

Essay

What Negligence Theory Needs to Learn from Automobile Insurance: “Fault is Predictively Irrelevant” (and Why)

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I. Introduction

I.1. Finding

It was established beyond the shadow of a doubt [in the early 1960s] that the individual who is involved in automobile accidents, regardless of whether he appears to cause them or not, is much more likely¹ to have accidents in the future than is the person who is accident free. These studies embraced probably well over 1 million cases in the aggregate. Note that I have just referred to accidents and not to claims, as it was learned early in the studies that involvement in an accident *regardless of who was at fault*, was the important consideration and not the size of the claim produced. . . . It does not matter whether the police records were accurate or inaccurate or who was to blame for the accident. It is the occurrence of the accident which counts. [Letter quoted in a 1967 Congressional report.]²

This 40-year-old finding—that *fault is irrelevant* to the use of individual past accidents to predict group claim frequencies per 100 car-years—has ever since been quietly corroborated by industry officials and actuaries in legislative, regulatory, trade, professional, and other forums.³ Notwithstanding the history of the finding, the response of legislators and regulators has been to restrict or prohibit automobile insurers from using any but at-fault accidents that—despite the unimportance of the size of the claim

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1. The phrase “much more likely” to have accidents in the future means a roughly 50% increase in a relatively small annual accident rate per 100 cars, which is still relatively small. As will be discussed herein, the “increase” in likelihood is strictly from the insurer’s point of view and can be explained as merely a consequence of the traditional car-year accounting method that insurers use.

2. Insurance company letter to an attorney representing an insured surcharged for a not-at-fault accident. U.S. Congress (1967: 82). Emphasis added. The studies the letter cites validated a relationship probably known to the industry in the 1930s when the actuarial literature started to debate the statistical impropriety of rating individual cars by accident record for marketing and other non-statistical purposes.

Professional criticism published in 1952 is quoted by Butler and Butler (1989: 223) in making the case that accident record rating does nothing economically useful but serves insurers as sales puffery—Good rates for good drivers—and as a rate-regulation red herring. The 1952 criticism concludes that “[t]he extremely small exposure in a single private passenger car risk does not lend itself to self analysis in terms of rate making as the element of chance overshadows a credibility expectancy.” In 1959 this statement was quoted by the president of the Casualty Actuarial Society who called it “profoundly actuarial.”

3. Some of these will be quoted in the discussions that follow.

produced noted above—either involve bodily injury liability or exceed a property damage liability dollar threshold.⁴ This amounts to a not-unprecedented political override of automobile insurance statistics.⁵

Despite political denial of the fact, however, the irrelevance of fault should lend strong support to “no-fault” automobile insurance reforms.⁶ Yet in decades of debate, apparently no scholarly work has engaged with the irrelevance of fault to accident frequency predictions.⁷ One reason may be the general consensus of scholars and public alike that accidents are caused by negligent drivers, a category in which almost nobody includes themselves. But a professional reason must be that neither scholars nor insurers have been able to explain why past accident involvement actually does predict future accident frequencies.

Explaining why fault is predictively irrelevant, however, does require challenging some of the conventional explanations for other correlations insurers use to assign cars to

4. For example effective July 1 2005, Pennsylvania increased its 3-year aggregate claim cost threshold for allowing premium increases by \$100 to \$1,150 [35 Pa.B. 612].

5. Auto insurers also routinely and systematically override their own statistics as will be shown in Parts II and III below.

6. This observation is not to be taken as indicating support for so-called no-fault reforms, which mainly involve post-accident payout arrangements. This Essay is concerned instead with pre-risk-taking pay-in arrangements—namely the perverse consequences of insurers using the car-year unit as the basis for pay-in prices.

7. As an early instance, Blum and Kalven (1964: 707) complained that California insurers disregarded negligence in their Safe Driver Insurance [pricing] Plan in which “each involvement in an auto accident, regardless of fault, is scored as a point against the insured.” However, they apparently did not consider that insurers might be doing this—not for presumed administrative efficiency—but in response to observed claim frequency correlations. As a consequence, these authors called for “greater daring in setting insurance rates for the sake of creating more deterrent impact,” without taking notice that this restriction to at-fault accidents only—preferably with larger surcharges to enhance deterrence—would require insurers to ignore statistical experience.

In a recent review of these Blum and Kalven observations, Abraham (2005: 607) points out that the insurer behavior they complained about should give support to pay-out systems not contingent on anyone’s fault or absence of fault. Abraham notes:

They readily recognized that, at the time, “liability insurers in allocating costs among the insured appear[ed] to think in strict liability terms.” However, instead of following this recognition where it seemed to lead—toward some form of nonfault liability—they argued that it would be better to improve the way in which liability insurance was priced so that it did differentiate based on driver fault. [Citations omitted, quotation marks and square brackets are in the original.]

Like Blum and Kalven, however, Abraham does not consider the possibility that actual claim frequency experience does justify future surcharging for past not-at-fault accident involvement.

Finally, Calabresi (2005: 749) describes what he knew in the 1960s about the predictive irrelevance of fault and tells why he did not include the information in his book (Calabresi, 1970).

[In the absence of empirical studies] what I did was to talk to insurance people who told me that they didn’t believe that whether somebody had been at fault or not was as a good predictor of future accident involvement by that person. They added that they only used fault in calculating insurance rates when the state required them to do so. And that seemed to me a pretty good indication that fault wasn’t likely to work well. But these loose conversations weren’t something one could cite, or even firmly rely on, and so I didn’t cite them.

However, even though Calabresi is not surprised here that fault is irrelevant to predictions, he does not theorize on *why* past accident involvement per se regardless of fault should be predictive of increased future accident probability on a 100 car year basis.

groups that predict accident and claim frequencies. Correlations with driver age and regional geography can be explained by variations in accident involvements per million miles established by engineering studies⁸ and are not considered further. Instead this Essay examines six prominent predictor variables including at-fault and not-at-fault accidents.⁹ The other four are driver sex, car age, residence zip code, and credit score. These variables are first examined in Part II using the conventional driver negligence explanations. Part III then offers a rival theory to explain the correlations. Part IV presents conclusions.

I.2. Rival Theories

Since most automobile accidents are caused by one or more negligent acts, the prevailing theory for predictive correlations is that they are proxy measures of *driver negligence*. The presumption is that variation in the amount of driver negligence explains correlations with variation in claim frequencies.¹⁰ If the drivers of a group of cars on average are less negligent, then the group will produce less risk and fewer claims than other groups of cars. In order to accurately deter negligence Posner (2003: 201-02) explains that liability premiums ideally should be closely related to differences in driver negligence.

Although the [current] premiums are not uniform, the differences frequently reflect criteria . . . that are only loosely related to negligence. . . . [T]he method of calculating liability insurance rates overdeters some drivers and underdeters others.¹¹

If the liability insurance market were not regulated, insurance companies might charge different premiums to their customers keyed more closely to differences in the probability that a customer would, through his negligence, injure someone in an accident.

