

Drinking, Driving, and the Price of Automobile Insurance

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ABSTRACT

This study describes premium penalties imposed by insurers for drunk driving and other chargeable accidents, assesses why variations in premiums for drivers with clean records and adverse records differ across states and insurers, and determines the effect of imposing penalties on persons convicted of drunk driving. There are significant differences among insurers in treatment of violators, both in underwriting and in premium setting—which are in part attributable to state policies, such as imposition of take-all-comer rules. Imposing premium surcharges for a charge of drunk driving has a significant deterrent effect on the probability of drinking and driving.

Introduction

Driving under the influence of alcohol (DUI) has become an issue of national concern, at both state and federal levels. Increased awareness of the danger of drinking and driving was reflected in a substantial amount of legislative activity during the 1980s—mainly to raise criminal sanctions for drunk driving—and in renewed efforts at law enforcement (Jacobs, 1989). At the same time, there was a consumer revolt against the rising price of automobile insurance, especially in certain jurisdictions such as California, where Proposition 103—which called for sweeping changes in auto insurance regulation—was enacted by voters in 1988.

Coexisting with applicable criminal law is the drunk driver's liability for property damage and personal injuries resulting from accidents under tort law, which is designed to deter careless behavior by making individuals financially

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responsible for the consequences of failing to take due care. Individuals purchase insurance to cover such losses when they occur. Such insurance may blunt the potential effect of tort liability, especially if premiums are not set to accurately reflect insureds' expected losses (Abraham, 1986, pp. 45-49; Boyer and Dionne, 1989; Shavell, 1979).

But insurance may not reflect insureds' expected loss for several reasons. First, precautions are costly for the insurer to observe and typically can be observed only after an accident. Second, these *ex post* observations of care are often inaccurate. Public records of drivers' key performance measures are often not well maintained. Errors, especially omissions, in public accident records have been documented.¹ Third, inferences about a person's driving behavior based on traffic violations may be even more problematic. The relationship between an adverse event, such as a traffic conviction, and subsequent driving performance is not understood. Fourth, some adverse events are rare, and by using a rare event for insurance classification, the insured may be placed in a risk category with a much higher premium based on that one relatively rare mishap (Palfrey and Spratt, 1985). A pricing system based totally on prior adverse events, especially rare ones, would place a substantial premium penalty on each event (Lemaire, 1985). Basically good drivers who make a very occasional lapse may be unduly penalized. But the alternative approach of relying largely on demographic factors for risk classification purposes has been viewed as inequitable, because the factors are beyond a policyholder's control and cannot be said to have caused an adverse record.²

To obtain information on underwriting and premium-setting practices of automobile liability insurers, we conducted surveys in 1991 of the 18 largest automobile insurers in the United States, seven companies specializing in nonstandard automobile risk, and all state insurance departments—the latter to document pertinent statutes and regulations. With these data and data from secondary sources, including state assigned-risk plans or other risk-pooling arrangements and the Behavioral Risk Factor Survey, this study addresses several questions: What are the premium penalties imposed by insurers for DUI charges and other chargeable accidents? What is the mix between underwriting and premium-setting practices? Why does observed variation in premiums exist, especially in surcharges imposed on drivers with traffic law violations and chargeable accidents? What are the potential causal factors reflecting both state and company policies? What effect have insurance surcharges on drunk drivers had on the propensity to drive under the influence of alcohol? The article concludes with a discussion of the policy implications of our findings.

¹ Using a sample of almost 28,000 collision claims, the Insurance Research Council requested motor vehicle records on those involved in accidents. Only 40 percent of accidents appeared in the records. Furthermore, 16 states do not make motor vehicle records available (Insurance Research Council, 1991).

² Such factors as race and age may be "inadmissible" for risk classification purposes for social and moral reasons (see Abraham, 1986, pp. 64-100). Raising premiums to persons in demographic groups with adverse driving records may reduce driving activity by such persons and, hence, reduce losses from accidents.

How Driving Records Affect Premiums

Overview

The automobile insurance industry comprises three different types of insurers: standard insurers, nonstandard insurers, and the involuntary market. The nonstandard market specializes in insuring risks that are rejected by standard insurers, but at appreciably higher premiums (U.S. General Accounting Office, 1986, p. 39). Five states have enacted take-all-comer laws, which state that insurers must insure all drivers; in these states, there is almost no market for nonstandard insurers.³

All states have established mechanisms for ensuring that drivers unable to obtain insurance in the voluntary market can obtain insurance at the minimum financial responsibility limits established by state law, but generally for higher premiums. Although nonstandard insurers' premiums tend to be lower than those in the involuntary market, they often limit the amount of coverage that a driver can purchase. Also, nonstandard insurers may not be willing to renew certain drivers' coverage.⁴ The nonstandard insurers may attract low risks by offering limited coverage at lower premiums than those charged in the involuntary market, thus leaving the higher risks to the involuntary market.

The involuntary market operates at a deficit in most states, with the amount of the deficit varying widely among states. Because insurers in the voluntary market must make up the deficit, much of the shortfall is ultimately borne by the policyholders of standard and nonstandard insurers. Since nonstandard insurers are less selective in underwriting but often limit coverage that can be purchased, one explanation of the deficit is adverse selection by those who purchase relatively high liability limit policies from the involuntary market coupled with lags in raising premiums.

Survey Methodology

We conducted two surveys of insurers by mail in 1991 to learn about how DUI convictions and chargeable accidents affect premiums and the willingness to sell coverage to persons with such violations and accidents. The Survey of Insurers was sent to the 20 largest automobile insurers measured in terms of premium volume. The insurers were asked to provide information on underwriting practices and premiums for the states in which they wrote coverage. Some insurers sold liability insurance through their nonstandard automobile insurance carriers as well as through standard carriers. Two insurers did not respond to the survey because they had withdrawn from the automobile liability line. One of the 18 responding insurers refused to provide premium information but did

³ The states are Hawaii, Massachusetts, New Hampshire, North Carolina, and South Carolina.

⁴ Documentation for this is provided below. In most states, the involuntary market is operated through an assigned risk plan. Each insurer is assigned drivers who apply to the plan in proportion to the insurer's share in the voluntary market. Other arrangements are joint underwriting associations, reinsurance facilities, and state funds (Automobile Insurance Plan Services Office, 1990).

answer the questions on underwriting policies. Another company refused to answer questions about underwriting but was willing to provide premium data. One of the 18 insurers surveyed sold automobile liability insurance in only one state. Several insurers surveyed sold auto liability insurance in virtually all states.

The questionnaire requested the following information: (1) general characteristics of the insurer; (2) underwriting practices as they apply to (a) new applicants and (b) renewals; and (3) premiums for various types of drivers—specified by both demographic characteristics and driving histories. The underwriting and premium-setting questions were asked for each state in which the insurer sold automobile liability insurance. Based on the advice of a panel of industry experts we convened prior to the survey, we did not request information on premium levels. Instead, the premium questions were specified in terms of percentage surcharges for particular violations and chargeable accidents. We posed the questions to ensure that responses were comparable across states and not dependent on drivers' characteristics and driving records included in the base. We described in detail the type of driver and driving history to which the surcharge was to apply. One respondent supplied information on premium levels, although we had requested information only on percentage surcharges.

