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PERSONAL AUTOMOBILE: COST DRIVERS, PRICING, AND PUBLIC POLICY

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Abstract

Traditional actuarial pricing procedures have focused on pre-accident driver attributes, vehicle characteristics, and garaging location in an effort to explain personal automobile loss cost "drivers." Although these traditional factors are important for statewide ratemaking in a static environment, they account for only part of the influences on auto insurance loss costs.

This paper draws on the industry research of the past fifteen years to present a more comprehensive four-dimensional framework for understanding auto insurance loss costs, comprising factors grouped into the following categories:

- *pre-accident driver attributes and vehicle characteristics;*

- *the external environment, such as road conditions and traffic density;*
- *compensation systems, such as tort liability versus no-fault; and*
- *post-accident factors, such as claimant characteristics, medical providers, and attorney representation.*

The paper shows the explanatory value of this framework as compared with the traditional decomposition of loss costs into frequency and severity components.

As an illustration, the paper shows how territory, which is sometimes considered a reflection of external conditions (such as road safety and traffic density), is more properly analyzed as a proxy for post-accident factors—specifically, the "treatment triangle" among claimants, medical providers, and attorneys in certain locations. The paper concludes with two proposed public policy reforms, demonstrating how the expanded four-dimensional framework for personal auto loss cost drivers facilitates the development of more efficacious methods for holding down auto insurance loss costs.

1. INTRODUCTION

Actuarial ratemaking sets policy premiums to cover anticipated losses and expenses. To estimate the needed premiums, the pricing actuary examines the "cost drivers"—that is, the factors that influence the expected future losses and expenses.

In the past, actuaries have concentrated on variables related to driver, vehicle, and geographic characteristics. Indeed, these are the factors most susceptible to policy rating, the traditional role of the casualty actuary.

Although this traditional approach produces accurate rates, it does not provide a full understanding of the underlying factors that influence automobile insurance loss costs. The recent stud-

ies of the Insurance Research Council (IRC, formerly AIRAC), the RAND Institute, and the Automobile Insurance Bureau of Massachusetts (AIB) illuminate a host of other factors that play significant roles in determining these costs.

This paper integrates the results of these studies into a comprehensive framework for analyzing personal automobile insurance loss costs. The framework looks at four dimensions that affect loss costs: (a) pre-accident driver attributes and vehicle characteristics, (b) the external environment, (c) compensation systems, and (d) post-accident factors. Section 6 shows how these four dimensions combine to influence territorial rates.

The implications for policy pricing are highlighted by comparison with the traditional "claim severity/claim frequency" paradigm, using national statistics compiled by the IRC and Massachusetts experience analyzed by the AIB. The importance of the expanded framework is further revealed by three other uses besides policy pricing:

- Several traditional classification dimensions are reinterpreted, underscoring their true effects on insurance loss costs. The IRC studies, for instance, show how territory is shifted from a factor related to the physical environment to a factor related to claimant characteristics.
- Changes in compensation systems can be more accurately priced. The AIB studies show how a simplistic prognosis of the 1989 Massachusetts no-fault reform vastly mis-estimated the true effects on loss frequency and loss severity.
- Public policy recommendations for lowering the cost and improving the efficiency of personal auto insurance are made more realistic and more effective.

These uses of the expanded framework for personal automobile insurance cost drivers reflect the widening role of the casualty actuary in today's insurance environment.

2. FRAMEWORK

Let us begin with the fundamental question faced by the pricing actuary:

> *An insurer issues a personal automobile insurance policy. What factors influence the loss cost expected from this policy?*

The traditional actuarial focus on ratemaking and classification systems, as well as a predilection for quantifiable data, has led to an emphasis on pre-accident factors—particularly driver, vehicle, and geographic characteristics—to the virtual exclusion of other factors that affect the insurer's payments. The likelihood and severity of an accident are considered to depend on driver attributes, vehicle characteristics, and garaging location. The amount of the claim and its monetary resolution stem directly from the physical aspects of the auto accident.

This perspective suffices for an insurance environment with an existing classification plan. It is insufficient for an actuary working with changing external conditions and compensation systems, or for an actuary refining classification plans, revising pricing procedures, or formulating public policy recommendations.

The expanded perspective in this paper groups loss cost drivers into four dimensions, as shown in Figure 1.

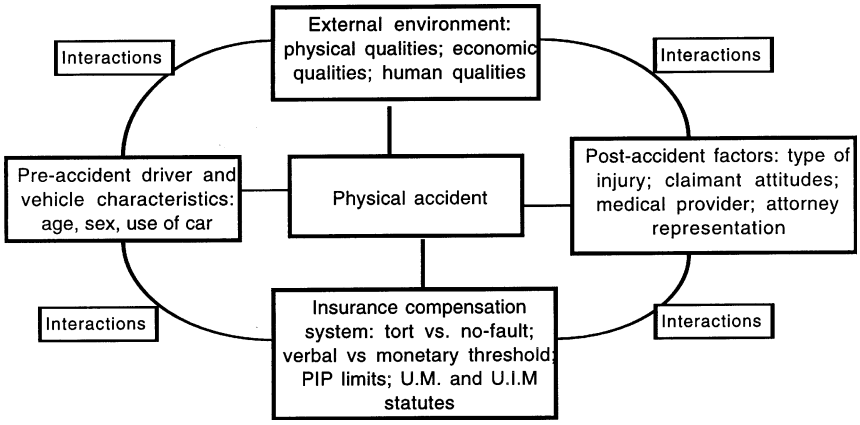
1. *Pre-Accident Driver Attributes and Vehicle Characteristics*

   Pre-accident characteristics include the traditional rating variables that are shown on the policy application:

   - *Driver attributes*, such as age, sex, marital status, driving record, driving experience, and driver education.
   - *Vehicle and vehicle use characteristics*, such as make and model of the car, horsepower, mileage driven, multicar discounts, and vehicle use (e.g., drive to work vs. pleasure).

FIGURE 1

DIMENSIONS OF LOSS COST DRIVERS



- *Policy age*, such as new versus renewal policy.

These factors are used for setting rate relativities in existing classification schemes, since they are known to the insurer at policy inception and they can therefore be used to rate the policy. These factors are most important for predicting the occurrence of a physical event (e.g., an accident). Once that event occurs, the insurance payments (if any) depend on a number of post-accident factors and on the compensation system.

