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Summary:

Automobile age and risk

Problem

How does the car accident risk depend on the age of the vehicle?

A common belief among transport planners, policy makers and the general public is that older cars are more dangerous than new cars, (i) because wear and tear may eventually lead to mechanical failure (a pure age effect), and (ii) because newer generations of cars typically exhibit more built-in (inner) safety than previous models (a cohort effect).

This hypothesis is often seen to gain support from certain statistical cross-tabulations, which tend to show a markedly higher injury accident frequency among older cars than among the newer.

However, such bivariate statistics may not be sufficient to conclude that automobile age *per se* is a risk factor. This is so on account of certain, potentially quite important covariates, such as (e g) the driver's age, gender, experience, or income, or the driving environment and driver behavior in general.

Older cars are generally less expensive than new cars and hence tend to be owned and driven by younger and less affluent people. But young drivers have a markedly higher accident risk than, say, middle-aged drivers. Thus, in principle, any positive bivariate correlation between automobile age and accident frequency may due to the confounding factor "driver's age" or "experience".

On the other hand, the higher risk associated with younger drivers might, in principle, be explained by the fact that they drive older and less reliable cars.

Method

To sort out and estimate the respective partial effects of these covariate risk factors, we have applied logistic regression (logit) analysis to a very large data set (appr 211 000 units) consisting of (virtually) all private automobile insurance policies within one of Norway's major insurance companies, the Gjensidige Forsikring. Each policy was followed over a period of three years (1992-94), during which all accidents reported to the company were recorded. As our (binary) dependent variable, we use the occurrence of at least one accident of a certain type during the observation period.
As for accident types, the study focuses mainly on (i) liability damage accidents and on (ii) injury accidents. For both of these, the reporting

incidence is fairly high and unlikely to be strongly influenced by any of the independent variables of interest.

The third type of accidents – i e, (iii) material damage accidents not involving liability charges – does not lend itself to reliable analysis, as these accidents are probably subject to systematic underreporting. Older and less valuable cars are frequently driven without collision coverage, in which case the owner has no incentive to notify the insurance company. And for those which do carry such insurance, the bonus/malus system provides an incentive not to make use of the insurance when the cost of repair, or the value of the car, is low.

The following independent variables were used in the logit models: annual distance driven, car model year (five categories), car owner's age (16 categories) and gender, and car owner's county of residence (19 categories).

Results

Partial results from the logistic regression analyses are shown in Figures 1 and 2. The diagrams show "standardized" accident probabilities by car model year, calculated by setting the probability within the newest car class equal to the observed accident involvement frequency within that class, and using the logit regression coefficients to derive corresponding probabilities for the older classes, assuming that all factors except model year remain constant.