The second survey, the Survey of Nonstandard Insurers, was sent to the ten largest companies that specialized in selling coverage to high risk drivers. Three insurers refused to participate, stating that they did not have the resources to complete the survey. This survey contained many fewer questions on underwriting practices because these insurers tend to impose few restrictions on whom they sell coverage. We requested state-specific information on premium levels for coverage at each state's minimum financial responsibility limit and for 100/300/50 coverage. Relatively few nonstandard insurers offered the more extensive coverage.

Both surveys revealed appreciable interstate variation in premiums or premium surcharges for most insurers. For example, one nonstandard insurer with business in most states charged from \$264 (South Dakota) to \$996 (Virginia) per annum for liability coverage at the financial responsibility limits to an over-25 married male driver of a 1988 Toyota Camry sedan with one DUI and no accidents or other moving violations.

Underwriting Practices and Premium Surcharges

Standard insurers. We asked standard insurers whether they accepted drivers with various types of driving records in their standard and nonstandard companies. We asked separate questions for new applicants and for renewals for the companies that had nonstandard business. Insurers described their underwriting policy for a married male over age 25 who drives a 1988 Toyota Camry Sedan 15,000 miles a year, drives to work less than ten miles each way,

and lives in a rural area⁵ with the following alternative driving records in the past three years: one DUI violation, one DUI violation and a chargeable accident, and one chargeable accident. The question about a hypothetical male driver with a DUI conviction was also asked for a male under age 25.

With the exception of take-all-comer states, where all risks are accepted, the vast majority of these insurers would not take a new applicant with a DUI violation during the past three years in their standard companies. The few standard insurers that had nonstandard companies would accept such a new applicant in their nonstandard companies. By contrast, new applicants with only one chargeable accident in the last three years were usually accepted by the standard companies. Insurers were slightly more willing to accept renewals with a DUI in their standard companies. The difference between renewals and new applicants is that the insurer has private information on renewals' accident records, and this information should increase accuracy in risk classification.

Standard insurers provided information on the average percentage surcharges by state for drivers with each of the histories described above and for two other scenarios: a male over age 25 with a chargeable accident with property damage over \$500, and a male under 25 with a clean record during the previous three years. Except in take-all-comer states, the premium differentials for drivers with a DUI applied to the few renewals these insurers were willing to retain.

Pooling information by insurers and states, the mean surcharge for one DUI for males over age 25 was 163 percent (see Table 1). For drivers under 25, the markup was even higher, 223 percent (262 less the 39 percent markup paid by under-25 male drivers with clean records). Surcharges for chargeable accidents were 37 to 39 percent on average. Judging from the standard deviations, there was appreciable variation in percentage surcharges among states and insurers.

There was a ten-fold variation in the percentage differentials for drivers with a DUI (see Table 2). The differentials among the five highest states varied from 503 percent (South Carolina) and 398 percent (North Carolina) to 210 percent (Michigan). Differentials among the five lowest states varied from 42 and 66 percent (Massachusetts and New Jersey) to 125 percent (Louisiana). The remaining states had mean differentials within a narrow range. The top three states were take-all-comer states, as was Massachusetts. However, in Massachusetts, the state department of insurance set premium levels ("bureau made rates").

In the states at the top and bottom of the distribution of percentage surcharges, point systems implemented by the states influenced the differentials.⁶ Without government intervention to ensure that careless driving is penalized, the dispersion in premium differentials among states would presumably have been somewhat lower, although sizable nevertheless.

⁵ Rural areas (lowest rated territory) across states are reasonably similar in terms of road conditions and traffic density. By contrast, states differ widely in these dimensions among their urban areas.

⁶ See U.S. General Accounting Office (1986) for a description of point systems in two states.

Table 1
 Premium Differentials for a Married Male Over Age 25 (in percent)

<i>Driving Record</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>N (All States Combined)</i>
One DUI	163	100	428
One Chargeable Accident with Property Damage over \$500	39	25	482
One Chargeable Accident	37	22	481
Clear Record Under Age 25	39	30	495
One DUI with Associated Chargeable Accident Under Age 25	262	146	422

Source: Survey of Standard Insurers.

Note: All differentials are relative to a married male over age 25 with a clean driving record. The driving record reflects experience during the past three years. The number of observations by state are available from the authors upon request.

There were appreciable differences in surcharges for a DUI within states. This was true even for states with low mean surcharges, such as New Jersey and Texas. We did not obtain information on numbers of policyholders surcharged.⁷

Dispersion among states in premium differentials for one chargeable accident was much lower. From the highest to the lowest states, the percentage differentials ranged from 55 percent for South Carolina to 20 percent for Massachusetts. Patterns for the remaining demographic/driving history scenarios included in our survey were quite similar to those presented in Table 2.⁸

The insurer that provided data on base premiums charged a mean of \$258 per annum for liability coverage, which just covered each state's minimum financial responsibility limits.⁹ This was for a male over 25 with the characteristics described above. The insurer charged \$532 for comparable coverage for one DUI and \$410 for one chargeable accident involving property damage over \$500. The percentage surcharge for one DUI was 106 percent, lower than the 163 percent surcharge for the standard insurer sample as a whole. The markup

⁷ There was intrastate variation in surcharges, even in states with point systems. Such variation may occur for several reasons. First, one insurer responding to our Survey of Insurers indicated that there were geographic differences within some states in the way point systems are applied. So the insurer's surcharge in a state would depend on the policyholder's exact location within the state. Second, point systems sometimes make finer distinctions than the scenarios we posed in our surveys. For example, in South Carolina, a DUI was to be assigned 15 points. However, 20 points were to be assigned if the driver convicted of a DUI caused bodily injury exceeding \$300 per person or resulted in damage to property of the insured or other person over \$750 (State of South Carolina, 1992, pp. 338-344). It was not possible to develop scenarios for insurers that would describe all possible nuances of point systems. Third, for various reasons, some insurers may have obtained exceptions to the surcharges specified in the point system.

⁸ The similarities are among the three chargeable accident categories and between the two DUI categories listed in Table 1.

⁹ The insurer's premiums are in the mid-range of standard insurers (*Consumer Reports*, 1988).

Table 2
 Highest and Lowest Surcharges for Males Over Age 25
 (Expressed as Percentage of Premium),
 18 Largest Automobile Insurers

	Mean	Minimum	Maximum	N
<i>One DUI, Five Highest States</i>				
South Carolina ^{a,b}	503	155	999	6
North Carolina ^{a,b}	398	381	405	6
Hawaii ^a	292	130	450	6
New Hampshire	253	110	480	7
Michigan	210	122	320	7
<i>One DUI, Five Lowest States</i>				
Massachusetts ^{a,b,c}	42	35	55	3
New Jersey ^b	66	0	178	5
Texas ^{b,c}	106	60	300	8
Rhode Island ^b	112	0	200	7
Louisiana	125	80	260	7
<i>One Chargeable Accident, Five Highest States</i>				
South Carolina ^{a,b}	55	20	136	6
California	53	13	201	12
New Hampshire	49	10	90	8
Arizona	47	10	90	10
New Mexico	44	10	90	9
<i>One Chargeable Accident, Five Lowest States</i>				
Massachusetts ^b	20	14	28	4
North Carolina ^{a,b}	25	10	40	7
New York	27	10	45	9
Alaska	30	10	50	6
Texas	30	15	73	9

Source: Survey of Standard Insurers.

Note: All differentials are relative to a married male over age 25 with a clean driving record. The driving record reflects experience during the past three years.

