the U.S. – only accounts for 12 percent of the market. This affects the diversification choices of insurers in Canada and can further affect entry and exit choice. Further, prior approval rate regulation is seen as a 'middle way' between a file and use approach and a government owned monopoly insurer. Currently there are four government monopoly insurers. In addition, one of the government insurers has subsidiaries that compete with private insurers in other provinces and another competes in the optional insurance market of British Columbia. This creates a recurring prospect of nationalization in provinces with private insurance.

Given the different socio-political context, combined with a different regulatory model (solvency supervision is largely federal, while market conduct and rate regulation, are under provincial jurisdiction)

TABLE 1
COMPARISON OF CANADIAN & U.S. P&C INSURANCE MARKETS

	Canada	United States	
Ownership			
Foreign controlled	63.5%	9.7%	
Domestic controlled	36.5%	90.3%	
Government owned insurers	5	0	includes only government owned insurers operating in the competitive market
Socio-political environment			
legal framework	bijural	common law	
health care	universal public	private	
solvency supervision	Federal/ provincial	state	
market conduct supervision	provincial	state	includes rate regulation
Market dynamics			
# of insurers	214	2,686	
HHI*	283.5	295.8	
C4 ratio*	24.1%	27.98%	
Leverage ratio	2.77	2.32	
Size of largest market (% total)	44%	12.2%	Ontario & California
Size of largest automobile insurance market (%)	25.8% (48.6%)	4.84% (11.5%)	Ontario & California % of total P&C market (% of total private auto market)

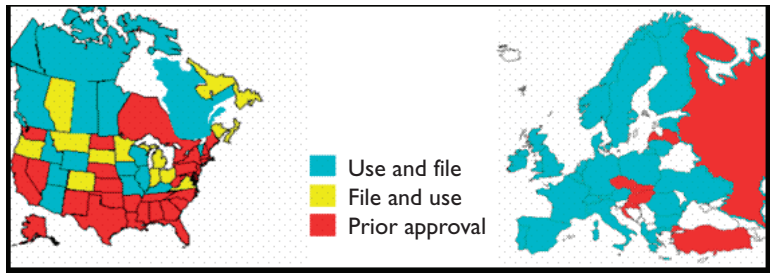
Source: data from MSA Research, III Insurance Factbook 2005 and 2002 OECD Insurance Statistical Yearbook
** HHI is the Herfindahl index and C4 ratio is the market share of the four largest companies in the market.*

there are questions about the applicability of the U.S. literature on rate regulation outside of the U.S. and specifically in Canada.

In seeking to extend this literature outside the United States, this paper adopts a two stage approach: in the first stage insurance prices are estimated based on structural economic characteristics and in the second stage, the unexplained volatility from the first stage is regressed in relation to regulatory conditions and structural economic volatilities.

The paper is organized as follows: we describe the contextual setting, considering the general trends in the price regulation of insurance in Europe, the U.S. and Canada; this is followed by an outline of the literature; with a discussion of the results.

FIGURE 1
PRICE REGULATION OF AUTO INSURANCE IN EUROPE AND NORTH AMERICA



Source: authors review of Canadian regulatory requirements, Insurance Information Institute data on rate regulation systems by state, Meyer (2000) for EU countries and authors review of regulatory requirements for Eastern European jurisdictions.

2. INTERNATIONAL EXPERIENCE

Rate regulation has had a longer history in both the U.S. and Europe than in Canada. American experience with auto-insurance regulation differs from Canada because of the different competition legislation and federal-state/provincial dynamics in each country. In the U.S., the *McCarran-Ferguson Act* of 1945 exempted any insurance company that was subject to other state regulations from federal anti-trust laws. In order to take advantage of this exemption, all states established state regulation of insurance by 1951, primarily for solvency purposes. Since then, for auto insurance, the most intensively

price regulated line of business, the utilization of strict regulation of insurance prices (prior approval) has varied over time. According to data from Harrington (2002) and the Insurance Information Institute, it was in place in up to 37 states during 1970's, as few as 25 in the mid-1980's, up to 32 in the late 1990's and following recent reforms in a number of states, strict price regulation was applied in 24 states in 2004.

In Europe, the *Third Council Insurance Directives* introduced the freedom of service principle and completed the establishment of a single European insurance market. The purpose of the directives was to create a market where consumers could have access to insurance undertakings and the range of insurance products available throughout the European Community in order to select the one that best fit their needs in terms of cover and cost. In order to accomplish this, the directives sought to create a level playing field for European insurance companies and to reduce barriers to competition. Incorporated within this, the directives laid out the framework by which insurance prices could be regulated. In particular the directives stated that:

Member States shall not, however, adopt provisions requiring the prior approval or systematic notification of general and special policy conditions, scales of premiums and forms and other printed documents which an undertaking intends to use in its dealings with policyholders. Member States may not retain or introduce prior notification or approval of proposed increases in premium rates except as part of general price-control systems.

The introduction of the *Third Insurance Directives* with their freedom of service principle resulted in the removal of strict price regulation in most European countries after 1992. Currently, European supervisory authorities generally have only very limited means of interfering with the premium policy of insurance companies.

Outside of Europe and North America, the regulation of insurance prices is relatively common in both Southeast Asia and Latin America.[2]

3. CANADIAN MARKET EXPERIENCE

With an anti-trust environment quite different from that of the U.S., Canada has not had *McCarran-Ferguson* like catalyst legislation to encourage government regulation of insurance premiums. Similarly, the ability to incorporate an insurance company federally and operate nationally under a single solvency regime has not generated a *Third Insurance Directive* like initiative in Canada. As a result, active price regulation in Canada is a relatively recent phenomenon and experience was restricted to Ontario until 2003. A hard insurance market with historically low profitability and subsequent premium increases for consumers has more recently spurred political reaction toward increased price regulation in several other provinces. Prior to 1989, automobile insurance in Canada operated under a competitive rating model.

However, during the hard market of the late 1980's, Ontario commissioned Justice Coulter A. Osbourne to identify recommendations to control increasing rates and study the feasibility of nationalizing the industry. In 1989 Bill 10, *the Automobile Insurance Rates Control Act*, *1989* received Royal Assent, implementing a strict prior approval regime. The system was subsequently modified under Bill 68, *the Insurance Law Statute Amendment Act* 1990. In 2000, the Financial Services Commission of Ontario introduced a respond-to-market (R2M) rate process whereby filing requirements and approval times were streamlined if rate increases fell below a threshold determined by the regulator. This change introduced some limited flexibility into the rate regulation process.