2. *The External Environment*

The external environment relates to non-insurance characteristics that affect claim frequency or claim severity. We group these factors into three categories:

- *Physical qualities*, such as traffic density, road hazards and maintenance, and safety regulations (such as speed limits and seat-belt statutes). The garaging location, or the rating territory, is often thought of as reflecting

physical road qualities. In truth, territory affects auto claim costs primarily by its relationship to several post-accident factors, such as attorney representation, the nature of the medical providers, and claimant characteristics. As the discussion below indicates, territory is not simply a reflection of road characteristics and traffic density.[1]

- *Economic trends*, such as the argument that in prosperous years people drive more, purchase new vehicles, and take more vacations, leading to higher bodily injury accident frequencies.

- *Individual circumstances*, e.g., a higher proportion of poor residents in certain geographic areas may lead to more uninsured motorists and higher UM costs.

3. *Compensation Systems*

Auto injury compensation systems may be grouped into tort liability, no-fault, and add-on systems. Tort liability systems may be subdivided by the financial responsibility limits and by the type of comparative negligence rule. No-fault compensation systems may be subdivided by the type of tort threshold: pure, verbal, and monetary. Verbal thresholds may be further classified by their definitions. Monetary thresholds may be further classified by their magnitude. No-fault systems may also be classified by the personal injury protection (PIP) limits, by the type of benefits provided, and by the compensation rate (e.g., "75% of wage loss").[2]

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[1]Physical factors may be important in particular instances, such as to explain a high accident frequency at a four way intersection with stop signs but no traffic light. They are less important in the aggregate. Two cities may have similar physical characteristics and similar accident rates but different claim frequencies.

[2]The types of auto compensation systems, and their resultant incentive effects, may also be categorized in relationship to other health care plans. For instance, traditional "fee for

The compensation system has a direct effect on claim frequency and claim severity, since a claim may be compensable under one system but not under another system. The compensation system has an incentive effect both on claim filing and on claim severity. For instance, claims may be built-up either to pass a monetary tort-threshold in a no-fault compensation system or to legitimize claims for pain and suffering awards in a tort liability system.

These incentive effects are sometimes subsumed under a broader "insurance lottery" perspective, which says that claim-filing behavior depends in part on the ease of pressing an insurance claim. States with strong anti-fraud statutes may greatly reduce claim frequency. The build-up of claims is useful only if it provides a greater net gain to the claimant and his or her associates. Incurring additional medical expenses in a no-fault state with a strong verbal tort threshold is sometimes pointless, if the type of injury does not allow a tort claim to be pursued.

Auto injury compensation systems are most important in explaining state-by-state differences in insurance costs. Not only the insurance compensation but also the occurrence of claims and the amount of economic damages depend on the state compensation system.

4. *Post-Accident Factors*

Studies of "classification efficiency" often fault traditional risk classification plans for failing to adequately explain the variance in insurance loss costs (see Spetzler, Casey, and Pezier [13], Giffin, Travis, and Owen [4], and Woll [16]). Indeed, the factors discussed above relate primarily to the occurrence of the physical event—i.e., cars colliding with one another. Other factors, such as the type of injury,

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service" medical plans require the claimant to pay both a deductible and a coinsurance payment, and they restrict over-payment by the collateral source rule. Most auto insurance compensation systems, in contrast, have no such offsets.

the honesty of the claimant, attorney representation, and the type of medical treatment sought, are strong predictors of insurance claim costs.[3]

Post-accident factors relate to (i) whether an injury claim will be brought for the physical accident and (ii) the amount of the claim. These factors may be grouped into the following categories:

- *Type of injury*, such as soft-tissue injuries (back and neck sprains and strains) vs. fractures vs. more serious injuries. The hierarchy of injury types should distinguish between injuries that are more or less susceptible to "build-up" and potential fraud. For instance, a fracture is readily discernable, and the length of needed treatment is objectively determinable. Soft-tissue injuries are harder to validate, and there is less consensus on their appropriate treatment. If claim frequency depends (in part) on claim-filing behavior, and if claim severity depends (in part) on "build-up," then a hierarchy of injury types that differentiates claims by the criteria mentioned above is most useful for forecasting loss costs.

- *Type of medical practitioner*, such as physician vs. chiropractor vs. physical therapist, as well as type of treatment, such as hospital admission vs. outpatient treat-

[3]See, for instance, Weisberg and Derrig [15], particularly Tables 2 and 3 on page 133, Table 4 on page 135, and Table 6 on page 138. Weisberg and Derrig note (page 132) that

> *For claims that involved strains or sprains, variables that reflected the seriousness of the injury explained little of the variation in medical expenses. For pure strains/sprains our model R^2 was only .04 and for mixed claims with strains/sprains and "hard" injuries, the R^2 was .21. … However, when variables related to treatment utilization and claimant behavior were added in, the value of R^2 for strain/sprain claims jumped to .78 and that for mixed claims to .79.*

In general, claimants are more likely to engage attorneys in more serious cases. However, even when the degree of injury is comparable, attorney-represented cases are more likely to settle for higher amounts, though the net proceeds to the accident victim may not be higher (AIRAC [2], IRC [7, pp. 56–62]).

ment.[4] The type of injury and type of medical practitioner variables have two or more values for most claims. In other words, many auto liability claims allege both a sprain/strain and another type of injury. Similarly, many claimants see two or more types of medical practitioner, such as a physician in an emergency room setting and then a chiropractor for extended visits.[5]

- Whether the claimant is being *represented by an attorney*. In tort liability claims, plaintiffs' attorneys are generally compensated on a contingent fee basis. That is, the attorney receives a percentage of the court award or of the insurance compensation, such as 33%.

For bodily injury (BI) claims, the insurance company's settlement offer is often a multiple of the economic damages (generally medical bills and wage loss) suffered by the accident victim. The plaintiff's attorney

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[4]The distributions of auto insurance claims by type of injury and type of medical practitioner differ from the distributions for standard health insurance. The distributions noted by Marter, Weisberg, and Derrig for claims reported in Lawrence, Massachusetts (an area suspected of widespread insurance fraud) are particularly revealing. Among the 1985–1986 Lawrence claims studied by Marter and Weisberg [12], 44 out of 48 were for sprains or strains (page 404). For these claims, moreover, 89% of the medical charges went to chiropractors, and only 10% went to physicians (page 407); see also Weisberg and Derrig [14].

