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An exploratory analysis of automobile leasing by US households

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Abstract

The share of new automobiles leased in the United States increased from 3% in 1984 to 30% by 1998. This paper explores the motivations behind consumers' preference for leasing by developing a model of vehicle acquisition decisions, including the type of vehicle to drive and whether to lease or purchase it. We find that leasing's recent popularity is largely attributable to its role in facilitating vehicle upgrading by high-income households. Because such households represent a small share of US households, we question projections that leasing will capture ever greater shares of the new vehicle market.

Keywords: Automobile leasing; Upgrade behavior; Nested-logit

1. Introduction

Between 1984 and 1998, the share of new automobiles leased in the United States increased tenfold—from 2.9% to more than 30%. The share of light trucks, including sport utility vehicles, that is leased also grew sharply (Fig. 1). Americans now lease 20–30% of new vehicles produced by US manufacturers, roughly 35% of those produced by Japanese manufacturers, and more than 60%

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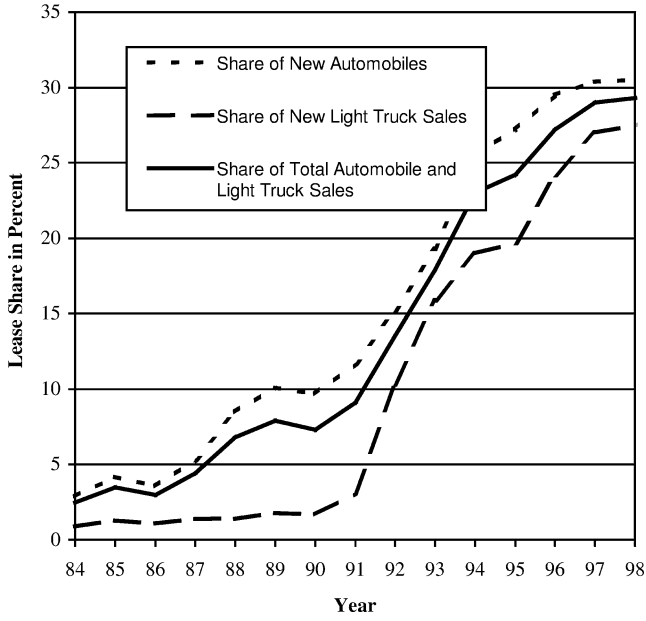

Fig. 1. Share of new vehicles leased by consumers (CNW Marketing Research, Brandon, Oregon).

of those produced by European manufacturers. Projections in the popular press suggest that Americans will soon lease nearly half of all their new vehicles.

A household that leases an automobile rather than purchasing it can lower both its down payment and monthly payments because those expenditures cover only vehicle depreciation over the term of the lease rather than the total cost of the vehicle.[1] At the end of the lease, however, the leasing household (unlike a purchasing household) has no vehicle. Thus the capital costs of leasing are typically greater than those of purchasing.

Given that economic disadvantage, why are consumers increasingly preferring to lease? Generally, consumer financing and leasing make possible consumption that would otherwise not be possible. Theoretical models of consumer behavior would therefore explain the growth in leasing as a response to credit constraints encountered by consumers who wish to enter the new-vehicle market. But a second explanation is that consumers strive to drive ever higher-quality vehicles over their "life cycle" consumption of automobiles. Because leasing facilitates such upgrade behavior by enabling consumers to acquire a higher-quality car for a given monthly payment, the growth in leasing could be explained by consumers' growing desire to upgrade their vehicles. Upgrade behavior could also enhance

[1] Aizcorbe and Starr-McCluer [1] present evidence that down payments for leased vehicles are lower than for purchased vehicles.

mobility. For example, a family that relocates from a central city to a suburb may reduce the disutility of a longer commute by leasing a high-quality vehicle that offers more comfort and safety than a vehicle they could afford to purchase.

In this paper, we explore the motivations behind consumers' preference for leasing by developing a model of their vehicle acquisition decisions, including the type of vehicle to drive and whether to lease or purchase it. Our empirical findings suggest that leasing's popularity is largely attributable to its role in facilitating vehicle upgrading by US households whose real income grew rapidly during the 1990s—that is, high-income households. Our analysis also distinguishes the roles played by leasing and traditional financing: leasing primarily helps households upgrade their vehicles; financing primarily accelerates their entry into the new-vehicle market. These findings could bear relevance to other markets, most notably housing, where the benefits from upgrading may motivate some (higher-income) households to rent rather than take out a mortgage on a new home.

Finally, our paper calls into question projections that leasing will capture ever greater shares of the US new-vehicle market. Because the high-income households that lease vehicles represent a small share of all US households—and because the less affluent households that tend to finance their vehicles are likely to maintain that preference—leasing has probably peaked.

2. Modeling the vehicle leasing decision

The analysis of consumer demand for vehicles has evolved to encompass the types of vehicles consumers choose to own, how many they choose to own, and how much they drive them (Train [2] and Hensher et al. [3] provide surveys). We extend this research by integrating consumers' choice of vehicle type with the way they acquire it—that is, paying for the vehicle in full (cash), paying for it over time (finance), or leasing it for a specified period (lease).

By jointly analyzing vehicle type and acquisition choices we account for a consumer's comparison of the utility from leasing a given vehicle with the utility from leasing a different vehicle and the utility from purchasing the same or a different vehicle. For example, the utility from leasing a Honda Accord is compared with the utility from paying cash for a Honda Accord, financing a Honda Accord, leasing a Lexus LS400, paying cash for a Lexus LS400, and so on. Consumers therefore have the opportunity to use leasing to acquire a car of higher-quality than one they could afford to purchase. Previous analyses of the vehicle leasing decision have restricted the utility maximizing choices that are available to consumers by treating the vehicle type-choice as given (Patrick [4], Nunnally and Plath [5], and Miller [6]).

As we discuss later, manufacturers and dealers have not especially encouraged leasing; thus, we focus on the behavior of consumers instead of performing an industry analysis. We use a disaggregate nested-logit model to simultaneously

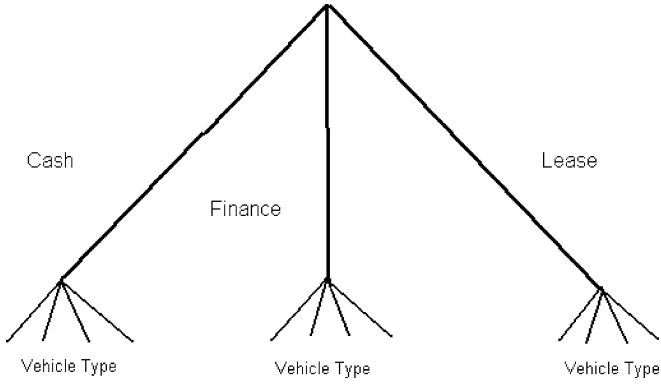

Fig. 2. Initial nested-logit model of acquisition and vehicle type-choice.

analyze the three financial options that consumers have when they decide to acquire a vehicle and the vehicle type choices that correspond to these decisions. McFadden [7] has shown that this model can be derived from consumers' utility maximizing behavior.