However, this traditional attribution of differences in probability of accidents to supposed differences in driver negligence entails, as will be shown, serious conflicts with insurance fact. In addition to the problem of not-at-fault accidents, another key observation is that the cars of financially stressed groups consistently seem to produce the most liability (and other) claims per 100 car years. Consequently, insurers charge these groups the highest prices, which makes compliance with mandatory insurance even more difficult for groups who should be if anything more risk averse and less negligent than

8. The strong variation with driver age of accident involvements per million miles is graphed by Williams (1999). The effects of different road types in rural and urban settings on fatalities per billion kms is summarized by Evans (1999: 78).

9. Explaining why other predictors used by insurers work, such as deductible choice and choice of tort rights (“choice no-fault”), requires in addition to the odometer miles theory a consideration of risk aversion theory. See Butler, 2006.

10. This association is the basis of negligence law’s purpose to deter negligence and so to reduce driving risk and thereby “prevent” statistically some accidents from occurring. The negligence theory of tort law therefore assumes that drivers suitably deterred can reasonably reduce their negligent acts.

11. Exactly what it is that premium rates charged on a per-car basis are capable of over- and under-detering is discussed in Section III on the odometer-mile theory.

average. These conflicts between observation and theory invite alternatives to the driver negligence theory.

The theory proposed by this paper to explain variations in claim frequency is that the predictor variables are proxies for *average odometer miles*. The more odometer miles per car year a group averages, the more claims per 100 car years the group produces. Since each mile a car travels has a chance of accident, each mile traveled produces a brand new cost. Each mile an insured car travels transfers a measurable risk and its cost to the car's insurance pool.¹² Even though during a year a large majority of cars in an insurance pool are accident-free, they all produce the total risk that is statistically realized by the few that have the pool's accidents.¹³ Therefore, a pool's claims are the inescapable realization of the risk transferred by every mile driven by *all* of the cars in the pool. For the sake of tying premiums to cost as it is occasioned, logically every odometer mile driven must count in paying for the insurance costs of road accidents.¹⁴

A final general consideration is that each theory to explain variations in claim frequencies among groups posits the existence of a single causal variable—either driver negligence or odometer miles—that is proxied by the predictive variables used by insurers. Therefore, the effects of the multiple proxy variables in predicting the single causal variable for variations in claim frequencies will overlap. To avoid the overlap and the double counting of the effects of different predictor variables (“risk factors”), Miller and Smith (2003) describe the use of multivariate analysis. They rank the individual predictors for strength, but do not adjust for the different degrees to which individual companies use each variable. For example they use model year and driver sex as though insurers used these variables for all cars they cover. As noted in the discussions that

12. Production of this cost is as real as the mile-by-odometer-mile production by cars of carbon dioxide, water vapor, and other exhaust products.

13. If fewer miles of risk are transferred to an insurance pool of cars, as happens whenever unemployment or gasoline prices rise sharply, the number of claims the pool experiences per 100 car years decreases more or less accordingly. (With a rise in unemployment, fatal accidents appear to decrease more than odometer miles because discretionary nighttime driving to entertainment and restaurants is preferentially reduced relative to daytime driving.)

14. An efficient odometer-mile insurance system would require odometer audits no more than once a year (mainly for totaling the miles driven by all of the cars in a pool during a time period in order to convert the total cost of the pool's claims incurred during the period to a cents-per-mile basis) and in verifying coverage for claim settlement. Car owners would purchase miles of insurance in advance at the going cents-per-odometer-mile rate for the car's class and driving coverages in amounts to suit individual needs and budgets. The miles purchased would be added to the odometer reading and recorded, along with the policy period, on the car's proof of insurance card. The owner would be responsible for buying more miles before the odometer limit was reached and coverage lapsed. (Exceeding the odometer limit and odometer tampering are standard coverage termination provisions in mechanical breakdown insurance contracts.) Comparisons with the current car-year system of transaction efficiency, fraud control, and mandatory insurance enforcement are contained in two reports: Butler (1993a) and (2000).

Although every car in use is already fully equipped to start using odometer-mile insurance, some insurers have recently tested installing global-positioning-satellite (GPS) systems on cars for recording miles (or minutes), location, and time of travel. At the outset of one test, Butler (2000, pp. 27-28) identified statistical credibility problems owing to the proliferation of the time of day and location data cells (some of which would either have too few claims for predictability or even be empty), noted the expense of equipment and installation and the administrative expense of *ex post* monthly billing for completed travel, suggested privacy concerns, and predicted failure, which occurred within two years.

follow, for marketing, public relations, and other compelling reasons, companies do not use available predictors consistently across all of the cars they insure.¹⁵

II. Driver Negligence Theory

II.1. At-Fault (AF) Accidents

In general, if the cars of drivers who have produced a liability claim in the past three years are separated from a main pool that produces, for example, 5 liability claims per 100 car-years, in the following year the sub-pool of these cars produces 7.5 liability claims per 100 cars, 50% more than the overall average. Also, as a consequence of such sorting, the claim frequency of the large claim-free pool decreases about 7%.¹⁶

The presumed explanation under driver negligence theory is that at-fault accidents over time will sort the cars whose drivers are more negligent than average from insurance pools into sub-pools. These sub-pools will produce more liability claims in the future than the main pool of cars in the same class that have not recently produced a liability claim.¹⁷

The theory maintains that financial liability for negligently causing an accident creates an incentive for drivers to be non-negligent. Allowing insurance against this liability risk at one time prompted concern that it would eliminate this deterrent to negligent driving. But the concern has been assumed to be resolved by the insurance practice of increasing premiums for the cars of drivers whose negligence has occasioned liability claims. Posner (2003: 201) explains that owing to this provision “the cost of an accident to the negligent injurer is no longer the victim's loss; it is the present value of any premium increase that the injurer may experience as a result of being found negligent.”

The appropriate size of a premium increase for an at-fault accident, much less at a discounted present value, is not considered by scholars, even though the size of politically-set traffic fines in order to balance deterrence and financial impact is the subject of scholarly study. Theorists leave it to auto insurers to base the surcharge on the approximately 50% increase in claim frequency experienced with subgroups of cars with recent at-fault accidents.

Schwartz (2000: 643) explains how varying premiums with driver negligence promotes corrective justice.

Keeping in mind that in the tort system almost all liability is filtered through liability insurance, one can ask how that system can succeed in promoting corrective justice.

15. Predictive characteristics of insureds that are known to insurers but are not used in pricing annuities are studied by Finkelstein and Poterba (2006). The authors also cite instances in automobile insurance and aptly name the phenomenon “unused observables,” but puzzle over reasons for why insurers are not using some risk-predictive information in pricing.

16. The amount is calculated from a model. In actuality, according to industry actuaries, “accident-free or claim-free drivers usually save at most 5%.” Butler and Butler (1989: 229). Insurers adjust base price levels so that claim-free discounts appear to be 10% to 20% or more. The at-most 5% real savings are supported by the 50% to 150% surcharges on the cars of the small minority of drivers that have had recent accidents or claims.

