

*Personal Automobile: Cost Drivers,  
Pricing, and Public Policy*  
by John B. Conners, FCAS  
Sholom Feldblum, FCAS

**Personal Automobile:  
Cost Drivers, Pricing, and Public Policy**

*Authors*

*John B. Conners*, FCAS, MAAA, is a graduate of Boston College, with a BA in mathematics (1967). He became a fellow of the Casualty Actuarial Society in 1974 and a member of the American Academy of Actuaries in 1976. Since 1987, he has been Executive Vice President and Manager of the Personal Markets Division of the Liberty Mutual Insurance Company, responsible for all underwriting, marketing, actuarial, and claims functions for personal automobile and Homeowners insurance. Previously, he served as Chief Actuary for Liberty Mutual, overseeing both personal lines and commercial lines actuarial functions.

Mr. Conners is past chairman of the board of directors of the Insurance Research Council (formerly the All-Industry Research Advisory Council), one of the country's leading research organization for personal automobile insurance. Mr. Conners is also past chairman of the board of directors of the Insurance Institute for Highway Safety, president of the board of directors of the Domestic Automobile Insurers of Massachusetts, and chairperson of the executive committee of the Insurers for Auto Insurance Reform in Massachusetts. During 1983-85, Mr. Conners was a member of the Board of Directors of the CAS, and in 1978, he served as president of the Casualty Actuarial Society of New England.

Mr. Conners has spoken at CAS seminars and conventions, as well as at other insurance industry meetings, on such topics as no-fault compensation systems and fraud in automobile insurance.

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*Sholom Feldblum* is an Assistant Vice President and Associate Actuary with the Liberty Mutual Insurance Company in Boston, Massachusetts. He was graduated from Harvard University in 1978 and spent the next two years as a visiting fellow at the Hebrew University in Jerusalem. He became a Fellow of the CAS in 1987, a CPCU in 1986, an Associate of the SOA in 1986, and a member of the American Academy of Actuaries in 1989.

In 1988-89, while working at the Allstate Research and Planning Center in California, Mr. Feldblum served as President of the Casualty Actuarial Society of the Bay Area (CABA), as Vice President of Research of the Northern California Chapter of the Society of CPCU, and as editor of the CABA newsletter. In 1989, he served on the CAS Education and Testing Methods Task Force, and in 1990-92, he served on the industry advisory committee to the NAIC Casualty Actuarial (Technical) Task Force.

Mr. Feldblum is presently a member of the CAS Syllabus Committee, the CAS Board of Directors, and the American Academy of Actuaries task force on risk based capital. He has previously served on the CAS Committee on Review of Papers and the CAS Committee on Principles, and he was the associate editor of the *Actuarial Review*. He is the author of numerous papers on ratemaking, loss reserving, statutory accounting, insurance economics,

competitive strategy, investment theory, solvency monitoring, and finance, which have appeared in *Best's Review*, the *CPCU Journal*, the *Proceedings of the Casualty Actuarial Society*, the *Actuarial Digest*, the *CAS Forum*, the *Journal of Insurance Regulation*, the *Journal of Reinsurance* and the *CAS Discussion Paper Program*. He was the recipient of the CAS Michelbacher Prize in 1993 for his paper on "Professional Ethics and the Actuary."

Mr. Feldblum's previous papers on personal automobile insurance include "Personal Automobile Premiums: An Asset Share Pricing Approach for Property-Casualty Insurance," "Expense Allocation and Policyholder Persistency," "Persistency and Profits," and "Repairing a Fragile Mechanism." In addition, he wrote several chapter drafts for the 1989 AIRAC study on personal automobile insurance loss costs.

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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 15 years to present a more comprehensive four dimensional framework for understanding auto insurance loss costs, comprising factors grouped into the following categories:

- Pre-accident drivers attributes and vehicle characteristics
- Post-accident factors: claimant characteristics, medical providers, and attorney representation
- External environment, such as road conditions and traffic density
- Compensation system, such a tort liability versus no-fault

As an illustration, the paper shows how territory, which is often 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.