Among the other regions, Alberta and the four Atlantic Provinces maintained variations on the file and use system where automobile insurers are required to file rates and, after a period defined in legislation, acquire "deemed approval" for use. Under such systems, regulatory authorities may disapprove a rate filing at any time prior to the "deemed approval" or may extend the period of evaluation. Following hard markets in 2001 and 2002 and the subsequent premium increases of more than on average 10% for many consumers, governments in several of these provinces introduced stricter price regulation in 2003 and 2004. The primary motivation for introducing rate regulation in Atlantic Canada was as a response to rising premium and claims costs. In order to make it politically feasible to introduce legislation to control claims costs, government's in the region needed to demonstrate that they were actively controlling prices and not allowing premium increases to inflate insurer profitability. At the time of the changes in Alberta's insurance market, prices were

rising but not in excess of inflation. However the near defeat of the New Brunswick government over the auto insurance issue and an imminent Alberta election resulted in preemptive government intervention, including government determined uniform premiums for private sector auto insurance.

British Columbia, Manitoba and Saskatchewan currently do not regulate rates for competitively delivered optional auto coverages. These provinces have monopolistic government-run insurers for mandatory basic automobile coverages and these government run insurers have been subject to state-governed price regulation.

Quebec maintains a use-and-file system for private insurers. Overall, automobile insurance remains the only line of insurance where rates are regulated in Canada.

4. LITERATURE REVIEW

There is an extensive empirical literature based in the United States on the market dynamics of prior approval rate regulation. A related literature, again largely based on the United States, on the causes of insurance cycles is equally extensive. One theory in the insurance cycle literature posits that rate regulation – through the process of introducing systemic lags – may be part of the cause of observed insurance cyclicity.

The insurance cycle literature provides a theoretical basis for explaining the observed insurance cycles. One theory, the capacity constraint theory, suggests that insurance cycles are caused by alternating periods of an abundance of capital and a constraining amount of capital. Gron (1994), Cummins and Danzon (1991) and Doherty and Garven (1995) find evidence that is consistent with this model, implying that changes in interest rates, capital markets and capital requirements could also generate the observed insurance cycles.

The other main theory and the one this paper focuses on, is that insurance companies are rational agents who take into account all available information when making pricing decisions. In this framework, outlined by Cummins and Outreville (1987), cycles are caused by external events such as rate regulation, accounting conventions and exogenous shocks such as catastrophes or shifts in the loss distribution (the regulatory lag model). To our knowledge, only a few studies have sought to extend research on this rational expectations/institutional intervention model outside of the U.S. (Cummins

and Outreville (1987), Lamm-Tenant and Wiess (1997), Chen et al (1999) and Meier (2001).

The capacity constraint theory of insurance cycles suggests that insurance cycles are caused by alternating periods of an abundance of capital and a constraining amount of capital. Gron (1994), Cummins and Danzon (1991) and Doherty and Garven (1995) find evidence that is consistent with this model, implying that changes in interest rates, capital markets and capital requirements could also generate the observed insurance cycles.

The regulation of insurance prices by governments has varied across time and jurisdictions. The U.S. based literature provides evidence that strict price regulation of insurance does not lead to lower insurance prices, on average.[3] A smaller body of research has investigated the effects of pricing regulation on price volatility and insurance availability.

The current literature suggests that the effect on rates from prior-approval regulation, relative to claims costs, varies over time (Harrington, 1987; Tennyson, 1997, & Cummins et al, 2001). The U.S. research has noted that while stricter forms of rate regulation tend to temporarily compress the premiums collected per dollar of loss experience, insurance premiums in jurisdictions with rate regulation are often higher than in jurisdictions with less stricter forms of rate regulation (Tennyson, 1997). In the long run, stricter forms of rate regulation have not been found to result in lower prices (Cummins et al, 2001 & Harrington, 2001).

TABLE 2
CORRELATION COEFFICIENT BETWEEN AVERAGE PREMIUMS & AVERAGE CLAIMS COSTS PRIVATE PASSENGER AUTOMOBILE INSURANCE

	Ontario	Alberta	Atlantic Canada
1986 – 1989	0.99	0.63	0.99
1990 – 2000	0.38	0.97	0.92
1986 – 2000	0.58	0.95	0.93

Source: IBC Insurance Information Division, Private Passenger Automobile Economic Trends Exhibit.

The results of the U.S. literature are consistent with theoretical models in which the level of an insurance premium is primarily dependent upon the cost of the product. Intuitively, similar results would be expected in other jurisdictions. Evidence of average premiums in high and low regulation jurisdictions, suggests that premiums will be, on average, higher or lower depending upon the product features. Statistical correlations in Canada between average earned premium and average claim incurred or claims incurred per earned vehicle have generally been close to one during the 1986 to 2000 period for most jurisdictions. The exception is Ontario following the introduction of a prior approval form of rate regulation.

Looking at U.S. data published by the National Association of Insurance Commissioners (NAIC), it is interesting to note that seven of the top ten, including all of the top five jurisdictions with the highest average premiums over the period 1997 – 2000 actively regulated automobile insurance rates, highlighting that prior approval regulation does not necessarily produce lower insurance prices without consideration of product features. In general, strict price regulation has been found to limit competition, reduce availability of coverage and increase volatility in insurance premiums (Tennyson, 1991 & Harrington, 2002).

Increased volatility in insurance premiums could be the result of volatility in claims-related costs or exogenous factors such as delays in the rate approval process under prior-approval rate regulation. Regulatory lags under prior-approval rate regulation could produce volatility by weakening the link between expected claims costs and premiums. These lags may be the result of the normal process of regulators working through rate filings or the result of a regulatory build-up. Regulatory build-ups occur where insurers hold off filing smaller, more frequent, rate increases in favour of larger rate increases that justify the costs of assembling the detailed actuarial filing requirements. Such lags have the potential for being significant. Table 3 provides a representative overview of the pricing lags experienced by insurers.

TABLE 3
PRICING LAGS IN AUTOMOBILE INSURANCE

	Small insurer	Large insurer
Loss data[a]	6 months	1 month
Actuarial analysis	1 month	1 month
Rate approval process by regulator[b]	6 months	6 months
Time to complete the renewal cycle	12 months	12 months
Total elapsed time	25 months	20 months

[a] Loss data exhibits at the Insurance Information Division of the Insurance Bureau of Canada are generally available 6 months after the year end. Large companies with their own sufficiently large loss databases may produce more real time information as they do not have to aggregate data from across the industry.