The initial structure of the model is summarized in Fig. 2. As pointed out by McFadden [7], the nested-logit model assumes that the acquisition method and vehicle type-choice are not sequential but instead reflect simultaneous decisions.[2] The nesting done here appropriately eliminates shared unobserved effects among vehicle types within each of the acquisition methods.[3]

Statistical tests revealed that the hypothesis of coefficient stability across vehicle type-choice models should be rejected; thus, it would be inappropriate to ignore how a vehicle was acquired and estimate one vehicle type-choice model for all households in our sample.[4] As shown in Fig. 2, we specify separate vehicle type-choice models for households who lease, finance, or pay cash for their vehicle. The utility function for each decisionmaker is given by

$$U_{i|a} = V_{i|a}(X\beta) + \mu_{i|a},$$

where $U_{i|a}$ denotes the random utility of vehicle alternative i conditional on financial acquisition (hereafter acquisition) choice a, V denotes the mean indirect utility, which is a function of a vector of explanatory variables X (including

[2] We could have also included the decision of how many vehicles a household chooses to own in the analysis, but we found that it was statistically justifiable to analyze this decision independently of the type-choice and acquisition decision.

[3] Although the nested-logit model allows errors to be correlated across decisions, it assumes that errors for alternatives within a given decision are uncorrelated. This assumption, however, can and will be tested at appropriate points here. In addition, the disaggregate nested-logit model assumes vehicle prices are exogenous because an individual consumer cannot significantly influence market prices.

[4] Based on a likelihood ratio test, we found that the hypothesis that the coefficients of the lease, finance, and cash type-choice models were equal could be rejected with more than 99% confidence.

vehicle attributes, socioeconomic characteristics of the decisionmaker, and other influences) and a vector of estimable parameters β, and μ is an error term assumed to have a generalized extreme value distribution.

Given this utility function, the multinomial logit probability that an individual selects vehicle alternative i conditional on acquisition-choice a is

$$prob_{i|a} = \frac{\exp(V_{i|a})}{\sum_I \exp(V_{I|a})}, \tag{1}$$

where $V_{i|a}$ denotes the indirect utility from vehicle alternative i conditioned on acquisition-choice a, and I is the set of vehicle alternatives.

Drawing on Mannering and Winston [8–10], we specify the indirect utility that consumers derive from their vehicle choice as a function of socioeconomic characteristics, vehicle attributes, brand loyalty, and brand preference. Socioeconomic variables include the consumer's age, household income, and residential location.

The vehicle attributes we include in each specification are purchase price, operating costs, insurance costs, residual value, vehicle size, horsepower, turning radius, availability of an air bag, and a repair index. These variables are consistent with those used in previous vehicle choice models. We also follow previous specifications by interacting purchase price with household income.[5] A key variable for our purposes is a vehicle's residual value, which is determined by the percentage of the manufacturer's suggested retail price that the vehicle is expected to retain after its first three years of use. The residual value is a good indicator of vehicle quality and depreciation and, along with the vehicle purchase price, influences the financial terms of a lease.

We included the purchase price, instead of total lease costs, in the type-choice model of consumers who lease vehicles because we were unable to get complete information on the full costs of a lease (down payment, monthly payments, and so on) for the vehicles in our sample. The substitution should be acceptable because a vehicle's purchase price is highly correlated with the full costs of leasing it and such correlation should not vary systematically by vehicle make and model. In addition, the purchase price (and vehicle depreciation) are important to consumers who lease because they can profit if their vehicle is worth more than its residual value when the lease expires.[6] A potential problem with using purchase prices would arise if automakers or dealers consistently offered greater incentives for

[5] Exploratory estimations indicated that the best statistical fits were obtained by specifying the natural log of vehicle price divided by the natural log of household income. This specification implies that a given price increase has a smaller impact on the demand for an expensive vehicle than on the demand for a less expensive vehicle.

[6] Under *closed-end* leases, which were introduced in the late 1980s, consumers return the vehicle to the dealer when the lease expires and assuming they have neither damaged the vehicle nor exceeded mileage limits, suffer no additional cost if the vehicle is worth less than the estimated residual value. If the vehicle is worth more than its estimated residual value, the consumer can purchase it and keep or re-sell it at a profit.

leasing than for financing or paying cash. Although incentives for leasing are offered from time to time, incentives are also offered for financing and paying cash. Thus the relative cost of leasing did not change much during our sample period. Indeed, as noted later, real purchase prices of automobiles and the real monthly costs of leasing remained fairly constant throughout the 1990s.

Drawing on our previous work (Mannering and Winston [9,10]), we distinguish between brand loyalty and brand preference. Brand loyalty captures the consumer's accumulated information about a brand. It is specified as the number of previous consecutive purchases (or leases) of the same brand of vehicle as the new-vehicle purchase (or lease) being considered. Brand preference captures the tendency for consumers to purchase (or lease) a specific brand of vehicle all else equal. It is specified by vehicle make dummy variables.

We now turn to the acquisition-choice. Statistical tests revealed that we could not estimate a consumer's acquisition alternatives jointly, as we specified them in Fig. 2, because this specification violated the independence of irrelevant alternatives (IIA) property of the logit model.[7] We thus decompose a consumer's acquisition-choice into two subchoices. First, we estimate a binary logit model of whether consumers pay cash for their vehicle or use a non-cash alternative (lease or finance) to acquire it. For consumers who use a non-cash alternative to acquire a vehicle, we estimate a binary logit model of whether they lease or finance it. The final structure of our nested-logit model of vehicle acquisition and type-choice is summarized in Fig. 3. (Again, this structure does not imply sequential decisionmaking; all decisions are simultaneous.)

Formally, the logit probability that an individual selects acquisition alternative k (cash or non-cash) to acquire a vehicle is given by

$$prob_k = \frac{\exp(V_k + \Theta L_k)}{\sum_K \exp(V_K + \Theta L_K)}, \tag{2}$$

where K is the set of acquisition alternatives (cash, non-cash), and V_k is the indirect utility from acquisition alternative k, which is a function of household socioeconomic characteristics. This choice probability is also a function of a summary index of the attractiveness of the vehicles available on the market. That index, known as the "inclusive value," is constructed from the systematic utilities from the lower-level decision of what type of vehicle to select. For the cash alternative, the inclusive value is $L_k = \log[\sum_I \exp(V_{I|c})]$, where $V_{I|c}$ is the indirect utility of vehicle types I conditioned on a cash acquisition c as determined in Eq. (1). L_k is interpreted as the expected value of the maximum utility obtained from the choice over all vehicles conditioned on a cash acquisition

[7] The IIA property of the logit acquisition model assumes that the error terms of the cash, lease, and finance alternatives are not correlated. Using the Small and Hsaio (1985) specification test, we found that this assumption could be rejected with more than 99% confidence. We also tested and rejected the specification of a joint choice logit model of vehicle type and acquisition.

