

AN EMPIRICAL INVESTIGATION OF THE EFFECT OF GROWTH ON SHORT-TERM CHANGES IN LOSS RATIOS

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ABSTRACT

Given the use of premium growth as a risk measure in regulatory and private risk assessment models, the impact of growth on underwriting profitability is an important question. Our results show a negative relationship between premium growth and changes in loss ratios, suggesting that premium growth alone does not necessarily result in higher underwriting risk. Further, there is a positive relationship between claim count growth and changes in loss ratios, suggesting that claim count growth may be a preferred measure of underwriting risk.

INTRODUCTION

The purpose of this article is to evaluate the short-term effect of premium growth on the loss ratio of property-casualty insurers. The effect of premium growth on underwriting profitability is a key consideration in the evaluation of the financial strength of insurers. For example, the A.M. Best Company's capital adequacy ratio (A.M. Best, 2003) includes a growth risk component, and several of the A.M. Best solvency studies over the years have cited premium growth as an indicator of financial impairment.

The National Association of Insurance Commissioners' (NAIC) two primary early warning systems, the Insurance Regulatory Information System (IRIS) and the Financial Analysis and Solvency Tracking System (FAST), both include premium growth ratios as early warning signals of financial impairment. The NAIC's risk-based capital formula includes two specific capital charges for excessive growth, one of which is applied to premiums to measure near-term risk, and the other is applied to reserves to address long-term effects.

In recent years, questions have been raised about the true effect of premium growth on profitability and on underwriting risk. In 2004, California's competitive workers'

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compensation fund, the State Compensation Insurance Fund (SCIF), sued the California Department of Insurance over the applicability of the NAIC's risk-based capital (RBC) standards to SCIF, specifically questioning the accuracy of the excess growth risk component. At the time, SCIF was the largest workers' compensation insurer in California and, with nearly \$8 billion in premiums, one of the largest in the country. The inclusion of an excess growth risk component in the NAIC formula was enough to trigger regulatory action under the risk-based capital statute in California. SCIF argued that the price strengthening that the company had imposed on its customers was fueling its premium growth, and that the organization was actually becoming stronger, not weaker, as a result.

A.M. Best makes a distinction between premium growth and exposure growth in its evaluation of the financial strength of insurers. In a presentation to industry CEOs, an A.M. Best vice president reported that rating analysts had begun to focus on growth risk in a different manner.

Because of the hard market, A.M. Best is also looking at rapid growth, the leading cause of insolvencies, differently. While rapid premium growth is a cause for concern, especially when it exceeds 20 percent, policy count is the index on which analysts focus in climate of rising prices, because it provides a better measure of exposure growth. (Horvath, 2004)

The development of the premium growth charge in the RBC formula was controversial in that the formula does not distinguish between exposure growth (an increase in the number of policyholders) and rate-level growth (an increase in the average price per exposure), although the two sources of risk are materially different (Feldblum, 1996). Premium growth attributable to rate increases can actually reduce the risk of the firm if the same customers are paying more for the same risk exposure. On the other hand, if the price increases alter the mix of customers, the new book of business can generate unexpected losses if the new mix of business is mispriced. Exposure growth would have no effect on profits if the products are properly priced, but in a competitive market, significant exposure growth may be an indication of underpricing. Therefore, there are a variety of outcomes that may result from premium growth, some of which are desirable and some of which are not.

This research focuses specifically on the impact of growth on reported underwriting profitability in the near term. The methodology employed here and described in later sections is useful for short-term changes in the loss ratio but does not address those long-term effects. Therefore, while there may be measurable longer-term effects of growth that alter the reserving practices or loss development of insurers, that is a separate research question left to another day.

UNDERLYING THEORY OF EXCESSIVE GROWTH RISK

Excessive growth has been cited as a primary risk factor in several insolvency studies (e.g., A.M. Best, 2006, 1991; U.S. General Accounting Office, 1989). Because of the lag between receipt of premiums and final payment of all claims, an insurance company practicing cash flow underwriting can grow at an excessive rate for a number of years before finally running out of cash to pay claims. Excessive growth is often assumed

to be a symptom of inadequate pricing, where a company grows its book of business by charging less-than-market rates. Additionally, excessive premium growth may signal reserving problems; if the insurer is underestimating the true actuarial cost of business, it may be inadvertently pricing the business below the fair market value. Conversely, excessive premium growth could be the result of the insurer increasing the price per exposure (rate) and simply charging more for its product. Traditional assumptions of competitive markets suggest that this is not possible. However, during periods of the well-known underwriting cycle (particularly hard markets) it is suggested that, periodically, the industry collectively raises prices in response to economic stimuli. The latest hard market period occurred during the early 2000s, and this cyclical pattern is still alive and well. There are also localized disruptions that may affect specific lines of business, such as the implementation of Proposition 103 in California in the late 1980s that reduced the number of competitive companies operating in that state. More recently, reforms in New Jersey's auto insurance market have led to an influx of companies now vying for market share.

Total premium can be written as follows:

$$\text{Total Premium} = \text{Average Rate} \times \text{Number of Exposures}$$

Premium growth can be accomplished through either increasing exposure counts (selling more policies) or by increasing the average price per exposure (increasing rates and/or by altering the mix of risk exposures). However, the exposure count and the price per exposure are not independent of one another. Increases in price will decrease the number of exposures unless the insurance product is perfectly inelastic. In fact, a company could be growing its exposure base dramatically through cut-throat pricing while showing little or no premium growth.