[b] The rate approval process may vary widely. Hard data on approval times was unavailable for most jurisdictions but a small anecdotal survey of insurers found that they expect up to four to eight months before approval of a rate increase. Rate decreases are generally approved faster and may still take a month to two months for approval (Source: informal insurer survey & published provincial rate hearing decisions). The difference in rate approval times suggests that insurance prices are upward sticky.

This illustration highlights how regulatory lags arising from the approval process may be significant and in the above example, account for between 46% and 75% of the estimated lag between identifying the need for a new price structure and beginning to implement it. In contrast, consumers are familiar with retailers who may change prices more frequently such as on a weekly basis. The example of daily price changes in retail gasoline is broadly experienced by consumers and reported on in the media and is a subject of extensive research.[4] In a survey of firms in France on their capacity to adjust prices to information changes or shocks, a third of firms indicated that they would be able to adjust their prices in less than a month given new information or an external shock. Overall, 60% – 70% of firms adjust their prices in response to a cost or demand shock within three months. Over the sample, including firms that did not face an external shock, the implicit duration of price was seven months (Loupias & Ricart, 2004). Similar research on price adjustments can be found for other countries in earlier European Central Bank and U.S. research and surveys conducted by national central banks.[5]

The effect of pricing lags can be illustrated through a rational expectations model such as that outlined by Cummins and Outreville (1987) where insurance losses in the current year are a function of insurance losses in the previous year and some unobservable or unknown (or imperfectly known) factors.

In this model, prices are a function of all available information on costs and unexpected loss shocks such as a severe weather event like a hurricane or ice storm and systemic errors may be generated by an exogenous source, such as price lags created by regulatory or contractual (renewal dates) factors.

The expected price an insurer would charge is therefore a function of observable factors that generate insurance losses and some unobserved systemic factors. Therefore, the model predicts that with data and regulatory lags, pricing will have some volatility even if insurers priced insurance using all available and known information[6].

Empirical analysis of the effects of rate regulation on premium volatility suggests that active price controls on insurance affect both the amplitude and length of the insurance underwriting cycle.[7] Analyses of the effects of rate regulation on loss ratios have provided evidence that active price controls on insurance exacerbates premium volatility (Witt and Miller, 1981; Outreville, 1990 and Harrington, 2001). In addition, there is some cross-country evidence that rate regulation increases the length of underwriting cycles in the insurance system (Lamm-Tennant and Weiss, 1997, Leng et al 2002). For example, in the United States during the period of 1950 to 1970, automobile insurance went through three underwriting cycles while all lines except automobile had only one full cycle. This trend continued during the 1980's but was moderated by increased competition. The cycle in automobile insurance has been largely statistical, reflecting regulatory lag in adjusting prices to costs (Cummins et al, 1991).

The purpose of this research is to extend the U.S. body of research on the impact of rate regulation on insurance premium volatility to another jurisdiction. To do so, this paper undertakes an econometric analysis of the effects of prior approval rate regulation of auto insurance in Canada during the period 1984 - 2001.

5. THE EMPIRICAL MODEL

The analysis presented here draws upon the general methodology and approach outlined in Harrington (2001) where the author tests the effects of rate regulation on volatility in the unexplained growth rate of average premiums by using a two-step approach. However, the approach in this paper differs from the literature in that average premiums (rather than traditional measures such as the loss ratio as the dependent variable) was used because it was a more intuitive and meaningful measure of the "street" price for consumers than other measures. These traditional measures tend to represent the insurer's price for providing the product rather than the consumer's price for the product.[8]

Further, the approach in this paper differs from that of Harrington (2001) in that in the final specification the regulation variable is not included in the first stage. Previous research (Cummins et al, 2001 & Harrington, 2001) have found that price regulation has no implications on the price level of insurance. Alternate specifications did include the regulation variable but it was not significant in explaining the level of insurance prices. As a result of these findings regulation, as an explanatory variable, was excluded in the final first-stage regression. In addition, due to data availability, different measures to describe the characteristics of insurance system (Herfindahl, average claims cost) were used to represent the features of the Canadian market. Finally, each coverage type (accident benefits, liability etc) that was tested are roughly analogous to including PIP (personal injury protection) and liability coverages in the U.S.. While previous studies have included these variables together, we test them separately. This approach permits testing as to whether insurance regime is a factor; it also allows us to test directly the influence of regulation on particular coverages. In addition, we include interest rates (both level and volatility measures tested separately) and equity market (Toronto Stock Exchange) variables as a test on whether macroeconomic variables affect insurance prices. If significant, this would suggest support for capacity constraints contributing to volatility in insurance pricing.

The unexplained growth of automobile insurance premiums is defined here as the growth in auto premiums that is not predicted by growth in claims costs, accident frequency or other variables expected to contribute to the cost of insurance. Under this framework the residual represents the unexplained volatility in the system. Recall that this is analogous to the model of Cummins and Outreville (1987).

In the first step, the average premiums were regressed on a set of explanatory variables[9]; the volatility of average premiums was then used as a proxy for the volatility of insurance rates and regressed on a regulation index and a second set of explanatory variables in order to test whether regulation possesses any power in explaining the unexplained volatility in insurance prices. To achieve this, panel data regression techniques were applied.

Model specification:

In the first step, the following model is estimated:

$$\textit{Average premium}_{jt} = \alpha + \beta X_{jt} + (\mu_j + \lambda_t + \varepsilon_{jt}) \qquad (1)$$

where the subscripts *j* and *t* refer to province *j* in year *t*. Where α is the intercept, X_{jt} is a vector of control variables that could influence average premiums apart from any effects of regulation and β is the set of coefficients for those control variables. The disturbance term is noted between brackets[10].

TABLE 4
VARIABLE DEFINITIONS

	Description
X_{jt}	
Average claims	Losses/number of claims
Underwriting profit margin	1- (Losses + expenses)/premiums
Herfindahl index	Measure of competition
CPI	Consumer price index
Accident frequency	Number of claims/number of earned vehicles

The disturbance term is a two-way error components disturbance

$$u_{jt} = \mu_j + \lambda_t + \varepsilon_{it} \quad j=1....,N \quad t=1....T$$

where μ_j denotes the unobservable individual effect , λ_t denotes the unobservable time effect and ε_{it} is the remainder stochastic disturbance term.