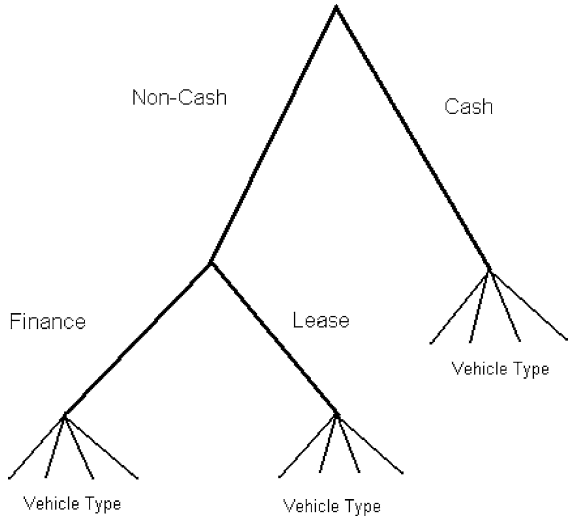

Fig. 3. Final nested-logit model of acquisition and vehicle type-choice.

(McFadden [7]). For the non-cash alternative (lease or finance), the inclusive value is $L_k = \log[\sum_M \exp(V_{M|nc} + \Omega L_M)]$, where L_k is now interpreted as the expected maximum utility obtained from the choice over all vehicles conditioned on a non-cash acquisition nc, and M is the set of non-cash acquisition alternatives (lease, finance). This inclusive value is more complicated than the preceding one because it is based on the attractiveness of vehicles available for leasing and financing (i.e., the two non-cash acquisition methods). It can be determined from the denominator of a binary logit model of the choice of whether to lease or finance a vehicle. The choice probability for this model is given by

$$prob_{m|nc} = \frac{\exp(V_{m|nc} + \Omega L_m)}{\sum_M \exp(V_{M|nc} + \Omega L_M)}, \tag{3}$$

where $prob_{m|nc}$ is the probability of a non-cash acquisition-choice m (lease or finance) conditioned on a non-cash choice, and $V_{m|nc}$ is the indirect utility from leasing or financing a vehicle, which is a function of household socioeconomic characteristics. The inclusive value in this model is $L_M = \log[\sum_I \exp(V_{I|M})]$, where $V_{I|M}$ is the indirect utility of vehicle types I conditioned on a non-cash acquisition method M as determined in Eq. (1). Note that vehicle attributes, such as prices, influence the choice of whether to lease or finance a vehicle through the inclusive value. Finally, the estimable coefficients Θ and Ω in Eqs. (2) and (3) must have a value between 0 and 1 for consumers' behavior to be consistent with utility maximization (McFadden [11] and Train [2]).

We estimate the nested-logit model with a random sample of 654 households who acquired 700 new automobiles or light trucks in the 1993, 1994, and 1995 model years, a period during which consumers' propensity to lease vehicles grew

Table 1
Sample statistics by acquisition method

	Acquisition method		
	Pay cash	Finance	Lease
Percent of vehicles acquired by	28.1	51.6	20.3
Annual average income of households who	$62,000	$54,000	$88,300
Percent of consumers who are college educated who	49.7	30.5	56.3
Average age of consumers	59 years	43 years	46 years

steadily.[8] The sample is drawn from a national household panel administered by National Family Opinion, Inc., and managed by Allison–Fisher, Inc. It is composed of consumers' new-vehicle type choices (make, model, and year) and acquisition choices.[9] The sample also includes consumers' socioeconomic characteristics, and vehicle ownership histories, which are used to construct the brand loyalty variables. Vehicle attributes are from 1993–1995 issues of *Consumer Reports* and the *Market Data Book* published by Automotive News, while vehicle expected residual values are from 1993–1995 issues of Edmunds *New Cars, Prices and Reviews*.

As shown in Table 1, consumers leased 20.3% of the vehicles in the sample, paid cash for 28.1%, and financed 51.6%. An inspection of our data revealed that the growth in leasing appears to be coming slightly more from consumers who previously financed their vehicles than from consumers who previously paid cash for them. Consumers who lease vehicles have, on average, much higher incomes than consumers who finance them, which provides some preliminary evidence that leasing and financing are serving different purposes. Consumers who lease vehicles also have, on average, higher incomes than consumers who pay cash for them and have more education than consumers who pay cash for or finance their vehicles. Consumers who pay cash are, on average, older than consumers who lease or finance. Generally, these sample statistics are consistent with population summaries of the automobile leasing market (e.g., Aizcorbe and Starr-McCluer [1]), indicating we have a representative sample.

[8] Consumers generally do not lease used vehicles. Because we want to study consumers' propensity to lease vehicles, we did not include used vehicles in the analysis.

[9] Acquisition choices are based on consumers' financial arrangements with automobile dealers. For example, if a consumer took out a home equity loan and paid cash for a vehicle at the dealer, the consumer's acquisition-choice would be specified as cash. The lease acquisition choices in our sample only include consumers who lease a car for their personal and business use and who make their own lease payments. Thus we do not include consumers who select vehicles that are leased by their employer or who select vehicles that are leased by a company they own and solely use them for business.

3. Estimation results

Statistical tests revealed that we could not reject the hypothesis that the coefficients of the vehicle type and acquisition-choice models were the same for 1993, 1994, and 1995 model years, thus we combined our annual data and estimated models for the 1993–1995 period.[10] As described above, we estimated separate vehicle type-choice models for consumers who leased, financed, or paid cash for their vehicles, and separate models for whether or not consumers paid cash for a vehicle, and whether they leased or financed a vehicle.[11]

3.1. Vehicle type-choice models

Table 2 presents the coefficient estimates for households who leased their vehicle.[12] The coefficients are generally reliable and have the expected sign. Consumers are more likely to lease a given vehicle if it has a passenger-side air bag, greater reliability, and greater performance (as measured by turning radius and vehicle horsepower), while an increase in a vehicle's operating (fuel) or capital (purchase) costs makes it less likely that they will lease that

[10] The stability of the lease, finance, and cash vehicle type-choice coefficients was tested with a likelihood ratio test. In all cases, the hypothesis of temporal stability across model years could not be rejected at the 95% confidence level. Tests for the temporal stability of the acquisition-choice coefficients produced the same result.

