Estimating the Uninsured Vehicle Rate from the Uninsured Motorist/ Bodily Injury Ratio

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Note: Comments and interpretations in this report are those of the author and do not represent official policy of the commissioner of the department.

This paper examines the assumptions involved in using the ratio of the frequency of uninsured motorist (UM) claims to the frequency of bodily injury (BI) claims as an estimate of the uninsured vehicle rate. Possible sources of biases include: including hit-and-run accidents in UM claims, different rate of UM fraud, those with UM coverage not representative of those without, higher accident rate of uninsured drivers, higher likelihood of filing a claim and having it paid for UM claims, and including property damage only (PDO) accidents in the UM claim frequency. It appears that several of the biases cause the UM/BI ratio to overestimate the uninsured vehicle rate. For some of the biases it was not possible to locate empirical evidence that would establish the direction of bias. It appears that some of the biases act to cancel each other out, but the overall bias inherent in the UM/BI ratio is to overstate the uninsured vehicle rate. The lack of a demonstrated stability in the several biases makes it questionable to use a time series of UM/BI ratios to estimate the trend in uninsured vehicles over time.

Introduction

An alternate method for estimating the uninsured vehicle (UV) rate involves calculating the ratio of the frequency of uninsured motorist (UM) claims (UM-BI_{freq}) to the frequency of bodily injury (BI) claims (BI_{freq}). This ratio has been described as a reasonable proxy for the number of injury accidents caused by uninsured motorists or hit-and-run motorists (see page 4, Insurance Research Council, 1989). However, the "reasonableness" of the proxy has never been thoroughly evaluated. The purpose of this analysis is to estimate the conditions that would be required in order for the UM/BI ratio to be an accurate measurement of the UV rate and to consider how reasonable they are.

To start with we define the key terms:

UV rate = UV / (UV + IV), where [1]

- UV = number of vehicles on-the-road[1] without liability insurance coverage, and
- IV = number of vehicles on-the-road with liability insurance coverage.

UM-BI_{freq} = $C_{UM\text{-}BI}$ / $EE_{UM\text{-}BI}$, where [2]

- $C_{UM\text{-}BI}$ = number of UM-BI claims, and
- $EE_{UM\text{-}BI}$ = number of years of earned exposure for UM-BI coverage.

BI_{freq} = C_{BI} / EE_{BI}, where [3]

- C_{BI} = number of BI claims, and
- EE_{BI} = number of years of earned exposure for BI coverage.

Hit-and-Run Accidents

At the outset it should be noted that UM claims include claims due to hit-and-run accidents. If the vehicle that caused the accident and then ran was uninsured, the accuracy of the UM/BI ratio is not affected because the accident would have been classified as caused by an uninsured driver even if the driver stopped and took responsibility. However, if the vehicle that caused the accident and then ran was insured, the number of UM claims due to uninsured drivers and the UM claim frequency is overstated. This results in the UM/BI ratio being inflated, which yields an *overstated* estimated UV rate.

In 1996, the California Highway Patrol (CHP) reported 21,496 hit-and-run injury accidents in California. This reflects 11 percent of all injury and fatal accidents reported in 1996. Unfortunately, by the very nature of a hit-and-run accident, it is not possible to tell much about the vehicle fleeing the scene. It is not known whether uninsured vehicles or insured vehicles are more likely to flee after causing an accident, all other things equal. With greater exposure to personal liability, the uninsured driver would seemingly have a greater incentive to flee. However, the decision to flee may not be an entirely rational one. Insured drivers could fear legal involvement and higher insurance costs. Also, there is a much higher percentage of insured vehicles on-the-road.