17. Abbring et al. (2003: 799) express this idea as: “an insuree with a large number of past claims is likely to be a bad driver and therefore to have a high future claim intensity.”

It does so by providing compensation to accident victims out of an insurance pool which itself is financed by charges on all motorists, and which varies the amount of those charges by taking into account the individual's negligent driving record and the negligent driving characteristics of the groups to which the individual belongs.

Schwartz (2000: 643) next explains how premium surcharges are supposed to deter negligent driving.

Given the intermediation of liability insurance, how might it be that the tort system reduces bad driving? The explanation might be that motorists, concerned about the prospect of insurance premium increases, seek to avoid faulty accidents and faulty driving that might lead to code violations.

These justice and deterrence goals, however, do not take into consideration the fact that insurers were permitted also increase premiums based on non-faulty involvement in accidents in which the driver of the insured car was not a negligent injurer but a victim.¹⁸

II.2. Not-At-Fault (NAF) Accidents

The cars whose drivers in the last three years have been involved but NAF in an accident—and who may or may not have filed a liability claim against another car's insurer or an Uninsured Motorist (UM) claim against their own car's insurer—as a sub-pool of cars produces about 50% more claims (of all kinds) per 100 car-years the following year than the main pool of accident-free cars from which they were separated. Also, as a consequence of such sorting, the claim frequency of the large claim-free pool decreases about 7%.¹⁹

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 belief that a small 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.” (News report, 1992.)

Lemaire (1985, 1997) describes the same correlations from the 1970s experience of a Belgian insurer. Just behind at-fault liability claims as the strongest predictor of claim frequencies per 100 car years is “the number of accidents where the driver is not at fault.” One of the explanations Lemaire offers is that “some drivers create a situation where an accident is likely to happen, even when they are not liable.”²⁰

18. Posner (2003: 201) seems to take note of this practice in saying “Although the premiums are not uniform, the differences frequently reflect criteria, such as accident involvement (*whether or not the insured was negligent*) . . . that are only loosely related to negligence.” Emphasis added. I take Posner's parenthetical comment to be a criticism of raising premiums for accident involvement without regard to negligence.

19. Calculated from a model that approximates auto insurance experience, Butler and Butler (1989).

20. Insurers cite cost justification for increasing the prices of coverages for cars hit from behind while stopped at a red light, which can hardly be called creating a “situation where an accident is likely to happen” as Lemaire suggests in the text above. However, in conversation some scholars will not even concede this point and instead suggest that the car in front may have stopped too abruptly when the light

A problem for this explanation, however, is that in order for the owner and occupants of the NAF driver's car to have claims against the insurer of the AF driver's car, or to have Uninsured Motorist (UM) claims against the car's own insurer, the car's driver must be entirely or mainly NAF. Any creating a "situation where an accident is likely to happen" would bar both kinds of claims under a state legal regime of Contributory Negligence, or reduce the claim amount under the increasingly prevalent state Comparative Negligence regimes. Owing to the adversarial character of liability claims settlement, occasions when drivers actually cause accidents to happen but are still held NAF probably are not common. Therefore, the success of NAF accident involvement as a group predictor of higher future claim frequencies per 100 insured cars remains a major problem for the driver-negligence explanation.

Schwartz (2000: 644) also considers the possibility that auto insurers increase premiums following first-party ("no-fault") claims for medical expense and income replacement when the driver of the insured car was not-at-fault. He sets out the problem in terms of the driver negligence theory of prediction:

Take an accident in which C is driving properly through an intersection, and C's car is hit by D's car, which is running a red light. C files a no-fault claim, and collects from his no-fault insurer. . . . Given the circumstances of the accident, *there is nothing that is predictive* of C's exposure to accidents in the future. Absent that prediction, there is no rational basis for a premium increase. [Emphasis added.]

Although there may be no rational basis in terms of negligence theory for a premium increase for victim C, there is a factual basis for an increase that is just as cost justified for victim C's car as it is for injurer D's car. Sub-pools of cars separately representing injurer and victim situations both subsequently produce more claims per 100 car years than the accident-free cars of their main pools.²¹ Problems with theory aside, there is no factual doubt that in using accident involvement to predict increased claim frequency, fault is predictively irrelevant.

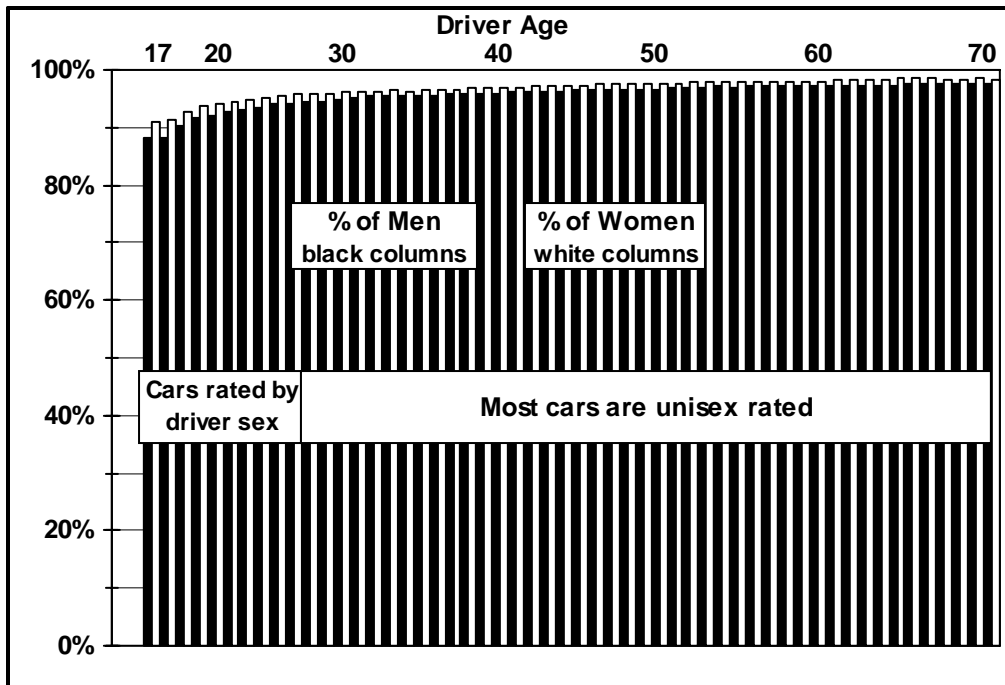
II.3. Driver Sex

was turning red—a basis insurers do occasionally use to resist paying a third party claim. The other explanation Lemaire offers is considered below in Part III's discussion of NAF accident involvements.

21. There is constant pressure on insurers to use known predictors either as competitive tools or out of fear of adverse selection because competitors may be using the predictors to lure away customers with lower predicted claim frequencies. Schwartz (2000: 644) surveyed several national insurers who said they did not use first party bodily injury claims arising from non-negligent accident involvements to raise subsequent premiums. However, evidence of pressure to do this is the laws cited by Schwartz prohibiting the practice in Hawaii and Michigan.