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**Introduction**

Actuarial ratemaking sets policy premiums to cover anticipated loss 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 perspective produces accurate rates, it does not provide a full understanding of the underlying factors that influence automobile insurance loss costs. The recent studies 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) driver and vehicle attributes, (b) claim and claimant characteristics, (c) compensation systems, and (d) environmental characteristics. The following section 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. This is comparable to the shift in the pricing of workers' compensation statutory amendments from "direct effects" to "direct plus incentive effects."
- Public policy recommendations for lowering the cost and improving the efficiency of personal auto insurance are made more realistic and more effective.

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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.

### Framework

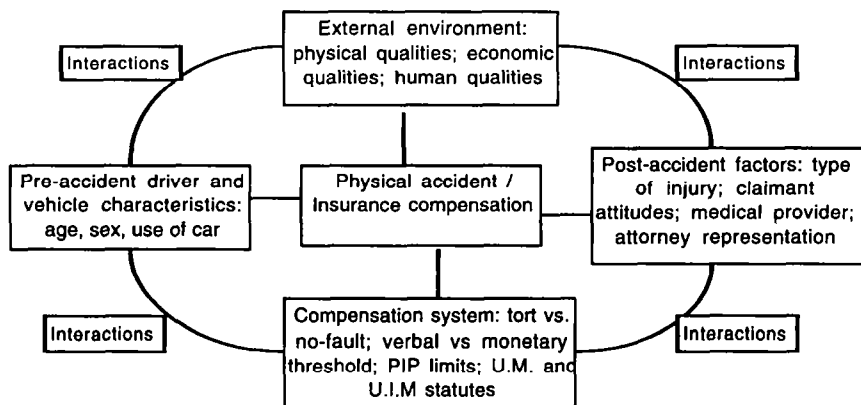
Let us begin with the fundamental question faced by the pricing actuary:

*An insurer issues a personal automobile insurance policy. What factors influence the expected claim costs 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 the novice actuary working in a static world with an automobile classification plan that is already optimal. It is inadequate 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:



#### 1 Pre-accident driver and vehicle characteristics

Pre-accident characteristics refer to the elements shown on the policy application:

- Driver attributes, such as age, sex, marital status, driving record, driving experience, and driver education.

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- *Vehicle and vehicle use characteristics*, such as make and model of the car, horsepower, mileage driven, multi-car discounts, and vehicle use (e.g., drive to work vs. pleasure).
- *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.

#### ⊗ *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 Pezler [1976], Giffin, Travis, and Owen [1978], and Woll [1979]). Indeed, the factors discussed above relate primarily to the occurrence of the physical event – i.e., of cars colliding with one another. Other factors, such as the type of injury, the honesty of the claimant, attorney representation, and the type of medical treatment sought, are strong predictors of insurance claim costs.<sup>1</sup>

*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 topology 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 topology of injury

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<sup>1</sup> See, for instance, Weisberg and Derrig [1993], 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<sup>2</sup> was only .04 and for mixed claims with strains/sprains and "hard" injuries, the R<sup>2</sup> was .21. . . . However, when variables related to treatment utilization and claimant behavior were added in, the value of R<sup>2</sup> 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 benefit to the accident victim is often questionable (AIRAC [1989], IRC [1994]).

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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 treatment in a practitioner's office.<sup>2</sup> 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.<sup>3</sup>
- Whether the insurance claim 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 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

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<sup>2</sup> The distributions of auto insurance claims by type of injury and type of medical practitioner differs 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 1985-86 Lawrence claims studied by Marter and Weisberg [1991], 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 [1991].

The predisposition of some actuaries is to view the lower back sprain treated by a chiropractor as a minor influence on auto insurance loss costs. On the contrary. In certain areas, such claims are the preponderant 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.