[11] A referee pointed out that this specification implies that if consumers are induced to switch, for example, from financing to paying cash, their valuation of vehicle attributes will change. This taste change is plausible if the switch were caused by an increase in income. It would be less plausible if, for example, the switch occurred because the cost of financing increased. That is, the mean tastes among those who finance their vehicles differ from the mean tastes among those who pay cash or lease, which is consistent with our empirical test, but consumers who switch from financing to paying cash do not change their tastes. Although this does not affect our primary conclusions, taste variation could be explored by estimating vehicle type choices with mixed logit (Brownstone and Train [12]). Unfortunately, this is not possible here because we must estimate a subsample of roughly 150–175 alternative makes and models (see next section). Consistent estimates for a multinomial logit model can be achieved from subsampling alternatives, but this property is not shared by the mixed logit model.

[12] The choice alternatives are new vehicles defined by make and model. As in other type-choice models (Mannering and Winston [9,10]), the logit independence from irrelevant alternatives (IIA) assumption was tested using the test proposed by Small and Hsaio [13]. The data were split in a number of ways to test for IIA violations (e.g., by foreign/domestic manufacturer and size and class of vehicle). In all cases, the IIA assumption could not be rejected at the 95% confidence level. For estimation purposes, we take advantage of the multinomial logit IIA property and estimate the type-choice models by random subsampling of 10 alternative vehicles including the chosen alternative. (During the time our sample was drawn, there were no constraints on the cars available for leasing.) Thus we need not estimate choices over the 150–175 different makes and models offered by manufacturers each year. Finally, we excluded households who made more than one new-vehicle purchase during our 3-year sample period to investigate whether the estimation results were affected by including households who made more than one vehicle purchase. We found that the estimation results were not affected by including these households; that is, the potential bias created by the correlation of the error terms of a household with multiple observations was negligible.

Table 2
Multinomial logit coefficient estimates for 1993, 1994, and 1995: new-vehicle choice—lease submodel

Variable	Coefficient (standard error)
Vehicle attributes and socioeconomic characteristics	
Passenger-side airbag dummy (1 if passenger-side airbag is standard on vehicle model, 0 otherwise)	1.045 (0.356)
Vehicle reliability based on the *Consumer Report's* repair index[a]	0.317 (0.133)
Turning radius (in feet)	0.152 (0.059)
Vehicle Horsepower (defined for households with annual income > $25,000)	0.0075 (0.0039)
Annual fuel cost (in dollars)[b]	−0.0018 (0.0014)
Natural log of vehicle price divided by the natural log of household income (in thousands of dollars)	−9.536 (2.484)
Vehicle residual value if sold by a US manufacturer (defined as the percentage of the manufacturer suggested retail price the vehicle will retain during its first three years of use)	0.092 (0.026)
Vehicle residual value if sold by a non-US manufacturer (defined as the percentage of the manufacturer suggested retail price the vehicle will retain during its first three years of use)	0.065 (0.026)
Subcompact class dummy if sold by a US manufacturer[c] (1 if vehicle is a US manufacturer's subcompact, 0 otherwise)	0.835 (0.678)
Subcompact class dummy if sold by a non-US manufacturer[c] (1 if vehicle is a non-US manufacturer's subcompact, 0 otherwise)	−2.208 (1.236)
Compact class dummy[c] (1 if compact vehicle, 0 otherwise)	1.845 (0.573)
Mid-size vehicle dummy[c] (1 if mid-size vehicle, 0 otherwise)	2.19 (0.58)
Large vehicle dummy[c] (1 if large vehicle, 0 otherwise)	1.342 (0.654)
Minivan dummy if sold by a US manufacturer[c] (1 if vehicle is a US manufacturer's minivan and the household has 3 or more members, 0 otherwise)	1.496 (0.635)
Sports Utility Vehicle dummy if sold by a US manufacturer[c] (1 if vehicle is a US manufacturer's SUV and the household has 3 or more members, 0 otherwise)	2.71 (0.74)
Sports Utility Vehicle dummy if sold by a non-US manufacturer[c] (1 if vehicle is a non-US manufacturer's SUV and the household has 3 or more members, 0 otherwise)	2.215 (0.768)
Brand loyalty and preference	
Number of previous consecutive GM purchases	1.66 (0.45)

Table 2 (*continued*)

Variable	Coefficient (standard error)
Number of previous consecutive Chrysler purchases	1.04
	(0.60)
Number of previous consecutive Ford purchases	1.65
	(0.546)
Number of previous consecutive Japanese manufacturer purchases	1.123
	(0.40)
Number of previous consecutive purchases for vehicles produced by European or other manufacturers[d]	4.656
	(1.307)
Number of previous consecutive *leases* of the same make of vehicle	0.668
	(0.394)
Ford manufacturer dummy (1 if produced by Ford, 0 otherwise)	−0.827
	(0.807)
GM manufacturer dummy (1 if produced by GM, 0 otherwise)	−1.673
	(0.826)
Chrysler manufacturer dummy (1 if produced by Chrysler, 0 otherwise)	−2.605
	(0.864)
Japanese manufacturer dummy (1 if produced by a Japanese manufacturer, 0 otherwise)	−0.137
	(0.384)
Summary statistics	
Number of observations	142
Estimation by maximum likelihood	
Log likelihood at zero	−340.5
Log likelihood at convergence	−203.4

[a] *Consumer Reports'* repair index is a measure of reliability that uses integer values from 1 to 5. A value of 1 indicates the vehicle has a "much below average" repair record, 3 is "average," while 5 represents a "much better than average" reliability. Although vehicles are becoming more reliable over time (i.e., a vehicle that currently is considered average may have been much better than average several years ago), this should not pose a problem here because our sample only covers three years.

[b] Annual fuel cost must be treated as endogenous because the vehicle choice of the household will impact the number of miles driven and the operating cost the household incurs. A two-stage least squares procedure was used to correct for the endogeneity of annual operating cost. Socioeconomic characteristics (e.g., education, household size, race, marital status, and gender) were combined with vehicle fuel efficiency and gasoline prices to obtain model specific instruments for the demand estimation.

[c] Vehicle class sizes (e.g., subcompact, compact) are defined by the US Environmental Protection Agency. Separate class dummies were specified for US and non-US manufacturers in some instances. They show that US manufacturers have achieved a certain dominance in the minivan market, as reflected by the positive coefficient of their minivan dummy (the minivan dummy for non-US manufacturers was insignificant). US manufacturers also have somewhat greater strength than non-US manufacturers in the sport utility and subcompact market.

[d] Other vehicles, mainly vehicles produced by Korean manufacturers, represent a small share of the vehicles in this classification.

vehicle.[13] Consumers are more likely to lease a given foreign or American vehicle if it has a higher residual value. Finally, the vehicle size class dummies reveal a growing preference among consumers to lease larger vehicles and sport utility vehicles relative to smaller vehicles (two-seater vehicles, mini-compacts, and pick-ups serve as the base classification).