The degree of price elasticity can vary with the type of insurance written as well as market conditions. Table 1 provides several illustrative examples of the relationship between premium growth, exposure growth, and elasticity of demand using elasticities ranging from 0 to 2.75. At the extremes, the first two rows show the effect of a 10 percent increase (or decrease) in premiums when the product is essentially inelastic. All premium growth is due to price changes, but the exposure count has remained unchanged. Assuming that there is no churning of the book of business (new customers swapped for seasoned customers), this would actually reduce risk as the insurer collects more money for insuring the exact same exposures. The last two rows show the opposite extreme, where an elasticity of 2.75 yields only a 5 percent change in premium, although the growth in exposure count is over 25 percent. Arguably, the firm now has become much riskier through two separate avenues: (1) they have an influx of new, unseasoned business and (2) they have relatively fewer dollars (premium per exposure unit) available to pay claims and expenses. Notice again that the former case would actually reduce the risk of the firm, and the latter case increases the risk for the firm. Yet, the former case would appear to be more risky if only premium growth, and not its components, were considered.¹

¹There are other sources of growth that can favorably impact an insurer's risk level, including alterations in reinsurance or intercompany pooling agreements (i.e., retaining a larger

TABLE 1
Growth in Rate Level and Exposure Count at Varying Price Elasticities

Original Average Rate Level	Original Exposure Count	Original Premium	New Average Rate Level	New Exposure Count	New Premium	% Change in Average Rate Level	% Change in Exposures	% Change in Premium	Price Elasticity
\$100	10,000	\$1,000,000	\$90.91	10,000	\$909,091	-10%	0%	-10%	0.00
\$100	10,000	\$1,000,000	\$110.00	10,000	\$1,100,000	10%	0%	10%	0.00
\$100	10,000	\$1,000,000	\$90.91	10,200	\$927,273	-10%	2%	-8%	-0.21
\$100	10,000	\$1,000,000	\$110.00	9,804	\$1,078,431	10%	-2%	8%	-0.21
\$100	10,000	\$1,000,000	\$90.91	11,000	\$1,000,000	-10%	10%	0%	-1.00
\$100	10,000	\$1,000,000	\$110.00	9,091	\$1,000,000	10%	-10%	0%	-1.00
\$100	10,000	\$1,000,000	\$90.91	13,000	\$1,052,632	-10%	26%	5%	-2.75
\$100	10,000	\$1,000,000	\$110.00	7,692	\$952,381	10%	-26%	-5%	-2.75

There is a significant difference in growth risk attributable to changes in exposure counts and growth risk attributable to price-level changes. There is some relationship between the price level and the quantity of policies sold, but it is not absolute. That is, exposure growth can occur even without changes in the price level charged. Insurance markets are generally competitive, but not perfectly competitive, and the competitiveness of a particular state or region can change from year to year. To adequately measure the additional risk associated with growth, the effect of exposure growth must be examined separately from the effect of price level growth.

Premium Growth Due to Increases in Exposures

Excessive growth attributable to increasing exposure counts produces additional risk from several sources. The new business coming into the insurance company may be unfamiliar to the underwriters, which can lead to adverse selection and mispricing problems. Additionally, due to the "aging phenomenon," unseasoned business is generally considered to be higher risk than seasoned business, and the influx of new exposures is by definition unseasoned. D'Arcy and Gorvett (2004) provide an excellent summary of the literature and explanation of the underlying theory behind the aging phenomenon, but the gist of the argument is that there exists adverse selection as higher risk exposures are brought into the existing book of business at less-than-actuarially fair rates. That would suggest that the new policyholders being added to an existing set of policyholders with seemingly similar risk characteristics (e.g., 21-year-old male drivers in the private passenger auto liability line of business) would actually represent a greater risk.

The difference in the makeup of the new business can lead to difficulty in estimating reserves and setting fair prices, although as the book of business matures, profitability should increase as the insurance company is able to winnow out the high-risk exposures through the underwriting process. Therefore, even though there may be short-term profitability problems that arise from growth, those may be irrelevant over the long run if the business is ultimately profitable. Still, an insurer must have sufficient capital in the short run to last long enough to enjoy the long-run profits, which is an argument that gives appropriate justification for regulators to consider growth risk.

In addition to seasoning problems in the mix of new/renewal business, there are expense pressures from excessive growth. Existing resources (claims personnel and underwriters) may have to deal with a sudden increase in workload, reducing the effectiveness of underwriting and claims settlement processes. That is, if the process of hiring and training additional staff is sticky, then the workload on existing personnel increases, leading to laxity in applying underwriting standards as well as less diligence in the claims settlement process. While increasing the workload of the existing staff may improve the expense ratio, it may do so at the cost of having higher loss ratios and adverse reserve development.

Changes in the number of exposure units may be caused by more efficient marketing (growth) or result from normal friction in the book of business. If the number of

proportion seasoned, profitable business) and increases in market share as a result of multiple insurer exits.

TABLE 2
Premium Growth Illustration

Class	Original Exposure Count	Original Class Rate	Total Premium	New Exposure Count	New Rate	New Total Premium	% Change in Class Rates
A	1,000	\$200	200,000	1,177	\$192	225,984	-4.0%
B	3,000	\$250	750,000	3,778	\$236	891,608	-5.6%
C	4,000	\$300	1,200,000	2,765	\$329	909,685	9.7%
D	3,000	\$350	1,050,000	1,201	\$440	528,440	25.7%
E	1,000	\$400	400,000	410	\$500	205,000	25.0%
Total	12,000		3,600,000	9,331		2,760,717	
Average		\$300			\$296		
Percentage change in average rate							-1.4%
Percentage change in exposures							-22.2%
Percentage change in total premium							-23.3%
Weighted average of the % change in class rates using original exposures as weights							10.0%

new policies grow at exactly the same rate that existing policies are lost, then the net exposure growth rate is zero. Competitive pressures, market cycles, and the actions of other insurers, though, will cause the new policy growth rate and the persistency rate to change from period to period, although not necessarily to the same degree. Additionally, the new policies may be materially different in risk from the old policies. Exposure growth through the addition of higher-risk customers could shift the pattern in historical claim development. Rate-level growth could also shift the mix of business, further altering the historical claim development patterns.