^a Take-all-comer states.

^b State used point system. Insurers were required to raise premiums by a percentage amount following a traffic conviction or chargeable accident.

^c State had bureau-made rates.

for one chargeable accident was similar: 59 percent for the company versus 60 percent for the entire sample.

Nonstandard insurers. The seven nonstandard insurers were always willing* to insure people with a DUI, but the majority limited the amount of liability coverage that they or people with much better records (e.g., one chargeable accident) could obtain. The nonstandard insurers provided information on premiums charged drivers with the same type of records described above. In contrast to the standard insurers, which imposed a much higher surcharge on a DUI, the nonstandard insurers charged about the same premium for a DUI as

for a chargeable accident—\$406 and \$407 on average, respectively, for coverage in the lowest rated (generally most rural) territory at the state's minimum financial responsibility limits.

Premium Surcharges Imposed by Involuntary Plans

We obtained comparable information on premiums from involuntary plans in 49 states from those plans' rating manuals. Comparing premiums for minimum financial responsibility coverage, the involuntary market plans consistently charged drivers with one DUI more than did the nonstandard insurers. In only three of 37 states (Illinois, Maryland, and Virginia) for which comparisons could be made was a nonstandard insurer's premium higher than the involuntary plan's.¹⁰ The involuntary plans charged a married male driver with one DUI a mean base premium of \$931, compared to \$406 charged by nonstandard insurers (see Table 3). There was considerable variation in premiums among the plans for nearly identical coverage. Premiums ranged from \$2,272 in Hawaii to \$418 in Nebraska. For example, South Carolina and North Carolina charged a male with one DUI in the last three years \$1,981 per annum for 15/30/5 coverage. By contrast, Massachusetts charged such a driver \$420 and New Jersey \$466 for the same coverage limits. The latter states were the two highest in the percentage of insured drivers in involuntary plans (Automobile Insurance Plan Services Office, 1990).

Premiums and Premium Differentials for a Bad Driving Record

Analytic Framework

Premium-setting model. In the theory underlying premium determination, the path of premiums for an insured over time involves a process of Bayesian updating (Lemaire, 1985). Initially, the individual's expected claims frequency is estimated based on the best information currently available. Lacking better information, such observable factors as age, sex, marital status, type and use of vehicle, and driving experience are used. At the end of each period, actual claims frequency is observed and the premium is modified. In an experience-rated system, the proxies receive increasingly less relative weight in determining the individual premiums as the insurer accumulates information on the insured.

We generally did not have access to specific premium-setting methodologies used by insurers. Our empirical analysis of premiums used the following approximation of the premium-setting process.

Let the base premium (premb) depend on several continuous variables, including claims frequency and severity (x), and binary characteristics of the regulatory environment and insurers (y):

¹⁰ The seven nonstandard insurers we surveyed did not write automobile liability coverage in all states.

Table 3
Mean Premiums Charged by Nonstandard Insurers and
Involuntary Market Plans (in Dollars)

	<i>Type of Coverage</i>					
	<i>Financial Responsibility Limit</i>			<i>100/300/50</i>		
	<i>Mean</i>	<i>Standard Deviation</i>	<i>N</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>N</i>
<i>Nonstandard Insurers</i>						
One DUI	406	200	104	602	339	37
One DUI and One Chargeable Accident	478	250	104	702	434	37
One Chargeable Accident	407	197	104	607	336	54
Male Under 25 with Clean Record	462	263	104	611	382	54
Male Under 25 with One DUI and One Chargeable Accident	712	455	104	1039	767	36
<i>Involuntary Market Plan</i>						
One DUI	931	538	49 ^a	---	---	---
One DUI and One Chargeable Accident	1123	614	49	---	---	---
One Chargeable Accident	493	213	48 ^b	---	---	---
Male Under 25 with Clean Record	573	219	48	---	---	---
Male Under 25 with One DUI and One Chargeable Accident	1465	638	49	---	---	---

Sources: Survey of Nonstandard Insurers and state assigned risk rating manuals.

Note: Unless otherwise specified, premium was based on married male over age 25. The number of observations by state are available from the authors upon request.

^a Excludes Missouri and New Hampshire.

^b Excludes Hawaii, Missouri, and New Hampshire.

$$\ln(\text{premb}) = \alpha_0 + \beta_0 \ln(x) + \gamma_0 y. \quad (1)$$

The premium after an adverse outcome has occurred (preme) is

$$\ln(\text{preme}) = \alpha_1 + \beta_1 \ln(x) + \gamma_1 y. \quad (2)$$

Then the difference, which is the percentage premium differential, is

$$\ln(\text{preme}) - \ln(\text{premb}) = (\alpha_1 - \alpha_0) + (\beta_1 - \beta_0) \ln(x) + (\gamma_1 - \gamma_0) y. \quad (3)$$

Characteristics of the policyholder are reflected in the α s. Thus, for example, α_0 might be a married male under 25 with a clean driving record; α_1 might be a married male under 25 with one DUI in the past three years. The estimated intercept of equation (3) gives the difference between the two alphas. If x and y affect premiums differently following the adverse event, the parameter estimates for the differences of individual β s and γ s should be nonzero.

Conceptually, there are reasons to expect differences in these parameters. Areas with high claims frequency and severity may have more policyholders with poor driving records in the base. Thus, drivers with identifiable bad

driving records may differ less from drivers charged the base rate than in areas with more favorable loss experience. Likewise, when public records on individual drivers are comparatively inaccurate, drivers in the pool used to calculate the base should be more heterogeneous, and drivers with more adverse experiences on their records consequently should be surcharged less. States' prohibitions against using particular demographic characteristics for rating purposes could affect the premium surcharge for an adverse driving record. If, for example, age is predictive of care in driving but cannot be used as a variable in premium setting, then adverse occurrences such as a DUI are likely to be given greater weight when they occur.

Role of information available to insurers. The amount of information available to insurers on new applicants is likely to vary. If information is poor, it is difficult for the insurer to distinguish good and bad drivers among new applicants. Lack of information should result in more heterogeneous drivers in the base and, hence, a higher base premium. Then, when an adverse event such as a DUI conviction or a chargeable accident subsequently occurs, the insurer would raise the premium less.

States vary in the percentage of accidents known to insurers that were found in state motor vehicle records. In 1990, eleven state motor vehicle divisions did not release accident records to other insurers without permission from the company that insured the accident, and five others released them on a very limited basis (Insurance Research Council, 1991). States also differed in the number of years that traffic-related convictions, including DUI convictions, stay on the books—from three to indefinitely (Insurance Research Council, 1991). In some states, DUIs and other major traffic-related convictions can be erased from one's motor vehicle record by attending a driving school.¹¹

Analysis of Premium Levels

Empirical specification. Lacking data on premium levels from our Survey of Standard Insurers, we examined variations in premium levels for drivers with clean records using data published in Smith and Wright (1992). The data were for base premiums for 50/100/25 coverage with uninsured motorist 15/20, collision \$250 deductible, comprehensive \$250 deductible, and MED/PIP = the amount of personal injury protection required by state law in 28 very large cities.¹² Premiums were published for hypothetical people/families with clean driving records for (1) a married male age 45 who drives a 1987 Chevrolet Caprice, (2) a single male age 19 who drives a 1987 Chevrolet Caprice, (3) a

¹¹ There is some empirical evidence that insurers engage in "low-balling," that is, lowering premiums as the insurer gains (favorable) experience with a policyholder (D'Arcy and Doherty, 1990). This creates a differential between what the policyholder's existing insurer charges and what any other insurer that would have less information on the person would charge. With our data, we were unable to study this phenomenon.

