Proof That Auto Insurance Rating by Accident Record Predicts Miles not Negligence: Fault is Predictively Irrelevant

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> "It was established beyond the shadow of a doubt that the individual who is involved in automobile accidents, regardless of whether he appears to cause them or not, is much more likely[1] to have accidents in the future than is the person who is accident free….[I]nvolvement in an accident regardless of who was at fault, was the important consideration."
> Insurance company letter to an attorney representing an insured surcharged for a not-at-fault accident. As justification the letter is citing the results of a large industry study six years earlier. U.S. Congress, 1967 (p.82).

Assurances like this that fault is predictively irrelevant apparently have been ignored by legislatures because insurance law continues to countenance using only at-fault accidents for insurance rating. On the other hand, insurers do not give lawmakers an explanation for why the determination of fault—the legal requirement for deciding which drivers involved should be held responsible for the accident costs of others—turns out to be statistically irrelevant to insurance rating. Rating on the basis of fault, however, remains key to the application of negligence theory to traffic accidents when liability insurance is involved.

Negligence Theory

The negligent-driver theory of the automobile accident tort system maintains that financial liability for negligently causing an accident creates an incentive for drivers to be non-negligent. Allowing insurance against this liability risk initially prompted concern that it would eliminate this incentive for non-negligent driving. But the concern has been assumed to be resolved by allowing insurers to increase premiums for the cars of drivers whose negligence has occasioned liability claims. Law and Economics pioneer Judge Richard Posner (1998, p. 221) explains that

1. The phrase "much more likely" to have accidents in the future means about 50% more likely and is strictly from the insurers' perspective on annual accident rates for sub-groups. Under the miles exposure theory discussed below, an individual's chance of a future accident is unaffected by their accident record.

"with [automobile] insurance, the cost of an accident to the negligent injurer…is the present value of any premium increase that the injurer may experience as a result of being found negligent." Negligence theory, however, leaves it to auto insurers to determine the size of premium increases.[2]

In fact, the amount that insurers increase premiums to insureds who occasioned a liability claim has no particular connection with the tort law goal of deterring negligent driving. Instead, the premium surcharges are solely determined by insurance cost correlations.[3] Generally, the small sub-pool of cars whose drivers have produced a liability claim in the past three years produces about 50% more liability claims per 100 insured cars in the following year than the matching large claim-free pool. Nonetheless, the correlation lends apparent support to the idea that drivers deemed negligent in a past accident that resulted in a liability claim continue to be prone to negligence and are therefore more apt to produce a liability claim in the future. Some scholars also presume that claim-rated higher premiums force what they label without definition "the most dangerous drivers" to give up driving.[4]

Not-at-fault Correlations

Competition drives companies to look beyond liability claims, which are the focus of negligence theory, for other claim-rate-predictive correlations.[5] Well established but little discussed are two parallel correlations: increased uninsured motorist (UM) claim rates for sub-pools comprising cars with past liability claims, and increased liability claim rates for sub-pools comprising cars with past UM claims. These additional correlations conflict with the theory that at-fault accidents identify drivers who are more negligent than average because—while payment of a liability claim requires the insured car's accident-involved driver to be *negligent*—payment of a UM claim requires *non-negligence* by the insured car's accident-involved driver.

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2. Without liability insurance on cars, the cost to the negligent driver would be the accidents costs of those involved who were non-negligent. Usually, but not always, this amount would be more than a multi-year increase in premiums.
3. Of course, the cost differentials insurers experience through rating by accidents can be increased or decreased to some extent through the definitions of the categories, like all other rating classification categories. An example is the choice of the three year period rather than four or two years as the time for which the surcharges count.
4. Since auto insurance is charged as a cost of car ownership, increased premiums are more likely to have the effect of making households give up some of their cars and share others rather than to force drivers to give up driving.
5. Insurers also find positive claim-rate correlations with traffic citations, and all other events that can only happen on the road regardless of driver culpability or cost to the insurer. (A Pennsylvania insurer once increased an insured's premium when it found that the insured paid the state for damage to a highway structure, even though the company was not involved at all.) Generally the practice might be termed "rating by road-incident record."