The predisposition of some actuaries is to view the neck and back sprains treated by a chiropractor as a minor influence on auto insurance loss costs. The contrary is true. In certain areas, such claims are the principal loss cost drivers. Even in the rest of the country, strains and sprains are the predominant type of auto injury in bodily injury claims, and treatment by chiropractors and physical therapists is becoming increasingly common.

[5]The Insurance Research Council [7] has documented both the multiplicity of injuries and of medical practitioners as well as the trends in these statistics in recent years. In 1992, the average BI claimant reported about two different types of injury and was treated by about two different types of medical practitioners.

> *The growing share of claimants reporting multiple types of injuries also is reflected in the growth of the average number of different types of injuries reported by BI claimants. BI claimants reported an average of 1.92 types of injuries per person in 1992, up from 1.79 types of injuries per person in 1987 [7, p. 2].*
>
> *On average, BI claimants were treated by 1.95 different types of medical practitioners per person in 1992, up from 1.59 in 1987 [7, p. 3].*

has a financial incentive to encourage the "build-up" of the claim.[6] The IRC studies have consistently shown higher average costs for attorney-represented claims, even when the type of injury is held constant (see IRC [7, page 61]).

Perspectives regarding post-accident factors vary widely, and can be illustrated by looking at two extremes. The difference in viewpoint is essential for understanding the costs of the auto insurance system and for developing reforms to reduce this cost.

Suppose an accident victim in a no-fault state with a monetary tort threshold suffers a lower back sprain, sees a chiropractor 30 times, recovers the out-of-pocket expenses from PIP coverage, and files a BI claim which is handled by an attorney.

- From an innocent (perhaps "idealistic") perspective, the physical injury itself is the loss cost driver. The back sprain incurred in the auto accident motivates the victim to seek out a medical

[6]An illustration should clarify this. Suppose that an insurance company settles most BI cases for three times the economic damages: that is, the compensation for "pain and suffering" is about twice the sum of wage loss and health care bills. Suppose also that attorneys require 33% of the award for most BI claims.

If an accident victim without an attorney incurs $1,000 in medical bills, the total BI compensation would be $3,000, for a "net monetary gain" to the claimant of $2,000. If the claimant is represented by an attorney, who takes 33% of the award, or $1,000, the claimant receives only $1,000. However, if the attorney "encourages" the claimant to stay home from work or to incur greater medical bills (perhaps by recommending a medical practitioner who sets a longer course of treatment), so that the economic damages rise to $2,000 and the insurance compensation rises to $6,000, the attorney's fee becomes $2,000 and the claimant's "share" is back to $2,000, which is the amount of general damages when no attorney is involved. Many insurance company personnel and industry researchers believe that this accurately depicts the role played by many (though not all) attorneys. In other words, attorneys often drive up the cost of the system, with little benefit to claimants (assuming there are no other collateral sources of compensation, such as sick pay plans and private medical insurance). See also the discussion later in this paper regarding the overtreatment of many automobile accident claims.

In no-fault states, there is a second incentive to build up claims. Many states have monetary tort thresholds, which allow accident victims to press bodily injury claims only if medical bills exceed a stated amount. (Most of these states also have verbal thresholds, which allow BI claims for "serious" injuries even if medical bills are low.) Attorneys can provide little aid in PIP recoveries. However, by encouraging their clients to "build up" the medical bills to exceed the tort threshold, they can file BI claims for "pain and suffering."

practitioner competent to handle such injuries. The length of the needed treatment and the lack of reimbursement for non-economic damages under PIP coverage (such as "pain and suffering") motivate the victim to file a BI claim. The complexity of the insurance claim process and the uncertainties of BI compensation motivate the victim to seek an attorney's aid. The "innocent perspective" sees the claim as the direct result of the physical accident and the insurance compensation as independent of the honesty of the claimant, attorney, or medical practitioner.

- The cynical perspective sees the "entitlement philosophy," or "claims-consciousness," or the "insurance lottery" as the loss cost driver.[7] Whether the accident victim files an insurance claim, seeks treatment from a particular medical practitioner, or even "suffers" a back sprain is not dependent solely upon the physical events in the auto accident. Rather, the accident victim, seeking to benefit financially from the accident, sees an attorney, who encourages him or her to be examined by a medical practitioner who has a history of recommending extended treatment. The medical practitioner diagnoses the back sprain and recommends an extended course of treatment. Either the medical practitioner or the attorney notes that the medical expenses will be covered by PIP (as well as by other health insurance) and that the BI claim will pay for additional "pain and suffering" costs. The accident victim, the attorney, and the medical practitioner all benefit from the extended course of treatment.

  In this "cynical perspective," the treatment provided was not solely the result of the physical accident. Rather, it is also affected by the desire of all three parties involved (the claimant,

[7]Casualty actuaries speak of "claims consciousness," which the IRC studies refer to as "claim-filing behavior." "Claim consciousness" has been measured by ratios of bodily injury to property damage claims. See the discussion of territory in the text. The "entitlement philosophy" is broader. Many accident victims, having paid thousands of dollars over the years for their auto insurance, now feel that they are entitled to recover their money from the "insurance industry."

the attorney, and the medical practitioner) to maximize the insurance compensation.

The difference in perspectives leads to differing public policy recommendations. The "innocent perspective" sees injury prevention as the key to reducing insurance costs. Injury prevention efforts include safety standards for new cars, safety inspections for older cars, mandatory seat belt laws, air bags, lower speed limits, and better policing of driving-while-intoxicated statutes. The "cynical perspective" sees the removal of the "lottery" incentives as the key to reducing insurance costs. Policy actions include anti-fraud units, peer review of medical practitioners, and verbal tort thresholds in no-fault states.

3. THE FREQUENCY-SEVERITY PARADIGM

The explanatory power of the expanded framework can be seen most clearly in contrast with the old frequency/severity paradigm. Previously, personal automobile loss cost drivers were viewed as inflation-induced changes in loss severity and as slow, long-term trends in loss frequency. The frequency trends have sometimes been modeled by econometric equations based on changes in gasoline prices, car density, and similar factors.[8]

Although this paradigm is an important component of actuarial ratemaking, it does not fully explain why claim frequency or claim severity may be changing, nor does it necessarily tell us what may be expected in the future. The expanded framework presented in this paper provides a broader perspective for viewing personal auto loss frequency and loss severity. It is particularly useful for understanding the causes of frequency and severity trends and for formulating public policy proposals to improve the auto insurance compensation system.