¹² Cities and suburbs were sometimes included as separate observations. Uninsured motorist coverage limits were for bodily injury only. The first number is the limit per person and the second is limit per accident.

two-car family with a father (married male) age 50 and son (single male) age 19 driving a Chevrolet Caprice and a mother (married female) age 50 and a son (single male) age 17 driving a 1982 Buick LeSabre, and (4) a married male age 45 who drives a four-door 1988 BMW 325E.

We also analyzed variations in premium levels for drivers with some adverse experience from our Survey of Nonstandard Insurers. The observational unit was the premium charged by an insurer in a state. These premiums were defined for a minimum financial responsibility liability policy for (1) a married male over age 25 with one DUI, (2) a married male over 25 with one chargeable accident, and (3) a male under age 25 with one DUI and a chargeable accident. Mean values by state of responses to our survey were the observational units.¹³

Explanatory variables common to all specifications were the number of paid claims per 100 drivers, the mean value of closed paid claims ("claim severity"), a binary variable indicating states with prior approval premium regulation with the omitted reference group being states with various forms of competitive rating, the percent of accidents known to insurers found in state motor vehicle records ("record accuracy"), the percent of total written car years in the state's involuntary market, the ratio of uninsured to insured bodily injury claims to measure the prevalence of uninsured drivers in the state, and a binary variable identifying states with no-fault plans.

In the city analysis, we also included a binary variable identifying observations corresponding to a suburb of a city and a binary variable for cities located in states with take-all-comer laws.¹⁴ A variable identified cases in which the observation was for drivers with clean records in a city suburb. In the analysis of premium levels based on our Survey of Nonstandard Insurers and other sources, a "high rating area" variable identified cases in which the nonstandard insurer reported a premium for the highest rated territory rather than an average for the state or for the lowest rated territory.

The dependent variable, claims frequency and severity, the record accuracy measure, the involuntary market share, and the variable for uninsured drivers were specified in natural log form. All other variables were entered linearly. We obtained information on state regulatory policies from a 1991-1992 survey of state insurance departments, to which all states responded. Definitions and data sources are shown in the Appendix.

¹³ Numbers of responses per state used to compute the observational means are shown in Table 3. When there was more than one observation per state, within-state differences in premiums tended to be large. For example, the premium range (mean, minimum, maximum) in the first five states in alphabetical order for married males over age 25 with one DUI are: Alabama—\$379, \$326, \$432; Arizona—\$514, \$225, \$1,068; Colorado—\$494, \$400, \$588; Florida—\$408, \$372, \$444; and Georgia—\$441, \$346, \$544. In initial runs, we included an explanatory variable for the states' minimum financial responsibility limits. This variable was dropped after it demonstrated no effect on premiums.

¹⁴ The latter variable was not included in the analysis of premium levels of nonstandard insurers, because there is virtually no nonstandard market in such states.

In an alternative specification, we treated the involuntary market share and the uninsured ratio as endogenous variables. We describe the approach used in the analyses of premium levels with the city as the observational unit here. Instrumental variables for the involuntary market share were binary variables for type of involuntary plan in the state, joint underwriting association versus other, and the percentage of the vote received by the 1984 Republican presidential candidate (a measure of political conservatism and, hence, relative reluctance to cross-subsidize drivers with poor records). The equation had an R^2 of 0.22. Parameter estimates on both explanatory variables were statistically significant at the five percent level. The joint underwriting association coefficient was positive, and the coefficient on the Republican variable was negative. The instrumental variables for the ratio of uninsured to total bodily injury claims were (1) a binary variable identifying states with a compulsory liability insurance law, (2) per capita income, and (3) population density in the state. Compulsory insurance should decrease the uninsured ratio. Since less affluent people have less to lose from a lawsuit, they should be less likely to purchase liability coverage. There are more transients in populous cities and, thus, more uninsureds. On the other hand, the claims rate would tend to be higher in such areas. The equation had an R^2 of 0.12. Only the parameter estimate on the per capita income variable was statistically significant at conventional levels. The coefficient was negative.

Results. In our analysis of premiums for people/families with clean driving records, the parameter estimates on mean severity imply elasticities of severity on premiums of slightly over one (see Table 4). However, the parameter estimates on the claim frequency variable are sometimes negative. The elasticities for claim frequency and severity are additive. The sum shows the effect of loss per 100 drivers on premiums. The sums of the parameter estimates are statistically significant at the one percent level and imply elasticities of premiums to loss ranging from 0.7 to just over one.

Prior approval regulation reduced premiums by 21 percent (fourth regression) to 31 percent (third regression). Not surprisingly, the positive effect of the take-all-comers rule is most apparent on premiums paid by young single male drivers. Standard insurers may often reject such applicants, but, in take-all-comer states, they must accept all such drivers, albeit at a higher premium (26 percent higher). As anticipated, premiums were lower in cities located in states in whose motor vehicle divisions maintained more accurate records on accidents. Holding other variables constant, the ratio of uninsured to total bodily injury claims has no impact on premiums.¹⁵ In the fifth regression, we specified the involuntary market share and uninsured ratio as endogenous variables. Treating these variables as endogenous does not have much of an effect on these or on the other coefficients. Premiums were 36 to 49 percent

¹⁵ The simple correlation between the uninsured motorist share and claims frequency is -0.06, and the simple correlation between the uninsured driver measure and claims severity is 0.12.

Table 4
Regression Results: Base Premium Levels in Very Large Cities

	<i>Married Male 45</i>	<i>Single Male</i>	<i>Married Two-Car Family</i>	<i>Male 45 Sports Car</i>	<i>Married Male 45^a</i>
Intercept	4.23* (0.98)	4.44* (0.95)	4.92* (1.01)	4.82* (1.15)	4.12* (0.97)
Claims per 100 Drivers	-0.35 (0.30)	0.007 (0.292)	-0.051 (0.312)	-0.33 (0.35)	-0.45 (0.28)
Mean Severity	1.13* (0.22)	1.07* (0.21)	1.10* (0.12)	1.02* (0.26)	1.14* (0.18)
Prior Approval Regulation	-0.29** (0.12)	-0.29** (0.11)	-0.37* (0.12)	-0.23 (0.14)	-0.26*** (0.14)
Take-All-Comer	0.063 (0.12)	0.23*** (0.12)	0.14 (0.13)	0.11 (0.15)	0.025 (0.16)
Record Accuracy	-0.102* (0.032)	-0.094* (0.031)	-0.086** (0.033)	-0.11* (0.04)	-0.114 (0.030)
Involuntary Market Share	0.013 (0.028)	-0.009 (0.027)	0.018 (0.029)	0.0003 (0.033)	-0.009 (0.047)
Uninsured	-0.057 (0.125)	-0.12 (0.12)	-0.091 (0.129)	-0.11 (0.15)	-0.015 (0.377)
No-Fault	0.31** (0.12)	0.40* (0.11)	0.33** (0.12)	0.33** (0.14)	0.30* (0.09)
Suburb	-0.29* (0.09)	-0.29* (0.08)	-0.26* (0.09)	-0.34* (0.10)	-0.28* (0.09)
R ²	0.87	0.89	0.87	0.81	0.87
Adjusted R ²	0.80	0.80	0.79	0.70	0.80
F(9,15)	11.6	11.8	10.9	10.9	11.7

Note: Dependent variables are premium levels for people/families with characteristics at top of column. Specifications based on equation (1) in the text. The dependent variable, claims frequency and severity, the record accuracy measure, the involuntary market share, and the variable for uninsured drivers are specified in natural log form. All other variables, including the dependent, are expressed in linear form. Standard errors are in parentheses.