Premium Growth Due to Price-Level Increases

Price level increases should, all else held constant, reduce loss ratios. However, relatively little is actually held constant when there is a change in price level. There are forces at work in insurance markets that can actually cause increases in risk following price-level growth. Rate changes can alter the demographics of the insurer's book of business, leading to pricing and profitability problems. When an insurer takes a "10 percent rate increase" the increase is almost always a weighted average, so that some exposures receive a higher than 10 percent increase and some receive a lower than 10 percent increase. Indeed, some exposures may actually receive rate decreases, as illustrated in Table 2.

In this example, the weighted average rate increase is 10 percent, but rating classes D and E have greater than average increases while A and B actually experience rate decreases. The end result is that the mix of business is considerably different following the rate increase, and the new mix of business has a lower average rate, \$296 versus \$300 (based on the new exposure counts), than the original book of business.² Further,

²Note that the insurer could also keep premiums constant and substitute high-risk insureds for low-risk insureds. Here the insurer would have no premium growth but a significant increase in overall risk.

to the extent that any of the insurer's costs are fixed, the reduction in volume would have an exaggerated impact on profitability because of operating leverage.³ If rating classes A and B were already underpriced, either through pricing error or deliberately through a "loss leader" marketing strategy, then the reduced rates for those classes could exacerbate existing profitability problems.⁴

An insurer may also maintain the same rate structure but still end up with higher average rates because of the actions of its competitors. Each insurer's price structure works within the framework of the overall market. If an insurer's competitors alter their pricing structure, the insurer may find itself with a higher proportion of higher priced (and higher risk) policyholders in its book of business as competition for customers adds or subtracts to its base. In the case of the California competitive workers' compensation fund (SCIF) cited earlier, SCIF argued that the influx of new business was more than adequately priced and that the additional growth was reducing its risk rather than increasing it.

Interaction Between Changes in Price and Exposure Levels

There is some presumed degree of price elasticity in insurance markets, so that rate increases will be somewhat offset by volume decreases. The use of premium growth as a risk measure includes both of these aspects of risk. Rate increases arguably make a company stronger, but the impact on the level of exposures and the mix of business must also be recognized. There are probably differences in elasticity and risk between new business and renewal business as well. Presumably, renewal business would be less elastic than new business because of consumer inertia, search costs, and information asymmetries. It is also assumed that the length of time that a customer has been with a particular insurer will magnify these effects and increase the persistency rate for those policies. There may be differences by line of business, as commercial insurance policies are presumed to be more elastic than personal insurance policies. The sensitivity of the policyholder or applicant to changes in the rates charged by a particular insurer, then, should differ by the type of product as well as by the type of customer. Therefore, sudden growth in the level of exposures may create short-term profitability problems but at the same time create long-term benefits. The question of what constitutes "excessive" growth, and the difference between exposure growth and rate level growth, present serious implications for a firm's appropriate level of capital and its continued financial stability.

³The presence of fixed costs in the expense structure creates operating leverage, which is the percentage change in operating profit given a percentage change in sales. The higher the proportion of fixed costs, the greater the leverage.

⁴This simplified example also assumes that there is a constant price elasticity of demand of -4.00 , measured as the natural log of the exposure growth divided by the natural log of the premium growth for all classes of business, which is far from valid. Some lines and sublines of insurance are much more price sensitive than others, insurance obtained through an independent agency should exhibit greater price elasticity than insurance obtained through a direct writer, renewal business should exhibit less elasticity than new business, and "name brand" insurance should be less price elastic than "generic" products from companies with lesser known names.

TABLE 3
Growth Risk Charges

Actual Growth Rate	Normal Growth	Excessive Growth	Reserves	RBC Charge– Reserves	Written Premium	RBC Charge– Premiums
0%	10%	0%	10,000,000	0	10,000,000	0
10%	10%	0%	10,000,000	0	10,000,000	0
20%	10%	10%	10,000,000	450,000	10,000,000	225,000
30%	10%	20%	10,000,000	900,000	10,000,000	450,000
40%	10%	30%	10,000,000	1,350,000	10,000,000	675,000

The NAIC Excessive Growth Risk Calculation

Although many rating agencies, researchers, and the NAIC are concerned with premium growth risk, the NAIC's RBC formula includes the most explicit charge. We use the NAIC as an example of how premium growth is generally viewed and penalized by rating agencies and regulators. As such, what follows is a brief discussion of the premium growth penalty. Details of the formula calculation can be found in NAIC (2003).

As shown in Table 3, the two primary types of risk addressed by the RBC formula's excess growth calculation are (1) the potential underpricing of new business in the short run and (2) the potential adverse development of reserves in the long run. The RBC formula applies a variable excess growth risk charge separately to the reserves as well as to the prior year's net written premium when the 3-year average growth rate of gross premiums (direct plus assumed) exceeds 10 percent. This research focuses on the relationship between growth and short-term underwriting profitability, which is the risk addressed in the R5 Written Premium Risk component of the NAIC's RBC formula. Although the effect of excess growth on reserve development is an important consideration, it is a separate line of research and is thus deferred to another time.