The disturbances are homoskedastic with $var(u_{jt}) = \sigma^2_\mu + \sigma^2_\lambda + \sigma^2_\varepsilon$ for all j and t, and

$$cov(u_{jt}, u_{is}) = \sigma^2_\mu \text{ for } j=i,\ t \neq s$$
$$= \sigma^2_\lambda \text{ for } j \neq i,\ t=s$$

and zero otherwise. This means that the correlation coefficient is

$$\begin{aligned}\text{correl}(u_{it}, u_{js}) &= \sigma^2_\mu/(\sigma^2_\mu + \sigma^2_\lambda + \sigma^2_\varepsilon) \text{ for } i=j,\ t \neq s \\ &= \sigma^2_\lambda/(\sigma^2_\mu + \sigma^2_\lambda + \sigma^2_\varepsilon) \text{ for } i \neq j,\ t=s \\ &= 1 \text{ for } i=j,\ t=s \\ &= 0 \text{ for } i \neq j,\ t \neq s\ .\end{aligned}$$

Since automobile insurance is a mechanism for spreading risk, pooling the resources of many to share the losses of a few, claims costs are expected to be an important factor in determining insurance premiums. Therefore, average claims costs are included as a control variable in order to control for different product/benefit levels among Canadian provinces. Similarly, the underwriting profit margin, calculated as one minus the combined ratio or underwriting cost index, was used as a profitability measure in order to control for underwriting capacity and profitability. An alternative measure of profitability, the rate of underwriting return on assets, calculated by subtracting earned premiums from claims incurred and dividing by insurer assets was also utilized for the aggregate auto coverage. This approach required that the share of an insurer's assets used to underwrite the auto insurance business and the various subcoverages was estimated. The share of auto claims to total claims was used to allocate the insurer's assets. In general the results were similar to the model with the underwriting profit margin but, given the greater level of assumption required, the underwriting profit margin was used as the profitability measure.[11]

A measure of competition, the Herfindahl index, was included to condition the results on the level of competition within an industry. As the cost of inputs to insurance and claims services would be expected to change as the general price level changes, the CPI was also included in the set of control variables. The CPI was included rather than deflating the variables due to the difficulty in identifying the appropriate deflator for each coverage and the unreliability of the data required to construct an appropriate deflator. For example, accident benefit coverages are primarily a health care coverage, involving physiotherapy, massage services and other rehabilitation services for which cost indices are not readily available. By using the CPI, the effects of changes in the general price level were accounted for and it was possible to test the interaction effects of the CPI with other variables.[12] In general, the trend effects were cleaned from the average claims and underwriting profitability variables where there did appear to be some trend effects.

Finally, as motor vehicle collisions are the primary source of claims in automobile insurance, a control for accident frequency was included.

Intuitively the first equation estimates the relationship between expected claims cost factors and a residual. Changes in insurance prices could therefore be the result of these claims related factors and some unexplained factors (the residual).

In the second step, using the residuals from equation (1) as a proxy for the unexplained volatility of insurance rates the following model is estimated:

$$\textit{unexplained volatility}_{jt} \equiv (\varepsilon_{jt} - \varepsilon_{jt})^2 = \eta + \gamma \textit{regulation}_{jt} + \Phi H_{jt} + (\Omega_j + \sigma_t + \phi_{jt}) \qquad (2)$$

Where unexplained volatility is the demeaned residuals of equation (1), *regulation* is an index of regulation (details could be provided upon request), H_{jt} is a vector of control variables, and the disturbance term is noted between brackets and the same conditions apply as for model (1). Both an index and dummy variable approach were tested, with very similar results. The results presented are those using a dummy variable. Our model assumes that sources of unexplained volatility are the result of structural changes in the environment. Traditionally, such structural changes may include the removal/addition of barriers to competition or a systemic shock to the system such as the development of a new risk such as terrorism. Changes in claims costs and changes in the competitive environment (Herfindahl) were therefore included as control variables.

6. PREMIUM VOLATILITY AND RATE REGULATION

We tested whether volatility in the unexplained growth rate in the average automobile insurance premium differs between Ontario's prior approval rate regime and the file and use rating systems of five other provinces.[13] We first regressed a vector of control variables on average premium expenditure as the dependent variable. The X vector of variables included a measure of claims costs, accident frequency, the consumer price index, a measure of underwriting profit and a measure of competition (the Herfindahl). Details on the variables and data used could be provided upon request. Various additional specifications of the X vector of the model were also estimated to test robustness. Measures of income were added to the regression to capture any income effects that might lead to higher levels of insurance expenditure. However, they were not significant and did not contribute to the explanatory power of the model. Measures of household income were therefore excluded from the final specification of the model.

TABLE 5
SUMMARY RESULTS FOR EQUATION 1 – TOTAL COVERAGE

		Fixed effects	
Variable	**P>| t |**	**Coefficient**	**Expected sign**
Average claims	0.0000	0.082	Positive
Underwriting profit margin	0.0000	320.410	Positive
Price level	0.0000	3.410	Positive
Herfindahl	0.0006	0.098	Negative
Accident frequency	0.0000	1371.487	Positive
Constant	0.0388	-98.764	
Adjusted R^2	0.985		

Jurisdiction effects:

Ontario & N.B. significant with positive sign. N.S. and P.E.I. significant with negative sign. Alberta & N.F. not significant.

Period Effects:

All years significant except 1991 & 1992. Years prior to 1991 were significant with negative sign. Years after 1992 were significant with positive sign.

Interest rates and equity market data were included in the model to provide some insight as to whether the capacity constraint theory may have some influence on price volatility. These variables (whether levels or volatility as measured by standard deviation) were not significant suggesting that capacity constraints were not a factor in price volatility over the period in question. However, it should be noted interest rates in particular were generally low and stable in Canada (as compared to previous periods) and so capacity constraints may be a factor in a more volatile environment. In addition, a number of interaction terms were used, including the interaction between average claims costs and accident frequency and the interaction between profit measures and the Herfindahl. These interaction terms did not typically contribute much to the overall explanatory power of the model and had no effect on the overall significance or sign of the regulatory variable in the second state of estimation. Therefore, for parsimony, the final specification of the model excludes the macroeconomic and interaction variables.

It is generally recognized that changes in the regulatory or product environment can generate volatility as time may be required for insurers to understand and adjust to a new claims environment. Therefore, jurisdiction (province) and period (annual) effects were included in the model to capture market specific effects. The statistical software package (LIMDEP) used uses an unconditional estimation to estimate coefficients for period and group dummy variables. The results for the primary specification could be provided upon request. The results from estimating this specification using jurisdiction and period effects are reported in Table 5. The estimated coefficients on the X vector of variables in the model are statistically significant at the 5 % level and of the expected sign.

Consistent with the expectations of the rational expectations model and intuition, we find that the average costs of claims and accident frequency are the primary determinants of average insurance premiums. Together these two variables account for more than 78 % of the explanatory power of the model, with average claims costs alone accounting for 71 % of the model's explanatory power.