^a Involuntary market share and uninsured specified as endogenous variables.

* Statistically significant at the one percent level (two-tail test).

** Statistically significant at the five percent level (two-tail test).

*** Statistically significant at the ten percent level (two-tail test).

higher in no-fault states. Not surprisingly, when the premium quoted applied to the city's suburb, it was appreciably lower.

In the analysis of nonstandard insurers' premiums, claims severity and frequency again have a substantial positive impact on premiums (see Table 5). But here the parameter estimates on claims frequency are large, positive, and statistically significant, implying that nonstandard insurers' premiums are highly sensitive to the average loss experience in the state.

Prior approval regulation has less of an impact on premiums charged by nonstandard insurers, and record accuracy has no effect. Although the nonstandard insurers indicated that they routinely check state motor vehicle records, they must have naturally assumed that they pool risks of policyholders with some adverse loss experience. The state's involuntary market share has a

Table 5
Regression Results: Premium Levels of Nonstandard Insurers

	<i>Married Male Over 25</i>				<i>Married Male Under 25</i>
	<i>One DUI</i>	<i>One DUI and One Chargeable Accident</i>	<i>One Chargeable Accident</i>	<i>One DUI^a</i>	<i>One DUI and One Chargeable Accident</i>
Intercept	2.30* (0.85)	2.90* (0.97)	2.48* (0.85)	3.29* (1.12)	2.44* (0.74)
Claims per 100 Drivers	0.78* (0.21)	0.85* (0.24)	0.80* (0.21)	0.86* (0.27)	0.85* (0.18)
Claims Severity	0.92* (0.18)	0.77* (0.21)	0.84* (0.19)	0.79* (0.24)	0.89* (0.16)
Prior Approval Regulation	-0.16** (0.08)	-0.090 (0.090)	-0.10 (0.08)	-0.15 (0.10)	-0.17** (0.07)
Record Accuracy	-0.015 (0.016)	-0.020 (0.019)	-0.008 (0.017)	-0.020 (0.022)	-0.028*** (0.015)
Involuntary Market Share	0.052* (0.019)	0.060* (0.022)	0.061* (0.019)	0.061** (0.025)	0.040** (0.018)
Uninsured	0.014 (0.083)	0.030 (0.095)	-0.032 (0.084)	0.045 (0.110)	0.058 (0.077)
No-Fault	-0.11 (0.09)	-0.14 (0.10)	-0.11 (0.09)	-0.091 (0.122)	-0.081 (0.081)
High Rating Area	0.67* (0.08)	0.64* (0.09)	0.52* (0.08)	0.44* (0.11)	--- ---
R ²	0.55	0.46	0.46	0.32	0.68
Adjusted R ²	0.51	0.41	0.41	0.27	0.63
F(8,95)	14.2	9.9	10.1	5.7	13.4 ^{b**}

Note: Dependent variables are premium levels for families with column-heading characteristics and driving records described in columns. Liability coverage is at the state's minimum financial responsibility limits. Specification based on equation (2) in the text. The dependent variable, claims frequency and severity, the record accuracy measure, the involuntary market share, and the variable for uninsured drivers are specified in natural log form. All other variables, including the dependent, are expressed in linear form. Standard errors are in parentheses.

^a Specification includes insurer binaries. Coefficients and standard errors on these binaries are not shown.
^b F(14,89) rather than F(8,95).

* Statistically significant at the one percent level (two-tail test).

** Statistically significant at the five percent level (two-tail test).

*** Statistically significant at the ten percent level (two-tail test).

small but positive effect on premiums. Although nonstandard insurers compete with the involuntary market, they are also required to participate in the voluntary markets' subsidy of involuntary markets' deficits.¹⁶ The take-all-comer variable was excluded, because there is no market for nonstandard insurers in states with such laws.

¹⁶ In the city analysis of premiums charged drivers with clean records, uninsured motorist coverage was included in the premium quote. In our survey, we failed to mention uninsured motorist coverage in our questions on liability insurance premiums. Some respondents may have included uninsured motorist coverage in their quote since it is tied to the sale of liability insurance coverage.

In the fifth regression we included binary variables for the insurers in the sample. Inclusion of these binary variables does not have much influence on the results even though the insurer binary variables increase the equation's explanatory power.¹⁷ Clearly, there is much interstate variation in individual insurers' premiums.

Analysis of Premium Differentials

Empirical specification. We analyzed premium differentials with information from the Survey of Standard Insurers, based on equation (3). Letting r be the surcharge expressed as a fraction, the dependent variable was $\ln(1+r)$. Observational units were states in which individual insurers wrote coverage.¹⁸ The dependent variables for our analysis of premium differentials were for married males over 25 with one DUI and, alternatively, one chargeable accident with property damage over \$500.

Explanatory variables were claims frequency, claims severity, accuracy of the states' department of motor vehicle records, the ratio of uninsured motorist to bodily injury claims, binary variables for states with prior approval regulation, state-mandated point systems (which require states to impose specific percentage surcharges for certain adverse events), no-fault and take-all-comer rules, and several insurer characteristics.

We developed a measure of underwriting strictness, based on each insurer's policies about accepting drivers of various risks in their standard companies. A response was assigned a value of one if the insurer had a very nonrestrictive underwriting policy (always accepted a driver with particular characteristics). A response was assigned a value of eight if the insurer had a very restrictive policy (never took such drivers). Policies in between the extremes were assigned values between one and eight (corresponding to responses of "rarely" to "usually"). Responses to four questions were then summed to yield an index of the insurer's underwriting strictness. The variable applied to the entire insurer (i.e., was not specified by state). A few single-state insurers had relatively lenient underwriting practices. Some national insurers were very strict. Index values varied from 4 to 14 with a mean of 11. We specified separate binary variables for insurers with scores above 11 and those with scores equal to 11 (the mode). Insurers with scores below 11 were the omitted reference group. The binary variables were defined to capture the underlying frequency distribution of insurer strictness and to allow for a sufficient number of insurers in each group. We also included binary variables for insurers that used agents and for those that insured the type of driver being

¹⁷ The regression presented is illustrative of the results with insurer binary variables included more generally. We had to exclude the variable identifying premium quotes for high rating areas within states because the variable was highly collinear with the insurer binaries.

¹⁸ With the one exception noted above, these insurers did not provide information on premium levels.

analyzed in the insurer's nonstandard company.¹⁹ Variables specified in log form are claims frequency and severity, record accuracy, the involuntary market share, and the uninsured driver measure; all other variables, including the dependent, are expressed in linear form.²⁰

Results. Several explanatory variables have no impact on surcharges for a DUI violation: claims frequency, claims severity, record accuracy, involuntary market shares, the uninsured ratio, and no-fault laws (see Table 6).