Whenever insurers classify cars by driver sex—which traditionally is done for about one in four cars, mainly in households with young drivers—the cars assigned to the man-driver categories produce more claims per 100 car years than the cars assigned to the woman-driver categories. State reported accident involvements show the difference between men and women drivers, not just for young drivers, but for drivers in each age group, Figure 1. The increase with age in the percent of licensed drivers who are accident

FIGURE 1. Texas Drivers With No State-Reported Accident in 1999.



free is very similar for women and men. The question is why at each age the percent of women and men drivers shows a small offset. But to insurers, the complementary percent accident-involved drivers is the significant value: men drivers' involvements exceed women drivers' by 25% (for younger drivers) to 60% (for older adults). Why is there this greater annual accident involvement of men relative to women across all driver ages?

The prevailing explanation for the difference between men and women drivers relates it to biological and behavioral differences.²² In their investigation of causal links between accident frequencies and credit scores, Brockett, Golden, and Dunn (2005) review studies of links between accidents and driver sex. The authors summarize ties to men's greater risky behavior.

22. Explanation is not a concern of some advocates for allowing insurers to price according to driver sex, such as Epstein (1995: 42) who argues that prohibition "is to invite further complex maneuvers by companies who are barred from taking into account information that everyone knows has some predictive value." But this unconcern with cause leaves it to readers to fill in their own reasons, which are often stereotyped rather than related to the facts presented in Figure 1.

It has been well established that high testosterone levels in men influence their behavior. However, there is no single biological factor that influences sensation seeking behavior; rather, it is the combination and interaction of multiple genetically determined biochemicals that cause this personality characteristic. For example, the psychobehavioral characteristics of risk-taking are related to impulsivity, sensation seeking, aggression, and sociability with men engaging in more overall risky behavior than women.

One variable the review does not consider, however, is that evaluating differences in accident frequencies between groups from a risk producing activity like using cars must take account of group differences in the amount of the activity. The reference above to “men engaging in more overall risky behavior than women” must be intended to mean more than men merely doing more driving than women. This comparing of risky behaviors must be intended to mean that when men are driving, they take more chances per mile than women do, such as driving a greater proportion of their miles using cell phones or at speeds exceeding the speed limit. Either behavior if being engaged in when an accident occurs is usually taken as legal evidence of driver negligence.

II.4. Car Age

Next is car age. Although the drivers of newer cars produce more *liability* claims per 100 car years than drivers of older cars,²³ insurers ignore the correlation in setting prices, as McNamara (1987: 47) explains:

[A 1963-1964 industry study showed] . . . that newer automobiles had a higher frequency of accidents leading to liability claims than the frequency associated with older automobiles. This fact was not reflected in the rating system because no reasonable relationship between the age of the automobiles and the likelihood of an accident leading to a liability claim could be established.

In addition to being unable to establish a reason for the negative correlation of the frequency of at-fault accidents with car age, McNamara²⁴ concludes generally that “even proponents of statistics as the basic justification of relativities among classes must recognize that the use of statistics should be leavened with a liberal dose of common sense.”

Common sense in fact also underlies Pinquet’s (1999: 76) different explanation for why the prices of French insurers, like those of American insurers, ignore the decrease in liability claim frequency with car age:

23. Collision claim frequencies also decrease with car age, as Bickerstaff (1972) states: “It is a well documented phenomenon that absolute [collision] claim frequency decreases as insured vehicles advance from one age group to another.” Page 80. From cars age one to age four the decrease in claims per 100 car years is 38% (page 90).

24. McNamara writes with authority as an industry leader, lawyer, actuary, and previously presidents of the Casualty Actuarial Society and the American Academy of Actuaries, and, at the time of writing, had been employed as the long-time president of the industry rating bureau (Insurance Services Office, Inc.) successor to the bureau that did the study he describes.

Actual tariff structures never give to the age of the car the influence measured by statistical analysis. Insurance companies lose money with recent cars, while older ones are profitable. This discrepancy between risks and premiums can be explained by the fact that policyholders do not want their premiums to *vary abruptly*. [Emphasis added.]

But why this constitutes common sense must be made perfectly clear. If insurers followed statistics and reduced premiums with car age, they would be unable to explain to clients why when older cars are traded for newer ones liability premiums *abruptly increase*. How can there be an increase in driver negligence if there is no change in drivers? This question presents a formidable challenge to a driver negligence explanation for the negative correlation of liability claim frequency with car-age.

II.5. Zip Code

In both rural and urban areas, automobile insurers experience the most liability, collision, and uninsured motorist (UM) claims per 100 insured car years—and therefore charge the highest prices—for covering the cars of owners living in low-income zip codes. In their study of Missouri zip codes, Harrington and Niehaus (1998: 454) report that the residents of higher black ethnicity and concurrently lower-income zip codes produce 36% more liability claims and 48% more collision claims per 100 insured car years than the cars of residents of other zip codes. But the report suggests no explanation for these correlations.

In agreement with these findings, SRI International (1979: 77) describes the findings of a 1978 MIT doctoral thesis: “In Massachusetts, the correlation between territorial rate relativities and median income is -0.978 ; between such relativities and percent black, 0.532 ; both sets of figures are stunningly high.” In a study of auto insurance subsidies across territories, driver sex, and other groups that Massachusetts regulations require, Blackmon and Zeckhauser (1991: 68) confirm that low income drivers produce higher costs *per car* than higher income drivers because the “subsidy of Boston and other [low-income] cities tends to flow from high-income towns to low-income towns.”

Variations across zip codes are not considered directly in the review of risky behavior studies by the Brockett, Golden, and Dunn (2005), but they discuss studies that link risk-taking to socio-economic status (SES).

Testosterone is positively correlated with novelty seeking, sensation-seeking and aggression. . . . Interestingly, socio-economic status provides a moderating variable to this relationship. In other words, weaker testosterone-behavior relationships were found among high SES subjects. [p. 14]

Since zip codes serve as proxies for SES and income level, the SES level of zip codes correlates negatively—according to this review—with risk taking and negligent driving behavior.

But two difficulties arise for this negligent-driving explanation. First, more liability claims—as presumed indicators of more driver negligence in low-SES zip codes—are

accompanied by more UM claims.²⁵ Although UM claims were not included in any of the studies, insurers assert in legislative and regulatory forums that higher UM claim frequencies accompany higher liability and collision claim frequencies in low-income zip codes. The difficulty with the theory of greater-negligence by low income drivers is that payment of a UM claim requires non-negligence by the driver of the insured car.