It has been well established that consumers who purchase vehicles have brand loyalty (Mannering and Winston [9,10]). Our findings indicate that consumers who lease vehicles also have brand loyalty.[14] The coefficients indicate that the probability that consumers will lease a vehicle of the same brand that they previously purchased is greatest for European vehicles. Consumers also have lease loyalty, which captures the effect of previous leases of a particular brand, rather than the effect of previous purchases, on the probability that a consumer will lease a given brand. In contrast to purchase loyalty, lease loyalty does not vary statistically by vehicle manufacturer and also has a weaker effect on the probability of vehicle type-choice, but it is possible that these findings could change as households develop more experience with leasing.[15] Finally, consumers who lease vehicles have the strongest brand preferences for European and Japanese vehicles (the European manufacturer dummy is normalized to zero, the Japanese manufacturer dummy is negative but small and statistically insignificant). The extent of brand loyalty and brand preference in the leasing market is particularly important to European manufacturers because leasing accounts for a much greater share of new European vehicle acquisitions in the United States than it does for new American and Japanese vehicle acquisitions.

With a few exceptions, the type choices of consumers who finance or pay cash for their vehicles are influenced by the same vehicle attributes that influence the type choices of consumers who lease their vehicles (quantitative differences in the attributes' effects on type-choice will be discussed shortly). Thus we

[13] Driver-side air bags were available for most vehicles in our sample; thus we were not able to capture their effect on vehicle choice. Turning radii have improved over the years to where they are rarely considered onerous by consumers. A greater turning radius, however, is highly correlated with unobserved factors associated with a smoother vehicle ride and greater comfort. Thus the positive sign for turning radius most likely reflects the influence of these vehicle characteristics. Finally, we found that households with annual incomes below $25,000 did not value horsepower, possibly because they can afford only entry-level vehicles that are in a narrow range of 80–90 horsepower. Thus, our specification of vehicle horsepower includes households whose annual income exceeds $25,000.

[14] As discussed in Mannering and Winston [9], brand loyalty estimates may capture state dependence or heterogeneity (i.e., unobserved consumer characteristics). We investigated this by conducting various tests including estimating the models using instrumented brand loyalty variables. We found, however, that the instrumented coefficient estimates were very similar to the uninstrumented coefficient estimates, thus the uninstrumented variables were used in the final estimation.

[15] CNW Marketing Research, 1998–1999 Reference Guide reports that people who lease vehicles typically consider fewer brands than people who purchase them.

summarize the key differences here and present the specific coefficient estimates in Appendices A and B.

Unlike consumers who lease their vehicles, consumers who finance them have *negative* lease loyalty (that is, when they finance a car, it is unlikely to be the same brand they leased).[16] At first glance, negative lease loyalty may be surprising because the low transactions costs facilitated by closed-end leases would seem to make it more likely that previous leasing experience would influence a consumer to purchase a vehicle of the same brand. However, our opposite finding is consistent with the notion that leasing and financing serve different purposes. Because consumers are attracted to leasing to upgrade the quality of the vehicles they drive but cannot afford to purchase, they would be unlikely to develop brand loyalty that would carry over to subsequent purchases.[17]

Why don't consumers who wish to upgrade their vehicles simply finance them? Because compared with leasing, financing could entail prohibitively high monthly payments. Financing is generally attractive not to those who wish to upgrade their vehicles, but to those who want to enter the vehicle market at a lower end. Thus when consumers shift from leasing to financing (or even paying cash), they are likely to have leased a brand's higher-quality vehicles and are "downgrading," possibly switching brands, because they now wish to purchase a vehicle. For example, a close inspection of our data revealed that one individual financed a Jeep Wrangler after leasing a Jaguar XJ6; another financed a Ford Escort after leasing a Cadillac Deville, and so on.[18]

Unlike consumers who lease or finance their vehicles, consumers who pay cash for them do not have lease loyalty or disloyalty (i.e., the lease loyalty variable was highly insignificant and not included in Appendix B). We speculate that these consumers have not had enough experience with leasing to develop either behavior.[19]

[16] This finding might arise if only a few people who leased vehicles subsequently purchased vehicles. But our sample includes a significant percentage of people who previously leased a vehicle and subsequently decided to finance one.

[17] Consumers who lease vehicles do have brand loyalty. This is not inconsistent with upgrade behavior because upgrading in this case is likely to occur within a brand.

[18] Unlike the leasing model, estimates of the financing model indicate that older consumers are more likely to acquire an American car, consumers who live in metropolitan areas whose population exceeds 500,000 are more likely to acquire (smaller) Japanese vehicles, presumably in response to more congested roads in these areas, and all consumers are less likely to acquire a vehicle if its insurance cost increases. On the other hand, we found that vehicle horsepower had a statistically insignificant effect on consumers' vehicle type choices regardless of annual income.

[19] In contrast to consumers who lease their vehicles, consumers who pay cash and live in metropolitan areas whose population exceeds 500,000 are more likely to acquire (smaller) Japanese vehicles. We also found that reliability and horsepower had a statistically insignificant effect on the type choices of consumers who paid cash, presumably because they only consider reliable vehicles that offer high performance.

Although all consumers' vehicle type choices are generally influenced by the same vehicle attributes, consumers who lease are willing to pay considerably more for certain "luxury" attributes than those who purchase. For example, leasers are willing to pay about twice as much for a passenger-side airbag and more than 80% more for additional horsepower.[20] Because leasers apparently place greater value on the attributes of higher-quality cars, we surmise that they are especially motivated by a desire to upgrade the quality of their vehicles.

3.2. Acquisition-choice models

The central objective of this paper is to understand consumers' growing tendency to lease; thus, the determinants of the choice of leasing a vehicle are especially important to this analysis (see Table 3). The coefficients of the vehicle type-choice models' inclusive values lie between 0 and 1, which is consistent with utility maximizing behavior.[21] They imply that consumers are more likely to lease a vehicle as their satisfaction from the set of vehicles available for leasing increases and more likely to finance as their satisfaction from the set of vehicles available for financing increases. The model year dummies indicate that, all else equal, leasing is becoming less onerous over time, which may reflect the growing value that consumers place on closed-end leases that reduce their transactions costs in the vehicle market. Consumers have to negotiate the terms of a lease, as they would have to negotiate a purchase price, but they do not have to worry about selling their vehicle when they want a new one.[22] Consumers are also more attracted to leasing if they have previously leased a vehicle because of a positive experience and the ability to draw on that experience to minimize the costs of excess wear and tear and use that they may have to pay at the end of the lease.[23]

[20] Estimates of consumers' willingness to pay (WTP) for vehicle attributes are obtained by forming the ratio of the coefficient of a vehicle attribute and the vehicle price coefficient. The estimates account for the fact that the vehicle price coefficient in our specification is multiplied by the natural log of vehicle price divided by the natural log of household income. The estimated WTP for horsepower by consumers who purchase their vehicles was based on a statistically insignificant coefficient for horsepower. Thus although consumers who lease their vehicles do place a higher value on horsepower than consumers who purchase, our estimate of the difference in WTP should be viewed with caution.