The results also suggest that underwriting profit margin is statistically significant and positive, suggesting that higher insurance losses influence average prices upward. Also, as would be expected, these results suggest that a rising general price level (after correcting for the trend effect) also contributes to increased insurance premiums.

Equation (2) is used to test whether rate regulation is significant in explaining volatility in the unexplained growth rate in average automobile insurance premiums. This analysis of volatility in premium growth provides an indirect test of whether rate regulation increases volatility in automobile insurance prices. Table 6 reports the results of this estimation. The regulation variable is positive and significant for the model. An interesting result is that the regulation variable appears to capture the group and period effects as these variables lost their significance from the first stage of the model. As regulatory regimes are typically consistent between bordering provinces, there is the potential that the regulatory variable is picking up geographical effects. Variables, such as income measures, that would be expected to capture some of the geographic factors were included in early versions of the specification but were not significant and so dropped in later versions. As the greatest geographic variations are in claims severity and accident rates it is likely that those variables are capturing most of the geographic effect.

TABLE 6
SUMMARY RESULTS FOR EQUATION (2) – TOTAL COVERAGE

	OLS	
Variable	**P>| t |**	**Coefficient**
Regulation	0.0000	632.010
Change in average claims	0.0639	-0.357
Change in competition	0.5751	-0.350
Constant	0.000	244.494
Adjusted R^2	0.300	

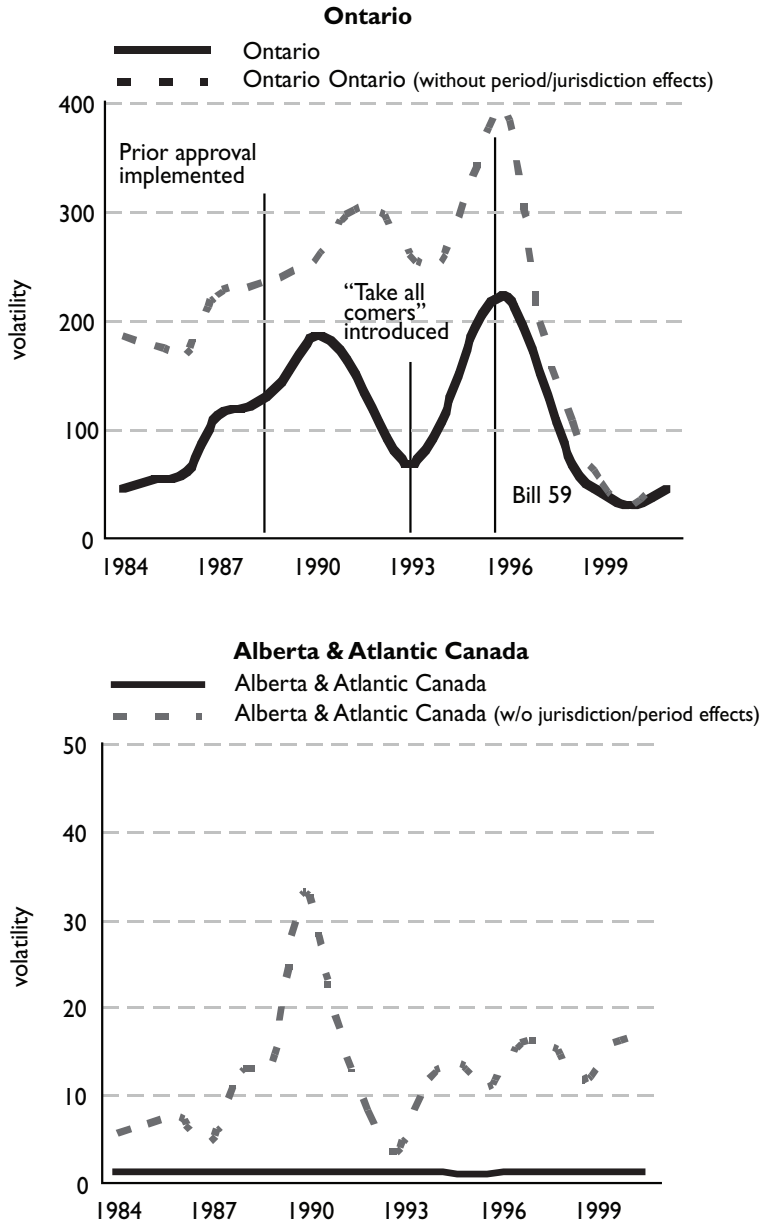
Jurisdiction effects: There are no significant group effects. Coefficients for Ontario and Alberta have positive sign, coefficients for other provinces have negative sign.

Period effects: Only three years show any significance (1991, 1995, 1999). Sign is negative throughout much of the 1980's and early 1990's.

It is generally recognized that changes in the regulatory or product environment can generate volatility itself and Ontario underwent a number of regulatory and product reforms over the period of the study. The results, illustrated in Figure 2, suggest that jurisdiction and period specific effects are an important source of overall volatility. [14] It is interesting to note that jurisdiction and period effects appear to be limited in the latter part of the study period. This may be due to the relative stability in the regulatory and product environment after Bill 59. While it appears that Ontario is an inherently more volatile jurisdiction, even after accounting for jurisdiction and period effects, Alberta and Atlantic Canada have also experienced periods of volatility, notably around 1990.[15] In that year, loss ratios for automobile insurance in Newfoundland and Prince Edward Island exceeded one hundred while they hovered between ninety-six and ninety-nine for Alberta and New Brunswick. Nova Scotia had a loss ratio over ninety-three.

Jurisdiction and period effects in Alberta and Atlantic Canada reduce the unexplained residual by a factor of twelve, on average, over the period. Relative to Ontario, where the effect is to reduce the unexplained residual by half, jurisdiction and period specific factors appear to be relatively more important in Alberta and Atlantic Canada.

FIGURE 2
JURISDICTION AND PERIOD EFFECTS



One possible explanation for this may be how the product is defined. Mandatory auto insurance policy terms are statutorily defined and changes to the product are debated in the public domain. In non-mandatory products, particularly those defined by contract terms and tort decisions, the changes to the product are generally less visible in the public domain, but can be quite significant in terms of changing the rules and terms around the product. For example, following the 2001 decision in *McNaughton vs Cooperators*, the court ruled against the application of a deductible where an insurer sells the salvage of a vehicle that has been written off, a long standing industry practice based on an interpretation of the statutory conditions.[16] In addition, non-economic loss provisions in provincial automobile insurance legislation in Atlantic Canada and Alberta have come under court challenge. A more prominent example, although for homeowners policies, would be the Supreme Court of Canada 2003 decisions, effectively transferring nine out of ten homeowner policies from the Fire Part of provincial Insurance Acts to the general Part of the statute[17]. Logically, therefore, "turbulence" from a changing environment occurs in tort environments as well. In that regard, volatility from changing product regimes is not unique to statutorily defined products subject to regulation. Where the uniqueness comes in is that when the statutory product is changes, the regulatory environment often changes as well.