The second difficulty is that the idea of greater negligence in low income areas conflicts with the general economic theory that people with fewer resources should be more risk averse and therefore, should be, if anything, not more but less negligent. Cars in low-income areas represent a larger portion of their owners' wealth than the cars of owners living elsewhere do. Loss of car use and repair costs are major concerns.²⁶

II.6. Credit-Based Score

Auto insurance claims per 100 insured car years increase almost linearly with the decrease in credit-based insurance scores of car owners. In an industry-sponsored statistical study of a large sample of company records, Miller and Smith (2003) report that

[i]nsurance scores do overlap to some degree with other risk characteristics, but after fully accounting for all interrelationships, [credit-based] insurance scores significantly increase the accuracy of the risk assessment process.²⁷

The property damage liability (PDL) claim frequency of the lowest credit score decile is nearly double the frequency of the highest decile, or after adjustment for other predictor variables (like driver sex), nearly 50% more.²⁸

Although Miller and Smith (2003) state that "it would be inconsistent with sound actuarial principles to require credit-based insurance scores to demonstrate a causal relationship," nevertheless they suggest one:

[W]e could reasonably speculate that there are psychological factors that likely affect how we manage our personal lives. . . . Insurance scores seem to provide an objective means of measuring personal responsibility and its effect on insurance losses"

The connection of accidents with "personal responsibility" is further developed by Brockett et al. (2005), as their introduction states:

25. Although this correlation between low income zip codes and higher UM claim frequencies is not noted in academic research, it is well known in the auto insurance industry.

26. The serious consequences for some of losing use of a car was described by the *Philadelphia Daily News* in an editorial, For Many a Car is not a Luxury, November 15, 1991. "When he told me my Datsun needed a new gasket or something, I started to cry. He looked at me funny. He asked. . . 'Why would you cry over a car?' This is why: . . . not having the use of a car meant carrying her 2-year-old most of the 10 blocks to his family daycare home, then taking two buses to work, arriving exhausted. And after eight hours at work, repeating the process in reverse. Not having a car meant putting off grocery shopping and laundry. If the kids got sick. she would have to take them to the doctor on the bus."

27. Although a driver sex was provided by insurers for each of the nearly 2.7 million car-year records composing the random sample studied and found to be among the most significant predictors of claim frequency, driver sex *did not* affect the price of insurance for 3 out of 4 of these cars.

28. Miller and Smith (2003) Exhibits III and VI

In this paper we will present evidence conceiving the relationship between credit history and predictability of risk through an analysis of the literature on biological, psychological, and behavioral characteristics of sensation seeking and how those characteristics affect financial decision making and risky driving habits.

But one immediate problem with the lack of personal responsibility and risky-driving-habits theory for why higher liability claim frequencies correlate with lower credit scores is the parallel correlation of higher uninsured motorist (UM) claim frequencies with lower credit scores. Miller and Smith (2003) do not include UM claims among the six coverages studied,²⁹ while Brockett et al. (2005) discuss only AF accidents. However, auto insurers say that both liability and UM claim frequencies increase together as credit scores decrease.³⁰ Although Brockett et al. (2005) concentrate on presumably negligent driver behavior, payment of a UM claim requires the driver of the insured car to have been NAF, i.e., non-negligent.

III. Odometer Miles Explanations

III.1. Exactly What Activity Does Automobile Insurance Deter?

Rival to the driver negligence theory to explain accident frequency predictors is the theory that the correlations proxy for group average odometer miles. Threshold to acceptance of this explanation is acceptance of the fact that private passenger auto insurance is charged, and reacted to by consumers, as a cost of car owning. Beyond acting as a lump sum tax on income, which may impinge on gasoline consumption, in no sense do auto insurance premiums act as a cost of operating a car. This fact requires emphasis because scholarly papers state or imply otherwise: that the price of auto insurance deters driving as well as negligent driving. For example, in synthesizing principal findings from a conference on price deregulation for property-casualty insurance, Cummins (2001: 12) mis-characterizes automobile insurance as a cost of driving.

Drivers decide how much and how safely they drive based on the marginal costs and benefits of driving. If high-cost drivers do not pay the full marginal costs they impose on the system, they will have an incentive to *drive more* and take less care; and if low-cost drivers pay more than their marginal costs, they will *drive less*, than under competitive rating. (Emphasis added.)³¹

29. The six coverages studied are property damage liability, bodily injury liability, collision, comprehensive, personal injury protection, and medical payments.

30. For example, the results of a multivariate study of claim-frequency correlations with credit scores were described by Brady Smith, Products Development Analyst at Mutual of Enumclaw, in a panel discussion at the Society of Insurance Research annual conference, November 2003. As with other instances of parallel liability and UM variations with claim frequency predictors, this information was delivered in a “can you believe this?” manner as if to signal an anomaly to the usual negligent driver explanation.

31. A recent law and economics example that incorrectly implies that automobile insurance cost impinges on the amount of driving is the argument made by Shavell (2004: 279) that a liability insurance requirement for drivers of cars “would improve incentives to . . . moderate activity levels . . .”

But whether rating is competitive or regulated, in all states per-car premiums are a cost of car owning. Premiums are specified and paid in advance so that unlimited mileage can be subsequently driven without any further charge. There is no marginal cost to a driver for each mile driven, despite the risk each mile produces and transfers to the car's insurer. Even though a company may apply a mileage surcharge (or discount) according to unverifiable representations on the application or renewal form of what the Texas Auto Insurance Manual (Rule 74G) typically calls "estimated [future] odometer mileage," insurers do no back billing (or refunding) at the end of the policy period regardless of how many miles (or few or even none) a car's odometer may actually have recorded. As a consequence, insurers charge insureds in the same class nearly identical premiums for a lot of driving and for no driving.

Table 1. Premium paid for 20,000 insured vehicle miles traveled (VMT)[†]

CASE	Annual miles per vehicle	Vehicles used to travel 20,000 miles a	Years taken to travel 20,000 miles b	Annual Premium per vehicle c	Premium for 20,000 VMT d (= a x b x c)	Premium per VMT (= d / 20,000 miles)
U	20,000	1	1	\$500	\$ 500	2.5 cents
V	10,000	2	1	400*	800	4
W	10,000	1	2	500	1,000	5
X	6,667	1	3	400**	1,200	6
Y	4,000	5	1	320***	1,600	8
Z	2,000	1	10	400**	4,000	20

[†] Hypothetical \$500 territorial base annual premium for a given "car-use" class such as Pleasure Only. Discounts applied are of typical size.
 * 20% multi-car discount.
 ** 20% discount for less than 7,500 estimated future mileage.
 *** Both discounts.

Table 1 presents six cases to show how different arrangements strongly affect the amount of premium paid for insuring 20,000 vehicle miles of travel under a hypothetical \$500 per car year base premium. The simplest arrangement is one car traveling the entire distance in a year, Case U. Dividing premium by vehicle miles traveled (VMT) shows that the insurer collects 2.5 cents a mile in this case. However when a household uses two cars to drive 20,000 miles in a year, or takes two years to drive the same distance in one car, then the amount paid arbitrarily jumps from 2.5 cents to 4 or 5 cents a mile, as shown by Cases V and W.