[21] The inclusive values are statistically significantly different from zero at more than 95% level of confidence for a one-tailed test and statistically significantly different from one at more than 99% level of confidence. The latter finding is important because if the inclusive values were not statistically significantly different from one, then it would be appropriate to use a standard multinomial logit structure instead of a nested-logit structure.

[22] Consumer dissatisfaction with open-ended leases, where consumers assumed the risk of vehicle depreciation, has been well documented. Closed-end leases still have uncertainty that is related, for example, to the unanticipated costs of mileage exceeding an allotted maximum. This has been a source of dissatisfaction among some consumers who drove more than they expected.

[23] To test for the possibility that the leasing dummy might be capturing unobserved heterogeneity, we instrumented this variable with (lagged) exogenous socioeconomic characteristics but found that

Table 3
Binary logit coefficient estimates for determining the probability of leasing/financing—non-cash submodel

Variable	Coefficient (standard error)
Inclusive value term from vehicle type/finance submodel	0.181
	(0.104)
Inclusive value term from vehicle type/lease submodel	0.15
	(0.096)
1993 model year dummy (1 if lease-finance choice was made on a 1993 vehicle, 0 otherwise, defined for leasing alternative)	−3.375
	(0.772)
1994 model year dummy (1 if lease-finance choice was made on a 1994 vehicle, 0 otherwise, defined for leasing alternative)	−2.41
	(0.746)
1995 model year dummy (1 if lease-finance choice was made on a 1995 vehicle, 0 otherwise, defined for leasing alternative)	−2.25
	(0.74)
Dummy variable if household has previously leased a vehicle (defined for leasing alternative)	2.08
	(0.36)
Household Income (in thousands of dollars, defined for leasing alternative)	0.012
	(0.0043)
Annual household debt[a] (in thousands of dollars, defined for leasing alternative)	0.0088
	(0.009)
Education dummy (1 if respondent graduated from college, 0 otherwise, defined for leasing alternative)	0.769
	(0.312)
Miles (in thousands) the household expected to drive over 12,000 (0 if under 12,000, defined for leasing alternative)[b]	−0.066
	(0.026)
Summary statistics	
Number of observations	503
Estimation by maximum likelihood	
Log likelihood at zero	−348.6
Log likelihood at convergence	−212.2

[a] Detailed monthly household payment information for credit cards, utilities, homeowners insurance, medical insurance, alimony, mortgage or rent, other debt payments, and other vehicle payments were used to create the annual household debt variable.

[b] To control for possible endogeneity of this variable, survey information on the number of miles each household expected to drive annually was regressed against household socioeconomic characteristics (e.g., age, income, occupation) to obtain an appropriate instrument (see Mannering and Winston [8]).

Consumers' "life cycle" automobile consumption can be generally characterized by a desire to upgrade the quality of the vehicles they drive. According to consumer pollsters, households have long sought to spend money on certain products such as vehicles to "show that they have made progress" or to keep up with the latest technologies and styles. This behavior is evident to vehicle manufacturers. For example, automobile executives such as Alex Trotman acknowledge that

this had a negligible effect on the estimated coefficient. Thus we used the uninstrumented variable here.

"we [Ford] grow a lot of consumers through our product lines. They start with Escorts and move on to some other vehicle."[24]

Life cycle consumption is propelled by rising incomes. Thus we interpret our finding that consumers are *more* likely to lease a vehicle as their income increases to indicate that they use leasing to upgrade the quality of their vehicles.[25] The income elasticity indicates the effect that a percentage change in income has on the probability that a consumer will lease a vehicle. Based on the coefficient estimates, the income elasticity of leasing is large and rises with income; households earning $75,000 per year have an income elasticity of 0.82 (i.e., a 1% increase in these households' income raises their probability of leasing by 0.82%), households earning $105,000 per year have an income elasticity of 1.09, and so on.[26] The pattern of these elasticities is consistent with Aizcorbe and Starr-McCluer's [1] finding that households with annual incomes greater than $100,000 have the highest leasing *rates* among all households.

The positive effect of income on leasing also indicates that leasing's role in expanding consumption possibilities differs from financing's role. When we included income in the financing alternative instead of in the leasing alternative, it had a negative and statistically significant effect, indicating that people finance to overcome the financial constraints (i.e., down payment and monthly payments) of acquiring *any* new-vehicle, not just a higher-quality new-vehicle. Our finding that annual household debt has a statistically insignificant effect on the probability of leasing a vehicle suggests that consumers do not lease to overcome the financial constraints of acquiring a new-vehicle.[27]

We also find that consumers are more likely to lease a vehicle as their level of education increases. Consumers with more education may be more inclined to focus on how leasing enables them to upgrade their vehicles. Finally, consumers are less likely to lease a vehicle if they expect to travel more than 12,000 miles a year because they will typically have to pay a surcharge for this extra mileage.

To complete the analysis, we estimated a model of the decision to acquire a vehicle by paying cash. Because most of the estimates are peripheral to our purpose here, full results are presented in Appendix C. The finding of greatest interest is that an increase in annual household debt makes it less likely that

[24] Louis Uchitelle, "As Taste for Comfort Rises, So Do Corporations' Profits," *New York Times*, September 14, 1997, p. 1.

[25] It is possible that dealers are more inclined to sell rather than to lease vehicles to lower-income consumers. Nonetheless, the high average income of households who lease vehicles (see Table 1) suggests it is highly unlikely that our finding of a positive effect of income on the probability of leasing reflects dealers' greater willingness to approve leases.

[26] Income has a direct positive effect on the probability of leasing and has an indirect positive effect through the inclusive values of the vehicle type-choice models. Specifying income in a linear manner in the leasing/financing choice model produced the best statistical fit.

[27] Aizcorbe and Starr-McCluer [1] also conclude that liquidity constraints on acquiring a vehicle are not a factor in leasing decisions.

consumers will pay cash for a vehicle. This may reflect habitual behavior; people with debt tend to accumulate it in other purchases. It may also indicate that as their debts increase, consumers use financing to enter the new-vehicle market.

4. Consumers' growing interest in leasing during the 1990s

We have interpreted a number of our empirical findings as support for the proposition that consumers' greater propensity to lease during the 1990s is consistent with their desire to upgrade the quality of the vehicles they drive. These findings include the *negative* lease loyalty of consumers who finance their vehicles after leasing, the higher value that consumers who lease place on certain luxury attributes, and the large positive effect of income on the decision to lease. These findings and others, such as the effect of household debt, also distinguish the role of leasing from that of traditional financing.