Data from the California Department of Motor Vehicles (DMV) and the California Department of Justice do show that younger drivers do have a relatively higher rate of arrest for hit-and-run accidents (Aizenberg, 1997). Since younger drivers are more likely to be uninsured, it is reasonable to assume that hit-and-run drivers are more likely to be uninsured than the general driving population. If the percent of all UM claims include about 11 percent due to hit and run drivers, and if about 60 percent of these hit-and-run claims were actually caused by an insured driver,[2] then about 7 percent (60 percent * 11 percent) of the UV claims were really caused by an insured driver. If these 7 percent of the UM claims were reclassified as a BI claim for the purposes of calculating the UM/BI ratio, the resulting estimated UV rate would be about 3 percentage points lower (e.g., and estimated UV rate of 32 percent would drop to 29 percent).

Assumptions Underlying UV Estimate

In order for a claim to occur, three things must happen (assuming the claim is not fraudulent).[3] First there must be an accident where a loss occurs. Second, the individual experiencing a UV loss or causing a BI loss must have insurance for the loss. And finally, the individual must report the loss to his or her insurance company and a claim for the loss must be filed and paid. These conditions can be written algebraically as:

$C_{UM\text{-}BI} = UV * r_{UV} * P_{UM} * P_{UM\text{-}C}$, where [4]

- r_{UV} = the rate that drivers of UV are considered at-fault in an injury accident
- P_{UM} = the probability of any vehicle having UM-BI coverage
- $P_{UM\text{-}C}$ = the probability of filing a UM-BI claim given being injured in an accident caused by an uninsured motorist and having UM coverage, and the claim being paid.

$C_{BI} = IV * r_{BI} * P_{BI\text{-}C}$, where [5]

- r_{BI} = the rate that drivers of IV are considered at-fault in an injury accident
- $P_{BI\text{-}C}$ = the probability of filing a BI claim given being injured in an accident caused by an insured motorist, and the claim being paid.

Since,

$IV = (IV + UV) * P_{BI}$, where [6]

- P_{BI} = the probability of having BI coverage

Equation [5] can be rewritten as:

$C_{BI} = (IV + UV) * r_{BI} * P_{BI} * P_{BI\text{-}C}$ [7]

The issue to be resolved can be rephrased as, "When does the UV rate equal the UM-BI_{freq} divided by the BI_{freq}?" Or, alternately, when does

$$\frac{UV}{(UV+IV)} \approx \frac{C_{UM\text{-}BI} / EE_{UM\text{-}BI}}{C_{BI} / EE_{BI}} \quad [8]$$

or

$$\frac{UV}{(UV+IV)} \approx \frac{UV * r_{UV} * P_{UM} * P_{UM\text{-}C} / EE_{UM\text{-}BI}}{(IV+UV) * r_{BI} * P_{BI} * P_{BI\text{-}C} / EE_{BI}} \quad [9]$$

Since the atio P_{UM} / P_{BI} is estimated by the ratio $EE_{UM\text{-}BI} / EE_{BI}$ these terms cancel each other out. In effect, by using the claim frequencies, we do not need to be concerned about the probability of a consumer purchasing UM-BI coverage given that they have purchased BI coverage. This also points out the assumption implicit in the UM/BI ratio approach: the UM claim frequency of consumers *with* UM coverage is representative of those drivers *without* UM (and possibly any) coverage.[4] That is, uninsured drivers are equally likely to be considered at fault in accidents with individuals who have UM coverage as with individuals who do not have UM coverage. We are not aware of any data that would show this assumption to be incorrect. However, to the extent that the UM claim frequency is not representative of the broader population, a bias would be introduced into the estimated UV rate.

With the P_{UM} , P_{BI} , EE_{UM-BI} , and EE_{BI} terms removed, equation [9] is reduced to:

$$\frac{UV}{(UV+IV)} \approx \frac{UV * r_{UV} * P_{UM-C}}{(IV+UV) * r_{BI} * P_{BI-C}} \quad [10]$$

From equation [10] we can see that the equality between the UV rate and the UM/BI ratio is established when:

$$r_{UV} * P_{UM-C} = r_{BI} * P_{BI-C} \quad [11]$$

The simplest way for equation [11] to be true would involve:

$$r_{UV} = r_{BI} \quad [12]$$

$$P_{UM-C} = P_{BI-C} \quad [13]$$

Ignoring the previous caveats temporarily, the issue of the accuracy of the UM/BI ratio's approximation for the UV rate reduces to the question of the accuracy of equation [11] (and implicitly, equations [12] and [13]).