The last three cases (X, Y, and Z) show that the company would be collecting from 6 cents up to 20 cents a mile for the same insurance. The company is obviously collecting much more in total premium—and much more per mile—for the same risk transferred to it and so is making much more profit from owners of cars driven few miles in a year's time. Any cross subsidies go to those using a single car to travel many miles in a year's time—as in Case U. In fact, premiums are a cost of car owning and therefore can affect only the number of cars owned.³²

32. Blackmon and Zeckhauser, 1991, report for Massachusetts: "The demand for insured vehicles per household was estimated as a log-linear (constant elasticity) function of income, price [of insurance], and household density." And "Our estimated coefficients were income 0.477, price -0.569, and density -

Earlier criticisms of auto insurance premiums as lacking an incentive bearing on how much to drive were made by Williamson, Olson, and Ralston, (1967: 248), who wrote that “the auto insurance premium . . . acts as a lump-sum rather than a marginal tax.” and by Vickrey (1968: 470), who concluded that rates “provide incentives that are largely inappropriate at the margins where decisions are actually made as to . . . whether to make a given trip by car.”

In Chapter 5 of the *Costs of Accidents* Calabresi (1970) also is clear that automobile insurance is a cost of owning a car, although he accepts the fact without criticizing it.³³ He describes a hypothetical situation the result of which absolutely depends on insurance being a cost of car owning.

If the cost of all automobile accidents were suddenly to be paid out of a general social insurance fund, the expense of *owning* a car would be a good deal lower than it is now since people would no longer have to worry about buying insurance. The result would be that some people would buy more cars. . . . [T]hey might be people who could only afford a second car so long as no added insurance was involved. In any case, the demand for cars would increase, and so would the number of cars produced. Indeed, the effect on car purchases would be much the same as if the government suddenly chose to pay the cost of steel used by automobile manufacturers and to raise the money out of general taxes.³⁴

Despite this car-owning-cost example, however, Calabresi goes on in Chapter 5 to imply that to be effective as an incentive to control accident costs auto insurance must be a cost of *operating* a car.³⁵ But if this were true, the situation described above—suddenly government pays the cost of all automobile accidents—would have a completely different result. If insurance were an operating expense that suddenly disappeared, rather than buying more cars, some people would do more driving. The demand for miles would increase. The effect on driving would be much the same as if the government suddenly chose to pay the cost of gasoline out of general taxes. In fact, Calabresi earlier in Chapter 5 actually makes the point that more driving would result if gasoline production were subsidized.³⁶

0.044.” This large negative effect of per-car insurance prices on car registrations has been confirmed nationally by Pritchard and DeBoer (1995) and for California by Jaffee and Russell (1998).

33. In a few places, however, Calabresi (1970: 9) inexplicably implies that liability insurance is a cost of driving. For example, he states that “[u]nder the current system, *driving costs* depend much more on the likelihood of imposing injuries on third parties” (Emphasis added.) In a later work on automobile accident costs Calabresi (1984: 836-37) does not even acknowledge that insurance is charged as a cost of car owning and instead calls it a “cost of driving.”

34. Emphasis added and footnotes omitted. Calabresi (1970: 71).

35. Despite very wide citations to most parts of *The Costs of Accidents*, the pages in Chapter 5 (68-94) are rarely cited. A noteworthy recent exception is in the book’s 35th anniversary symposium volume. Posner (2005: 15) comments that “[t]he exposition of the basic economics of accident control, notably in Chapter 5 of *The Costs of Accidents*, is exemplary.” It seems that Chapter 5’s exposition of the essential part automobile insurance plays for free market control of how much driving is done, and how it is done by vehicle type, has mainly not been engaged with.

36. *Id.* at 70 note 2. He notes the effect of subsidizing another cost of driving even if driving bears its share of the costs of accidents. “[I]f the petroleum industry were subsidized, we might have too much driving”

III.2. AF and NAF Accidents

Traffic accident involvements can be modeled as a process of random sampling of cars.³⁷ But unlike balls sampled from an urn, cars assigned to an insurance pool are not equally likely to be picked at random by an accident. They differ from each other by the number of miles each is exposed on the road to being sampled. While accidents randomly pick the pool's low annual miles cars along with middle- and high-miles cars, an accident sample of the pool obviously will not represent the mix of cars assigned to the pool but rather the proportions of miles these cars travel on the road. Therefore, the accident sample of cars in an insurance pool will be biased to the cars driven more miles.

The biasing process can be modeled by an imaginary insurance class pool composed of a mix of 2/3 5K annual-mile cars and 1/3 20K annual-mile cars, which approximates the highly skewed distribution of cars shown in Figure 2 (below). This mix produces a pool overall average of 10K annual miles per car. After three years at a road sampling rate (with replacement) of 5 accident involvements per 1 million miles traveled, the pool may be divided into a large accident-free main pool and a small accident-involved sub-pool. In the main pool the proportion of 20K mile cars is slightly reduced lowering the average annual miles from 10K to about 9.93K annual miles per car. But the accident-involved group shows a large increase in the proportion of 20K annual miles cars from 1/3 of the undivided pool to nearly 2/3 of the small accident-involved sub-group. Thereby its average miles becomes 14.6 K miles per car year, which is nearly 50% more than the pool 10K miles overall average.

It is inescapable that accident samples of insurance pools will be biased to sharply greater annual miles per car averages. Higher average miles per car will mean proportionately more claims per 100 car years. Furthermore, accidents as a random sampling process are indifferent to which of the accident-involved cars happened to have had drivers negligent at the time and which cars did not have drivers negligent at the time.

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. But this parallels the driver negligence idea that sub-groups of cars whose drivers are found negligent in past accidents will as a sub-group of their class continue to be negligent in the future.

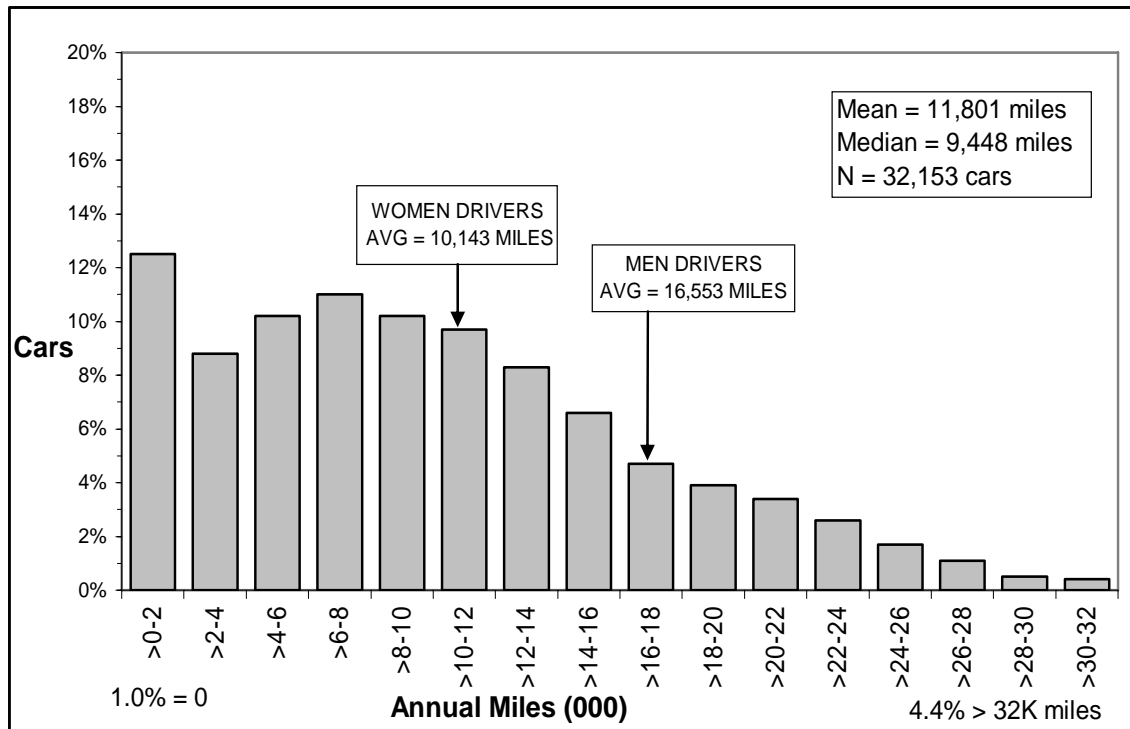
Where the group average odometer miles theory surpasses driver negligence theory in explaining accident-record predictors is that higher odometer miles per car predicts not only more liability claims per 100 insured car years for the group, but more accidents and claims of all kinds, at-fault and not-at-fault. This conclusion accords with the second suggestion by Lemaire (1985: 89) 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."