[8]The Insurance Services Office, for example, has studied the effects of various economic factors on automobile insurance claim frequency and it has suggested potential econometric models incorporating these factors.

Frequency

The Insurance Research Council studies of the mid-1990s, using data compiled by the Insurance Services Office (ISO) and the National Association of Independent Insurers (NAII), note that the countrywide property damage (PD) claim frequency decreased by 12% from 1987 to 1992. This is a measure of accident frequency; and it is consistent with fewer youthful drivers, greater public awareness of drunk drivers, and better quality cars.

Over the same time period, the frequency of bodily injury claims increased by 16%. Given the 12% decline in accident frequency, this is a 32% increase in bodily injury claims per physical accident.[9]

For bodily injury, the changes in claim-filing behavior among the public overwhelm the changes in physical accident frequency. The frequency drivers are not economic and environmental attributes like gasoline prices and car density. Rather, the primary causes lie in the claim and claimant characteristics dimension of the expanded framework:

- *Type of injury*: The greatest increase over this period was in "soft-tissue" injuries (sprains and strains). Moreover, sprains and strains are particularly dominant in urban areas, which also have the highest ratio of BI to PD claims. In fact, the May 1994 IRC study, *Paying for Auto Injuries* [9], concludes that "almost all of these additional injury claims are for difficult-to-verify injuries such as sprains and strains."
- *Type of medical practitioner*: The greatest increase over this period was in chiropractic treatment, especially for sprains and

[9]Formally, $32\% = [(1 + 16\%) \div (1 - 12\%)] - 1$. For the full IRC studies, see Insurance Research Council [7; 10]. See also Insurance Research Council [9]: "More people involved in auto accidents are making claims for injuries, even though accident rates have been declining. … Many states enacted seat belt laws during these years, resulting in substantial increases in seat belt use. Seat belts reduce the number and severity of injuries in auto crashes. Around the same time, states passed tougher drunk driving laws in response to growing public awareness of this problem. In addition, the federal government now requires additional safety standards for vehicles that make cars safer for passengers."

strains. Conversely, injuries requiring hospital stays have declined.

- *Attorney involvement*: Between 1977 and 1992, the percentage of claimants represented by lawyers rose from 31% to 46% for all injury coverages combined and from 47% to 57% for bodily injury claims (IRC [7, pp. 43–44]).[10]
- *Law changes*: In 1989, the threshold in Massachusetts for pursuing a BI liability claim was increased from $500 to $2,000. The traditional actuarial analysis would predict that the frequency of BI claims would decrease substantially, because injury claims with medical expenses between $500 and $2,000 would no longer be eligible for BI liability payments. In fact, the frequency reductions were minimal, because of incentive effects. The higher tort threshold encouraged accident victims (and their attorneys) to "build up" the medical expenses so that a bodily injury claim could be filed (see Marter and Weisberg [12]; Weisberg and Derrig [14]).

In sum, changes in claim and claimant characteristics are the key drivers for bodily injury claim frequency trends. Moreover, the claim frequency trends for BI coverage have been different from the corresponding claim frequency trends for property damage liability and for collision coverage, even though these trends ostensibly relate to the occurrence of the same auto accidents.

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[10]Of additional concern to pricing actuaries are the relative differences by state, which are relevant for severity and frequency trends. Credibility weighting statewide severity and frequency trends with the corresponding countrywide trends is inappropriate if the statewide trends are affected by changes in claim and claimant characteristics and in the compensation system in ways that the countrywide figures are not affected.

The same phenomenon may be seen in workers compensation insurance. In the past, statewide medical benefit trends were credibility weighted with countrywide trends. However, trends were lower in states with medical fee schedules than in states without such schedules. (The existence of a state medical fee schedule might be considered a workers compensation counterpart to the medical practitioner dimension of the personal automobile framework here.) Now, the figures assigned the complement of credibility in workers compensation medical benefit trends depends on whether the state has a medical fee schedule.

Loss Severity

Actuaries have traditionally used two methods to project trends in loss severity.

A. Trend projections based on internal data fit observed average costs per claim to an exponential curve and assume that the same trend will continue in the future.

B. Trend projections based on external data correlate the historical average costs per claim with an economic index, such as the medical cost component of the CPI, and then estimate future claim severity based on the expected future values of the economic index.

Both methods work well in certain environments. The first method works well when the underlying trends are stable, so that past changes in loss severity are deemed to be unbiased predictors of future changes. The second method works well when loss cost trends are considered to be closely linked to recognized inflation indices.

In personal automobile bodily injury insurance, loss severity trends are composed of several influences, such as:

- *Trends in cost of treatment*. This includes both (a) medical cost inflation and (b) trends in utilization rates that are independent of the personal auto compensation system.[11]
- *Trends in loss frequency*. Severe automobile accidents lead to insurance claims regardless of the claim-filing proclivity of the accident victim. The growing influence of attorneys and the changing claim-filing behavior of the public lead to greater claim frequency for minor injuries, such as sprains and strains with no visible signs of impairment. These are often low cost

[11]For instance, even when the personal auto compensation system remains unchanged, the development of new medical procedures may engender greater utilization of services, medical malpractice suits may stimulate more "defensive medicine," and the increased use of chiropractic treatment and physical therapy may change the mix of claims.

claims. In other words, the factors that increase loss frequency often lead to decreases in average loss severity.[12] A change in expected frequency stemming from changes in claim or claimant characteristics should be partially offset by changes in expected severity.

- *Changes in compensation systems and in claim handling procedures*. Compare the discussion above on the tort threshold change in Massachusetts in 1989. The new low severity projections changed dramatically because a whole cohort of cases, which formerly had medical costs between $500 and $2,000, moved up to over $2,000, with higher pain and suffering awards (see Marter and Weisberg [12]; Weisberg and Derrig [15]).

4. PROXIES

Many of the traditional classification variables used today are proxies for the true ("causative") factors affecting insurance loss costs. To clarify the difference between a causative factor and a proxy, let us contrast life insurance with automobile insurance.