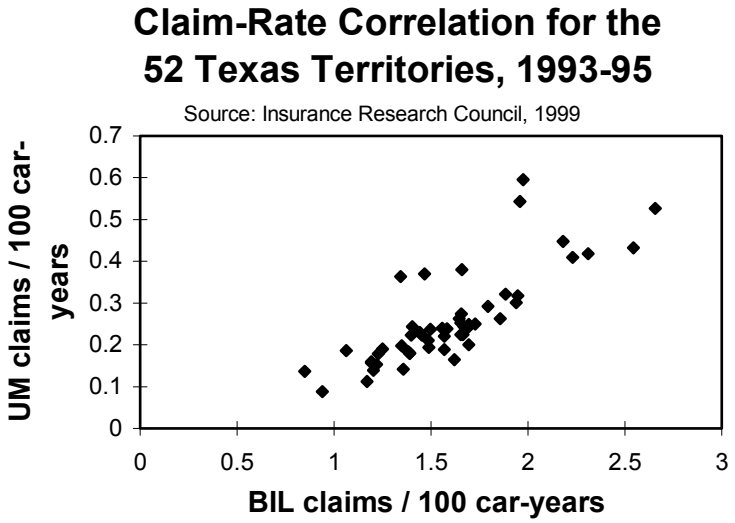

Figure 1. *UM and BIL claim-rate correlation, 52 Texas-county territories, 1993-95.*

These correlations occasionally become the subject of legislative and regulatory debate because the use by insurers of a UM claim as a basis for increasing a liability premium is controversial. It contravenes the common belief that a minority class of negligent drivers—rather than random negligence by all drivers—causes automobile accidents. For example, in 1992 the National Association of Independent Insurers in opposition to a proposed Texas insurance department restriction testified that "not-at-fault accidents are as effective as at-fault mishaps in predicting future insurance loss claims." (*Insurance Advocate*, 1992.)

Lemaire 1985 describes the same correlation of not-at-fault to at-fault accident rates from the experience of a Belgian insurer (pages 87-89). Just behind *at-fault* liability claims as the strongest predictor of claim rates is "the number of accidents where the driver is *not at fault*." In addition to theorizing that "some drivers create a situation where an accident is likely to happen, even when they are not liable,"[6] Lemaire offers the alternative theory that "it may be that those who drive a great deal and spend a greater than average amount of time on the road are liable to have more accidents, whether they are responsible for the accidents or not," which is equivalent to the miles exposure theory adopted by this study.

6. This "creating accident situations" extension of negligent-driver theory of risk has apparent factual support in that drivers at the youngest and oldest ends of the driver age spectrum are involved in both more at-fault and not-at-fault accidents on a per-mile basis. However, this is an age-group characteristic that would be accounted for by cents-per-mile rating of cars by age of driver. As to the theory that some presumably otherwise unidentifiable small minority of accident-involved drivers not only have more at-fault accidents but also are creating accident situations in which they are not at-fault, the theory cannot have significant effect because negligence law looks for such extenuating situations to absolve the at-fault driver of responsibility. At one time, U.S. tort law nominally absolved the at-fault driver of all financial responsibility if the not-at-fault driver could be shown to have contributed in the smallest way to the accident causation beyond just being present.

Miles Exposure Theory

The occurrence of traffic accident involvements can be modeled as a process of random sampling of cars. Unlike balls in an urn, however, cars assigned to an insurance pool differ from each other by the number of miles each is subsequently exposed on the road to being sampled at random. While accidents randomly pick the pool's low annual miles cars along with middle- and high-miles cars, obviously an accident sample of the pool will not represent the mix of cars assigned to the pool but the proportions of these cars that are on the road. Therefore, the accident-involvement road sample of cars in a pool will be biased to the cars driven more miles. All else made equal by insurers' classifications, more miles per car will mean more claims per car for the sub-pool of cars previously involved in an accident.

Even though increases in liability claim rates related to past-accident involvement have no direct connection to the miles exposure theory, the correlation lends support to the idea that sub-groups of cars whose drivers have been involved in an accident in the past continue in the future to be driven more miles than average. Where the miles exposure theory surpasses negligence theory in using accident-records for predictions is that the exposure theory explains not only higher future liability claim rates, but higher future accident and claim rates of all kinds, at-fault and not-at-fault.