Unexplained volatility for Alberta and Atlantic Canada is negligible after period and jurisdiction effects are accounted for. Ontario however, retains significant unexplained volatility after these effects are accounted for. The estimation results appear to suggest that regulation is the primary difference in premium volatility between jurisdictions and over time, after accounting for changes in the product and other input costs, is the regulation of prices. The lack of significance for the proxy for opportunities for strategic behaviour (the change in the level of competition) suggests that the scope for firm action to adapt and innovate following a change in its competitive environment is limited.

In addition to testing whether rate regulation is important in explaining volatility in automobile insurance premiums for all coverages, we test the effects of rate regulation for individual lines of coverage. Table 7 reports a summary of these results for Equation (4). Detailed results could be provided upon request.

Similar to the results for total coverage, claims, CPI and underwriting profit margins are all significant and of a positive sign. Competition, measured by the Herfindahl is significant for all coverages except for collision. Accident frequency is not significant for Accident Benefits, but is significant for all the other coverages. Jurisdictional effects are significant primarily in the comprehensive coverages.

TABLE 7
SUMMARY RESULTS FOR EQUATION 1 – BY TYPE OF COVERAGE

	Collision		Comprehensive		Accident Benefits		Third Party Liability	
	Coefficient	**P>| t |**	**Coefficient**	**P>| t |**	**Coefficient**	**P>| t |**	**Coefficient**	**P>| t |**
	Random effects model		OLS model		OLS model		OLS model	
Average claims	0.060	0.0000	0.041	0.0000	0.018	0.0000	0.038	0.0000
Underwriting profit margin	262.694	0.0000	65.439	0.0000	37.757	0.0000	224.172	0.0000
Price level	1.424	0.0000	0.731	0.0000	1.365	0.0000	3.443	0.0000
Herfindahl	0.002	0.8785	-0.028	0.0000	-0.017	0.0100	-0.039	0.0078
Accident frequency	3654.868	0.0000	603.495	0.0000	909.258	0.1693	6444.294	0.0000
Jurisdiction effects			All groups significant except N.S. ON, AB and N.B. have positive sign, others negative.		ON & P.E.I. are negative and not significant. Others are significant.		N.S. modestly significant. Others not significant.	
Period effects			All significant except 1991. Negative sign before 1991, positive after.		All periods except 1992 are significant. Positive before 1992 and negative after.		Period effects are not significant.	

Period effects are significant for comprehensive and accident benefit coverages but have opposite signs.

That neither period nor jurisdictional effects are significant for third party liability coverages may reflect the convergence of tort decisions across the country. This coupled with the fact that legislative changes are effectively captured in the loss estimation (average claims) process suggest that this line of coverage may approximate the theoretical model of prices reflecting all available information without informational lags.

The direction and significance of the rate regulation variable is significant and positive for accident benefit coverages and not significant for third party liability and the optional automobile coverages of collision and comprehensive.[18]

TABLE 8
SUMMARY RESULTS FOR EQUATION 2 – BY TYPE OF COVERAGE

	Collision		Comprehensive		Accident Benefits		Third Party Liability	
	Coefficient	P>| t |	Coefficient	P>| t |	Coefficient	P>| t |	Coefficient	P>| t |
	Random effects model		OLS model		OLS model		Random effects model	
Regulation	-45.749	0.6136	-77.386	0.2184	707.635	0.000	-115.966	0.8933
Δaverage claims	-0.078	0.1402	0.134	0.4394	-0.026	0.4352	-0.250	0.2047
ΔHerfindahl	0.846	0.034	-0.182	0.6265	-0.440	0.4828	4.721	0.1564
Jurisdiction effects			NF is modestly significant.		Not significant			
Period effects			1986 and 1989 are significant and positive		1996 modestly significant.			

The introduction of a prior-approval regime in Ontario was concurrent with the introduction of a no-fault insurance system. Under this no-fault system, accident benefit claims costs grew by 476 percent between 1989 to 2001. Such growth in claims costs placed upward pressure on premiums and therefore the influence of rate regulation would be expected to be important on this coverage.

Claims costs for third party liability and collision coverages were generally stable over the period of the study, growing below the rate of inflation over the period.[19] If regulation controls upward adjustments and is less stringent on downward adjustments, then with less pressure on premiums from claims costs the effects of rate regulation would be expected to be limited.[20] The results for these coverages suggest support for the premise that there is little systemic disturbance in these coverages and that prices are largely determined by pure loss factors and unexpected and uncorrelated shocks. Comprehensive, which covers loss or damage from any peril other than through a collision with an object, had a highly variable claims experience over the period -- on average, between 100 and 500 basis points depending upon the jurisdiction. However, this claims experience was highly correlated with severe weather events (hailstorms, floods etc) in Ontario and Alberta (correlation coefficient of 0.77 and 0.89 respectively), suggesting that that weather-related shocks are an important factor in this coverage.[21] The results for this coverage also suggest support for the premise that there is little systemic disturbance in this coverage and that prices are largely determined by pure loss factors and unexpected and uncorrelated shocks.

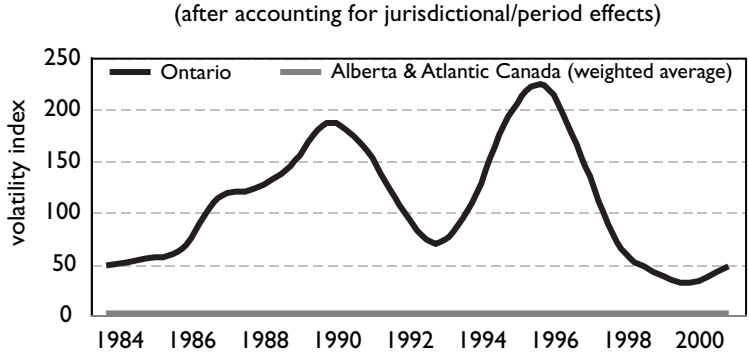
Again, an interesting result is that the regulation variable appears to capture the jurisdiction and period effects for accident benefits as these variables lost significance from the first stage of the model. For the comprehensive coverage, the jurisdiction and time effects in the first stage equation were significant individually but not together, with a reported p-value = 0.22 from the LM test. The jurisdiction and period effects largely lost their significance after the second stage equation was estimated.