Rate of Accident Involvement

How similar is the accident rate among uninsured and insured drivers? Unfortunately we do not have any direct data to shed light on this issue. However, we do know something about who is likely to be an uninsured motorist. According to surveys, uninsured motorists tend to be:

- younger
- less educated
- receiving less income
- renters of their home
- spending less time in their home
- Hispanic or African American

Income and ethnicity are not currently used as rating factors for estimating the accident potential (and hence the premium). However, age and the purchase of a homeowners policy are auto rating factors many insurers use. Proxies for education, discounts oriented to certain professionals, are used by some insurers. The use of age, or its proxy, years of driving experience, is almost universal. For each of these factors the profile presented by the uninsured motorist would be considered a higher risk. Age in particular is a very influential risk factor.

In an analysis of CHP data from January 1988 to July 1989, Marowitz (1991) reported "44.6 percent of motorists involved in BI accidents were uninsured, while only 34.2 percent of CHP traffic citations were given to UMs. Since unsafe driving behavior is more likely to be evidenced in repeated citations than in accidents, the rate of UMs in accidents would be expected to be less than the rate for citations. Since it is greater, it appears that UMs are overrepresented in BI accidents and that BI accidents involve a biased sample of UMs. Thus, BI accidents cannot be used for estimating the rate of UMs."

From this evidence it would appear that a more likely hypothesis is that the rate of accidents for uninsured motorists is greater that the rate of accidents for insured motorists, or

$$r_{UV} > r_{BI} \quad [14]$$

To determine how much greater we need a more accurate description of the uninsured population. From this detailed description of the population an actuarial assessment of the risk level associated with that population could be estimated and the extent of the bias could be quantified. Using only the age rating factor, it is not uncommon to find the risk level of younger drivers to be twice that of the risk level associated with older drivers.

If equation [14] is true than it follows that

$$r_{UV} / r_{BI} > 1 \quad [15]$$

and this implies that the UM/BI ratio would tend to *overstate* the actual UV rate.

Claiming Behavior of UM vs. BI Victims

Given that an accident has occurred, an injury is sustained, and the other party is at fault, what is the likelihood that the injured party will file a claim and it will be paid? More specifically, if the accident is caused by an uninsured motorist and the injured party has UM coverage, is the insured more or less likely to file a claim than an injured person in an accident caused by a driver with BI coverage?

Another way of looking at this is, when would a claim not be filed? When an accident is caused by a driver with insurance, a claim filing could be avoided if the driver negotiated a settlement directly with the injured person. The insured driver might be motivated to settle directly with the injured person if they were concerned about increased insurance costs and the injuries were relatively minor. As the distribution of BI losses is biased toward lower loss amounts, a large number of BI accidents would likely fall into the category of relatively minor injuries. A recent survey by the Independent Insurance Agents of America (IIAA) estimated that 17 percent of all drivers had paid for damages out of pocket rather than file a claim (IIAA, 1998).

A similar type of direct settlement between the parties is possible when the accident was caused by an uninsured motorist. However, if the reason the uninsured motorist does not have insurance is due to a lack of income or assets, the likelihood of a direct settlement between the parties seems less likely. If this is the case, then:

$P_{UM\text{-}C} > P_{BI\text{-}C}$, or [16]

$P_{UM\text{-}C} / P_{BI\text{-}C} > 1$ [17]

Equation [17] would imply that the UM/BI ratio would tend to *overstate* the actual UV rate.

This overstatement could be further magnified by the practices of insurers. Khazzoom (1997) has pointed out that insurers are likely to be more liberal in processing UM claims as these claims involve their own policyholders, whereas BI claims by a third party are more likely to be rejected. This would lead to an upward bias in the claim frequency of UM compared to BI. This would result in the UM/BI ratio further overstating the actual UV rate.