As explained in the previous section, then, premium growth can generate additional risk but can also generate additional safety. Yet, the NAIC RBC formula makes no distinction between exposure growth and rate-level growth. The growth risk portion of the NAIC formula was developed during the early 1990s by an American Academy of Actuaries (AAA) advisory committee, and the results that the AAA derived were heavily influenced by the experience of the alternating hard and soft markets of the 1980s. The development of the risk factors, which is described in NAIC (1993), made a number of assumptions about the relative risk of different lines of business and the impact of exposure growth that were untestable at the time. There was an assumption that exposure growth would exhibit different risk parameters than premium growth, but that information was not then and has never been available in the regulatory annual statements. According to Horvath (2004), though, A.M. Best has access to exposure data and uses that information in its version of RBC, the Best Capital Adequacy Ratio. There was an assumption that growth risk was related to size, although the size charge was eventually dropped (Feldblum, 1996). There were also a host of issues that were untestable because of the data limitations in Schedule P, such as the effect of loss sensitive products or risk differentials between occurrence

and claims-made policies. Since that time, though, the NAIC has added more detailed reporting to Schedule P to address some of those data limitations. One of the additions, Schedule P Part 5, includes a reasonable proxy for exposure growth, although the RBC growth risk component continues to be calculated solely on aggregate premiums.

The NAIC RBC formula uses the annual gross written premiums for the prior 4 years to calculate a 3-year average growth rate. Group premiums, rather than company premiums, are used in the calculation to alleviate potential accounting oddities. Growth in each year is capped to be no more than 40 percent, although there are no lower limits on negative growth rates. If the company has no prior experience, then its average is capped at 40 percent for the year it begins business. The average over the 3-year period is adjusted for "normal" growth, defined as 10 percent per year. Therefore, the excess growth risk factor is any premium growth over 10 percent.

One limitation of the NAIC formula is that it assumes that premium growth below 10 percent is normal while premium growth above 10 percent is excessive. During the period 2002–2003, nearly two-thirds of the active groups and stand-alone companies in the NAIC database had premium growth in excess of 10 percent. Much of the premium growth during that period is attributable to the hardening market, and high premium growth rates were normal across the various lines of business. During the development of the formula, the Actuarial Advisory Committee themselves assumed that the NAIC would modify the 10 percent average growth factor to reflect rate-level changes in the market if warranted (NAIC, 1993).

Another limitation is that there is no differentiation by line of business or by type of growth (rate increases or increases in exposure counts). If the company's average premium growth rate exceeds the normal growth rate of 10 percent, then an RBC charge is created. The excess growth capital requirement for reserve risk is calculated by multiplying the excess growth risk factor times 45 percent of the reserves. The excess growth capital requirement for written premium risk is calculated by multiplying the excess growth factor times 22.5 percent of the prior year's written premium.

The excess growth risk capital requirement for reserve risk is added to the R4 component of the formula while the written premium excess growth capital requirement is added to the R5 component. Because of the covariance adjustment in the RBC formula, there is some reduction to the total RBC risk generated by the formula.⁵ Therefore, in the example in Table 3, if the company generated and additional \$1,350,000 in reserve risk and \$675,000 in written premium risk, the actual additional RBC would be somewhat less than the \$2,000,000 sum of the components.

METHODOLOGY

This research tests to what extent, if any, either premium growth or claim count growth is a predictor of changes in short-term profitability. Ideally, this type of research would use both price data and exposure data to evaluate the different types of growth, but that information is not publicly available. Premiums reflect both the number

⁵The covariance adjustment reduces the sum of the various risk-based capital requirements from all of the "R" risk factors (R0—affiliated investments risk; R1—fixed income investment risk; R2—equity investment risk; R3—receivables risk; R4—reserve development risk; and R5—written premium risk). The impact of the adjustment varies from company to company and from year to year, depending on the actual mix of risk components.

of exposures and the average price per exposure, and consequently any growth in premiums reflects the concurrent growth in the price of the policies, the number of policies sold, or both. Similarly, although we use the claim counts reported in Schedule P as a proxy for exposures, the claim counts are actually a reflection of both the exposures and the underlying risk of the insurance pool. That is, a company might maintain the same number of exposures but still show claim count growth simply by switching from low-frequency customers to high-frequency customers.

If a company doubled its exposures while holding all else constant (including maintaining the same *unit* price of the insurance), then there should be no change in the loss ratio. The company would be writing twice as much business at the same level of relative profitability. If, on the other hand, a company doubled its prices while holding all else constant, then there would be a negative relationship between premium growth and the loss ratio because the same customers would be paying twice the amount of premium while having the same exposure to loss. In practice, all else is never held constant. Changes in premium are a mixture of both price changes and exposure changes, and changes in claim counts are some mixture of both changes in exposures and changes in the underlying risk of the loss portfolio. Our research question is to test whether there is a measurable effect on the loss ratio following either premium growth or claim count growth.

We use direct plus assumed earned premiums from Schedule P Part 1 to calculate premium growth to be consistent with the direct and assumed claim counts reported in Schedule P Part 5. Intercompany pooling arrangements are prevalent in the data, so we limited our sample to insurer groups and to stand-alone insurance companies found in the public NAIC database for the 1998–2005 statement years.⁶ Claim counts are only reported for certain lines of business, so our research is also limited to those lines found in Schedule P Part 5 for the available accident years:

A	Homeowners/farmowners multiperil	HOF
B	Private passenger auto liability	PPA
C	Commercial auto liability	CAL
D	Workers compensation	WKC
E	Commercial multiperil	CMP
FA	Medical malpractice—Occurrence	MMO
FB	Medical malpractice—Claims made	MMC
HA	General liability—Occurrence	GLO
HB	General liability—Claims made	GLC
RA	Products liability—Occurrence	PLO
RB	Products liability—Claims made	PLC

We test two models for each of these lines of business:

$$\ln \left(\frac{L R_{i,j,t}}{L R_{i,j,t-1}} \right) = \beta_{i,j0} + \beta_{j1} \ln \left(\frac{P_{i,j,t}}{P_{i,j,t-1}} \right) + \varepsilon_{i,t}, \quad (1)$$