Why was upgrade behavior on the rise during the 1990s? As noted, consumers' life cycle, and thus upgrade, behavior is propelled by rising incomes. Although real median US household incomes stagnated during 1980–1995, the real incomes of the top fifth of US households increased 28%. They grew 8% from 1990 to 1995, which includes the period covered by our sample. These same households increased their wealth during the 1990s because of growth in the US stock market. The top 5% of US households enjoyed even greater capital gains from the growth in the stock market, while their real incomes increased 53% during 1980–1995, 17% during 1990–1995.[28] Real incomes of the top fifth and top 5% of US households grew much faster during these periods than during any economic expansion since the 1950s.[29]

The rising incomes of upper-income households during the 1990s coupled with the large income elasticity of leasing has substantially contributed to the growth in leasing. Greater incomes have also made leasing more attractive because individuals' value of time rises with income, and, as reflected in the model year dummies in the leasing choice model, consumers increasingly value the low transaction costs of disposing of a leased vehicle.

The plausibility of the upgrade explanation for consumers' increasing propensity to lease vehicles is strengthened by the absence of empirical support for alternative explanations such as changes in new car prices and quality, dealers' behavior, tax laws, and drivers' behavior. For instance, conditional on acquiring a vehicle, our leasing choice model indicates that the price elasticity of leasing

[28] These data are from the US Census Bureau, Historical Income. The Consumer Price Index probably overstates the costs of inflation to these households, hence the growth in their real incomes has been even greater than these figures suggest.

[29] This conclusion is based on examining the growth in real incomes of the top fifth and 5% of US households for a 5 year period starting with the expansion that began in May 1954 up to the expansion that began in July 1980.

is positive (i.e., an increase in vehicle prices increases the probability that a consumer will lease a vehicle), but the size of this elasticity is very small.[30] Moreover, the increase in real vehicle prices throughout 1980–1995, including the effect of government mandated equipment, was negligible.[31] As indicated in various trade publications, such as *Consumer Reports*, the quality and reliability of new cars continued to improve throughout the 1990s. Thus it is unlikely that consumers are increasingly leasing to minimize the costs of uncertainty in vehicle quality (i.e., the "lemons" problem). In addition, the vehicles that tend to be leased are among the most reliable (e.g., Lexus, Infiniti, Mercedes, and so on).

Although dealers made leasing more attractive in the late 1980s by introducing closed-end leases, we uncovered no evidence that vehicle manufacturers or dealers significantly promoted leasing during the 1990s. Interviews with automobile dealerships in Seattle revealed that salespeople do not get higher commissions for leasing than for selling a given vehicle. Some salespeople have a slight preference for leases because, in their view, consumers generally lease a better vehicle than they would purchase and tend to enter the vehicle market more frequently than do people who purchase.

Nor does leasing offer notable tax advantages. The 1986 tax reform eliminated the interest deduction on car payments, but some consumers have taken out home equity loans, which are tax deductible, and paid cash for their vehicles. If tax reform had a pronounced effect on leasing behavior, one would expect to see a sharp jump in leasing shortly after 1986 instead of the steady increase that began around 1990. Finally, leasing would have become more attractive if vehicle miles traveled (VMT) per vehicle fell sharply because people would have been less likely to incur surcharges for excessive mileage. But VMT per vehicle increased during the 1990s, reflecting longer commutes and increasing the attractiveness of upgrading.

5. Conclusion

Consumers' vehicle acquisition behavior, hitherto relatively ignored by economists, has assumed considerable importance because of the recent growth in leasing. We have argued that consumers' growing attraction to leasing arises from their ongoing desire to upgrade their vehicles—a pattern of behavior stimulated during the 1990s by unprecedented income growth among the top 20% of US households. But the leasing market may be starting to reach saturation because at this point its growth is largely attributable to this small share of US households. Indeed, preliminary data through 2001 indicate that the share of new automobiles

[30] The effect of vehicle prices on the probability of leasing is obtained through the inclusive values of the vehicle type-choice models.

[31] Real new car prices from 1980–1995 with and without government mandated equipment are reported in the American Automobile Manufacturer's Association, *Motor Vehicle Facts and Figures*, 1996 edition.

that are leased has not grown much since 1998.[32] If leasing's share does stabilize along with income growth during the next decade, this would be consistent with the special role that we claim leasing has played in expanding some automobile consumers' consumption possibilities.

Appendix A.

Table A.1
Multinomial logit coefficient estimates for 1993, 1994, and 1995: new-vehicle choice—finance submodel

Variable	Coefficient (standard error)
Vehicle attributes and socioeconomic characteristics	
Age of consumer (defined for US manufacturers)	0.016
	(0.011)
Metropolitan size of consumer's residential location (1 if Honda, Nissan, or Toyota alternative and population exceeds 500,000, 0 otherwise)	0.598
	(0.312)
Passenger-side airbag dummy (1 if passenger-side airbag is standard on vehicle model, 0 otherwise)	0.573
	(0.183)
Vehicle reliability based on the *Consumer Report's* repair index[a]	0.342
	(0.073)
Turning radius if vehicle sold by a US manufacturer, 0 otherwise (in feet)	0.248
	(0.04)
Turning radius if vehicle sold by a non-US manufacturer, 0 otherwise (in feet)	0.107
	(0.043)
Expected vehicle insurance (in hundreds of dollars)[b]	−1.04
	(0.52)
Annual fuel cost (in hundreds of dollars)[c]	−0.105
	(0.077)
Natural log of vehicle price divided by natural log of household income (in thousands of dollars)	−9.47
	(1.67)
Vehicle residual value if sold by a US manufacturer (defined as the percentage of the manufacturer suggested retail price the vehicle will retain during its first three years of use)	0.041
	(0.016)
Vehicle residual value if sold by a non-US manufacturer (defined as the percentage of the manufacturer suggested retail price the vehicle will retain during its first three years of use)	0.096
	(0.017)
Subcompact class dummy if sold by a US manufacturer[d] (1 if vehicle is a US manufacturer's subcompact, 0 otherwise)	0.916
	(0.334)
Compact class dummy[d] (1 if compact vehicle, 0 otherwise)	1.32
	(0.24)
Mid-size vehicle dummy[d] (1 if mid-size vehicle, 0 otherwise)	1.58
	(0.28)
Large vehicle dummy[d] (1 if large vehicle, 0 otherwise)	0.71
	(0.34)

[32] Preliminary data are from CNW marketing research.