The miles exposure theory does much more than just prove better than negligence theory at explaining accident-record correlations. The miles exposure theory depends on accident involvements representing a road sample of all of the miles that are being driven. Since every mile a car is driven has a statistical but real chance of accident, every mile driven transfers a cost to the car's insurer. Even though a very large majority of cars in an insurance pool are accident-free during a year, they all produce the total risk that is statistically realized by the unlucky few who have the accidents. Therefore, all miles driven must count in paying for the costs of road accidents. A number of Law and Economics scholars appear to be coming to this conclusion despite their continuing support for the idea that accident-record rating by insurers is a significant control on negligent driving.

For example, Cooter and Ulen 2003 point out that (page 333): "To hit two policy targets, two controls are usually required, just as two stones are usually needed to hit two birds. Thus, an additional control variable from outside liability law may be needed to control activity levels. For example, the number of miles driven by motorists can be influenced by a gasoline tax or an

insurance policy whose premiums increase with the number of miles driven."[7] What also needs to be recognized is that accident record rating merely reflects not greater negligence but the greater average miles of exposure of a random sampling by accident involvement of cars on the road.

Two Variables to Measure Driving Risk

Although costs for private passenger automobile insurance traditionally have been kept on the basis of a single variable—the car-year—this study specifies two variables to measure separately 1) individual amounts of accident-producing activity in terms of odometer car-miles and 2) class risk rates in terms of claims or accidents per million car-miles.

Accurate conceptualization of the annual risk of individual cars depends on seeing practical ways to evaluate two cost variables: a cents-per-mile rate—the risk rate variable—and number of miles driven—the exposure variable. The exposure variable is already measured for cars because federal and state law—backed by civil and criminal penalties—requires that the number of miles driven by each car be permanently recorded on its odometer. Therefore miles traveled can be objectively verified. This variable is intrinsically individual, perfectly determinate, varies widely among cars, and for individual cars generally varies—widely at times—from year to year.

In sharp contrast to the individual nature of how much a car may be driven in a year (the exposure variable), a risk rate (accident cost per unit of accident-producing activity) is intrinsically a class property. It is statistically impossible to measure an individual risk rate. Because traffic accidents are infrequent and random, only the accident cost experience resulting from about 1,000 claims (which takes 200 million vehicle miles at a risk rate of 5 claims per million miles and therefore requires a large number of cars belonging to the defined risk class) can determine a risk rate per mile that reliably predicts future accident costs. A risk rate, therefore, is not a property of individual cars, but rather is the property of a large defined class of cars to which individual cars are assigned.

Miles versus Negligence Theory in a Model

To distinguish between the two theories in regard to accident-record predictions, we set up a two-component model insurance pool. Table 1 shows the composition of the undivided model pool with two-thirds (100,000) cars with an annual risk rate for each car of 0.025 liability claims

7. While surcharging gasoline to insure against traffic accidents would gain activity control, it stands to lose important risk-class variables. Without special arrangement, each gallon would be taxed at the same cents-per-gallon rate. For example, motorcycles would pay less per mile than automobiles, there would be no variation in the cents-per-mile rate for cars by age of drivers, and for first-party collision insurance no variation in rates for the value of vehicles. On the other hand, cents-per-mile rates would vary with risk category based on insurers' experienced costs per mile for the category.

and one-third (50,000) cars with an annual risk rate for each car of 0.100 liability claims. Because the cars are indistinguishable and mixed together in a pool, the insurer cannot measure the two separate annual risk rates the model assumes for the cars. The insurer, however can measure the annual risk rate of 0.050 liability claims for the undivided pool, Table 1, and the risk rate averages from the accident-record sub-pools.

Table 1. *Values assumed for model pool comprising cars of two annual risk values.*

MODEL POOL UNDIVIDED		NEGLIGENCE THEORY			MILES-EXPOSURE THEORY		
	Liability accident rate per car-year (= A x B) or (= C x D)	Miles each car driven in year (A)	Negligent accidents per million car-miles (B)	Non-negligent accidents per million car-miles	Miles each car driven in year (C)	Negligent accidents per million car-miles (D)	Non-negligent accidents per million car-miles
100,000 low annual risk cars	**0.025**	10,000	**2.5**	5.0	**5,000**	5.0	5.0
50,000 high annual risk cars	**0.100**	10,000	**10.0**	5.0	**20,000**	5.0	5.0
Pool Average	**0.050**		**5.0**		**10,000**		

Under the Negligence theory in Table 1, all of the cars of both annual risks are driven the same distance, 10,000 miles in a year. Therefore, the four times difference in annual liability risk is assigned entirely to a four times difference in negligence rate between the two annual-risk components: 2.5 and 10.0 liability claims per million car miles, respectively. Since negligence theory says nothing about non-negligent accidents, the pool average 5.0 at-fault involvements per million miles is assumed for both the high- and low-annual risk cars. Justification for this assumption says that if the model pool stands for the complete universe of accident involvements—each involving one at-fault car and one not-at-fault car—the number of at-fault involvements must be equal to the number of not-at-fault involvements.