Insurers imposed a much higher surcharge on policyholders convicted of a DUI in take-all-comer states. The parameter estimates imply that, holding the other factors constant, the premium paid by DUI violators was almost twice the base premium. In contrast, the coefficients on the point system variable imply that surcharges for a DUI conviction were about the same in states with point systems as in other states. The two policies tend to be imposed in the same states, so it is difficult to distinguish their separate effects. It is inconceivable that the difference in surcharging practices could reflect insurers' loss experience in states with take-all-comer requirements and point systems compared to other states. Rather, this appears to reflect an activist public policy to ensure that all drivers have access to liability insurance but that careless drivers not be cross-subsidized by careful ones. Take-all-comer laws and point systems had no effect on the surcharge for a chargeable accident. Insurers using independent agents imposed much lower premium surcharges on drivers with a DUI conviction. Surcharges imposed on drivers with a DUI conviction were lower in states with prior approval premium regulation.

The insurers with the strictest underwriting standards (scores over 11) tended to impose higher surcharges on drunk driving. This result is plausible. Strict underwriting standards should reduce the base premium. But then an adverse event, like a DUI, leads to a larger change in anticipated loss.

Overall, the results show that premium levels are primarily driven by claims frequency and severity. However, premium surcharges for a DUI are greatly affected by state policy.

Although positive, the coefficient on the take-all-comer variable is much smaller in the regression for surcharge for a chargeable accident and no longer statistically significant. Underwriting strictness has a similar effect for DUI, but the impact of strictness on the surcharge is lower.

Do Insurer Surcharges Deter Drunk Driving?

Data and Empirical Specification

To learn when the premium differentials for a DUI reduce drunk driving, we performed a microanalysis with the individual driver as the observational unit.

¹⁹ We included explanatory variables for restrictions on use of age, sex, and marital status in preliminary specifications. These variables had no effects on premium differentials and, for this reason, were subsequently dropped.

²⁰ In some specifications, we substituted a continuous (cardinal) measure of underwriting strictness for the binary variables. Results were very similar to those reported below.

Table 6
Regression Results:
Premium Differentials for DUI and Chargeable Accidents
for a Married Male over 25

	<i>One DUI</i>	<i>One Chargeable Accident with Property Damage over \$500</i>
Intercept	1.27* (0.34)	0.35*** (0.18)
Claims per 100 Drivers	-0.05 (0.08)	-0.01 (0.04)
Mean Severity	-0.00 (0.06)	0.007 (0.035)
Prior Approval Regulation	-0.056*** (0.032)	-0.007 (0.017)
Take-All-Comer	0.53* (0.07)	0.052 (0.036)
Point System	-0.10*** (0.05)	-0.026 (0.028)
Record Accuracy	-0.00 (0.01)	0.001 (0.003)
Involuntary Market Share	-0.005 (0.008)	-0.006 (0.004)
Uninsured	0.014 (0.034)	0.012 (0.018)
No-Fault	0.011 (0.035)	0.004 (0.019)
Underwriting Strictness > 11	0.13* (0.04)	0.086* (0.030)
Underwriting Strictness = 11	0.033 (0.040)	0.002 (0.031)
Agency Writer	-0.28* (0.05)	-0.043 (0.032)
Nonstandard Insurer	-0.15* (0.03)	0.20* (0.04)
R ²	0.32	0.14
Adjusted R ²	0.30	0.12
F(13,354)	13.0	
F(13,405)		5.2

Note: Results are based on equation (3) in text. The dependent variable, claims frequency and severity, the record accuracy measure, the involuntary market share, and the variable for uninsured drivers are specified in natural log form. All other variables, including the dependent, are expressed in linear form. Standard errors are in parentheses.

* Statistically significant at the one percent level (two-tail test).

** Statistically significant at the five percent level (two-tail test).

*** Statistically significant at the ten percent level (two-tail test).

Data on drinking, driving, and other personal characteristics came from the 1989 Behavioral Risk Factor Survey collected by the U.S. Centers for Disease Control on people over age 18 in 40 states. The survey measured the number of drinks per month, the number of times the person drove "when s/he had too

much to drink," and demographic characteristics. In our analysis, we dropped observations from Hawaii and the District of Columbia, leaving a final sample of over 56,000 observations.

The dependent variables were (1) the probability of drinking at all during the past month; (2) the probability of drinking and driving at least once during the last month, for those who drank at all; and (3) the number of times the person drove during the last month when she or he had had too much to drink. Because the sample was so large, for computational convenience we randomly selected 50 percent of the sample for the analysis of the probability of drinking. The analysis of any driving conditional on drinking and the frequency of drinking and driving used the entire sample of drinkers and drinker-drivers, respectively.

The key issue in this analysis was the effect of insurance surcharges for a DUI on drinking and on drinking and driving. We merged information on two premium differentials: (1) the difference between the state's nonstandard insurers' premiums for one DUI and the base premium charged by one major national insurer for married males over age 25, and (2) the difference between the involuntary market plans' premiums for a DUI and the same base premium. The two differentials were positively correlated ($r = 0.63$).

In addition, we included variables for the threshold in medical expense for filing a suit in each no-fault state; a binary variable for Michigan, which had no-fault but no monetary threshold;²¹ mandatory minimum fines; jail terms (in days); and the mandatory term for license revocation (in days) for a DUI. The fine, jail, and license revocation were defined for a first DUI offense. Also included were individual characteristics: age, sex, marital status, family income, and education. Three binary variables were used for education—baccalaureate degree or more, some college, and high school diploma or equivalent—with individuals without a high school diploma serving as the omitted reference group.

Half of the respondents reported that they had consumed at least one drink during the month before the survey; of these, six percent said that they drove when they had too much drink at least once during the prior month. Most persons who drank and drove did so one to three times even though the frequency of drinking ranged as high as 30 times per month. The probability equations were estimated using probit analysis, and the equation for the frequency of drinking and driving was estimated using ordinary least squares.²²

Results. Not surprisingly, the premium differentials had no effect on the probability of drinking (see Table 7, first and second regressions). However, for persons who drank, the parameter estimates imply that a \$1,000 annual premium differential for a DUI conviction would reduce the probability of

²¹ When the observation was from Michigan, we set the medical expense threshold to zero.

²² Most drinker-drivers drove when they had had too much to drink only once or twice in the month before the survey, which suggests that tobit analyses would be appropriate to account for the concentration of observations at the lower limit of zero. The tobit results, however, were very similar to those from ordinary least squares, so only the latter are presented here.

