Short-Term Effects of Safety-Related Recalls on New Vehicle Purchase Decisions: An Empirical Analysis

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Since passage of the National Traffic and Motor Vehicle Safety Act, the federal government has played an active role in regulating vehicle safety. In addition to mandating that vehicle manufacturers equip new vehicles with a variety of accident prevention and crash protection devices, the federal government requires manufacturers to report any defects that may develop. To date, much of the research in this area has concentrated on the highway safety effects of accident prevention and crash protection regulations. On the other hand, there has been relatively little research on government recall campaigns and the effect these may have upon the demand for new vehicles. Although it is known that well-publicized recalls of a major defect (e.g., the gas tank problem in the Ford Pinto or the recent accelerator problem in the Audi 5000) will have an immediate effect on current demand for the recalled vehicle, there are other questions whose answers are less clear. Will such campaigns affect contemporaneous demand only or will there be lingering effects on future demand? Do recall campaigns of a less serious nature have any effect upon new vehicle purchase decisions? The purpose of this paper is to develop and estimate an economic model that addresses the short-term effects of recall campaigns upon consumer behavior.

In 1966, Congress passed the National Traffic and Motor Vehicle Safety Act, which empowered the federal government to set national safety standards for motor vehicles. Section 151 of this act requires that if a manufacturer:

> (1) obtains knowledge that any motor vehicle or item of replacement equipment manufactured by him contains a defect and determines in good faith that such defect relates to motor vehicle safety; or
>
> (2) determines in good faith that such vehicle or item . . . does not comply with an applicable Federal motor vehicle safety standard prescribed . . . ; [then] he shall furnish notification to the Secretary [of Transportation] and to owners, purchasers, and dealers . . . and he shall remedy the defect or failure . . . .

In an effort to distribute this information, the National Highway Traffic Safety Administration (NHTSA) publishes quarterly summary reports on safety-related recalls conducted by domestic and foreign manufacturers.

Reflecting the significant amount of private and public resources devoted to ensuring that new motor vehicles satisfy government-mandated regulations, much of the research in this area has focused upon the highway safety effects of the regulations [Lave and Weber (*1*), Peltzman (*2*), Arnould and Grabowski (*3*), Graham et al. (*4*), and Crandall et al. (*5*)]. On the other hand, surprisingly little research has been undertaken on the effects of motor vehicle recall campaigns upon new car purchase decisions.

The purpose of this paper is to develop and estimate a model that identifies the effects that a recall campaign will have upon new car purchase decisions. All else held constant, a safety-related recall for a particular make/model may affect the expected benefits associated with the recalled vehicle. To the extent that it does, one would expect the recall campaign to alter the relative choice probabilities of the available set of new vehicles.

In the following section, the theoretical effects of a safety-related campaign will be discussed. Following this, the sources of data and development of an estimation data set will be outlined. The estimation results are then presented followed by a summary of the paper and concluding comments.

THEORETICAL CONSIDERATIONS

In economic theories of consumer behavior, individuals are generally assumed to be wealth or economic welfare maximizers. This implies that individuals will continue to consume a commodity up to the point at which the marginal benefit of one more unit equals the marginal cost of obtaining one more unit. Equalizing marginal costs and benefits typically characterizes individual consumption of a good that can be altered in small amounts, that is, a divisible good. If the good in question is discrete rather than divisible, then it is not possible to increase or decrease the consumption of the good in response to a change in existing economic circumstances. Rather, the consumer will simply switch from one good to another. In the case of discrete commodities, an individual has a set of alternatives available to him/her and will select that alternative that provides the greatest level of economic welfare. Suppose, for example, that an individual is in the market for a new car and that, all else held constant (including the prices of other new vehicles), the price of a particular make/model vehicle increases 10 percent. Because the individual has not yet purchased an automobile he will not respond by consuming a little less of the vehicle. The increase in price will, however, decrease the *probability* that the consumer will purchase this particular make/model. For discrete commodities, then,

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changing economic circumstances or other factors that affect the expected benefit derived from the good will alter the probability of selecting the good.