The Miles Exposure theory in Table 1 attributes the difference between the two annual risk components entirely to a four time difference in annual miles: 5,000 and 20,000 miles respectively. The per-mile accident rates for negligent (liability claim) and not-at-fault accidents are assumed to be the same for both the low and high annual risk cars, 5.0 liability claims and 5.0 not-at-fault accidents per million car miles.

The accident-producing process operating on the model pool may be envisioned as random sampling of cars on the road. Under the negligence theory interpretation of the model pool of cars, both the low and high-annual risk cars are equally exposed (10,000 miles annually), so the difference in annual risk per car can be seen as a four times different per-mile sampling rate. (In

analogy of drawing balls from an urn to represent accidents, the high annual risk cars would be larger and more subject to being blindly picked in draws.)

Under the miles exposure theory, the model insurance pool consists of two-third cars each driven 5,000 miles annually and one-third cars driven 20,000 miles annually and produces a pool average of 10,000 miles per car-year. Since the 20,000-mile cars put four times more miles per car on the road, however, an accident sample of car-miles on the road will consist of about two-thirds 20,000-mile cars and about one-third 5,000-mile cars.[8] (Alternating draws of cars on the road could be considered at-fault and not-at-fault involvements respectively, but this refinement is unnecessary under the miles exposure theory because the two kinds of accident-record sub-pools have the same predictive effect on annual claim rates.) This accident-involved sample sub-pool averages nearly 15,000 miles per car, which models the presumed 50% greater average exposure per car and observed 50% greater future accident rates for sub-pools of cars with an accident involvement.

Table 2 shows the effects in terms of sub-pool populations after the model pool has been in existence for three years. The sub-pools are divided into at-fault and not-at-fault sub-pools and shown with the sub-pool annual liability claim rate averages dictated by the mix of high- and low-annual risk cars. The predictions of future fourth-year annual claim rates per car differ for the not-at-fault sub-pool between the negligence theory and miles exposure theory interpretations. The relationships displayed in the table are more easily seen in the pie charts, Figures 2-4, that follow. (The area size of each pie representation of a pool and sub-pool is proportional to the number of cars in the pool and sub-pools.)

Table 2. *Sub-pool populations by 3-year accident records using Table 1 values.*

	Undivided Pool			At-fault Accidents Sub-Pool			Not-at-fault Accidents Sub-Pool		
	Number of cars	ann. liability claim rate	Ann. miles	Cars involved in 3 years	Ann. miles	4th year liab. claim rate / car	Cars involved in 3 years	Ann. miles	4th year liab. claim rate / car
NEGLIGENCE THEORY									
Low Negl. Rate Cars	100,000	0.025	10,000	7,500			15,000		
High Negl. Rate Cars	50,000	0.100	10,000	15,000			7,500		
Pool averages		0.050			**10,000**	**0.075***		**10,000**	**0.050****
MILES EXPOSURE THEORY									
Low Ann .Miles Cars	100,000	0.025	5,000	7,500			7,500		
High Ann .Miles Cars	50,000	0.100	20,000	15,000			15,000		
Pool averages		0.050	10,000		**15,000**	**0.075***		**15,000**	**0.075***
* Insurers affirm the approx. 50% increases in liability claim rates over claim rates for undivided pools.									
** Insurers deny this non-increase in the liability claim rates for sub-pools of cars in not-at-fault accidents.									

8. The increase is not exactly 50% because the model sampling is done with replacement. This is done so that a very small minority of cars realistically will be involved in multiple accidents during the observation period.