<sup>3</sup> The Insurance Research Council has documented both the multiplicity of injury and of medical practitioners as well as the trends in these statistics in recent years. In 1992, the average BI claimant reported about 2 different types of injury and was treated by about 2 different types of medical practitioners, as reported in the IRC's September 1994 volume, *Auto Injuries: Claiming Behavior and Its Impact on Insurance Costs*: "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." and "On average, BI claimants were treated by 1.95 different types of medical practitioners per person in 1992, up from 1.59 in 1987."



plaintiff's attorney has a financial incentive to encourage the "build-up" of the claim.<sup>4</sup> The IRC studies have consistently shown higher average costs for attorney represented claims, even when the type of injury is held constant.<sup>5</sup>

Perspectives regarding post-accident factors vary widely; we illustrate by two extremes. The difference in viewpoint is essential for estimating 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.

• The innocent (sometimes termed "naive") perspective sees the physical injury as the "loss

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<sup>4</sup> 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 medical 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 gain" of \$2,000. If the claimant is represented by an attorney, who takes 33% of the award, or \$1,000, the "net gain" to the claimant is only \$1,000. However, if the attorney "encourages" the claimant 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 "net gain" remains \$2,000. 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 private medical insurance).

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, if by encouraging their clients to "build up" the medical bills to exceed the tort threshold they can file BI claims for "pain and suffering," both they and their clients can "profit."

<sup>5</sup> See AIRAC [1988] and IRC [1994]. The IRC study notes that "Attorney involvement in auto insurance injury claims has more than doubled in the last 15 years, moving from 19% in 1977 to 42% in 1992. . . . The use of attorneys results in a big cost to the auto insurance reimbursement system. Attorney-represented claimants incurred medical expenses and other economic losses averaging \$14,718, compared with an average of \$4,123 for claimants without attorneys." Figure 4-7 and the accompanying discussion on pages 29-33 of the IRC study show that this same pattern holds true even when claims are stratified by type of injury.

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cost driver." The lower back sprain incurred in the auto accident motivates the victim to seek out a medical 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"), motivates 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. No one "profits" from the claim.

- The cynical perspective sees the "entitlement philosophy," or "claims-consciousness," or the "insurance lottery" as the "loss cost driver."<sup>6</sup> Whether the accident victim files an insurance claim, seeks treatment from a particular medical practitioner, or even "suffers" a lower back sprain is not dependent solely upon the physical events in the auto accident. Rather, the accident victim, seeking to profit from the event, sees an attorney, who encourages him or her to be examined by a certain medical practitioner. The medical practitioner diagnoses the lower back sprain and recommends the course of treatment. Either the chiropractor 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 "profit" from the claim.

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 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 "claim 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.

#### ④ *Compensation systems*

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 PIP limits, by the type of benefits provided, and by the compensation rate (e.g., "75% of wage loss").

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 on claim filing (the "insurance lottery" perspective) and on

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<sup>6</sup> Casualty actuaries speak of "claims consciousness," which the IRC studies refer to as "claim filing behavior." "Claim consciousness" is frequently measured by BI/PI ratios; 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 own auto insurance, now feel that they are entitled to recover their money from the "insurance industry." The fact that their past auto premiums are unrelated to the insurance claim at issue rarely deters people from linking the two.

claim severity (e.g., the "build-up" of claims 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).<sup>7</sup>

Compensation system 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.

#### ① 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.<sup>8</sup>
- *Economic qualities*, such as the "underwriting beta" argument that in prosperous years people drive more, purchase new vehicles, and take more vacations, leading to higher bodily injury accident frequencies.
- *Human qualities*: e.g., a higher proportion of poor residents in certain geographic areas may lead to more uninsured motorists and higher UM costs.

### The Frequency-Severity Paradigm

The explanatory power of the expanded framework can be seen most clearly in contrast with the old "loss frequency - loss severity" paradigm. Previously, personal automobile loss cost drivers were viewed simply as inflation-induced changes in loss severity and as slow, long-

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<sup>7</sup> The "insurance lottery" perspective says the incentive effect on claim filing depends 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. The incurral of 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.

<sup>8</sup> 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 but different claim frequencies.

term trends in loss frequency. The frequency trends were often modeled by econometric equations based on changes in gasoline prices, car density, and similar factors.

This paradigm is still useful for certain isolated analyses in static environments. But it provides no clue regarding why claim frequency or claim severity may be changing, or what the insurer should expect in the future. The expanded framework provides a different framework for viewing personal auto loss frequency and loss severity.