Change in the competitive environment is a statistically significant variable for collision coverage. One possible interpretation of this result is that the firms in the industry have greater scope for engaging in strategic behaviour in the repair of physical damage to vehicles as they respond to changes in the competitive environment. For example, firms in Ontario are able to enter into preferred collision repair agreements to control quality and costs or have greater flexibility in responding to consumers than is permitted in other lines of coverage.

7. DISCUSSION

Using the residuals obtained from equation (1) to construct a volatility index we find that the unexplained volatility in automobile insurance prices, after accounting for period and jurisdiction effects, is generally greater in Ontario than that of the other provinces between 1986 and 2001.[22]

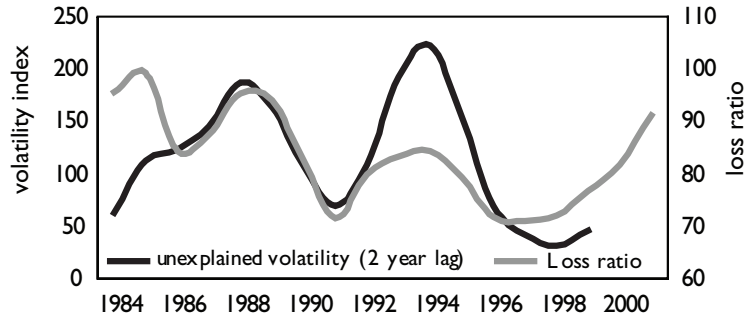
FIGURE 3
UNEXPLAINED VOLATILITY IN ONTARIO



As noted previously, the patterns depicted in Figure 3 suggest that Ontario over the period has been an inherently more volatile jurisdiction than the other provinces over the period, even after accounting for period and jurisdiction effects. The closer the curve is to the horizontal axis, the less unexplained volatility was found to be in the system, suggesting that changes in claim related costs largely account for changes in average premium levels. The further an unexplained volatility curve is from the horizontal axis, the greater the impact of unexpected or structural shocks on changes to average insurance premiums.

There is an increase in unexplained volatility curve in the late 1980's. It is not clear what the source of the early increase in unexplained volatility would be. It may be that uncertainty regarding whether the industry would be nationalized or increased solvency related interventions contributed to the volatility. During the period of 1985 to 1989, a record eight insurance companies (out of the nine-

FIGURE 4
UNEXPLAINED PREMIUM VOLATILITY AND THE INSURANCE CYCLE IN ONTARIO



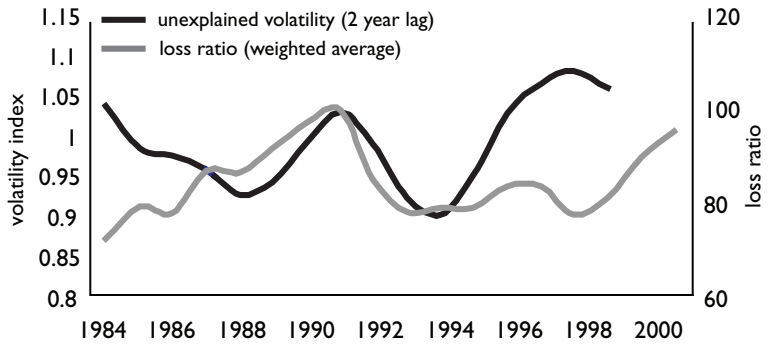
teen failures of insurers operating in Ontario over the period 1980 to 2005) went insolvent. In addition, during this period automobile insurers were subject to increasing regulatory supervision and scrutiny under the Justice Coulter A. Osbourne's Royal Commission, including whether the industry should be nationalized.

The relatively low unexplained volatility, after accounting for claims related costs and jurisdiction and period effects, in Alberta and Atlantic Canada suggest that in these provinces, insurers have been able to adjust prices in response to changing claims trends.

Following the introduction of Ontario's prior-approval rate regulation regime, unexplained volatility becomes synchronized (with a two year lag) with that of the insurance cycle (see Figure 4). This is comparable with the anecdotal evidence on pricing lags described in Table 3. Unexplained volatility prior to 1990 does not appear to be synchronized with the insurance cycle, further suggesting that other factors where contributing to volatility in the market.

In contrast to the unexplained volatility curve of Ontario, the unexplained volatility of Alberta and the Atlantic provinces over the estimated period was relatively low, suggesting that changes in claims related costs largely account for changes in average premiums in those provinces. Further, as illustrated in Figure 5, there is no apparent synchronization of the insurance cycle and unexplained volatility.

FIGURE 5
UNEXPLAINED PREMIUM VOLATILITY AND THE INSURANCE CYCLE IN ALBERTA AND ATLANTIC CANADA



A two year lag in unexplained volatility appears to have some synchronicity with the hard market of the early 1990's but volatility appears more contemporanous in the late 1990's.

This may reflect technological change as information systems improved the speed with which insurers may assess loss cost trends and respond.

8. SUMMARY

We find that the variation in insurance premiums is largely attributable to claims costs. Volatility will occur in response to changes in claims trends and other factors that influence loss costs. We do not find evidence that capacity constraints were a significant influence in price volatility over the period. However, by historical standards, interest rates were low and stable over the period, perhaps influencing the result. Market interventions on pricing are often identified as a policy tool for constraining insurance prices that may be increasing in response to changing claims trends. The primary argument for regulation is to provide consumers with greater stability in insurance prices. Previous studies using U.S. data have found that regulation of insurance premiums affects both the amplitude and length of the insurance cycle, introducing a structural volatility in the pricing of insurance. The statistical evidence has supported the hypothesis that

prior-approval rate regulation increases volatility in insurance premiums. In addition, rate regulation, through higher costs of filing requirements, also affects insurer filing and rate setting behaviour, further amplifying rate swings caused by regulatory lag. Regulatory lags under prior-approval rate regulation increase the magnitude and frequency of price swings, contributing to greater uncertainty for consumers.

As the Canadian insurance market and experience with rate regulation has been somewhat different from that of the United States, the objective of this study was to extend this literature to the Canadian context using panel data and to estimate whether rate regulation produces increased premium volatility in Canada.