37. Such models are described and compared with insurance company surcharge schedules and state accident-involvement records by Butler and Butler (1989) and Butler (1993b).

III.3. Driver Sex and Car Age

The two predictors—driver sex and car age—provide calibration for the proxy odometer miles theory. Periodic Federal household transportation surveys give information not only on annual mile averages by car age and driver age and sex, but also on the much more important distributions of individual annual miles within these categories. Figure 2 shows the bimodal and positively skewed distribution of cars by

FIGURE 2. Distribution of Cars by Odometer Miles in 1995



annual odometer miles, but men’s 60% greater annual miles average than women’s—16,553 miles versus 10,143 miles, Fig. 2—does not tell much. Men at every age average more miles of driving and concurrently more state-reported accident involvements than women the same age, as shown in Fig. 1 (above). However, by adjusting the driver age and marital status definitions of price classes, insurers confine direct pricing by driver sex to a minority of cars.³⁸ Where insurers do use driver sex, the price classes serve as proxy odometers for the average annual miles of cars. But pricing of any or all cars by driver

38. Discretionary use of pricing rules to favor some customers is noted for French insurers by Chiappori and Salanié (2000: 71) where a company may allow—evidently contrary to its guidelines—a young driver to share a parent’s “Bonus” (years-claim-free) discount instead of having over the years to earn their own discount but that “a typical insurance company will be reluctant to accept such a deal unless the father is a good customer.”

sex is wildly inaccurate for individual cars.³⁹

In separate distributions of men and women drivers by annual miles and by annual accident involvement probabilities, the miles and probabilities of a large minority (about 30%) of men drivers are less than the averages for women drivers, and concurrently a somewhat smaller minority (about 12%) of women drive more and have a greater probability of accidents than men's average miles and accident probability.⁴⁰

Federal travel surveys also confirm common knowledge that older cars are driven less than newer cars, Figure 3. In fact Pinquet (1999, p. 50) observes that

hidden variables are correlated with observable ones: for instance, the age of a vehicle is a good proxy for annual mileage.⁴¹ The price of second-hand cars depends more on their age than on their mileage, so the less you drive, the more you are financially incited to buy a car second-hand, and to keep it as long as possible. This explains the significant influence of the age of the vehicle on the frequency risk.

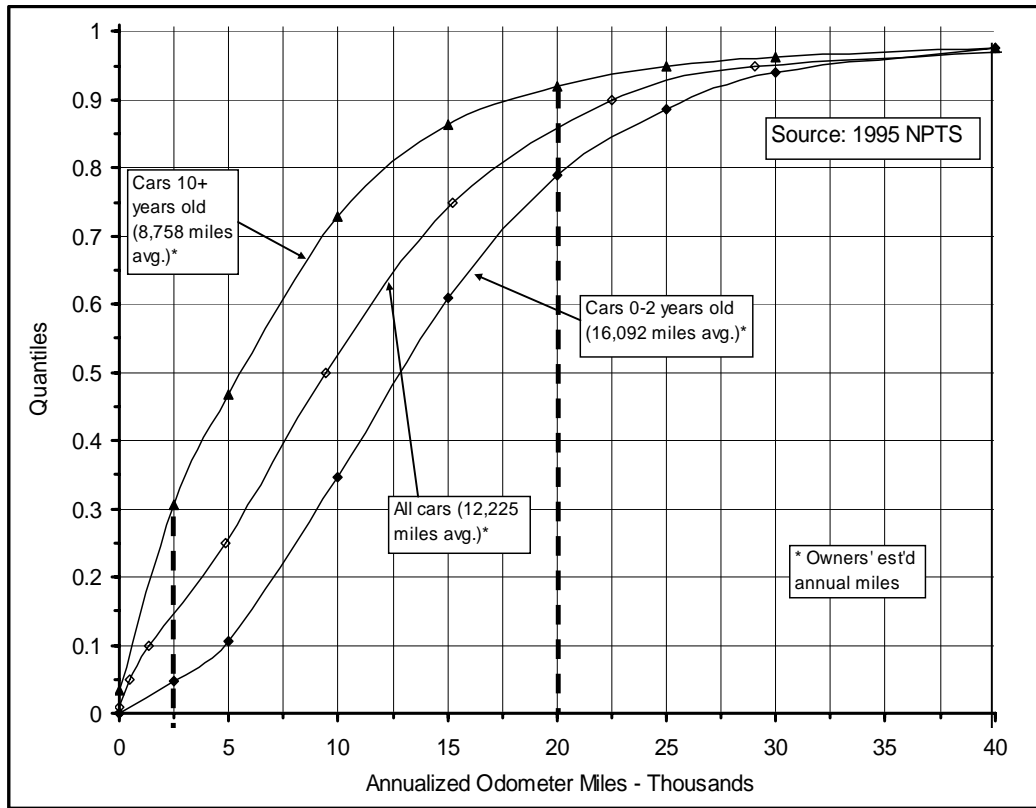
Nonetheless, categorizing cars by age would be using the category averages as proxy odometers, when the use of individual real odometers is called for. Despite the relatively large spread in annual mile averages represented by car-age categories, federal surveys show a much larger spread *within* age categories. Several million late model cars are only driven a few thousand miles a year while many million older cars are still driven above average miles.

39. The distribution of cars by annual miles is positively skewed because from three-fifths to two-thirds of cars are driven less than average, overall and for different car age groups. 1995 NPTS age group and overall average miles from Hu & Reuscher, 2004, Table 22.