To be more explicit, assume that individual n is in the market for a new car and has J_n mutually exclusive and exhaustive make/model alternatives available. Each available make/model alternative provides the individual with some level of economic welfare, $U_{in}(x_{in},t_n)$ $i \varepsilon J_n$, where x_{in} is a set of variables that characterizes vehicle i and t_n represents attributes specific to individual n.

Included in x_n is not only the capital and operating costs of the vehicle but myriad other factors that influence an individual's choice of one vehicle over another, including (but not exclusive to) acceleration, vehicle comfort, styling, safety, and passenger/cargo space. All else held constant, an increase (decrease) in any attribute of a given make/model which would increase (decrease) the level of economic welfare associated with this vehicle would increase (decrease) the frequency with which the vehicle is purchased.

The second set of variables, t_n, corresponds to all characteristics of individual n relevant to his/her vehicle choice decision. These include such factors as household size, household income, preferences for imported versus domestic vehicles, and life cycle stage.

If make/model i provides individual n with the highest level of economic welfare, then

$$U_{in}(x_{in},t_n) > U_{jn}(x_{jn},t_n) \; i,j \varepsilon J_n; \; i \neq j \qquad (1)$$

In order to examine fully the effects of safety recalls on consumer choice, two aspects of the process will be identified: the impact of announced recalls on one make/model when a manufacturer has no history of producing defective automobiles; and the screening effects associated with a manufacturer that has a history of producing defective vehicles.

EFFECT OF A SAFETY-RELATED RECALL IN THE CURRENT MODEL YEAR

To isolate the effect that vehicle recalls have on new car purchase decisions, suppose that one manufacturer annually produces all new vehicles sold. Then, in any given year, an individual in the market for a new vehicle will purchase that vehicle that maximizes his level of economic welfare. Note that included in the vector of vehicle attributes, x_{in}, is vehicle reliability. Initially, because each vehicle is new and produced by the same manufacturer, there is no reason to believe, a priori, that one model will be any more or any less reliable than any other model. In effect, an individual is assumed to have equal uncertainty about the future reliability of each model in the new vehicle market so that, at the margin, this attribute is irrelevant to one's decision.

Suppose this assumption is relaxed. In particular, assume that until the current model year no defective vehicles in previous production years were produced. However, in the current model year, all production units of a given model have a safety-related defect. Before a purchase decision, the problem is identified by the government and a recall campaign for that model is announced. All else held constant, the expected benefits of the recalled model will fall relative to all other vehicles offered, which lowers the probability of an individual purchasing the vehicle. In this case, the identified problem increases the uncertainty regarding future performance of the recalled vehicle relative to the rest of the market. This result is true notwithstanding that the identified problem is corrected prior to one's purchase. Assuming that identified safety-related defects cannot be solved through engineering design changes in the current model year production, ad hoc procedures employed to fix a safety-related defect will still reduce a recalled vehicle's expected benefits relative to non-recalled vehicles on the market.

EFFECT OF A SAFETY-RELATED RECALL IN PRIOR MODEL YEARS

The above conclusion rests upon the assumption that the identified problem occurs in the current model year. Alternatively, assume that with the exception of the previous model year production no vehicles produced by the manufacturer were defective. In the previous model year, a given model was subject to a safety-related recall. As concluded above, the recall in the previous year would have a negative contemporaneous effect upon the probability of purchasing that model. However, there are two potential effects on *current* model year consumption. First, if the recall is indicative of declining production quality, the uncertainty associated with the model's expected performance would increase and the probability of purchase would decrease, all else held constant. This is not a likely result, however, since the model has posited a one-time recall occurrence. That is, the manufacturer has not exhibited a history of defective production. Second, a profit maximizing manufacturer has an economic incentive to correct problems identified in a previous model year production. In order to minimize the direct costs of a recall as well as liability costs, the less costly procedure, when possible, for fixing a safety-related defect is through vehicle redesign rather than employing ad hoc procedures.

Thus, all else held constant, a consumer in the current model year will have greater certainty regarding the vehicle's performance on that attribute which was subject to recall in the previous year. By increasing the expected benefits of that model, the probability of purchase would increase.