Combining the Factors

The factors that have been identified as likely to affect the accuracy of UV rate estimates based on the UM/BI ratio include: inclusion of hit-and-run accidents in the UM frequency, the likely higher accident rate of uninsured drivers, and the claiming behavior of UM vs. BI victims. For each of these factors the bias introduced is one of *overstating* the actual UV rate. The effect of each of these biases is cumulative. When all the sources of bias are considered simultaneously, the effect is greater than any one of the individual biases.

An approximated effect was estimated for the inclusion of hit-and-run accidents in the UM claim frequency. An estimated UV rate of 32 percent was reduced by about 10 percent to a partially adjusted UV rate of 29 percent. If the other two sources of biases introduced a similar sized bias, the combined effect of the three biases would yield an adjusted estimated UV rate of 23 percent (= 32 percent * 90 percent * 90 percent * 90 percent). It bears repeating that at this point in time we do not have any empirical estimates of the difference in accident rates or claiming behavior. Also, we do not know how a different UM fraud rate or lack of representativeness among those with UM coverage would affect the estimated UV rate. Subjectively, it seems that the bias because or differential accident rates is greater than the bias because of differential claiming behavior.

UV Rate Estimates

Data from the California Department of Insurance's Statistical Analysis Bureau were used to calculate an unadjusted UV rate based on the UM/BI ratio. These data cover the years 1991 to 1995 and are subject to extensive editing and data cleaning procedures. It is important to note that the UM data used here only refers to UM-BI exposures and claims. This is important because the assumptions underlying the use of the UM/BI ratio assume that the UM claim frequency is only measuring the frequency of *injury* accidents caused by uninsured motorists. Many sources of UM data do not differentiate UM-BI exposures and claims from UM-PD (PD stands for property damage) exposures and claims. Including a count of property damage only (PDO) accidents caused by uninsured motorists would inflate the UM frequency and overstate the estimated UV rate.

As can be seen in Table 1, the unadjusted estimated UV rate ranged from 32 percent to 35 percent during the 1991 to 1995 time period. The low of 32 percent was estimated in both 1991 and 1995, the high of 35 percent was estimated for 1993. As was expected from the preceding discussion of the biases associated with this process, these unadjusted estimates seem very high. If these unadjusted UV rate estimates were adjusted using the hypothetical bias amounts referred to previously, the adjusted UV rate estimates would be in the 23 percent to 26 percent range. These adjusted UV rate estimates are lower than the 29 percent to 32 percent UV rate estimates derived from the UV model based on using total vehicle counts and number of insured vehicles for the years 1991 to 1996 (described in Hunstad, 1999). This could imply that some of the biases affecting the UV rate may be lower. A more likely hypothesis is that some of the biases act to inflate the UV estimate, and some of the biases act to deflate the UV estimate. To some extent, some of the biases may offset each other.

Summary and Conclusion

Potential biases contained in a UV rate estimated from the UM/BI ratio can be seen in Table 2. The biases for which the direction of the bias can be reasonably established all point to an inflated UV rate estimate. The precise size of each bias is difficult to establish. It appears that some of the biases may offset each other.

Without a more accurate measurement of the identified biases associated with the UM/BI ratio method for estimating the UV rate, the method seems unlikely to produce an accurate estimate of the true UV rate. In a similar light, the use of a time series of the UM/BI ratio to gauge the relative improvement or deterioration of the UV rate seems questionable. Until the magnitude and stability over time of the different sources of biases can be established, it is impossible to tell if a year-to-year change in the ratio is due to a change in the actual UV rate or a change in one of the biases affecting the estimate.