Table 7
Regression Results: Effects of Premium Surcharges and
Other Factors on Drinking and Driving

Explanatory Variables	Probability of Drinking		Probability of Drinking and Driving		Frequency of Drinking and Driving Episodes	
	1	2	3	4	5	6
Intercept	-0.57* (0.09)	-0.39* (0.09)	1.79* (0.15)	-1.75* (0.14)	2.46* (0.74)	2.35* (0.67)
Premium Differential	0.0025	---	-0.40* (0.08)	---	-0.65*** (0.36)	---
Nonstandard (in Thousands)	---	---	---	---	---	---
Premium Differential	---	0.019 (0.27)	---	-0.12* (0.04)	---	-0.36* (0.18)
Involuntary (in Thousands)	---	---	---	---	---	---
No-Fault Monetary Threshold (in Thousands)	0.027* (0.009)	0.035* (0.008)	-0.0046 (0.012)	0.016 (0.011)	-0.080 (0.053)	-0.046 (0.049)
Michigan	---	0.10* (0.05)	---	0.23* (0.07)	---	0.38 (0.30)
Fine (in Thousands)	0.31* (0.09)	0.34* (0.07)	-0.12 (0.13)	0.026 (0.100)	-0.92 (0.57)	-0.72 (0.43)
Jail	-0.095* (0.016)	-0.13* (0.01)	-0.060* (0.025)	-0.043** (0.022)	0.060 (0.11)	0.093 (0.098)
License Revoked	0.0007* (0.0002)	0.0010* (0.0002)	0.17 (0.27)	0.0002 (0.0003)	-0.0012 (0.0012)	-0.0007 (0.0015)
Age	-0.0029 (0.0041)	-0.011* (0.04)	0.010 (0.007)	0.0091 (0.0068)	-0.037 (0.037)	-0.033 (0.034)
Age Squared	-0.0009** (0.0004)	-0.00001 (0.00004)	-0.00037* (0.00009)	0.0091 (0.0068)	0.00057 (0.00046)	0.00053 (0.00044)
Male	0.37* (0.02)	0.35* (0.02)	0.54* (0.03)	0.54* (0.03)	0.55* (0.15)	0.58* (0.14)
Not Married	0.22* (0.02)	0.23* (0.02)	0.38* (0.03)	0.37* (0.03)	0.21 (0.14)	0.22*** (0.13)
Income (in Thousands)	0.0090* (0.0001)	0.010* (0.001)	-0.0004 (0.0008)	-0.0008 (0.0007)	0.0023 (0.0036)	0.0020 (0.0032)
High School	0.27* (0.03)	0.23* (0.03)	0.080 (0.061)	0.062 (0.054)	-0.13 (0.27)	-0.097 (0.24)
Some College	0.40* (0.04)	0.41* (0.03)	0.073 (0.062)	0.049 (0.055)	-0.29 (0.27)	-0.17 (0.24)
Bachelor's Degree or More	0.51* (0.04)	0.48* (0.04)	-0.040 (0.065)	-0.33 (0.57)	-0.60** (0.29)	-0.52** (0.26)
R ²					0.03	0.03
Adjusted R ²					0.02	0.02

Note: The dependent variable, claims frequency and severity, the record accuracy measure, the involuntary market share, and the variable for uninsured drivers are specified in natural log form. All other variables, including the dependent, are expressed in linear form. Standard errors are in parentheses.

* Statistically significant at the one percent level (two-tail test).

** Statistically significant at the five percent level (two-tail test).

*** Statistically significant at the ten percent level (two-tail test).

drinking and driving by 0.03 on average in the variant with the nonstandard insurers' differential (third regression) and by 0.01 in the variant with the involuntary plans' differential (fourth regression). These fairly large changes relative to the sample probability of 0.06 imply that lengthening the mandatory jail term for a DUI also has a deterrent effect on drinking and driving for those who drink. The fact that the premium differentials affect driving under the

influence but not drinking per se suggests that the differentials measure more than merely antidrinking sentiment in a state.

For people who drove when they had too much to drink, the premium penalties had negative impacts on the number of times a person drove when she or he had had too much to drink. The result on the nonstandard differential implies that a \$1,000 premium surcharge for one DUI offence would reduce the number of times per month the person drove under the influence by 0.65. With the premium differential imposed by the involuntary plans, there would be a reduction of 0.36. An identical increase in the fine for a first DUI would have up to twice the effect. Mandatory jail terms and license revocation did not affect the behavior of this group although jail terms appear to deter drinking and driving at least once. Mandatory minimum fines had no impact on the decision to drink and drive.

Interestingly, family income was positively related to the propensity to drink but had no effect on the joint activities of drinking and driving. Higher income drivers have more to lose from accidents, yet they are also probably better insured. Unfortunately, the survey obtained no information about insurance coverage from households.

Discussion and Conclusion

Automobile insurance is treated increasingly like social insurance (see, e.g., Cummins, 1989). For many individuals, driving is a necessity for getting to work and performing family responsibilities, and driving without insurance is considered unacceptable (and illegal in many states). The public's demand for universal entitlement has led to a flattening of premium differentials across driver categories and territories and, in a few states, pricing of insurance below cost (Kiefer, 1991). The high involuntary market shares in a few states are a consequence of policies aimed at making automobile insurance available to all at affordable rates.

At the same time, two other forces have been at work. First, pricing insurance on the basis of unalterable characteristics such as age and sex is increasingly viewed as discriminatory (Markus, 1991). If there are to be pricing differentials at all, insurers must place more weight on individuals' driving records. Second, the public has become more aware of the costs imposed on others by undesirable driving behavior, particularly drunk driving. This led to increased minimum drinking ages and a considerable toughening of criminal sanctions against drunk drivers during the 1980s; state interventions requiring premium penalties to be imposed by insurers on drivers with various types of driving records is part of this much larger trend.

Some of the substantial observed variation in premiums would not have occurred without government intervention. States vary little in percentage premium surcharges for chargeable accidents. However, the large differences in percentage surcharges for a DUI violation reflect policy differences across states in the presence or absence of take-all-comer rules, in point systems that

have often been imposed in take-all-comer states, and in the premiums set for persons who obtain insurance in involuntary markets.

Such intervention is justified under some circumstances. First, society's equity concerns or the political influence of voters with adverse driving records may lead to flatter premiums than profit-seeking insurers would charge. Examples are the low surcharges imposed on DUI violators in such states as Massachusetts and New Jersey. But public concern for safety might call for steeper premium penalties than the market would provide without intervention.

Public intervention in premium determination, however, may also have adverse side effects. External restraints on insurance premiums in either direction will affect demand for automobile insurance. To the extent that good drivers subsidize losses incurred by bad drivers, the good drivers will buy less insurance than they otherwise would. Conversely, imposing huge surcharges on drunk drivers and others convicted of major violations may well lead such drivers to drop insurance coverage altogether. This, in turn, will impose costs on safe drivers who become accident victims. Our finding that surcharges deter drinking and driving suggests that dropping insurance in the face of a surcharge is an option not taken lightly. In fact, by the end of the 1980s, virtually all states had compulsory automobile liability insurance laws. But to the extent that surcharges lead to decreased liability insurance coverage, personal bankruptcy of tortfeasors becomes more likely, and greater reliance for deterrence would have to be placed on criminal sanctions.

A clearly appropriate role for government is to make accurate information on individuals' driving records readily available to insurers. We found that, in states with relatively accurate records on accidents, base premiums for drivers with clean records were somewhat lower. However, we observed no difference in the surcharge imposed on DUI violators by standard insurers.²³

That surcharges deter drunk driving is an intriguing finding. However, the data set we used is a fairly limited one. Drinking and driving was self-reported, but such measures appear to be fairly accurate.²⁴ Any errors in measurement would decrease the equation's explanatory power. There is no reason to expect bias in our estimate of the deterrent effect of premium surcharges, although any measurement errors in the dependent variable would adversely affect the precision with which such effects are estimated. But it is noteworthy that we obtained statistically significant estimates of deterrent effects even so.

²³ Insurers now use private data banks (such as Equifax) on individuals' driving histories. Our preliminary analysis considered other measures of information obtainable from public records—the number of years DUIs and other major convictions remain on the record and whether a conviction may be removed from the record if the driver attends a good driving school. None of these variables affected premium levels or differentials.