- **Frequency:** The Insurance Research Council studies of the mid-1990s show that the countrywide *property damage* claim frequency has 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.<sup>9</sup>

For bodily injury, the changes in "claim filing" behavior among the public overwhelms the changes in physical accident frequency. The "loss frequency drivers" are not economic and environmental attributes like gasoline prices and car density. Rather, the drivers 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*, 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 strains. Conversely, injuries requiring hospital stays have declined.
- ☛ **Attorney involvement:** between 1977 and 1992, the percentage of claims represented by lawyers rose from 31% to 46% for all injury coverages combined and from 47% to 57%

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<sup>9</sup> Formally,  $32\% = [(1 + 16\%) + (1 - 12\%)] - 1$ . The full IRC studies, see Insurance Research Council, *Auto Injuries: Claiming Behavior and Its Impact on Insurance Costs* (Oak Brook, Illinois, September 1994), and Insurance Research Council, *Trends in Auto Injury Claims*, Second Edition, Part One: Analysis of Claim Frequency (Wheaton, Illinois, February 1995). See also Insurance Research Council, *Paying for Auto Injuries: A Consumer Panel Survey of Auto Accident Victims* (Oak Brook, Illinois, May 1994): "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."

for bodily injury claims.<sup>10</sup>

- *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.

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 may be entirely different from the corresponding claim frequency trends for property damage liability and for collision coverage, even though all of these trends ostensibly relate to the occurrence of auto accidents.

- ② *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 static environments. The first method works well when inflation is stable, so that past changes in loss severity are deemed to be unbiased predictors of future

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<sup>10</sup> These statistics are from the IRC closed claim studies. Compare also the IRC consumer panel surveys, which show a similar ending point for 1992, but a lower starting point in 1977: "Attorney involvement in auto insurance injury claims has more than doubled in the last 15 years, moving from 19% in 1977 to 42% in 1992" (IRC, *Paying for Auto Injuries* [May 1994]).

Of particular importance to pricing actuaries are the relative differences by state, which are relevant for loss severity and loss frequency trends. Credibility weighting statewide loss severity and loss frequency trends with the corresponding countrywide figures is inappropriate if the statewide trends are affected by changes in (a) claim and claimant characteristics and (b) the compensation system in ways that the countrywide figures are not affected.

The same phenomenon may be seen in workers' compensation. In the past, statewide medical benefit trends were credibility weighted with countrywide trends. However, trends were lower in states with medical fee schedules, the 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.

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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 three influences.

1. 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.<sup>11</sup>
2. 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 claims. In other words, the factors that increase loss frequency often lead to decreases in average loss severity.<sup>12</sup> A change in expected claim frequency stemming from changes in claim or claimant characteristics should be *partially* offset by changes in expected claim severity.
3. 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.

#### 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.

- Sex and age are physiological attributes that affect expected mortality rates, so they are used as rating variables for life insurance underwriting and life annuity underwriting.
- Sex and age have equally 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

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<sup>11</sup> For instance, the development of new medical procedures may engender greater utilization of services even when the personal auto compensation system remains unchanged.

<sup>12</sup> 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, *Trends in Auto Injury Claims*, Second Edition, Part One: Analysis of Claim Frequency (Wheaton, Illinois, February 1995), chapters 1 and 2.

ages when bodily functions deteriorate) have little intrinsic relationship with accident propensity. Rather, they are proxies for other driver characteristics, such as maturity.

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

### Interactions

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

- *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.<sup>13</sup>
- *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 lengthened the average number of outpatient visits to chiropractors, who handled the majority of neck and back sprains and strains incurred in auto accidents.

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

### 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 for seeing 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, territorial relativities are not normally affected by the demographic characteristics of the drivers in

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<sup>13</sup> 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 little assets are often "judgment proof" and therefore carry low liability limits of coverage.

that territory.<sup>14</sup>

- ⑨ *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. While this is true, a combination of road design, traffic controls, and law enforcement can reduce the variation caused by traffic density.