Suppose, on the other hand, that the only safety-related recall occurred two years prior to the current model year. Again, since the manufacturer does not exhibit any historical pattern of defective production, this will not have an adverse effect upon the probability of purchase in the current model year. But it may again increase the probability of purchase since this information reduces a consumer's uncertainty in the present period. Moreover, if recent information is valued more than distant information, the effect on the probability of purchase will be less in this case than when the recall occurred in the immediately preceding year.

In general, economic theory suggests that recalls which occur in previous years will increase the probability of purchasing current year models, all else held constant. But this effect will be greater the more recent the recall.

SCREENING BEHAVIOR

In the preceding analysis, it was assumed that all vehicles were produced by a single manufacturer with no history of

producing defective vehicles. Suppose, alternatively, that there are two producers each of which manufactures multiple vehicle models. In addition, assume that one firm consistently produces vehicles not subject to recalls and the second firm has had its models recalled in the previous model years. In the current model year, neither the firm nor the purchaser knows which, if any, of its models will be recalled. This suggests that a consumer uses a manufacturer's past recalls to screen models produced in the current year. For firm two, then, expected reliability of *all* current models is lower. This reduces the economic welfare associated with firm two vehicles, which reduces the probability of purchase, all else held constant.

If the manufacturer of less reliable vehicles experiences a recall in the current model year, the effect on the probability of purchase reinforces the screening effect. Consequently, a recall in the current model year will lead to the same qualitative results for both the "safe" and the "unsafe" producers, although one would expect to see a stronger effect for the "unsafe" producer.

The effect of previous year recalls upon current model demand leads to ambiguous effects in the presence of screening effects. Although, as discussed above, prior year recalls increase the probability of purchase in the present year (all else held constant), a history of government recall actions reduces, if not completely offsets, this effect. Thus, the effect of prior year recalls upon the likelihood of current model purchases is expected to be positive for the "safe" manufacturer and ambiguous for the "unsafe" producer.

DATA

Data for this analysis came from three sources. In July 1985, J.D. Powers and Associates conducted a nationwide survey of new 1985 vehicle buyers who had taken delivery in February/March 1985. A total of 68,825 surveys were mailed and 30,306 returned 5 yielding a 45 percent response rate. For each of the 143 vehicle models produced in 1985, a stratified random sample was used to obtain approximately 200 usable observations per model. The survey obtained information on multiple facets of new vehicle purchase decisions, including a description of the new vehicle purchased, purchasing and financing arrangements, source of sales by make and market segment of vehicle, owner loyalty, and socioeconomic characteristics of the principal purchaser and household.

A second source of information was the Automobile Club of Southern California. Since 1984, the Automobile Club has had a Target Car program in which it evaluates currently manufactured four passenger vehicles on various design characteristics, including crashworthiness potential, fuel economy, luggage capacity, size, ride quality, entry and exit, interior noise, and interior size. Cost information and performance characteristics for each vehicle are also collected.

A third data source was NHTSA, which provided detailed information on safety-related recalls for 1984 and 1985 model year vehicles.

Although the national survey of households provided purchase information on each of the 143 make/models produced in 1985, the usable data set included a smaller number of make/models. This reflected two factors. First, the Target Car program did not test each of the new vehicles but annually evaluated a subset of vehicles based upon the following criteria: four passenger vehicle; significant new design; vehicle not tested in the previous year; enclosed cargo/luggage area; and similar vehicles not tested. Specifically excluded from the testing program were sports cars (e.g. Porsche) and "sporty" cars (e.g., Ford Mustang, Chrysler Laser). And second, Ford, Chrysler, and General Motors have "sister" cars; that is, automobiles that are structurally similar. For example, Tempo and Topaz for Ford; Reliant and Aries for Chrysler; and Toronado, Riviera, and Eldorado for General Motors are, respectively, in the same family line. In the event that a given make/model was not tested by the Automobile Club but a "sister" car was evaluated, the specifications for the sister car were used. Thus, from the 143 make/models produced in 1985, the set of included make/models numbered 68.

In addition to the smaller number of included make/models, a second factor that reduced the size of the usable sample was absence of relevant data. Thirty percent of the surveyed households were eliminated as a result of missing data on a number of important variables (e.g., household income and household size).