⁶The NAIC sells data from its database to the public, but not all carriers that report to the NAIC are included in the data sold to the public. Additionally, the public data are not updated or corrected after release. Therefore, there will be some discrepancies between the internal NAIC data and the publicly available data.

and

$$\ln \left(\frac{LR_{i,j,t}}{LR_{i,j,t-1}} \right) = \phi_{i,j0} + \phi_{j1} \ln \left(\frac{C_{i,j,t}}{C_{i,j,t-1}} \right) + \varepsilon_{i,t}, \quad (2)$$

where LR is the loss ratio, P is premium, and C is claim count. The i subscript refers to the individual company or group, the j subscript refers to line of business, and the t subscript refers to the accident year. We utilize a fixed effects model for (1) and (2) with $\beta_{i,j0}$ and $\phi_{i,j0}$ representing the firm-specific effect; $\varepsilon_{i,t}$ represents the random error component. We also include dummy variables for each year in our sample to capture any time-related effects.

These models measure the elasticity of the loss ratio with respect to changes in either premium volume or claim counts. The loss ratio for the i th company's j th line of business is assumed to be a random variable with mean LR , so the actual dollar losses for period t would be $LR_{i,j,t} * P_{j,t}$. Premiums grow at some rate γ , another random variable, so P_t is equal to $(1 + \gamma) * P_{t-1}$. The premium growth rate on the right-hand side of model (1) reduces to $\ln(1 + \gamma)$, the log of one plus the premium growth rate. The loss ratio is a function of the number and type of exposures. Assuming that the insurer prices to a long-range loss ratio, the growth rate of the loss ratio (λ) would have an expected value of zero. The left-hand side of Equation (1) reduces to $\ln(1 + \lambda)$, the log of one plus the loss ratio growth rate. Similarly, the claims are assumed to be a function of exposures. Absent exposure growth, the claim count in time t should have growth rate δ with mean of zero. The right-hand side of model (2) reduces to $\ln(1 + \delta)$, the log of one plus the claim growth rate.

Ultimately, we will test whether or not the coefficients on the independent variables in Equations (1) and (2) are significantly different from zero.⁷ If premium growth is related to increased risk, β_{j1} in Equation (1) will be significant and positive. If exposure growth is related to increased risk, ϕ_{j1} in Equation (2) will be significant and positive. Of course, the converse could equally be true. That is, premium growth or exposure growth could decrease insolvency risk, in which case the coefficients, in Equations (1) and (2) will be negative. Formally, our testable hypotheses for each equation can be stated as:

$$\begin{array}{ll} H_0: \beta_{j1} = 0 & \text{and} \quad H_0: \phi_{j1} = 0 \\ H_1: \beta_{j1} \neq 0 & \quad \quad H_1: \phi_{j1} \neq 0 \end{array}$$

Data to compute premium growth for accident years 1998 through 2005 are taken from column 1 of Schedule P Part 1 for each accident year, which would be row 11 (accident year t) and row 10 (accident year $t - 1$). Growth rates for accident years 1990 through 1997 are computed from rows 2 through 9 of the 1998 annual statement.

⁷Given a random premium growth rate and random loss ratios in periods 1 and 2, it can be shown that the $\beta_{i,j0}$ term should be zero. That is, even though premium is on both sides of Equation (1), if the premium does not affect the loss ratio, the covariance between the log of the change in loss ratio and the log of the change in premium should be zero. See the Appendix for proof.

Major changes to Schedule P became effective with the 1998 statement year, so prior-year statements do not contain sufficient detail to compute the claim count growth statistic used in this study. As a result, the loss ratios for the 1990–1997 accident years reported in the 1998 schedule use losses that are more developed than the ones taken from the annual statements accident years 1998 through 2005.

The use of claims counts is by no means a perfect measure of exposure units. However, there are arguments in favor of claim counts as a better proxy of growth risk, albeit imperfect, than premiums. Since some premium growth is accomplished through price increases, the change in price would not necessarily alter the relative number of claims unless the mix of business changed. That is, if a company increased its rates but not its exposures, then theoretically there should be no change in the expected number of claims reported. However, if the company maintained the same rates and simply doubled the number of exposures it was insuring, one would expect that the claim count would double, assuming again that the mix did not change. If the aging phenomenon were present and/or the mix changed to a more risky book of business, doubling the number of exposures would presumably more than double the number of claims.

Gross incurred loss and loss adjustment expenses from column 26 of Schedule P Part 1 are used to compute the loss ratio (direct and assumed business) for each accident year. The growth rate of the loss ratio is measured as the natural log of the loss ratio for accident year t divided by the loss ratio for accident year $t - 1$. The growth rate of claims is computed from Schedule P Part 5 Section 3 as the natural log of the initial reported claim count for accident year t divided by the initial reported claim count for accident year $t - 1$. Both values are taken from the diagonal of Schedule P Part 5 Section 3 for the appropriate year's annual statement. The rates for accident years 1990–1997 were computed from the 1998 annual statement but still use the initial development year values to compute the growth rate.

In order to reduce the effect of outlier values, the following limitations, based primarily on judgment and on experience working with the NAIC data, were imposed:

- Premiums in year $t - 1 > = \$1$ million.
- Premiums in year $t > = \$200,000$.
- Losses in year $t - 1 > = \$200,000$.
- Losses in year $t > = \$40,000$.
- Claim count in year $t - 1 > = 100$.
- Claim count in year $t > = 20$.
- $1/5 < = (\text{Premium}_t / \text{Premium}_{t-1}) < = 5$.
- $1/5 < = (\text{Claim Count}_t / \text{Claim Count}_{t-1}) < = 5$.
- $1/5 < = (\text{Loss Ratio}_t / \text{Loss Ratio}_{t-1}) < = 5$.