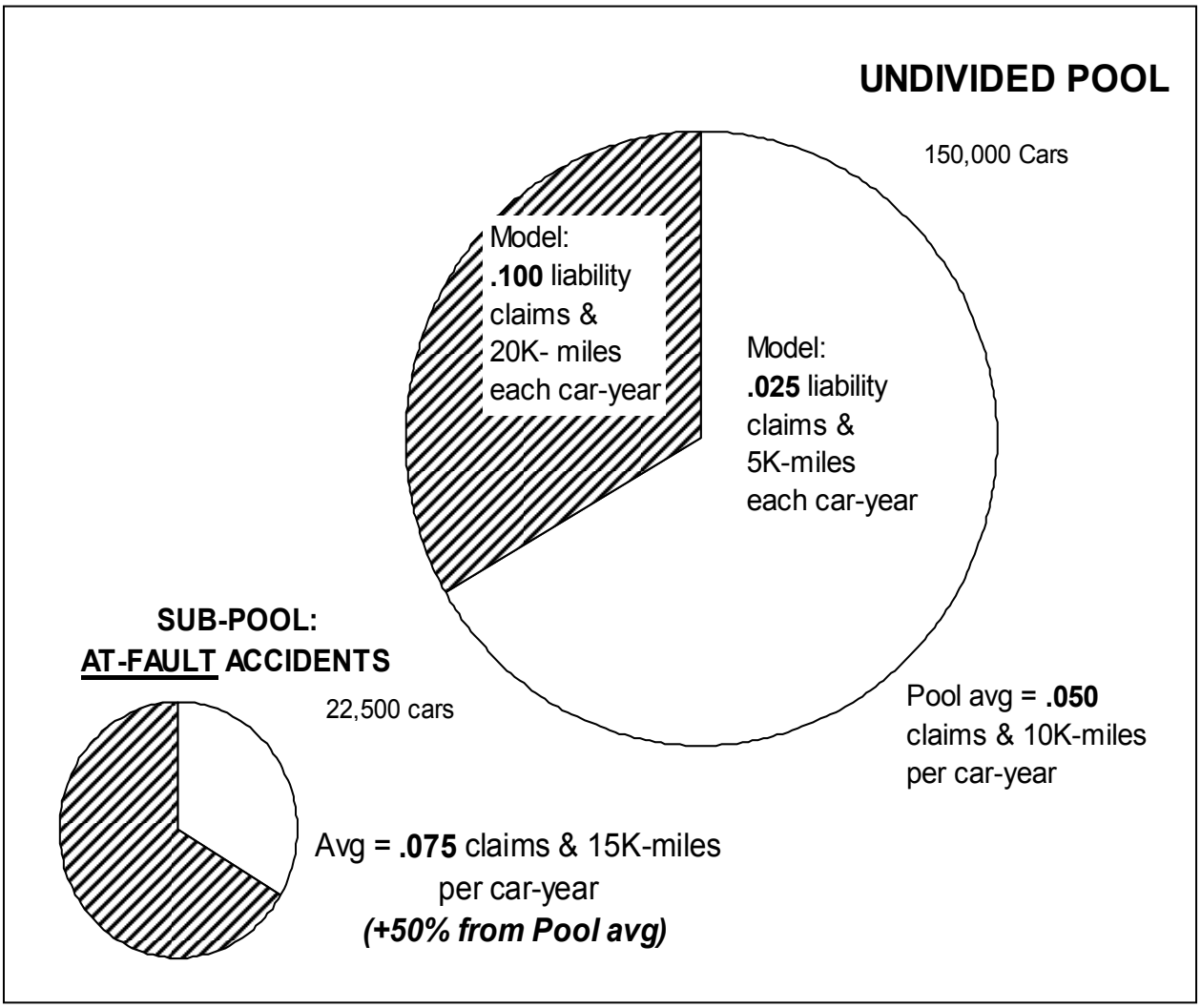

Figure 2. *Claim rate increases for at-fault accidents under both predictive theories, "miles exposure" and "negligence."*

Figure 2 shows that under both theories, the sub-pool defined by 3-years of at-fault accident records shows an increase in the proportion of high-annual-risk cars from one-third of the undivided model pool to two-thirds of the accident-record sub-pool. Although the result is the same, the interpretation of the concentrating process is quite different under the two explanatory theories. The negligence theory posits for the model a four-times greater per-mile rate of at-fault accidents for the high-annual-risk cars relative to the low-annual-risk cars given an equal number of annual miles of exposure (the model assumes 10,000 annual miles).