In a 1988 study, the Insurance Services Office and the National Associate of Independent Insurers compared the variation in traffic density with the variation in property damage (PD) claim frequencies.<sup>15</sup> 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.<sup>16</sup>

In sum, there is a tendency to overestimate the effects of traffic density on automobile claim frequencies. 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 to a relatively small percentage over the statewide average frequency.

Table 1 shows 1993 property damage claim frequencies by state.<sup>17</sup> With only 2 exceptions, the states lie in a narrow range from 20% above the countrywide average of 4 claims per 100

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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, *Trends in Auto Injury Claims*, 1995) shows a similar relativity, with the Chicago PD claim frequency being about 13% higher than the statewide average claim frequency.

17 The data are taken from Figure 2-6 in the IRC study, *Trends in Auto Injury Claims*.



insured vehicles to 25% below the countrywide average.<sup>18</sup>

Table 1: Number of PD Claims per 100 Insured Vehicles (1993)

Massachusetts	7.13	Indiana	3.98	California	3.65	S Carolina	3.38
Dist of Colum	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	N Carolina	3.31
Illinois	4.35	Michigan	3.81	W 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	Pennsylv	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
N. Hampshire	4.02	Delaware	3.67	Idaho	3.39	Countrywide	4.00

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 levels of uninsured motorists. Finally, the cost of services provided by insurers, such as auto body shop repair costs and medical costs, vary by region, and they therefore affect territorial relativities.

③ *Post-Accident Characteristics:* The occurrence of an automobile accident is a physical event. The decision to press a bodily injury 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 accident itself. Post-accident characteristics relate to the probability of a claim being filed given that an accident has occurred.

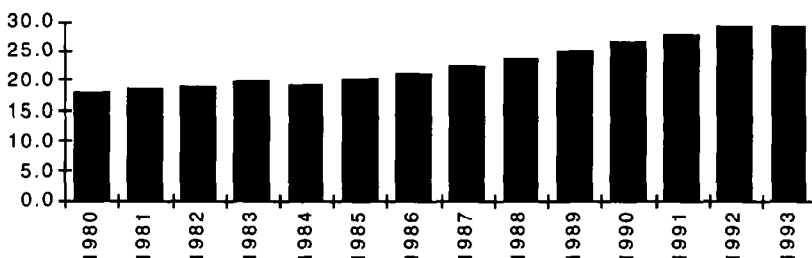
We want to measure this probability for bodily injury (BI) claims. Note carefully: we are not concerned with BI claim frequency or with automobile accident frequency. Rather, we are concerned with the probability of a BI claim being filed given that an accident has occurred where another driver could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

We presume that the filing of a property damage (PD) liability claim is influenced primarily by the nature of the physical accident, so relative PD claim frequency is a proxy for relative

<sup>18</sup> The two exceptions are the District of Columbia, which is an entirely urban area, and the Commonwealth of Massachusetts, which seems to have a statewide penchant for aggressive driving.

accident frequency where another driver could potentially be liable for damages. The ratio of bodily injury (BI) claims per 100 PD claims serves as a measure of the propensity to press personal injury claims. 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.<sup>19</sup>

**Table 2: BI Claims per 100 PD Claim**



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.]

*Table 3: Number of BI Claims per 100 PD Claims (1993)*

California	60.7	Massachusetts	34.8	W Virginia	26.9	Nebraska	19.5
Louisiana	49.4	Oregon	34.3	Indiana	26.0	Florida	19.1
S Carolina	46.8	N Carolina	34.1	Maine	26.0	S 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
Dist of Colum	38.8	N 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	N Dakota	5.6
Mississippi	35.3	Wisconsin	27.4	Iowa	19.9	<i>Countrywide</i>	<i>29.3</i>

<sup>19</sup> The data for the exhibits in this section derive from Insurance Research Council studies. They are from both full tort states and no-fault states. These are BI liability claims; they do not include no-fault claims.

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 such 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 the metropolitan area than in other parts of the state.

IRC data from 1989 through 1991 illustrates 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.