²⁴ Smith et al. (1990) found a correlation of 0.81 between per capita sales of alcoholic beverages and presence of these drinking behaviors as reported in the Behavioral Risk Factor Survey using the state as the observation unit. Giovannucci et al. (1991) evaluated the reproducibility and validity of alcohol consumption data from self-reports and found them to be generally accurate.

A possible shortcoming of our analysis is that, with a single cross-section, the possibility cannot be eliminated that large premium differentials could exist in states where fewer people drink and drive. Using a time series of cross-sectional state data from the Fatal Accident Reporting System and a fixed effects specification, Sloan, Reilly, and Schenzler (forthcoming) found that motor vehicle fatalities were lower when large premium surcharges were imposed. These results on mortality lend strong support to this study's findings based on self-reported drinking and driving.

We had no information on the amount of liability insurance the individuals had or on their actual perceptions of the impact of DUIs and other forms of careless driving behavior on their insurance premiums. Such data do not currently exist; collecting and analyzing such data would be very worthwhile.

Appendix

Definitions and Sources

Base Premiums in Very Large Cities (See Table 4)

Source

Dependent Variable

Base Premium Married Male Age 45; Chevrolet	Smith and Wright (1992) ^a
Base Premium Single Male Age 19	Smith and Wright (1992) ^a
Base Premium Two-Car Family	Smith and Wright (1992) ^a
Base Premium Married Male Age 45; BMW	Smith and Wright (1992) ^a

Explanatory Variable

Paid Claims Per 100 Drivers	Insurance Research Council (1990) ^a
Mean Dollar Value of Paid Claims	Insurance Research Council (1990) ^a
Prior Approval Regulation (0-1)	Survey of State Insurance Departments ^b
Take-All-Comers (0-1)	Survey of State Insurance Departments ^b
Accidents Known to Insurers Found in State DMV Records (%)	Insurance Research Council (1991) ^b
Share of Total Written Car Years in State Written in Involuntary Market (%)	Auto Insurance Plan Services Office (1989/1990)
Uninsured Claims/Bodily Injury Claims (N)	Smith and Wright (1992) ^a
State Has Auto No-Fault Law (0-1)	State Farm (Press Manual) ^b
Suburb of City (0-1)	Smith and Wright (1992) ^a

Premiums Charged by Nonstandard Insurers (See Table 5)

Source

Dependent Variable^c

Premium: Over 25, One DUI	Survey of Nonstandard Insurers
Premium: Married Male over 25, One DUI and One Chargeable Accident	Survey of Nonstandard Insurers
Premium: Married Male over 25, One Chargeable Accident	Survey of Nonstandard Insurers
Premium: Married Male under 25, One DUI and One Chargeable Accident	Survey of Nonstandard Insurers

Explanatory Variable

Paid Claims per 100 Drivers	Insurance Research Council (1990)
Mean Dollar Value of Paid Claims	Insurance Research Council (1990)
Prior Approval Regulation (0-1)	Survey of State Insurance Departments
Accidents Known to Insurers Found in State DMV Records (%)	Insurance Research Council (1990)
Share of Total Written Car Years in State Written in Involuntary Market (%)	Auto Insurance Plan Services Office (1989/1990)
Uninsured Claims/Bodily Injury Claims	Insurance Research Council (1984)
State Has Auto No-Fault Law (0-1)	State Farm (Press Manual)
High Rating Area (0-1)	Survey of Nonstandard Insurers

Premium Differentials for DUI and Chargeable Accidents (See Table 6)

Source

Dependent Variable^d

Surcharge for One DUI, Married Male over 25 (%)	Survey of Standard Insurers
Surcharge for One Chargeable Accident with Property Damage over \$500	Survey of Standard Insurers

Explanatory Variable

Paid Claims per 100 Drivers	Insurance Research Council (1990)
Mean Dollar Value of Paid Claims	Insurance Research Council (1990)
Prior Approval Regulation (0-1)	Survey of State Insurance Departments
State Has Take-All-Comer Rule (0-1)	Survey of State Insurance Departments
State Uses Point System (0-1)	Survey of State Insurance Departments
Accidents Known to Insurers Found in State DMV Records (%)	Insurance Research Council (1991)

Share of Total Written Car Years in State Written in Involuntary Market (%)	Auto Insurance Plan Services Office (1989/1990)
Uninsured Claims/Bodily Injury Claims	Insurance Research Council (1984)
State Has Auto No-Fault Law (0-1)	State Farm (Press Manual)
Underwriting Strictness	Survey of Standard Insurers
Agency Writer (0-1)	Survey of Standard Insurers
Insurer Uses Its Nonstandard Company for Nonstandard Risks (0-1)	Survey of Standard Insurers
Effects of Premium Surcharges and Other Factors on Drinking and Driving (See Table 7)	Source
<i>Dependent Variable</i>	
Probability of Drinking ^c	U.S. Centers for Disease Control (1989) ^f
Probability of Drinking and Driving (0-1) ^c	U.S. Centers for Disease Control (1989)
Number of Drinking and Driving Episodes ^c	U.S. Centers for Disease Control (1989)
<i>Explanatory Variable</i>	
Premium Differential for DUI Nonstandard (in Thousands) Versus Clean Record (See Text for Further Detail)	Survey of Nonstandard Insurers and One Major Standard Insurer from Survey of Standard Insurers ^g
Premium Differential for DUI Involuntary versus Clean Record (in Thousands; See Text for Further Involuntary Plan Detail)	Rating Manuals for Each State's Involuntary Plan and One Major Standard Insurer (See Above)
No-Fault Monetary Threshold for Medical Expense (in Thousands) ^h	State Farm (Press Manual)
Michigan (0-1)	
Mandatory Minimum Fine for DUI Conviction (in Thousands) ⁱ	U.S. Department of Transportation (1991)
Mandatory Minimum Jail Term for DUI Conviction (in Days) ⁱ	U.S. Department of Transportation (1991)
Mandatory Minimum Term Licenses Revoked for DUI Conviction (in Days)	U.S. Department of Transportation (1991)
Age	U.S. Centers for Disease Control (1989)
Effects of Premium Surcharges and Other Factors on Drinking and Driving (See Table 7)	Source
Male (0-1)	U.S. Centers for Disease Control (1989)
Not Married (0-1)	U.S. Centers for Disease Control (1989)
Family Income (in Thousands)	U.S. Centers for Disease Control (1989)
High School Graduate (0-1) ^j	U.S. Centers for Disease Control (1989)
Some College (0-1)	U.S. Centers for Disease Control (1989)
Bachelor's Degree (0-1)	U.S. Centers for Disease Control (1989)

^a Defined for the city.

^b Defined for the state in which city is located. See State Farm (n.d).

^c All variables were defined for the state, except the binary variables.

^d All variables were defined for the state, except underwriting strictness index, agency writer, and binary for insurers with nonstandard company, which were defined for the insurer.

^e Defined for the month before the survey. Probability of drinking and driving for people who said they drank. Number of episodes for people with one drinking and driving episode during the month before the survey.

^f The Behavioral Risk Factor Surveys contain state identifiers.

^g This insurer was the only one willing to provide levels of base premiums by state. The insurer wrote liability coverage in every state.

^h We set the value for Michigan to zero and defined a binary variable for respondents from this state.

ⁱ Defined for first DUI offense.

^j Less than high school is the omitted reference group.

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