- Age is generally considered a physiological attribute that directly affects expected mortality rates, so it is used as a rating variable for life insurance underwriting and life annuity underwriting.
- Sex and age also have strong correlations with auto accident frequencies, so they are used to set auto insurance rate relativities. Indeed, a 17 year old unmarried male may have about the same mortality rate as a 30 year old married female, but he may have several times the auto bodily injury claim frequency rate that she has. Yet sex and age (except at advanced ages when bodily capabilities deteriorate) have little intrinsic relationship with accident propensity. Rather, they serve as prox-

[12]The IRC studies demonstrate this phenomenon. Among the BI, PD, and PIP coverages over the 1980 to 1993 period, BI had the greatest increase in claim frequency and the smallest increase in claim severity; see especially Insurance Research Council [10, chapters 1 and 2].

ies for other driver characteristics that are not easily defined or measured, such as "risk-taking" predilections or psychological maturity.

The use of territory as a proxy for external conditions, driver attributes, and claimant characteristics is discussed below.

5. INTERACTIONS

The factors in one dimension of the expanded framework presented here may interact with the factors in another dimension to determine expected loss costs. We illustrate with two examples.

- *Pre-accident underwriting attributes and compensation systems:* Age, sex, and marital status may be more important as rating variables in tort liability systems, which focus on the tortfeasor's "fault," than in no-fault compensation systems, in which all accident victims are compensated. Conversely, the applicant's income and employment status may be important in no-fault compensation systems with high PIP wage-loss limits.[13]
- *Claim characteristics and compensation system:* The "padding" of claims, or "build-up," can be stimulated by a no-fault compensation system with a low or moderate monetary tort threshold. The AIB studies by Marter, Weisberg, and Derrig referenced above show how the 1989 increase in the Massachusetts tort threshold increased the average number of outpatient visits to chiropractors, thereby resulting in more claimants exceeding the tort threshold.

The interactions of the four components of the expanded framework are essential for proper pricing and public policy recommendations, as discussed in the final section of this paper.

[13]The comments in the text relate to relative importance only. Thus, age, sex, and marital status are important for no-fault compensation systems as well, since young, unmarried, male drivers are not only more likely to cause accidents, they are also more likely to be injured in accidents. Similarly, income and employment status are important for tort liability systems as well, since unemployed persons with few assets are often "judgment proof" and therefore carry low liability limits of coverage.

6. TERRITORY AS A RATING VARIABLE

Territory is one of the chief variables used by U.S. insurers for automobile rate setting. Territory provides an excellent example of how pre-accident driver characteristics, the pre-accident physical environment, post-accident characteristics, and the compensation system all affect automobile insurance loss costs.

Pre-Accident Driver Characteristics

Pre-accident driver characteristics, such as age, sex, and marital status, do not generally have a direct effect on territorial relativities. Since the distributions by age and sex are relatively constant by territory, these variables do not affect territorial relativities.[14]

External Environment

The physical environment in an area can raise or lower the expected number of accidents. For instance, population density and vehicle density are often cited as explanatory variables for accident frequency on the assumption that, with more cars per square mile, there will be more accidents per car.

In a 1988 study, ISO and the NAII compared the variation in traffic density with the variation in PD claim frequencies.[15] Although the major cities in each state had traffic densities over ten times the statewide average, these cities had PD claim frequencies that were often only 10% higher than the statewide average.[16]

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[14]An exception would be communities, such as retirement communities, where a disproportionate number of senior citizens reside. This lowers the average pure premium of the territory, but the class rating system should produce the correct overall territorial rate.

[15]Traffic density, or "vehicle density," is defined in the study as car registrations per square mile.

[16]For example, the 1988 study shows a traffic density for Chicago of 5,423 cars per square mile, versus the statewide average of 152 car registrations per square mile. Nevertheless, the PD claim frequency in Chicago was only 11.7% higher than the statewide average claim frequency. More recent data (Insurance Research Council [10]) shows a

In sum, traffic density does not explain much of the elevation of automobile claim frequencies in urban areas. In theory, accident frequencies might be expected to increase proportionately with traffic densities. In practice, traffic safety devices in urban areas, such as traffic lights, stop signs, and well-designed roads, by causing traffic to move at a somewhat lower speed, keep the increase in the accident frequency over the statewide average frequency to a relatively small percentage.

Table 1 shows 1993 property damage claim frequencies by state.[17] With only two exceptions, the states lie in a narrow range from 20% above to 25% below the countrywide average of four claims per 100 insured vehicles.

Several other attributes of the physical environment also affect automobile insurance rates. Automobile theft rates vary by geographic location. Higher theft rates in urban areas cause higher comprehensive losses and therefore higher premiums for comprehensive coverage. Similarly, the 1988 ISO/NAII study shows substantially higher uninsured motorist costs in many urban areas, presumably resulting, at least in part, from higher numbers of uninsured motorists. Finally, the cost of services provided by insurers, such as auto body shop repair costs and medical costs, varies by region; and they therefore affect territorial relativities.

Post-Accident Characteristics

The occurrence of an automobile accident is a physical event. The decision to press a BI claim once an accident has occurred, however, varies dramatically by state and even within a state.

The two dimensions of the expanded framework discussed directly above—pre-accident driver characteristics and pre-accident physical characteristics—relate to the occurrence of the

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similar relativity, with the Chicago PD claim frequency being about 13% higher than the statewide average claim frequency.

[17]The data are from IRC [10, Figures 2–6].

TABLE 1

NUMBER OF PD CLAIMS PER 100 INSURED VEHICLES (1993)

Massachusetts	7.13	Indiana	3.98	California	3.65	South Carolina	3.38
District of Columbia	5.38	Nebraska	3.98	Oklahoma	3.64	Hawaii	3.38
Texas	4.76	Georgia	3.89	Kentucky	3.63	Vermont	3.36
Missouri	4.72	Alaska	3.89	Wisconsin	3.62	South Dakota	3.32
New York	4.67	Iowa	3.89	Arkansas	3.60	North Carolina	3.31
Illinois	4.35	Michigan	3.81	West Virginia	3.59	New Mexico	3.29
Rhode Island	4.23	Ohio	3.77	Virginia	3.54	Mississippi	3.26
Maryland	4.18	Nevada	3.76	Tennessee	3.54	Alabama	3.26
Connecticut	4.11	Minnesota	3.73	Colorado	3.52	North Dakota	3.26
Utah	4.09	Pennsylvania	3.70	New Jersey	3.50	Maine	3.23
Louisiana	4.05	Florida	3.69	Washington	3.45	Montana	3.19
Kansas	4.03	Arizona	3.68	Oregon	3.45	Wyoming	3.02
New Hampshire	4.02	Delaware	3.67	Idaho	3.39	Countrywide	4.00

accident itself. Post-accident characteristics relate to the probability of a claim being filed given that an accident has occurred.