The usable data set containing all of the relevant socioeconomic and vehicle data comprised 4,902 observations. Since this was too large for estimation purposes, a sample was drawn from the usable data set under the constraint that the sample proportion of each of the 68 make/models represented in the usable data set equaled the proportion in which each of these are represented in the population. This procedure guarantees that the estimated parameters of the model will be consistent [Ben-Akiva and Lerman (*6*)]. This sampling strategy resulted in a random sample of 726 observations. Comparing the mean values on a large number of vehicle and socioeconomic characteristics revealed that the random sample was representative of the larger sample.

Finally, before estimating the model, it was necessary to define the alternative choice sets for each individual in the sample. Since the Automobile Club and the J.D. Powers data contained 68 new car make/models, 14 randomly selected vehicles were drawn from the set of feasible make/models and assigned to each of the 726 observations in the estimation sample. These 14 assigned alternatives combined with an individual's chosen alternative give each observation a choice set of 15 make/models. McFadden (*7*) has shown that this sampling-of-alternatives technique satisfies a uniform conditioning property, which ensures that the coefficient estimates will be efficient. For a more comprehensive discussion of the data development, see McCarthy (*8*).

ESTIMATION RESULTS

Conditional logit analysis was used to estimate the effect that recall campaigns have upon new car purchase behavior. Table 1 identifies the relevant vehicle attributes and household socioeconomic factors that determine an individual's choice of vehicle. The expected effect of most variables upon new car purchase behavior is straightforward. All else held constant, it is expected that each of the cost-related attributes will decrease the likelihood of purchase. Also, assuming that increased vehicle performance is associated with lower slalom

TABLE 1 VEHICLE ATTRIBUTES AND HOUSEHOLD SOCIOECONOMIC FACTORS

Variable	Definition
Cost-Related Attributes	
Price share	Purchase price of vehicle divided by annual household income.[a]
Operating cost	Per mile fuel cost, defined as the average gasoline price in respondent's home state divided by the EPA's fuel economy for city driving.
Performance-Related Attributes	
Slalom	Time required to complete a slalom test course (seconds).[b]
Comfort-Related Attributes	
Front/rear leg room	The sum of front and rear leg room (inches).[c]
Front/real shoulder room	The sum of front and rear shoulder room (inches).[d]
Interior noise level	Interior noise level at 30 mph (decibels).
Entry/exit	Ease of entry and exit from the vehicle. Entry/exit takes on a value from 1 to 10 where 10 is the best.[e]
Door sill height	Door sill height (inches).
Safety-Related Attributes	
Crashworthy index	Dummy variable which equals 1 if vehicle is identified as one of the most crashworthy vehicles in the 1985 model year, 0 otherwise.[f]
Vehicle weight	Vehicle weight (pounds).
Cargo Carrying Attributes	
Trunk size	Size of cargo space specified in the EPA fuel economy guide (cubic feet).
Vehicle Reliability	
Recall (1984)	Total number of recalls associated with the 1984 model year of make/model.
Recall (1985)	Total number of recalls associated with the 1985 model year of make/model.
Recall date (1984)	Number of months, before purchase, of latest recall for 1984 model year make/model.
Recall date (1985)	Number of months, before purchase, of latest recall for 1985 model year make/model.
Technical service index	An index representing the frequency and quality of routine maintenance and repair work by a dealer on a newly purchased vehicle. A higher index number is associated with improved performance on this dimension.[g]
Other Attributes	
Brand loyalty	Dummy variable that equals 1 if new vehicle purchased is of the same make as the respondent's previous vehicle, 0 otherwise.
American motors	Dummy variable that equals 1 if vehicle is manufactured by American Motors Corporation, 0 otherwise.
Chrysler	Dummy variable that equals 1 if vehicle is manufactured by Chrysler Corporation, 0 otherwise.
Ford	Dummy variable that equals 1 if vehicle is manufactured by Ford Motor Company, 0 otherwise.
Foreign	Dummy variable that equals 1 if vehicle is manufactured in a foreign country, 0 otherwise.

[a]The purchase price is defined as the manufacturer's base vehicle price, adjusted for engine option, transmission option, freight, and California emission system.