The miles exposure theory, on the other hand, sees a four times greater number of annual miles exposure on the road (20,000 miles versus 5,000 miles) which raises the average miles of the

sub-pool from 10,000 miles of the undivided pool to 15,000 miles in the at-fault accident sub-pool. However, the predictive results of at-fault accident records in terms of the annual liability claim rates per car that insurers use to set premiums (Figure 2) are the same under both theories. But the predictive results are not the same under each theory for *not-at-fault* accident records.

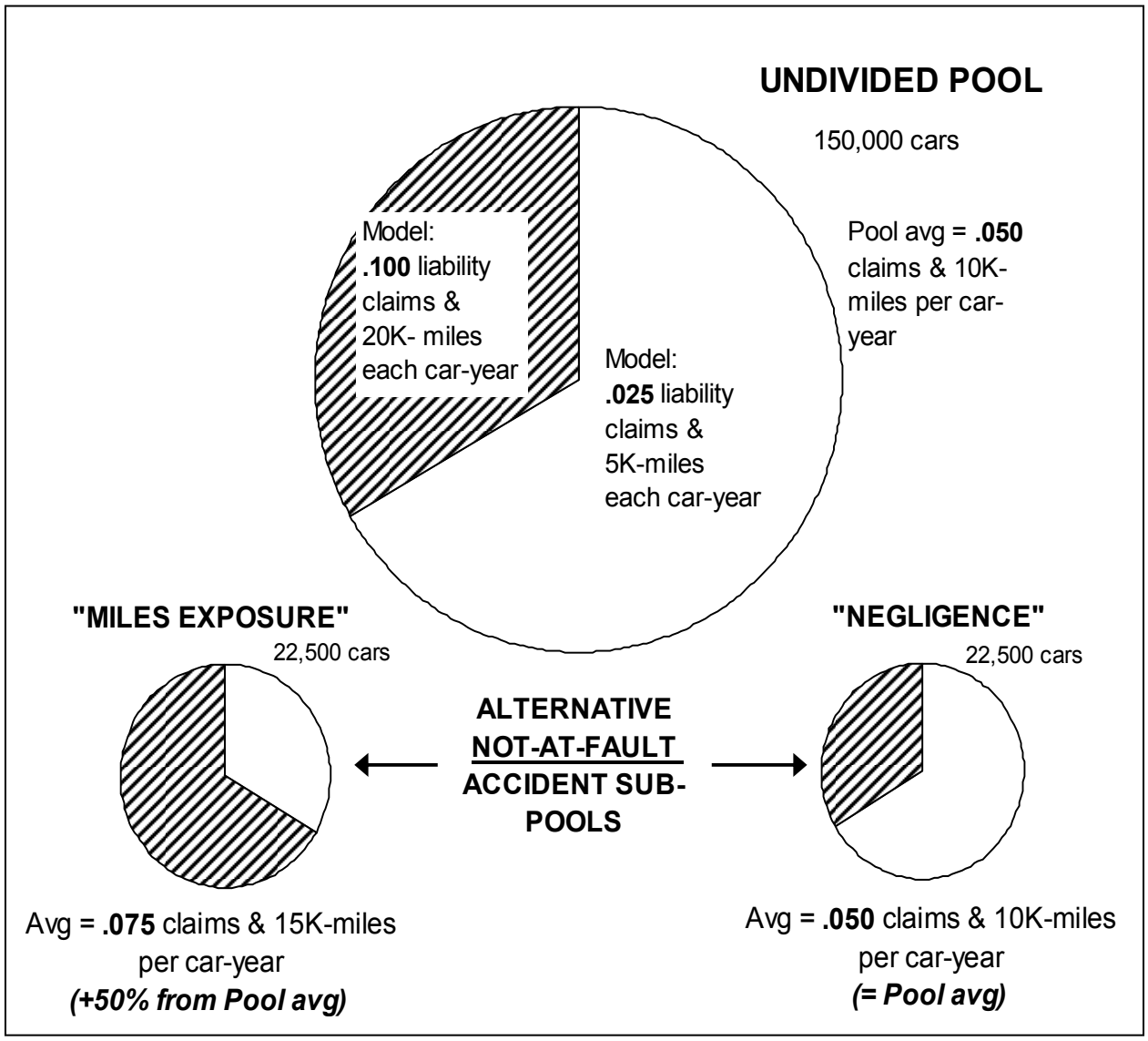

Figure 3. *Not-at-fault accident record sub-pools: Model results differ by predictive theory, "miles exposure" or "negligence"*

The "miles exposure" predictive result for not-at-fault accidents in Figure 3 is identical to the increases in the average miles and annual liability claim rate predicted in Figure 2 with at-fault accident records. This result conforms with the long time affirmations by insurers that fault is irrelevant to accident record predictions of future increased claim rates.