We want to measure this probability for BI claims. Note carefully: we are not concerned with BI claim frequency or with automobile accident frequency. Rather, we are concerned with the probability of a BI claim being filed given that an accident has occurred where another driver could potentially be liable for damages.

We presume that the filing of a PD liability claim is influenced primarily by the nature of the physical accident, so relative PD claim frequency is a proxy for relative accident frequency where another driver could potentially be liable for damages. The ratio of BI claims per 100 PD claims serves as a measure of the propensity to press personal injury claims.[18] Table 2 shows the countrywide trend in this ratio over the past 15 years, from 18 BI claims per 100 PD claims in 1980 to over 29 BI claims in 1993.[19]

Our concern here is the relationship of this ratio to geographic location; that is, the variation in this ratio by state and by territory within state. Indeed, the BI/PD ratios vary greatly by state, as Table 3 shows. California, for instance, produces 61 BI claims for every 100 PD claims, whereas Wyoming, which is also a tort state, produces only 18 BI claims. (The effects of the compensation system are also evident from Table 3: the eight states with the lowest BI/PD ratios are all no-fault states.)

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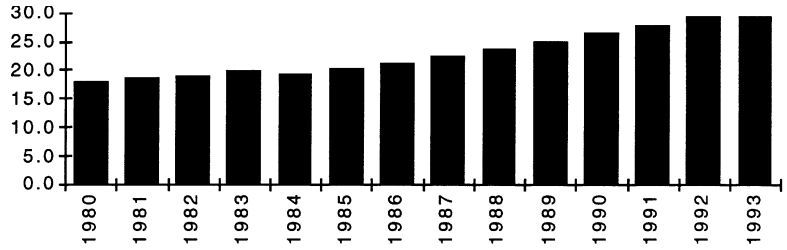
[18]The Institute for Civil Justice (RAND) uses a similar measure, the ratio of soft injury claims to hard injury claims; see Carroll, Abrahamse, and Vaiana [3, page 13]. The reasoning is similar to that underlying the BI/PD ratios. Hard injury claims, such as broken bones, will be pressed in almost all circumstances, whereas the number of soft injury claims, such as sprains and strains, depends in part on the propensity to file insurance claims. The Institute for Civil Justice estimates the cost to consumers from over-treatment and similar types of claim buildup and fraud to be between $13 billion and $18 billion a year [3, p. 3]. IRC estimates this cost to be between $5.2 billion and $6.3 billion a year [8, p. 23].

[19]The data for the exhibits in this section are derived from IRC studies. They are from both full tort states and no-fault states. These are BI liability claims; they do not include no-fault claims.

TABLE 2

CLAIMS PER 100 PD CLAIM



The trends in BI/PD ratios over time and the variations by territory highlight the strong effects of post-accident characteristics on auto insurance loss costs. In California, for instance, the 61% BI/PD ratio for 1993 marks a steady climb from a 31% BI/PD ratio in 1980.

A common perception is that the accident frequencies themselves vary greatly by territory, being far higher in urban areas than in rural areas. Although these differences in accident frequencies do exist, the preceding statement confuses two issues, and it misinterprets the reasons for the territorial differences. Often, the frequency of physical accidents and of PD liability claims is only marginally greater in metropolitan areas than in the surrounding region. Once the accident occurs, however, the BI claiming pattern is substantially different in metropolitan areas than in other parts of the state.

IRC data from 1989 through 1991 (IRC [10, App. B]) illustrate this phenomenon. For instance, the PD claim frequency during these years was about 10% higher in Los Angeles than in the rest of the state, but the BI/PD ratio was 98.8% in Los Angeles, versus 45.2% in the rest of the state. In other words, it was not accident frequency differences that were driving up BI liability costs in Los Angeles, but BI claim filing patterns that were causing the difference.

TABLE 3

NUMBER OF BI CLAIMS PER 100 PD CLAIMS (1993)

California	60.7	Massachusetts	34.8	West Virginia	26.9	Nebraska	19.5
Louisiana	49.4	Oregon	34.3	Indiana	26.0	Florida	19.1
South Carolina	46.8	North Carolina	34.1	Maine	26.0	South Dakota	18.5
Nevada	45.4	Arkansas	33.9	Idaho	25.6	Wyoming	17.6
Arizona	45.3	Georgia	33.6	Alabama	25.1	New York	16.3
Rhode Island	39.7	Virginia	31.3	Connecticut	24.9	Kentucky	15.9
Oklahoma	38.9	Illinois	30.4	Montana	24.3	Hawaii	13.9
District of Columbia	38.8	New Hampshire	29.8	Utah	22.2	Colorado	12.8
New Mexico	37.6	Delaware	29.1	Alaska	21.3	Minnesota	11.7
Washington	37.4	Ohio	28.1	New Jersey	21.2	Kansas	9.2
Texas	36.7	Tennessee	28.1	Vermont	20.9	Michigan	8.2
Maryland	35.5	Missouri	27.8	Pennsylvania	20.4	North Dakota	5.6
Mississippi	35.3	Wisconsin	27.4	Iowa	19.9	Countrywide	29.3

Although BI/PD ratios are generally higher in large metropolitan areas, a simple urban/rural dichotomy is not always a good proxy for the actual claim-filing patterns. For instance, during the 1989 through 1991 period, the state of Pennsylvania as a whole had a BI/PD ratio of 23%, the city of Pittsburgh had a ratio of 18%, and the city of Philadelphia had a ratio of 78%.

The attributes of territorial differences implicit in the discussion above have major implications for understanding auto bodily injury liability loss cost drivers:

- Loss cost differences by region are great, with some areas, whether urban centers or entire states, having high insurance costs and affordability concerns.
- Traffic congestion is *not* the primary determinant of these differences. In fact, the variations in PD claim frequencies are often minor between urban areas and the statewide average.
- Differences in the BI/PD ratios account for much of the variation in BI loss costs by region, with higher cost areas having higher BI/PD ratios.