40. Butler et al., 1988, pages 395-401.

41. The distinction here between *hidden* and *observable* variables implies that a car's age but not its odometer is observable by insurers. Despite being ignored by insurers, however, by law a car's odometer must permanently and observably record each mile the car is driven. Rather than incorrectly being called a hidden variable, odometer miles are in the category of "unused observables" that are not used as a price unit for driving coverages by insurers despite availability and relation to risk. As noted above in footnote 15, this insurance practice is analyzed by Finkelstein and Poterba (2006). They note that in many insurance markets (including automobile insurance), "asymmetrically used information occurs because insurance companies choose not to use risk-related buyer information that they collect, or could collect, to set prices." They investigate whether or not buyers themselves instead might be unilaterally ("asymmetrically") making use of the risk-related information to their own advantage even though insurers also have access to the information.

Figure 3. Annual Miles Distributions of Cars by Age Group



The overlap between new and old cars in annual miles is illustrated in Figure 3 at two annual mile values. Among the household cars extrapolated to be driven less than 2,500 annual miles are nearly 5% of the new cars zero to two years old, and 31% of the old cars ten or more years old. Similarly among the cars driven more than 20,000 annual miles are 8% of the old cars and 21% of the new cars.

Insurers are using correlations with proxy odometers that register 50% to even 100% differences between groups in claim frequencies per 100 car years. But the eight times difference between 2,500 miles and 20,000 miles excludes about 30% of cars that are driven less and more than these amounts. Insurers may be indifferent to such ranges in miles, but car owners whose needs for miles and whose economics are constrained by income and financial condition cannot afford to be indifferent to the car-owning economics of auto insurance.

III.4. Zip Code and Credit Score

Zip codes and credit scores separate drivers according to their financial status. Each variable is a measure of how strongly car owners might need to economize on auto insurance as well as on all other expenditures. Owners residing in low-income zip codes and owners in all zip codes with straitened financial circumstances indicated by low credit scores evidence a stronger need to economize than do owners living in higher income zip codes, or with higher credit scores. If insurers decide in deference to favored market segments to disregard some proxy-odometer variables, such as car age entirely

and driver sex for a large majority of cars, then it is logical to expect insurers to employ other proxy-odometer variables when the segments affected are not so favored. This is true for residents of low income zip codes whose insured cars produce more claims per 100 car years than produced by the cars of owners living in nearby zip codes.⁴² Similarly, the stigma of poor credit is making it politically feasible even in higher income areas for insurers to use the correlation of higher claims per 100 car years with low credit scores as a basis for higher prices. As is the case with men's cars and newer cars, category values that produce more claims per 100 car years are evidencing more miles driven per car. Even though low-income drivers average less driving, the insured cars they share must be driven more than average to account for more than average claims per 100 car years.

The basis for the sharing-insured-cars explanation was described in 1968 by William Vickrey. In enumerating obvious economic harms caused by charging for insurance as a cost of owning a car, he included these two: "The premium structure thus has the general effect of promoting excessive use of a given stock of cars and undue stinting on the ownership of cars." Vickrey (1968: 471). Although Vickrey noted the harm to automobile manufacturers, neither he nor any other economist since has identified the apparently not-so-obvious harmful feedback effects the price structure must have on some of the insurance prices themselves.

The first theoretical description of how undue stinting on ownership of cars and excessive use of a given stock of cars must cause high insurance prices in low income zip codes was published in a report to the Texas Legislature by Butler in 2000 (pp. 18-19). Drivers who want to economize on automobile insurance buy less of it. Since the purchase unit is a car year (divisible into car days), these drivers first take their less-driven, marginal cars out of insurance pools and then they share cars kept insured. But each action constitutes adverse self-selection against the pools: first by taking more premium than miles out of the pools, and then by adding miles without premium to the pools by sharing insured cars. When insurers react to more claims per 100 car years by increasing the price of coverage per car in what they call hard-to-serve zip codes,⁴³ the price increase can set off an upward spiral of fewer insured cars, more average odometer miles per insured car, more claims per 100 insured car years, and further increases in the per-car price of insurance.

42. *E.g.*, urban area zip codes in Missouri that contain higher black (and concurrently lower-income) populations average 8.25 liability claims per 100 insured car years which is 36% more than the 6.06 claims averaged by car owners living in the other urban area zip codes. Harrington and Niehaus (1998, p. 454).

43. The price increase may not be directly targeted at a zip code. Instead the increase results from standard companies using underwriting criteria that refuse insurance to most car owners in the zip code. Therefore, these owners are forced to buy higher-priced insurance from so-called non-standard companies. In some cases, the companies with higher prices are members of the same corporate group as the lower-priced standard companies.

IV. Conclusions

Each theory to explain variations in claim frequencies per 100 car years posits the existence of an unmeasured cause proxied by the predictive variables considered. Either the variables serve as proxies for driver negligence, or they serve as proxies for average odometer miles.

Three of the six predictors considered are most telling *against* the driver negligence theory and *for* the odometer miles theory. First, insurers find that in using accident involvements, fault is predictively irrelevant. This fact is incompatible with the driver negligence explanation, but it is a necessary consequence of the average odometer miles explanation.

Second, if insurers used the car age predictor, driver negligence theory could not explain why negligence increases when an old car is traded for a newer one. But this predictor *is* explained by the known decrease in average odometer miles with car age.

Third, to explain the predictor variables that proxy for financial condition, the driver negligence theory—often by implication in default of an alternative explanation—further stigmatizes low-status groups as high-risk drivers. But the proxy odometer miles theory explains that the correlations are the irresistible result of Demand Law reactions to insurance charged as a cost of car owning. The car-year price structure actually forces—against the wills of car owners—adverse selection of marginal cars out of insurance pools and thereby creates hard-to-serve, self-destructive markets.⁴⁴

Ironically, very popular public policy for greater enforcement of mandatory liability insurance amounts to attempts to force marginal, below-average-miles cars back into insurance pools. Understanding of the odometer miles theory, however, would suggest that the increased risk of arrest for driving uninsured cars just forces more miles onto the cars that are kept insured. Of course, this in turn increases the price of insurance which forces more marginal cars out of the insurance pools.⁴⁵

Confronted by such dilemmas, as well as by automobile insurance predictive correlations, driver negligence theory seems to be incapable of providing any coherent explanations.

44. Understanding the current adverse self-selection spiral, which affects about 20% of the market, gives insight into why established insurers might be extremely reluctant to offer a cents-per-odometer mile alternative to their current dollars-per-car-year prices. The stability of 80% of the current market absolutely depends on the financial ability of owners of cars driven low miles annually to pay premiums tied to the average miles per car year of their class risk pools. Offered a choice, many of these owners would switch their cars from car-year to odometer-mile class pools. As now when economizing drivers take low miles cars out of car-year pools, the switch to odometer mile pools would take more premium than miles from current pools. The annual miles per car—and claim frequency per 100 car years—would rise. The inevitable rise in car-year prices would cause more owners of cars driven less than their pool's rising average miles to switch them to odometer mile pools. But, instead of a threat, such a spiraling effect would represent an opportunity for a startup company selling automobile insurance only by the odometer mile.

45. The automobile insurance industry response to this dilemma is to oppose mandatory liability insurance and its enforcement, as the industry has adamantly but quietly (owing to its public popularity) done in state legislatures since at least the 1920s.

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