Table 1
UM and BI Claim Frequencies and Estimated UV Rate

	Year	Exposure	Number of Claims	Claim Frequency	UM(freq)/BI(freq)
BI					
	1991	13,915,140	244,688	0.017584	32.1%
	1992	13,652,545	233,601	0.017110	33.2%
	1993	13,434,840	223,310	0.016622	35.4%
	1994	13,628,312	239,777	0.017594	34.0%
	1995	13,887,382	240,469	0.017316	32.2%
UM					
	1991	11,729,692	66,186	0.005643	
	1992	11,695,698	66,522	0.005688	
	1993	11,598,263	68,242	0.005884	
	1994	11,784,243	70,443	0.005978	
	1995	11,867,424	66,119	0.005571	

Table 2
Potential Biases Contained in the UM/BI ratio

Source of Bias	Effect on the Estimated UV Rate
Including not operated vehicles in the UV rate	unknown
Including hit-and-run accidents in UM claims	increase
Different rate of UM fraud	unknown
Those with UM coverage not representative of those without	unknown
Higher accident rate of uninsured drivers	increase
Higher likelihood of filing a claim and having it paid for UM claims	increase
Including PDO accidents in the UM claim frequency	increase

Endnotes

[1]Note that the definition of the UV rate refers to the vehicles *on-the-road*. The purpose in limiting the UV rate in this manner is so that it will measure the rate of violating the mandatory insurance law. There is no requirement for vehicles not operated on public roadways to be insured. There is a lack of definitive data on the number of uninsured vehicles not used at all or not used on public roads. The upper bound of the percent of uninsured vehicles not used on public roads may be as high as 50 percent (Hunstad, 1998).

In order for the non-use of some uninsured vehicles to influence the UV rate estimated by using the UM/BI ratio method, it would be necessary for the percent of vehicles not used on public roads to be the same for UVs and IVs. This seems unlikely.

[2]The data from a separate analysis of CHP-issued violations seems to indicate that even more than 60 percent of the hit-and-run accidents may be caused by an insured driver. In 1997, only 11 percent of the drivers cited for hit-and-run were also cited for being uninsured. Based only on this data the estimated percent of hit-and-run accidents caused by an insured driver would be 89 percent, not 60 percent. However, in 1996 it appears that only about 14 percent (3,070/21,496) of the hit-and-run drivers were caught and cited. It is not possible to determine if those who were caught and cited are representative of those who were not caught.

[3]Given that at least some amount of fraud is an almost certainty, the assumption of a non-fraudulent claim needs to be examined in greater detail. The issue relevant to the UM/BI ratio method is whether the rate of fraud is higher in UM-BI claims or BI claims. This is a difficult area to get definitive information on. Conversations with fraud investigative staff indicate that some insurers are less likely to investigate and report suspected fraud in a UM claim. This is due to the first-party relationship with the claimant in a UM claim, the possibility of a bad faith accusation, and the frequent lack of any other witness. The insurer is likely to take a harder stance in dealing with a third-party claimant in a BI claim. Because of this, some believe that fraud is easier in UM claims than in BI claims and more difficult to detect.

On the other hand, a 1996 study by the Insurance Research Council found a greater incidence of the appearance of fraud in BI claims compared to personal injury protection (PIP) claims. In this study 36 percent of the BI claims and 21 percent of the PIP claims were classified as having the appearance of fraud. While PIP coverage is not the same as UM coverage, they are both a first-party-type of coverage and so they should share some similarities. However, the comparison of BI to PIP fraud is somewhat biased due to the different areas the claims were sampled from. PIP claims only came from states with no-fault insurance.

At this point in time, it is difficult to say whether fraud is greater in BI claims than in UM claims. If the comparison of BI to PIP applies to BI and UM claims, then the BI claims would be overstated relative to UM claims. This overstatement of BI claims would tend to underestimate the UV rate using the UM/BI ratio method. If the UM claims tend to have more overstatement due to a higher fraud rate, then the estimated UV rate would be overstated.

[4]An analysis of data on earned exposures in California from 1992 to 1995 indicates approximately 87 percent to 88 percent of the vehicles with BI also have UM coverage. At this point in time, there are no data that indicate the insureds with UM coverage are different from insureds without UM coverage.

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