Thus, once an accident occurs, the decision of whether to overtreat the injury, or even to seek medical treatment when no injury exists, is one of the major factors driving the cost differences between states for bodily injury coverage.

The Treatment Triangle

The over-treatment of automobile injuries in certain locations, as well as the treatment of non-existent injuries, results from the interaction between claimants, medical providers, and attorneys; and it depends upon the type of injury and the structure of the compensation system. Our emphasis in this paper is on the loss cost drivers affecting territorial relativities. In particular, the major factors affecting territorial relativities are *not* pre-accident driver characteristics or pre-accident physical characteristics. Rather, the post-accident characteristics and the com-

pensation system attributes determine how automobile accidents affect insurance payments.

Television reports on the human toll of highway accidents leave us with grisly pictures of torn metal and mangled bodies, as if most automobile accidents resulted in severe injuries. In fact, the opposite is true. About 60% of BI claimants report their only injury to be a strain or a sprain, and another 23% claim to have suffered a strain or a sprain plus another injury (IRC [7, p. 19]). Most strain and sprain injuries are difficult to verify, their severity is hard to measure, and radically different treatment patterns may be recommended by medical providers.

For over-treatment of injuries to occur, it is necessary that all parties deciding on the course of treatment gain from the over-treatment. For injuries and illnesses *not* covered by automobile liability insurance or workers compensation insurance, the patient generally derives no financial gain from the medical treatment. Even if the patient has health insurance coverage (whether individual health insurance or employer provided group health insurance), the coverage simply reimburses the hospital costs or physicians' charges, and it often requires a co-payment from the patient.

Automobile bodily injury claims are different. BI liability awards consist of two parts: economic damages, such as medical costs or wage loss, and general damages, or "pain and suffering." Medical expenses comprise about three-fourths of economic damages. "Pain and suffering" damages are not objectively determinable on their own. Rather, the general damages are usually pegged as a multiple of the economic damages.

In sum, the medical expenses incurred by the claimant drive not only the insurance reimbursement for economic damages but also the insurance award for general damages. Each dollar of medical expenses incurred may translate into three dollars of

insurance compensation.[20] In fact, many potential BI claims in the United States are not even pursued unless there is a sufficient amount of medical expense to support a "pain and suffering" claim.

Three parties are needed for excessive treatment to exist on a large scale, and the interactions of these parties are a major influence on territorial relativities. The three parties are:

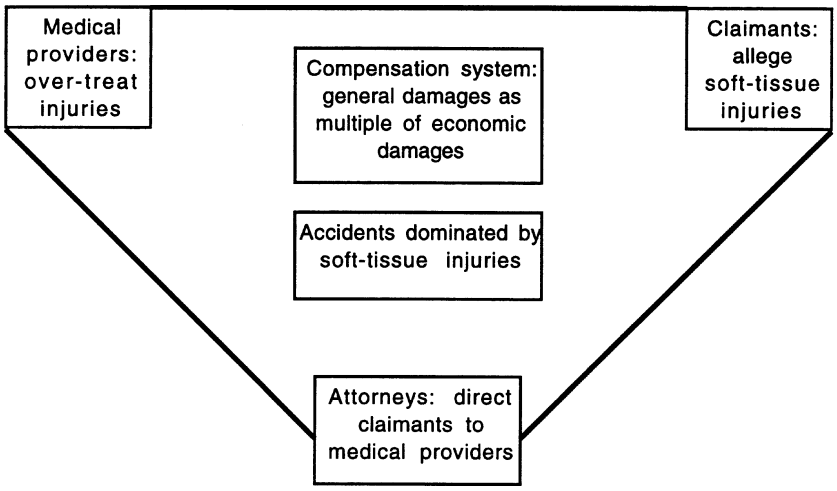
- Medical providers who aggressively treat even routine strain and sprain injuries in order to increase the medical expenses paid. The vast majority of medical providers, of course, do not engage in such over-treatment of minor injuries. Rather, a small coterie of medical providers who specialize in injuries covered by automobile liability and workers compensation insurance serve this function well.
- Accident victims willing to complain of soft-tissue injuries, even when objective medical impairment is non-existent or slight.
- A third party who can direct a willing accident victim to the proper medical provider. Most auto accident victims are not sufficiently aware of the auto liability compensation system to take full financial advantage of the system. In the United States, a relatively small number of attorneys who specialize in strain and sprain injuries in automobile liability and workers compensation insurance claims fulfill this function by directing potential BI claimants to medical providers willing to over-treat soft-tissue claims.

In automobile accident cases, excessive treatment of soft-tissue injuries inures to the financial benefit of the claimant, the medical provider, and the attorney, and to the detriment of the driving public who pay the premiums that fund these loss pay-

[20]The actual ratio, of course, varies by state and by year, since it is greatly influenced by the type of compensation system.

FIGURE 2

THE TREATMENT TRIANGLE



ments. This phenomenon raises the BI/PD ratios and is a major driver of auto insurance loss costs.

This treatment triangle is shown schematically in Figure 2.

This phenomenon is exceedingly difficult to police, even when insurers are aware of its existence in a given location. As long as the accident victim claims to be injured, the medical provider can continue the aggressive treatment pattern. To justify the recommendation of a particular medical provider, the attorney need only state that the medical provider is licensed by the state and has produced "good results." Sting operations are difficult to run, since a claimant who claims not to be injured will simply not be treated.

Evidence for over-treatment of automobile injuries is necessarily indirect, though in some locations it is compelling. The data from Massachusetts, where a detailed claim database has been in existence for four years, illustrate this point.

Were there no incentive to over-treat injuries, one would expect a wide dispersion of treatment costs for each provider, with some patients requiring substantial treatment while others require minimal treatment, depending on the severity of the injury. Moreover, one would expect that the number of BI claimants treated by a medical provider would be about half the number of PIP claimants, since all injuries need treatment, whereas a BI claim may be filed only if another driver was at fault.[21]

The automobile compensation system in Massachusetts has a $2,000 tort threshold. That is, a BI claim may be filed only[22] if the PIP medical expenses exceed $2,000. A small number of medical providers in Massachusetts have a large percentage of their patients suffering from automobile accident injuries who routinely require greater than $2,000 in treatment. The implication is that the course of treatment is being determined not by the type of injury but by the desire to reach the tort threshold in order to file a BI claim.