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 generally minor between urban areas and the statewide average.
- Differences in the BI/PD ratios account for most 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 over-treat the injury, or even to seek medical treatment when no injury exists, drives the major costs 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 lost cost drivers affecting territorial relativities. In particular, the major factors affecting territorial relativities are not pre-accident driver

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characteristics or pre-accident physical characteristics. Rather, they are the post-accident characteristics and compensation system attributes which 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 1994: 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 generally 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 two dollars of insurance compensation.<sup>20</sup> 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.

In automobile accident cases, excessive treatment of "soft-tissue" injuries inure 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 payments. This phenomenon raises the BI/PD ratios and is a major driver of auto insurance loss costs.

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

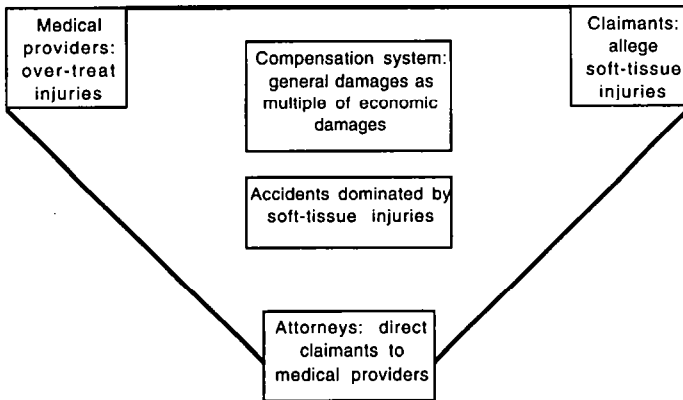
1. Medical providers who aggressively treat even routine strain and sprain injuries in order to increase the medical expenses paid. The vast majority of medical providers, of course, do not engage in such over-treatment of minor injuries. Rather, a small coterie of medical providers who specialize in injuries covered by automobile liability and workers' compensation insurance serve this function well.

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<sup>20</sup> The actual ratio, of course, varies by state and by year, since it is greatly influenced by the type of compensation system.

2. Accident victims willing to complain of soft-tissue injuries, even when objective medical impairment is non-existent or slight.
3. 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.

This "treatment triangle" is shown schematically below.



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. We illustrate with data from Massachusetts, where a detailed claim database has been in existence for two years.

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 ("personal injury protection") claimants, since all injuries need treatment

(PIP) whereas a BI claim may be filed only if another driver was at fault.<sup>21</sup>

The automobile compensation system in Massachusetts has a \$2,000 tort threshold. That is, a BI claim may be filed only if the PIP medical expenses exceed \$2,000.<sup>22</sup> A small number of medical providers in Massachusetts have a large percentage of their patients suffering from automobile accident injuries who routinely require above \$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.

- ① *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 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 have a larger percentage decrease 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. Between states, the incentive effects of compensation systems account for much of the wide variation in claim frequencies and loss costs. Within states, the "treatment triangle" phenomenon accounts for much of the variation in territorial relativities.

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<sup>21</sup> 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).

<sup>22</sup> For certain types of severe 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.

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## 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's 1955 PCAS paper.<sup>23</sup> 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.<sup>24</sup>

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 only 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 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.<sup>25</sup>

① *Peer review of medical treatment:* The discussion above of claim characteristics and of medical treatment indicate that one of the major factors contributing to the increases in

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<sup>23</sup> See B. Fratello, "The Workmen's Compensation Injury Table and Standard Wage Distribution Table - Their Development and Use in Workmen's Compensation Ratemaking," *Proceedings of the Casualty Actuarial Society*, Volume 42 (1955), pages 171-202.

<sup>24</sup> See John Gardner, *Return to Work Incentives: Lessons for Policymakers from Economic Studies* (Cambridge, Massachusetts: Workers' Compensation Research Institute, 1989), as well as the numerous state specific studies from the Workers' Compensation Research Institute.

<sup>25</sup> Other reforms would be equally effective. For instance, most auto 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.

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 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 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.

- ④ *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 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 frightening 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.

### Conclusion

The days of simple claim severity and frequency trends in automobile rate making are gone. 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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