[b]Based upon a test developed by Motor Trend Magazine, the test course is 800 ft long and 100 ft wide. Each variable is tested three times on the course. Slalom is an average of the three test scores. Other measures of performance, including acceleration from 0 to 60, 40 to 60 (seconds), and net horsepower were tried. Slalom time led to the best model fit.

[c]Front leg room is measured from the accelerator pedal heel point up over the lower seat cushion to the seat back. Rear leg room is measured from the rear of the front seat back, horizontally to rear seat lower cushion, down the lower cushion to the intersection of the rear seat back and rear lower cushion.

[d]Front (rear) shoulder room is measured laterally across the width of the vehicle at a height of 18 in. vertical from the intersection of the front (rear) seat back with the lower seat cushion.

[e]The procedure was developed by the Automotive Engineering Department of AAA with the assistance of Man Factors, Inc., a human engineering research company. The primary concern of the procedure is with entry/exit into the rear seat area.

[f]See *The Car Book* by Jack Gillis, 1985 Edition. For each size class of vehicle, a crash test index is calculated that is based on occupant protection in a frontal crash at 35 mph.

[g]The Technical Service Index was developed by J.D. Powers and Associates for 1985 make/models. The index reflects consumer satisfaction on a variety of reliability dimensions, including type and frequency of repair problems, cost of repairs, and quality of dealership servicing.

times, the coefficient of slalom is expected to carry a negative sign. With the exception of interior noise level, increases in each of the comfort-related variables enhances the vehicle's comfort, all else held constant, and is expected to have a positive coefficient. Interior noise level is expected to carry a negative sign since higher decibel levels are associated with less comfort. Each of the vehicle safety variables is expected to carry a positive sign, indicating that safer vehicles are preferred to less safe vehicles, all else held constant.

Trunk size is expected to carry a positive sign, all else held constant. However, the fact that other vehicle size measures are incorporated in the estimating equation (interior roominess and vehicle weight, which is highly correlated to length of vehicle), larger trunk capacity may come at the cost of smaller dimensions in other areas. Its overall effect, therefore, is ambiguous. Because the effect of trunk size is expected to differ by size of family, this variable was interacted with two family size variables: households with 3 or fewer members and households with 4 or more members.

Brand loyalty is expected to have a positive sign. And the criterion for including the manufacturer/foreign dummy variables is the effect upon overall fit of the model.

With respect to vehicle reliability, the technical service index is expected to carry a positive sign. And from the theoretical model discussed above, it is expected that recall (1984) and recall (1985) will have a positive and negative sign, respectively. Although data on recalls was not available prior to the 1984 model year, month of recall for the 1984 and 1985 model years was available and was used to test the hypothesis on the value of information over time. Date of recall is a number that varies from 0 (corresponding to a recall in the month the car was purchased) to 20 (indicating that the latest recall occurred 20 months prior to purchase). Assuming that more recent recalls provide more information, and hence are of greater value for new car purchase decisions than more distant recalls, recall date (1984) and recall date (1985) are expected to carry positive signs.

The data in Table 2 summarize the estimation results, which for the most part are consistent with a priori expectations. Cost, performance, vehicle comfort, and safety-related attributes all have their expected signs and are significantly different from 0 at the .05 level (most are significantly different from 0 at the .01 level). Trunk size is significant for smaller households and its negative sign indicates that, all else held constant, a larger trunk volume decreases the probability of purchase. Somewhat unexpectedly, the coefficient for trunk size was larger in absolute value for smaller relative to larger families.

As expected, brand loyalty was positive and significantly different from 0. And, among the manufacturer/foreign dummy variables, only that for Chrysler was significantly different from 0. Its positive sign indicates that, all else held constant, an individual prefers a Chrysler to a non-Chrysler made vehicle.

Focusing on vehicle reliability, it is seen in Table 2 that the technical service index, as expected, carries a positive sign and is significant at the .01 level. In addition, each of the recall variables has its expected sign. Recall (1984) is positive and significant, consistent with the hypothesis that recall in a previous year make/model reduces uncertainty in purchasing the given make/model in the current year, all else held constant. On the other hand, recalling a make/model in the current model year increases consumer uncertainty, which reduces the probability of purchase. This is consistent with the sign and significance on recall (1985). When considering the time of recall, recall date (1984) and recall date (1985) both carry positive signs, although only recall date (1985) is significantly different from 0. Thus, even for current year make/models, more recent recalls, which correspond to a decrease in recall date (1985), decrease vehicle choice probabilities.