Similarly, among automobile accident victims being treated by these same medical providers, the number of BI plus uninsured motorist claimants is almost equal to the total number of PIP claimants. The implication is that patients are being referred to these medical providers for the primary purpose of building up the PIP expenses so that a liability suit can be pursued.

Compensation Systems and Benefit Levels

The type of compensation system and the level of benefits are reflected in the statewide rates and the territorial relativities. Changes in state laws require an analysis of the effectiveness of the current law and of the proposed law. For example, in an

[21]In fact, we would expect the number of BI claimants treated by a medical provider to be less than half the number of PIP claimants, since only those cases exceeding the tort threshold can lead to a BI claim (see below in the text).

[22]For certain types of injuries, such as significant scarring, fractures, and serious injuries, a BI claim may be filed even if medical expenses do not exceed $2,000. However, these types of severe injuries are relatively rare in auto accidents. When they do occur, the $2,000 tort threshold is quickly reached.

urban area, the current tort system or monetary tort threshold in a given state may lead to substantial medical overtreatment, with resultant high rates, in comparison to a suburban or rural area with little overtreatment. A law change that curtails this overtreatment would cause a larger percentage decrease in costs in the urban territory than in the suburban or rural territories.

Summary: Territory and the Four-Dimension Framework

Geographic location, or rating territory, has often been a difficult classification variable for the actuary to explain. Why should auto insurance policies cost more in California than in other states? Why does auto coverage cost so much more in certain urban areas?

Driver characteristics do not differ significantly from place to place. Physical conditions, such as road hazards and traffic density, have a minor effect on accident frequencies. They contribute only marginally to the observed loss cost differences by territory. Rather, geographic location and rating territory serve as proxies for powerful but often overlooked factors that drive auto insurance loss costs, particularly the treatment triangle phenomenon discussed here.

7. PRICING AND PUBLIC POLICY

The framework for analyzing personal automobile loss cost drivers presented in this paper has numerous ratemaking and public policy implications, ranging from territorial relativity analysis to pricing statutory amendments. In workers compensation, for instance, the pricing of statutory amendments is a finely honed actuarial tradition, well described in Fratello [4]. It is also half wrong, as shown by the consistent actuarial misestimates throughout the 1980s, since it covers only the direct effects of law changes, not the incentive effects.[23]

[23]See Gardner [5], as well as the numerous state specific studies from the Workers' Compensation Research Institute.

Compensation system reforms in personal auto insurance are often accompanied by mandatory rate rollbacks. If no changes are assumed in claim-filing behavior, then the cost effects of the reform may be grossly over- or under-estimated, as shown by the 1989 Massachusetts changes. It is vital for casualty actuaries to understand the complete system of personal auto loss cost drivers in order to accurately price system changes.

The availability and affordability of auto insurance are of public concern in many jurisdictions, and casualty actuaries are often called to testify on these issues. The actuary who knows what the existing rating plan indicates, but who does not understand why rates are higher in some territories than in others, or how the compensation system affects loss costs, makes a poor prognosticator. Rather, the actuary must measure and explain how claimant behavior and the compensation system interact with the traditional driver attributes, vehicle characteristics, and the external environment to determine the expected loss costs.

We provide two possibilities for public policy reforms to reduce automobile insurance loss costs that stem from the expanded framework in this paper. These are not the only possible reforms, but they are efficacious and practical proposals.[24]

Peer Review of Medical Treatment

The previous discussion of claim characteristics and of medical treatment indicates that one of the major factors contributing to the increases in bodily injury loss costs over the past decade has been the "build-up" of hard-to-verify soft-tissue injuries, generally with extended courses of treatment by a small number of chiropractors, physical therapists, and physicians, often

[24]Other reforms would be equally effective. For instance, most actuaries agree that movement from a tort liability compensation system to a no-fault system with a strong verbal tort threshold, as in Michigan, would reduce overall costs. However, there are strong interest groups opposing such a move, and who support instead such changes as epitomized by California's Proposition 103: rate rollbacks, classification restrictions, and prior approval, but no attack on the real problem of overtreatment.

orchestrated by attorneys experienced in such claims. Insurance claims adjusters are aware of the "padding" in these claims. Yet it is nearly impossible for claims adjusters to find objective evidence of unnecessary or inappropriate treatment, especially on any specific case.

Peer review of medical treatment in auto insurance claims, by state panels of physicians and other medical practitioners, could succeed in eliminating the worst abuse and stemming or reversing the upward trend in bodily injury loss costs. The state insurance department or the Board of Registration would appoint a panel of medical experts to review treatment patterns by individual medical providers. A substantial database of auto injury losses would be needed to properly identify such patterns. It is generally impossible to determine over-treatment by reviewing any one specific case since the severity of any soft-tissue strain or sprain is a subjective estimate. However, by reviewing all treatment by particular medical providers, patterns of overtreatment can be recognized. Medical practitioners would be more hesitant to provide excessive treatment on a consistent basis if they knew that their actions would be subject to professional review.

Consumer Representation

A second factor contributing to the increase in bodily injury loss costs over the past decade has been the rapid increase in attorney representation of insurance claims. If the attorney helps build up the economic damages, there is generally no net loss to the claimant despite the hefty contingency fee, and sometimes there is even a net gain. In addition, the attorney handles all the claim filing paperwork and negotiates with insurance loss adjusters. Both of these activities can be confusing to the average citizen, particularly in third party cases.

State insurance departments could provide claims representatives to handle claim filing and negotiation on behalf of auto accident victims who need aid in insurance matters. The claims representatives would be compensated by salary, so they would

have no interest in building up claims. The insurance industry would defray the costs of these claims representatives.

All parties could gain. Claimants would have representation by state insurance officials, who could guide them through the claims process—*at minimal cost to the claimant*. Insurance companies would gain because the cost of such claims representatives is far less than the costs of claim "build-up." The general public would gain by lower insurance premiums and increased satisfaction with the insurance claim process. State insurance departments would gain because they would be offering additional and highly valued services.

8. CONCLUSION

Although claim severity and claim frequency trends are important tools for automobile insurance ratemaking, their explanatory power is limited. The ultimate cost of automobile insurance is a complex and changing mosaic of many diverse factors. Actuaries who understand these factors will be of great value to their companies, and they may eventually help design systems to control the cost of automobile insurance.

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