Table A.1 (*continued*)

Variable	Coefficient (standard error)
Minivan dummy if sold by a US manufacturer[d] (1 if vehicle is a US manufacturer's minivan and the household has 3 or more members, 0 otherwise)	1.74 (0.35)
Sports Utility Vehicle dummy if sold by a US manufacturer[d] (1 if vehicle is a US manufacturer's SUV and the household has 3 or more members, 0 otherwise)	1.385 (0.468)
Sports Utility Vehicle dummy if sold by a non-US manufacturer[d] (1 if vehicle is a non-US manufacturer's SUV and the household has 3 or more members, 0 otherwise)	0.758 (0.491)
Brand loyalty and preference	
Number of previous consecutive GM purchases	0.98 (0.19)
Number of previous consecutive Ford purchases	1.617 (0.332)
Number of previous consecutive Chrysler purchases	0.645 (0.39)
Number of previous consecutive Japanese manufacturer purchases	1.202 (0.378)
Number of previous consecutive purchases for vehicles produced by European or other manufacturers[e]	0.644 (0.392)
Number of previous consecutive *leases* of the same make of vehicle	−1.123 (0.509)
Ford manufacturer dummy (1 if produced by Ford, 0 otherwise)	−3.549 (0.76)
GM manufacturer dummy (1 if produced by GM, 0 otherwise)	−4.11 (0.79)
Chrysler manufacturer dummy (1 if produced by Chrysler, 0 otherwise)	−3.935 (0.763)
Japanese manufacturer dummy (1 if produced by a Japanese manufacturer, 0 otherwise)	−1.359 (0.273)
Summary statistics	
Number of observations	361
Estimation by maximum likelihood	
Log likelihood at zero	−865.6
Log likelihood at convergence	−569.5

[a] *Consumer Report's* repair index is a measure of reliability that uses integer values from 1 to 5. A value of 1 indicates the vehicle has a "much below average" repair record, 3 is "average", while 5 represents a "much better than average" reliability.

[b] Vehicle insurance rates vary according to a vehicle's make and model and household socioeconomic characteristics. Thus, household socioeconomic characteristics were combined with vehicle attributes (e.g., vehicle horsepower) to create model specific insurance rates (i.e., regressing observed insurance rates against household socioeconomics and vehicle attributes), that could be used in the vehicle type-choice estimation.

[c] As indicated in Table 2, annual fuel cost is treated as endogenous.

[d] Vehicle class sizes (e.g., subcompact, compact) are defined by the US Environmental Protection Agency.

[e] Other vehicles, mainly vehicles produced by Korean manufacturers, represent a small share of the vehicles in this classification.

Appendix B.

Table B.2
Multinomial logit coefficient estimates for 1993, 1994, and 1995: new-vehicle choice—cash submodel

Variable	Coefficient (standard error)
Vehicle attributes and socioeconomic characteristics	
Metropolitan size of consumer's residential location (1 if Honda, Nissan, or Toyota alternative and population size exceeds 500,000)	1.659 (0.463)
Passenger-side airbag dummy (1 if passenger-side airbag standard on vehicle model, 0 otherwise)	0.524 (0.262)
Turning radius if sold by a US manufacturer, 0 otherwise (in feet)	0.278 (0.037)
Annual fuel cost[a] (in hundreds of dollars)	−0.153 (0.104)
Natural log of vehicle price divided by natural log of household income (in thousands of dollars)	−8.036 (2.292)
Vehicle residual value if sold by a non-US manufacturer (defined as the percentage of the manufacturer suggested retail price the vehicle will retain during its first three years of use)	0.116 (0.022)
Subcompact class dummy if sold by a US manufacturer[b] (1 if vehicle is a US manufacturer's subcompact, 0 otherwise)	0.142 (0.441)
Compact class dummy[b] (1 if compact vehicle, 0 otherwise)	1.129 (0.405)
Mid-size vehicle dummy[b] (1 if mid-size vehicle, 0 otherwise)	1.746 (0.373)
Large vehicle dummy[b] (1 if large vehicle, 0 otherwise)	1.546 (0.416)
Minivan dummy if sold by a US manufacturer[b] (1 if vehicle is a US manufacturer's minivan and the household has 3 or more members, 0 otherwise)	1.563 (0.624)
Sports Utility Vehicle dummy if sold by a US manufacturer[b] (1 if vehicle is a US manufacturer's SUV and the household has 3 or more members, 0 otherwise)	0.531 (0.463)
Brand loyalty and preference	
Number of previous consecutive GM purchases	0.735 (0.225)
Number of previous consecutive Ford purchases	1.212 (0.371)
Number of previous consecutive Chrysler purchases	2.877 (0.628)
Number of previous consecutive Japanese manufacturer purchases	1.095 (0.451)
Number of previous consecutive purchases for vehicles produced by European or other manufacturers[c]	1.726 (0.916)
Ford manufacturer dummy (1 if produced by Ford, 0 otherwise)	−4.567 (1.162)

Table B.2 (*continued*)

Variable	Coefficient (standard error)
GM manufacturer dummy (1 if produced by GM, 0 otherwise)	−5.387 (1.215)
Chrysler manufacturer dummy (1 if produced by Chrysler, 0 otherwise)	−6.124 (1.224)
Japanese manufacturer dummy (1 if produced by a Japanese manufacturer, 0 otherwise)	−0.882 (0.425)
Summary statistics	
Number of observations	197
Estimation by maximum likelihood	
Log likelihood at zero	−472.4
Log likelihood at convergence	−316.6

[a] As indicated in Table 2, annual fuel cost is treated as endogenous.
[b] Vehicle class sizes (e.g., subcompact, compact) are defined by the US Environmental Protection Agency.
[c] Other vehicles, mainly vehicles produced by Korean manufacturers, represent a small share of the vehicles in this classification.

Appendix C

Table C.3
Binary logit coefficient estimates for determining the probability of cash/non-cash

Variable	Coefficient (standard error)
Constant (defined for cash alternative)	3.315 (0.747)
Inclusive value term from non-cash submodel (leasing/financing model)	0.291 (0.209)
Inclusive value term from cash submodel	0.0278 (0.0646)
Annual household debt[a] (in thousands of dollars, defined for cash alternative)	−0.0434 (0.0097)
Education dummy (1 if respondent graduated from college, 0 otherwise, defined for cash alternative)	1.664 (0.265)
Miles (in thousands per year) the household expected to drive at purchase[b] (defined for cash alternative)	−0.406 (0.05)
Gender dummy (1 if male, 0 otherwise, defined for cash alternative)	1.139 (0.211)
Homeowner dummy (1 if respondent owned home, 0 otherwise, defined for cash alternative)	0.783 (0.348)

Table C.3 (*continued*)

Variable	Coefficient (standard error)
Summary statistics	
Number of observations	700
Estimation by maximum likelihood	
Log likelihood at zero	−485.2
Log likelihood at convergence	−343.9

[a] Detailed monthly household payment information for credit cards, utilities, homeowners insurance, medical insurance, alimony, mortgage or rent, other debt payments, and other vehicle payments were used to create the annual household debt variable.

[b] As indicated in Table 3, the expected mileage variable is treated as endogenous.

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