ELASTICITY MEASURES

In order to investigate the sensitivity of consumer demands to vehicle attributes, elasticity measures were calculated for a variety of representative vehicles and are reported in Tables 3 and 4. In Table 3, there are several interesting facts to note. First, the elasticity of choice with respect to the cost variables shows an increasing trend with size of vehicle, a result consistent with standard theory. Goods which make up a larger proportion of one's budget will have higher price elasticities of demand. Second, vehicle choices are very sensitive to interior noise levels—a 1 percent increase in the interior noise level reduces the probability of choice by 4–5 percent. New car vehicle choices are also sensitive to vehicle performance and safety (to the extent that weight reflects vehicle safety).

Table 4 provides elasticity measures for the recall variables included in the analysis. The results indicate that choice behavior is inelastic with respect to recall campaigns. However, as reflected by the measures for 1984 and 1985 recalls, vehicle choices are twice as sensitive to recall campaigns associated with current model year vehicles than with previous model year vehicles.

OTHER CONSIDERATIONS

The results presented in Table 2 reflect the short-term effects of vehicle recalls upon new car purchase decisions. Table 2 does not incorporate information as to whether a given manufacturer has a history of producing vehicles subject to a recall. As noted in the theoretical section, this would reinforce the contemporaneous effects of a recall but lead to ambiguous effects of recalls that occurred in prior years. Although it is not possible in the present study to estimate a dynamic vehicle choice model, it is possible to gain some insight into this issue. Over the past few years, there has been considerable discussion regarding the quality of American-produced vehicles relative to their foreign counterparts, particularly the Japanese [see, for example, Crandall et al. (*5*) and Mannering and Winston (*9*)]. Assuming that the quality of the vehicle is inversely related to the incidence of recall campaigns, then the hypothesis that the United States produces poorer quality vehicles can be tested by interacting the recall (1984) and recall (1985) variables with a dummy variable reflecting country of origin.

Estimating the model in which recall (1984) and recall (1985) were disaggregated by country of origin (domestic and foreign) yielded results that were virtually identical to those presented in Table 2. Moreover, the coefficient estimates for the interacted recall variables were consistent with the hypothesis

TABLE 2 EFFECT OF RECALLS ON NEW VEHICLE PURCHASES

Independent Variable	Coefficient Estimate	Asymptotic t-statistic
Price Share	- 4.587	- 8.85
Operating Fuel Cost	- .256	- 2.35
Slalom	- .258	- 1.69
Front/Rear Leg Room	.0570	2.91
Front/Rear Shoulder Room	.0575	3.66
Interior Noise Level	- .0847	- 3.90
Entry/Exit	.250	3.84
Door Sill Height	.182	6.18
Crashworthy Index	.443	3.14
Vehicle Weight	.000609	2.80
Trunk Size (Household size $\leq$ 3)	- .0414	- 6.71
Trunk Size (Household size > 3)	- .0071	- 1.02
Technical Service Index	.0112	4.71
Recall (1984)	.256	2.06
Recall (1985)	- .956	- 2.88
Recall Date (1984)	.00926	.72
Recall Date (1985)	.276	3.05
Brand Loyalty	2.068	16.98
Chrysler	.788	4.28