Even after these limitations, the resulting data set contained nearly 24,000 observations and over \$3.3 trillion in total premiums, which was almost 95 percent of total premium volume available for these lines during these accident years.

UNIVARIATE STATISTICS

Table 4 provides some sample statistics for the three growth rates (λ for the loss ratio, γ for premium, and δ for claims) by line of business. The growth rate of premiums

TABLE 4

Univariate Statistics on Growth Rates of Premiums, Claim Counts, and Loss Ratios by Line of Business

Line	No. of Obs	Premium Growth Rate (γ)		Claim Growth Rate (δ)		Loss Ratio Growth Rate (λ)	
		Mean	<i>p</i> Value	Mean	<i>p</i> Value	Mean	<i>p</i> Value
A	4,298	0.059	<.0001	-0.013	0.0221	-0.004	0.4641
B	4,181	0.042	<.0001	0.010	0.0540	-0.005	0.0691
C	3,365	0.048	<0.0001	0.008	0.1572	-0.011	0.0272
D	3,108	0.055	<0.0001	-0.008	0.1597	-0.008	0.0591
E	3,601	0.067	<0.0001	0.012	0.0244	0.010	0.0947
FA	268	0.036	0.0698	-0.080	0.0019	-0.038	0.0626
FB	856	0.058	<0.0001	0.011	0.3394	0.008	0.4067
HA	2,770	0.052	<0.0001	-0.014	0.0480	0.008	0.2071
HB	814	0.069	<0.0001	0.003	0.8121	-0.006	0.6450
RA	606	0.017	0.1560	-0.070	<.0001	0.012	0.4679
RB	88	0.078	0.0691	-0.049	0.3725	-0.013	0.8154

averaged around 5 to 6 percent over the period and was positive for all lines. The growth rates for claim counts and loss ratios were statistically significantly positive for some lines of business, but not as high as the growth of premiums. While some of the lines showed statistically significant differences from zero, the mean growth rates for claims and loss ratios were generally not materially greater than zero and were positive in some cases and negative in others. From these results, we conclude that there is a naturally positive growth rate for premiums but not for loss ratios and claim counts during this time period.⁸

Table 5 is a time series view of these ratios by year. Looking over time, it is obvious that the growth rate of premiums was significantly higher during 2001–2003, reflecting price strengthening during that period of time. In that instance, premium growth far outstripped claim count growth while at the same time the loss ratio growth was negative. During this hard market, the industry became stronger, not weaker, because the growth in premiums was driven by price increases rather than by exposure growth.⁹

⁸This result is consistent with those reported in by A.M. Best in the “Masterson Indexes” as well by Pecora (2005), which shows a general positive increase in claims costs.

⁹It is interesting to note that during the debate over instituting a growth rate charge in NAIC’s risk-based capital formula, some of the opposition to the excessive growth risk charge was based on this scenario. When excessive growth is due to price increases, the industry will be hit with higher capital charges at a time when the industry is actually becoming safer through price strengthening. Presumably, should future price levels be reduced and margins squeezed, the industry will be looking at lower capital requirements at a time when companies are becoming less financially secure. Although we feel this is an important public policy question, we are not suggesting a solution and are leaving the debate to another forum.

TABLE 5

Univariate Statistics on Growth Rates of Premiums, Claim Counts, and Loss Ratios by Accident Year

Year	No. of Obs	Premium Growth Rate (γ)		Claim Growth Rate (δ)		Loss Ratio Growth Rate (λ)	
		Mean	<i>p</i> Value	Mean	<i>p</i> Value	Mean	<i>p</i> Value
1990	1,215	0.067	<0.0001	0.061	<0.0001	0.000	0.9845
1991	1,324	0.043	<0.0001	0.027	0.0018	0.009	0.2174
1992	1,400	0.050	<0.0001	-0.023	0.0078	0.011	0.2516
1993	1,414	0.052	<0.0001	0.042	<0.0001	-0.024	0.0055
1994	1,502	0.060	<0.0001	0.072	<0.0001	0.037	<0.0001
1995	1,557	0.031	<0.0001	-0.037	<0.0001	-0.036	<0.0001
1996	1,576	0.023	0.0002	0.045	<.0001	0.070	<0.0001
1997	1,610	0.031	<0.0001	-0.069	<0.0001	-0.053	<0.0001
1998	1,648	0.004	0.4601	0.029	0.0006	0.056	<0.0001
1999	1,572	0.018	0.0018	-0.014	0.1226	0.013	0.0963
2000	1,598	0.068	<0.0001	0.024	0.0033	-0.011	0.1614
2001	1,602	0.103	<0.0001	0.014	0.1325	-0.027	0.0003
2002	1,209	0.106	<0.0001	-0.028	0.0083	-0.084	<0.0001
2003	1,596	0.112	<0.0001	-0.046	<0.0001	-0.044	<0.0001
2004	1,599	0.065	<0.0001	-0.084	<0.0001	-0.007	0.3244
2005	1,533	0.034	<0.0001	-0.035	<0.0001	0.045	<0.0001

Although only the aggregate results are shown in Table 5, the same general pattern holds true when the analysis is repeated for each separate line of business. The growth rate of premiums is significantly higher in 2001, 2002, and 2003 than in prior years, reflecting a pricing cycle. Note, however, that claims growth is negative during this period. This is evidence that the premium growth during this period actually reduced risk because the premium growth was dominated by price growth rather than exposure growth.