The analysis of this paper suggests that changes in average premium levels are largely the result of changes in claims related costs. In addition, we find evidence that rate regulation contributes to volatility in a manner consistent with the regulatory lag model. It should be noted that rate regulation is not the only source of volatility, in fact given the identified large impact that claims have on price, volatility in the claims environment is likely to have an impact far exceeding that of rate regulation. However, this analysis suggests that rate regulation contributes to volatility rather than mitigating it. In fact there may be a feedback process, whereby a jurisdiction experiencing price volatility, perhaps related to claims volatility, introduces rate regulation, which in turn adds to volatility. This analysis does not test this but there is some evidence for such a process. For example, between 1989 and 2001, both Ontario and South Carolina used prior approval systems and reformed their rate regulation system through legislative/regulatory amendments on average every four to five years. Illinois with a competitive rating process did not reform its system over the period.

For the third party liability, collision and comprehensive coverages, our analysis suggests that expected claims related costs and uncorrelated random shocks (severe weather and such) drive changes in average price levels. For accident benefits, while claims related costs were the primary driver in changes to the average price level, the regulation of insurance premiums appears to be a significant variable in explaining the changes in insurance prices that could not be attributed to claims related costs. Overall, the results are consistent with the stylized facts that accident benefits are the largest component of automobile insurance coverage in Ontario and the most intensively regulated. Given reliable data, an interesting extension would be to examine the relative stringency and effectiveness of regulatory mechanisms across coverages and over the underwriting cycle.

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Notes

1. Real average insurance prices (average premiums relative to disposable income) have remained generally in this range over the period despite volatility in year to year price. For Ontario, average insurance prices were 3.20% of average disposable income in 1987, and 3.19% in 2001.

2. For example, Argentina, Honduras, India, Nicaragua, Sri Lanka, Taiwan, Thailand and Venezuela all classes of insurance are subject to supervision of premium rates. Brazil, Colombia, Macau, Malaysia, and the Philippines are subject to premium supervision on compulsory classes of insurance (OECD, 2001). However a number of these jurisdictions (such as India) are currently reviewing their regulation of insurance rate as part of the process towards increasing competition in their markets (Moody's, 2005).

3. For surveys of this literature see Harrington (1984, 2000) and Cummins, Phillips, and Tennyson (2001).

4. There is an extensive literature on how firms adjust their prices in response to shocks or new information. Retail gasoline has generated particular interest in the U.S. It is generally accepted that in most industries, firms may only change their prices infrequently and with some cost. The predicted frequency and size of price changes given new relevant information or shock, is largely dependent upon the cost adjustment function.

5. For additional information on these surveys, Loupias and Ricart (2004) provides comparisons and references.

6. The model predicts serial autocorrelation whose order depends on the length of the information lag. In the original model formulation (Cummins & Outreville, 1987) an AR(2) process was predicted with some empirical support. Subsequent work by Leng & Venezian (2003), Meier (2006) and Leng et al (2006) suggest that structural breaks in the early 1980s reduce the empirical support for the explanatory power of the early model for more recent years, particularly for some lines and jurisdictions. Leng & Venezian (2003) and Meier (2006b) suggest that other market dynamics such as macroeconomic variables and competition should perhaps be reflected in the model.

7. The underwriting cycle is an insurance business cycle, where rates and premiums (and subsequently profits) alternately rise and fall, rather than growing smoothly.

8. In order to test the robustness of the results using average expenditure, we also ran the specification using the loss ratio as the dependent variable. The results were largely similar, with regulation being significant (but with a higher p-value). The plot of the volatility index was also largely consistent. The primary difference appears to be in the loss of significance for some control variables, such as accident frequency when the loss ratio is used. Our thanks to the anonymous referee who suggested this.

9. Using differences provided similar results.

10. Time lagged variables were also considered in the model and the results were similar to the ones reported. The issue is the length of the lag due to regulatory issues, whether it is less than or greater than a year. While companies report that the lag is material for them, it is usually somewhat less than a year.

11. While still similar, differences were more marked at the subcoverage level where allocations between coverages are somewhat artificial as insurers in practice allocate assets to support whole rather than partial risks.

12. Overall, the results using alternative deflators (health care etc) found that the control variables were sensitive to the choice of deflator but the results for the regulation were consistent throughout.

13. Harrington (2001) notes that this approach does not consider an interesting and related question of whether rate regulation distorts consumer and insurer incentives for loss control and therefore increases claim costs and average rate levels. There is an extensive literature around the potential distortionary effects that price regulation effected through underwriting controls can have on accident frequency and claims costs (Chiappori, 2000; Dionne et al, 2000; and Kovacs et al, 2002).

14. In addition to using the statistical software to estimate the period and jurisdiction effects, dummy variables were created around specific legislative/regulatory changes. However, the dummy variables did not affect the significance of the regulation variable.

15. It is uncertain why Ontario is appears to be an inherently more volatile jurisdiction than the other provinces. While Ontario is predominantly no fault and the others tort, the higher volatility existed at the beginning of the sample (pre-no-fault) as well.

16. In 2005, the Court reversed its decision. While an Ontario judgment, in the intervening years, numerous class action cases were brought forward in Alberta and British Columbia.

17. These decisions (KP Pacific Holdings Ltd. vs. Guardian Insurance Company of Canada & Churchland vs. Gore Mutual Insurance Company) restricted the application of statutory provisions, including limitations on policy exclusions for terrorism/earthquake, to fire insurance policies. On comprehensive policies, the vast majority, previously subject to those statutory conditions insurers could introduce exclusions. While this paper focuses on auto insurance, the example highlights that the rules also change in non-regulated lines.

18. These regressions were estimated using OLS, fixed effects and random effects and the results were similar. We report the results from the model suggested by the Hausman test for each coverage.

19. Without data on stringency, we were unable to test the stringency of regulation in aggregate or by coverage type. Third party liability claims costs in Ontario experience significant volatility but on average over the period claims cost growth was below inflation.

20. We tested whether the CPI variable was a factor for these coverages and found that, while there did appear to be some influence on the regulation variable, it did not materially alter the results.

21. Calculated using claims experience from the Insurance Bureau of Canada's Economic Trends (Private Passenger Auto) statistical exhibits and data from the Institute for Catastrophic Loss Reduction on severe weather events. There was insufficient data for the other provinces (on auto insurance losses related to severe weather events) to evaluate them.

22. The index is constructed by imposing a transformation on the residuals and squaring the weighted average from the relative jurisdictions. Several data points (1984 – 1990) were of a negative value, but when squared became large positive values. Graphically this provided the erroneous impression of higher volatility in the early part of the period than in later years. The graph looks the same pre- and post transformation but with the transformation all values are positive.