Number of households: 726

Number of observations: 10,890

Log-likelihood at 0: 1966.0

Log-likelihood at convergence: 1576.7

$\chi^2 = 778.7$

$\chi^2_{.05}(19) = 30.14$

$\rho^2 = .198$

TABLE 3 CHOICE PROBABILITY ELASTICITY MEASURES—VEHICLE ATTRIBUTES

Market Segment	$E_{Pr,Price\ Share}$	$E_{Pr,Operating\ Cost}$	$E_{Pr,Slalom}$	$E_{Pr,Noise}$	$E_{Pr,Weight}$
Subcompact					
Ford Escort	- .91	- .87	-2.11	-5.12	1.17
Honda Accord	- .92	- .86	-1.84	-4.77	1.09
Compact					
Chrysler Lebaron	-1.25	-1.04	-2.23	-4.81	1.49
Mazda 626	-1.20	-1.04	-2.34	-4.95	1.49
Intermediate					
Buick Regal	-1.26	-1.36	-2.50	-4.64	1.76
Nissan Maxima	-1.51	-1.33	-2.14	-5.11	1.76
Large					
Cadillac Eldorado	-2.17	-1.48	-2.14	-4.61	1.96
Oldsmobile 98	-1.58	-1.23	-2.16	-4.58	1.74

that the quality of American-manufactured vehicles is lower than vehicles produced outside of the United States, all else held constant. All recall variables had their expected signs. For 1985 recalls, the coefficient for domestic vehicles was uniformly greater (in absolute value) than the coefficients for foreign-produced vehicles. This is consistent with the notion that recalls associated with domestically produced vehicles involve greater uncertainty regarding expected reliability. Similarly, previous year recalls for domestic vehicles had a larger effect upon the probability of purchasing current year make/models relative to their foreign-produced counterparts. However, these results should be viewed as tentative since a likelihood ratio test of the hypothesis of equal coefficients for domestic and foreign-produced vehicles could not be rejected at the 0.05 level.

SUMMARY AND CONCLUSION

Since the seminal research of Peltzman (*2*), there has been a considerable amount of effort devoted to the role and the effects of the federal government's regulatory efforts to promote vehicle safety. One aspect of this issue that has received little attention is the effect of government-sponsored recall campaigns upon the purchase of new vehicles. Economic theory suggests that recall campaigns will alter the probability of purchasing a recalled vehicle, all else held constant, but that the direction of the effect will depend upon the model year of the vehicle recalled. By increasing the uncertainty associated with a recalled vehicle's expected reliability, a recall occurring in the current model year will adversely affect the probability of an individual purchasing the vehicle. Alternatively, if the recall corresponds to a prior model year, it will act to reduce the uncertainty of the vehicle's expected reliability in the current model year; hence, it will increase the probability of purchasing the current make/model. This effect, however, will be less the more distant the recall from the present period.

To test this hypothesis, detailed household socioeconomic and vehicle attribute information was obtained from a national survey of new car buyers and the Automobile Club of Southern California, respectively. This was supplemented with Department of Transportation data on new car vehicle recalls during the 1984 and 1985 model years. The data were used to estimate a conditional logit model of new vehicle type choice and the results were consistent with the underlying hypotheses.

The main conclusion from this analysis is that recall campaigns have predictable short-term effects upon individual choices of new vehicles. In particular, the number of recalls as well as the timing of the recall significantly influence the demand for new vehicles. Moreover, there was limited evidence to support the hypothesis that recall campaigns have more pronounced effects on manufacturers that are perceived to produce lower quality vehicles. Although this latter result is not conclusive, it does imply the need for further research in this area. In the longer term, a history of poor quality production will affect market demand and be capitalized into the price of the vehicle, all else held constant. A more accurate, albeit more complex, model would incorporate the inter-

TABLE 4 CHOICE PROBABILITY ELASTICITY MEASURES—RECALL VARIABLES

Market Segment	$E_{Pr,Recall}$ 1984	$E_{Pr,Recall}$ 1985	$E_{Pr,Recall}$ Date 1984	$E_{Pr,Recall}$ Date 1985
Subcompact				
Ford Escort	.45	-	.04	-
Compact				
Chrysler Lebaron	-	-.85	-	-.49
Toyota Camry	.21		.12	
Intermediate				
Buick Regal	.47	-	.04	-
Chevrolet Celebrity	-	-.75	-	1.08
Large				
Cadillac Eldorado	.24	-	.11	-

[a]A dash in the table indicates that the particular make/model was not subject to a recall in the specified year.

action between government recall actions, market demand, and the resulting influence on capital cost.

The primary policy implication is that there are potential benefits from increased dissemination of recall information to the public. Although this analysis does not provide any insight into the net benefits of the recall program, it does indicate that these campaigns are relevant to one's decision making.

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