FIXED EFFECTS MODEL RESULTS

Table 6 summarizes the results from the regression models after controlling for the fixed effects of individual firms and adding time dummy variables for each of the years. In every instance, the premium growth measure showed a negative relationship with changes in the loss ratio. That is, as premiums grew, the loss ratio tended to decrease. On the other hand, the claim count growth rate was positively associated with changes in the loss ratio: as the claim count grew, the loss ratio grew as well. In most instances, there was a statistically significant positive relationship between the growth rate of the claim count and the growth rate of the loss ratio. That does not mean that in every instance this is true, but it does mean that on average, premium growth is negatively correlated with changes in the loss ratio.

The results shown in Table 6 include all observations for accident years 1990 through 2005. We also ran the regression with only accident years 1998 through 2005 to see whether the results were affected by the use of developed data for accident years 1990

TABLE 6

Fixed Effects Results Dependent Variable: Yearly Growth Rate of Loss Ratio

Line	No. of Obs	Adjusted $R^{2(1)}$	Parameter Estimate	Std Error	p Value
Independent Variable: Growth Rate of Premiums					
A	4,298	0.093	-0.124	0.033	0.0002
B	4,181	0.041	-0.084	0.012	<0.0001
C	3,365	0.007	-0.152	0.023	<0.0001
D	3,108	0.085	-0.142	0.017	<0.0001
E	3,601	0.008	-0.104	0.033	0.0021
FA	268	0.369	-0.389	0.058	<0.0001
FB	856	0.290	-0.259	0.040	<0.0001
HA	2,770	0.044	-0.304	0.031	<0.0001
HB	814	0.138	-0.393	0.052	<0.0001
RA	606	0.181	-0.540	0.062	<0.0001
RB	88	0.128	-0.666	0.207	0.0023
Independent Variable: Growth Rate of Claims					
A	4,298	0.306	0.468	0.014	<0.0001
B	4,181	0.035	0.046	0.009	<0.0001
C	3,365	-0.002	0.072	0.017	<0.0001
D	3,108	0.062	0.035	0.014	0.0134
E	3,601	0.051	0.246	0.020	<0.0001
FA	268	0.234	0.008	0.049	0.8759
FB	856	0.257	0.076	0.028	0.0075
HA	2,770	0.010	0.063	0.019	0.001
HB	814	0.079	0.117	0.035	0.001
RA	606	0.060	0.031	0.043	0.4696
RB	88	0.003	0.248	0.146	0.0965

¹The p -values reported in Table 6 reflect the probability that the growth statistic (premiums or claims) is equal to zero. We have added the adjusted R^2 for completeness. However, given the large number of companies and the 16 data years included as dummy variables in the fixed effects procedure, the R -square values should be treated with caution.

through 1997. The reduced data set produced essentially the same results for premium growth, although they were not as robust for claim growth. The parameter estimates for the growth rate of claims are relatively small to begin with, and the reduced data set had larger standard errors. As a result, although the parameter estimates for claim growth were still positive, most of the lines did not show a statistically significant relationship when the 1990–1997 data were omitted. While our results are robust for premium growth, we must temper our conclusions for the effect of claim count growth.

It should be noted that this type of data is subject to heteroskedasticity, as the error terms are inversely related to the volume of the book of business. That is, there is more statistical variance in a \$1 million book of business than a \$1 billion book of business. We estimated our model using errors corrected for heteroskedasticity and found the results to be the same.

TABLE 7

Fixed Effects Results Dependent Variable: 3-Year Average Growth Rate of Loss Ratio

Line	No. of Obs	Adjusted R^2	Parameter Estimate	Std Error	p Value
Independent Variable: 3-Year Average of Growth Rate of Premiums					
A	3,103	0.152	-0.038	0.026	0.1528
B	3,196	0.243	-0.078	0.011	0.0001
C	2,428	0.215	-0.081	0.019	0.0001
D	2,171	0.336	-0.093	0.016	0.0001
E	2,570	0.171	-0.026	0.025	0.3079
FA	156	0.554	-0.497	0.093	0.0001
FB	560	0.487	-0.129	0.039	0.0001
HA	1,902	0.234	-0.204	0.028	0.0001
HB	480	0.309	-0.194	0.053	0.0003
RA	380	0.243	-0.284	0.076	0.0002
RB	37	0.089	-0.301	0.333	0.3804
Independent Variable: 3-Year- Average of Growth Rate of Claims					
A	3,103	0.278	0.313	0.014	0.0001
B	3,196	0.233	0.029	0.009	0.0019
C	2,428	0.21	0.037	0.017	0.0261
D	2,171	0.328	0.053	0.015	0.0004
E	2,570	0.201	0.17	0.018	0.0001
FA	156	0.447	0.061	0.062	0.3312
FB	560	0.479	0.059	0.031	0.0552
HA	1,902	0.211	0.029	0.018	0.114
HB	474	0.303	0.116	0.036	0.0016
RA	380	0.225	0.108	0.044	0.0149
RB	37	0.043	-0.037	0.147	0.8057

We also computed the model including only those companies with 10 percent or higher premium growth and for those companies with 20 percent or higher premium growth to ascertain whether the negative relationship between premium growth and changes in loss ratio held for higher levels of premium growth. Although parameter estimates changed in magnitude and the power of the tests were reduced because of loss of data points, the results obtained using the reduced data set were consistent with those results from using the full data set. We also computed the model with the premium growth rates adjusted for the average growth for each year. Again, the results were consistent. Given that the fixed effects model employs dummy variables for each year, that already accounts for at least some of the differences in average growth rates from one year to the next.