Negligence theory tacitly assumes that all cars are equally subject to being an "innocent" (not-at-fault) victim of another driver's negligence. As shown on the right in Fig. 3, the consequence is that involvement in this kind of accident does not alter the proportions of the high- and low-negligence-rate cars. Therefore, the liability claim rate prediction should be unchanged from the rate of the undivided pool. In affirming the contrary, the predictive relevance of not-at-fault accidents, insurers are denying that this is the case.

Should Better Accident-Record Rating Be Allowed?

Given that accident involvement predicts sub-pools of cars with greater average annual miles of exposure, should the legal prohibitions on rating by not-at-fault accidents be lifted? In answering this, it is taken as proven that—all else made equal by insurers' classifications for driver age, car use, geographic area of garaging—within each class pool the difference in annual risk arises from difference in the miles each car is driven.

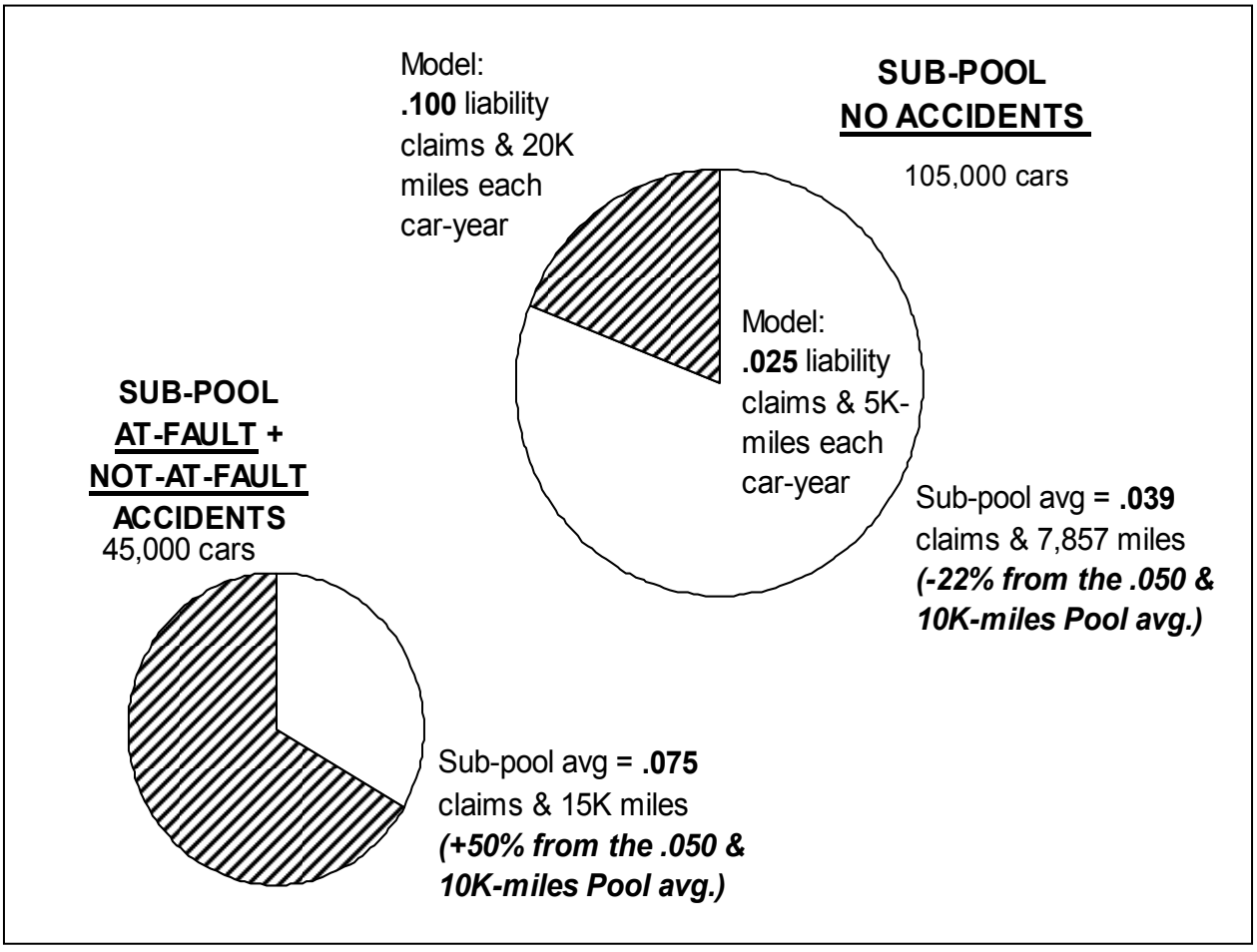

Figure 4. Model *claim-rate predictions using 3-year records of all accident regardless of fault.*

Figure 4 shows that rating by accident involvement without regard to fault increases the number of the high-miles cars separated from the low-miles cars. For the model the number of cars with an accident in three years doubles to 45,000 cars, which concurrently reduces the accident-free sub-pool to 105,000 cars. The removal by accident involvement of twice as many 20K-miles cars as 5K-miles cars from the pool also has a noticeable effect (-22%) on the average liability claims rate for the accident-free sub-pool. Twice as many cars would experience a 50% increase in annual premiums by being shifted from the undivided pool averaging 10K miles per car year to a sub-pool that averages 15K miles. Concurrently the larger sub-pool of cars without an accident involvement for three years would drop from an average 10,000 miles to 7,857 miles, which represents a 22% decrease from the undivided pool's average.

On the face of it and from an economic perspective, bringing auto insurance premium rates more into line with insurer-measured experienced costs is desirable. With reference to Figure 4, lowering insurance rates per car 22% for a majority of cars that were not involved in an accident in any way would be acceptable to the public—by itself. But this rate reduction could not happen in isolation; the reduction would depend on raising premium rates by 50% for the large minority of cars involved in an accident. The half of this minority that was involved in an accident and