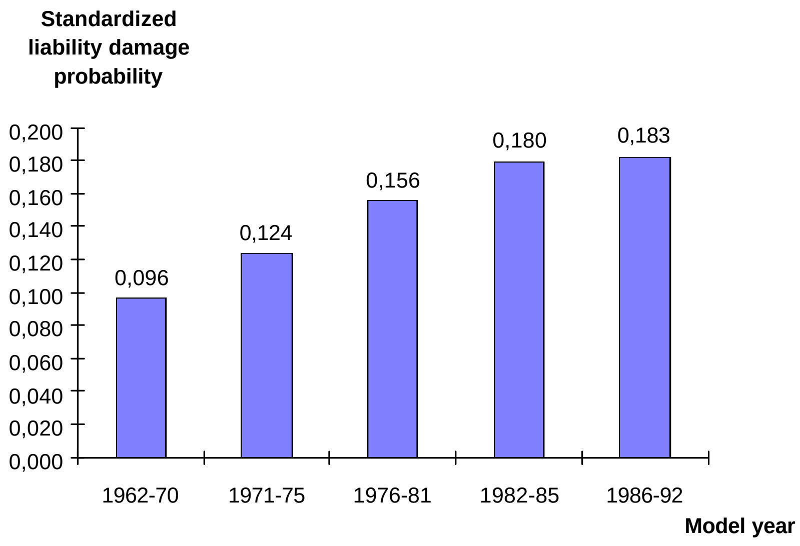

Figure 1: Partial effect of car model year on liability damage accidents

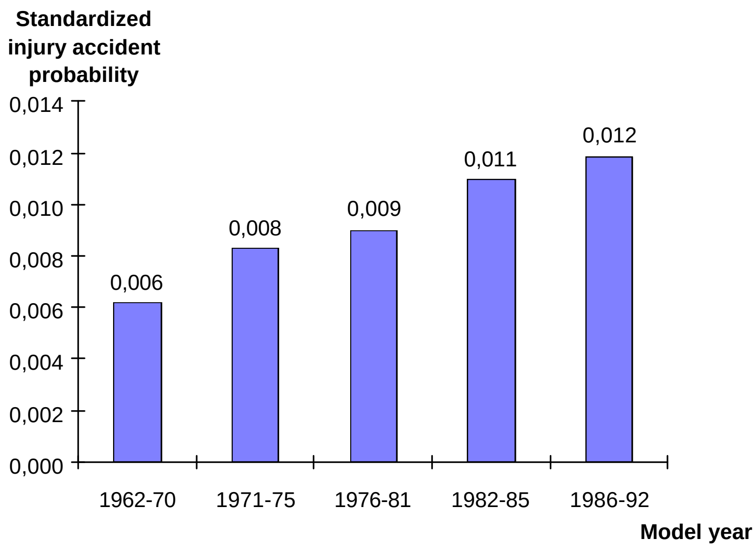

Figure 2: Partial effect of car model year on injury accidents

When annual mileage, car owner's age, gender and county of residence are controlled for, the older classes of cars are seen to have a markedly lower accident involvement frequency than the newest class of cars.

This tendency is statistically significant, consistently monotonous, and strikingly similar between liability damage accidents and injury accidents.

The oldest cars appear to represent only about half as high accident probabilities as the newest class.

Discussion

These results clearly run counter to commonly held beliefs about automobile age and safety. How can they be explained?

The limited amount of information available in our data set unfortunately does not allow us to provide an in-depth empirical analysis.

Since our data set is drawn, in its entirety, from one insurance company only, one cannot, in principle, rule out the possibility of self-selection biases affecting the coefficients of the logit model. If, e g, this company somehow appears particularly attractive to unusually safe drivers owning old cars, such a selection mechanism might help explain the results obtained. Since, however, liability damage accidents usually involve clients from another company as well, and since the most important cofactors have probably been controlled for in the analysis, it seems unlikely that such selection biases could be sufficient to explain the strong and consistent tendency found in the data. A repeated analysis based on similar data from other companies is, however, highly recommended.

Another possible explanation could be that large, heavy or expensive cars have a longer than average life on the road and hence might be overrepresented among the older cars in our data set. Large cars provide better protection for their occupants and hence tend to have a lower than average injury accident risk. Again, however, it seems implausible that this effect could explain the tendency found for liability damage accidents, since most of these are two-party crashes involving material damage only.

In our view, therefore, the most relevant and powerful explanation is likely to be found in the theory of risk compensation (behavioral adaptation). Drivers adjust their behavior to changes in the perceived risk as represented by the vehicle or driving environment. Newer cars are generally more comfortable, causing less noise and vibration. They are also, in general, pictured, promoted and conceived of as technically safer. It is possible that drivers take advantage of these perceived safety enhancements to adopt a less defensive style of driving.

Indeed, our analysis suggests that this “lulling effect” is strong enough to more than outweigh the “engineering effect”, i e the objectively lower risk offered by newer vehicles under (the assumption of) constant driver behavior.

Put otherwise, our analysis may be taken to suggest that drivers of older cars, being aware of the augmented risk, and feeling the stronger noise and vibrations generated by such a car, actually “overcompensate” for the hazards involved, bringing the empirical injury or accident risk down to a lower level than for brand new cars.