We also constructed two additional models using 3-year-averages of changes in loss ratio, premium growth, and claim count growth to reduce the natural statistical variability that is present in the dependent and independent variables. The results, which are shown in Table 7, are consistent with the results of the model using yearly observations reported in Table 6. Adjusted R^2 improved, but there was some weakening in the power of the tests of the slope coefficients. Even so, these results show that

premium growth exhibits an inverse relationship with changes in the loss ratio, while claim count growth exhibits a positive relationship in the loss ratio.¹⁰

Most regulatory models of insurer risk and the private sector models that evaluate the financial health of insurers view premium growth as being risky. These results indicate that growth in premiums actually reduces the loss ratio, on average, which should be viewed as reducing risk. Premium growth can arise from price increases as well as from increases in the number of policies, and growth through price changes appears to be “good growth” in that the growth appears to be leading to more profitable business.

These results show that, on average, premium growth leads to lower loss ratios. However, while that is true on average, it is certainly not true in all cases, and there are a number of examples of excessive growth companies going bankrupt soon after. The parameter estimates from the regression model are not company specific, though; rather, they are industrywide averages, based on individual company results. Based on this research, premium growth is not in and of itself evidence of decreasing underwriting profitability; indeed, these results suggest just the opposite.

Claim count growth, on the other hand, shows a positive relationship with loss ratio growth. Our assumption is that claim counts are closely related to the number of exposures, and a doubling of exposures would lead to a doubling of claims. That would not, holding all else constant, lead to a doubling of the loss ratio, though. Indeed, the loss ratio should stay the same unless the new mix of business was somehow less profitable than the old mix of business. These results suggest that growth, measured by changes in claim count, leads to higher loss ratios in each of the lines of business, at least in the short run.

CONCLUSIONS AND RECOMMENDATIONS

Both regulatory risk models and private risk models assume that premium growth leads to higher risk. Our results show that there is an inverse relationship between short-term changes in the loss ratio and the growth rate of premiums. Changes in premium may be attributable to exposure growth or rate level growth or some combination of the two, but the simplistic regulatory solvency ratios as well as the NAIC RBC formula makes no distinction between exposure growth and rate-level growth. To its credit, A.M. Best does reportedly consider alternatives to simple premium growth when evaluating capital adequacy. Although excessive growth has been shown to be a factor in the financial impairment of some property-casualty insurers in the past, high premium growth in and of itself may also signal greater profitability and reduced risk. Naive measures of premium growth cannot isolate the “good growth” from the “bad growth.” Rating agencies, researchers, and regulators should therefore be careful about committing a “Type II” error when penalizing firms with high premium growth rates.

These results show that there is a positive relationship between short-term changes in the loss ratio and growth in claim counts reported in Schedule P Part 5. This suggests that growth in the number of claims reported by an insurer might be a better

¹⁰We thank an anonymous referee for suggesting these two robustness checks.

indicator of the short-term risk than premium growth. On the other hand, premium growth exhibits an inverse relationship with changes in short-term loss ratios, which is inconsistent with the growth risk that the RBC formula attempts to measure. Still left to explore are the long-run effects, but the short-term effect of premium growth does not appear to have the negative effect on underwriting results that some of the regulatory and private risk models currently assume.

Finally, we note that claim counts are not necessarily the most appropriate measure of growth risk. Critics argue that claims counts are easy to manipulate, are subject to catastrophe risk, and are not consistently calculated from one insurer to the next. Some of these arguments may be applied to premiums as well, though to a lesser extent. Yet claim counts do exhibit some advantages as a measure of risk. The results reported here show that there is a direct association between changes in loss ratios and changes in claims counts, consistent with the risk that the RBC growth charge is attempting to measure. Additionally, changes in the mix of policyholders whereby one group of low-risk policyholders is replaced by another group of high-risk policyholders may not be reflected in premium changes but would be reflected in higher claims counts. Although the continued use of premiums as a proxy for growth risk have the advantage of being easier to calculate and easier to audit, those arguments have no bearing if the current premium growth measure does not have a demonstrated positive relationship to underwriting risk.

APPENDIX

Let P be the premium set by an insurer in period 1 and $P^* = P(1 + \tilde{r}_p)$ represent the premium set by an insurers in period 2 where $\tilde{r}_p$ is a random premium growth rate.

The log of the change in premium is then

$$\ln\left(\frac{P^*}{P}\right) = \ln\left(\frac{P(1 + \tilde{r}_p)}{P}\right) = \ln(1 + \tilde{r}_p).$$

Now, let $L = P * \tilde{l}$ be the losses in period 1 where $\tilde{l}$ is a random loss ratio and $L^* = P * (1 + \tilde{r}_p) * \tilde{l}^*$ be the losses in the period 2 where $\tilde{l}^*$ is the second period random loss ratio.

The log of the change in loss ratios is then

$$\ln\left(\frac{LR^*}{LR}\right) = \ln\frac{\tilde{l}^*}{\tilde{l}} = \ln\tilde{l}^* - \ln\tilde{l}.$$

The covariance between the log of the premium change and the loss ratio change is then

$$\begin{aligned} \text{cov}\left(\ln\frac{LR^*}{LR}, \ln\frac{P^*}{P}\right) &= \text{cov}[(\ln\tilde{l}^* - \ln\tilde{l}), (\ln(1 + \tilde{r}_p))] \\ &= E[(\ln\tilde{l}^* - \ln\tilde{l}) * (\ln(1 + \tilde{r}_p))] - E[(\ln\tilde{l}^* - \ln\tilde{l})]E[(\ln(1 + \tilde{r}_p))]. \end{aligned}$$

Since the loss ratios (l 's) and the growth rate in premium (r) are independent, the right-hand side simplifies to

$$E[(\ln \tilde{l}^* - \ln \tilde{l})]E[(\ln(1 + \tilde{r}_p))] - E[(\ln \tilde{l}^* - \ln \tilde{l})]E[(\ln(1 + \tilde{r}_p))] = 0.$$

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