found at fault appears to accept such surcharges now, probably owing to the stigma of having negligently "caused" the accident. The other half of this large minority, however, would be being asked to accept a 50% surcharge because another car negligently ran into them. That would be an insurmountable political barrier to insurers openly rating on the basis of not-at-fault accidents. Of course, the very strong predictive correlations that insurers experience in their claim data are so compelling that insurers are motivated to take such information (from, for example, third party claims their insureds have made against other insurers) into account in their underwriting decisions.

Alternatively, the two-component model provides the basis for prohibiting *any* accident-record rating of automobile insurance. Some insurance professionals and academics condemn the practice as charging individuals again for what they already paid their premium or "an organized renunciation of insurance." Over the years, many other practical and theoretical objections have been raised.[9]

The critical objection to accident-record rating is its failure to tie premiums to individual risk. In the two annual-risk-components model above interpreted by the factually-consistent miles-exposure theory, the 5K-miles cars and the 20K-miles cars in the undivided pool are paying the

[9] Many of these objections are discussed, and new issues raised, in Butler and Butler, 1989.

same annual premium for the annual liability claim rate per car year produced by the pool's average 10K-miles per car. The 5K-mile cars are paying twice the pool's average cost per mile and the 20K-mile cars are paying half. The change produced by full accident-record rating (Figure 4) with the accident sub-pool averaging 15K-miles per car is that a larger proportion of 20K-mile cars are paying three-quarters instead of half of the pool's average cost per mile, while the unlucky 5K-mile cars are paying three times instead of twice the pool's average per-mile cost. The "benefits" of the 22% reduction from the pool's average 10K-miles in the sub-pool of accident-free cars, is that the 5K-mile cars would pay slightly less than twice the pool's per-mile cost, and the 20K-mile cars, instead of paying half, would pay less than half the pool's per-mile cost.

The success of the miles exposure theory in explaining the predictive irrelevance of negligence in accident-record rating strongly argues that the premium basis for automobile insurance driving coverages should be converted from the car-year exposure unit to the car-mile unit.

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