By treating leasing and financing contracts as differentiated products with their own unique acquisition costs, the authors develop a structural model of a consumer's choice of automobile and the related decision of whether to lease or buy it. They estimate the model on a data set of new car purchases from the entry-luxury segment of the U.S. automobile market. A key finding is that consumers are myopic and prefer contracts with lower payment streams even when they have higher total costs. The authors also find that consumers are more likely to lease than to finance cars with higher maintenance costs because this provides them with the option to return the car before maintenance costs become too high. The authors demonstrate how automobile manufacturers can use the model to evaluate the effectiveness of promotional incentives, such as cash rebates, interest rate subsidies, and increased residual values.

To Lease or to Buy? A Structural Model of a Consumer’s Vehicle and Contract Choice Decisions

Leasing and financing are two alternative ways to acquire a durable good that are becoming increasingly important in the U.S. economy. For example, most capital equipment in the United States is acquired through a variety of financial contracts, nearly one-third of which are leases. Not only are such contracts common in the business world, but they are also becoming a pervasive phenomenon in numerous consumer markets. Many durable goods that were traditionally purchased outright, such as cars, computers, furniture, and many household appliances, are now either leased or financed over extended periods.

Despite these emerging trends, there is relatively little research on how consumers choose from among these contracts. Much of the previous research on leasing and financing, which is largely game theoretic in nature, abstracts away from the consumer decision-making process to focus on understanding why firms may choose to lease or sell their products (Bucovetsky and Chilton 1986; Bulow 1982; Desai and Purohit 1998, 1999; Gul, Sonneschein, and Wilson 1980; Stokey 1981). These models typically assume that leasing and financing are financially equivalent and that consumers are indifferent between the two types of contracts.

There are several reasons these assumptions may be unrealistic in practice. First, financial contracts for consumer durables typically consist of multiple terms and conditions, including a price, an interest rate, an initial or down payment, and a payment period, which makes it unlikely that the financial costs of different contracts are exactly the same (Miller 1995; Nunnally and Plath 1989; Patrick 1989; Scerbinski 1988). Second, a consumer's discount rate also affects the financial cost of a contract. Thus, consumers with a low discount rate may perceive a contract with higher payments as more costly than consumers with a high discount rate. Finally, the total cost of acquiring a durable is also affected by factors other than the financial conditions specified in the contract, such as maintenance and operating costs.

Such contracts are particularly common in the automobile market, in which a majority of sales involve either finance or lease contracts, making it an ideal setting to understand consumers’ contract choice behavior. Moreover, automobile manufacturers are increasingly competing for consumers using the terms and conditions of these contracts.
(e.g., General Motors offers 0% financing to “keep America rolling”). However, most market-level studies on automobile choice (Berry, Levinsohn, and Pakes 1995, 2004; Goldberg 1995; Petrin 2002; Sudhir 2001) ignore the choice of contract and simply use the manufacturer’s suggested retail price to estimate demand. Previous research on consumer choice of contracts in the automobile market (Aizcorbe and Starr-McCluer 1997; Johnson 2000) has examined how demographic factors, such as income and age, affect a consumer’s decision to lease or finance a vehicle, but it has overlooked nonfinancial factors related to contract choice, such as the cost of maintaining and operating the vehicle, and has also ignored the link between vehicle and contract choice, a critically important input into a manufacturer’s promotional planning process.

In summary, although manufacturers continue to compete aggressively using the terms of these contracts, little is understood about how consumers evaluate and choose between them or how these choices affect consumers’ choice of which vehicle to drive. In this article, we develop a structural model of the consumer’s vehicle acquisition decision—that is, his or her choice of vehicle and the related decision of whether to lease or finance it. We believe that this is one of the first empirical studies to link the lease versus financing decision to vehicle choice behavior. In contrast to previous research that has treated leased and financed vehicles as homogeneous products, we conceptualize the leasing and financing of the same vehicle as different products, each with its own costs of acquisition (Desai and Mehta 1997).

We identify three types of acquisition costs associated with each vehicle/contract combination: (1) the “net price” or financial cost, (2) the cost of maintenance, and (3) operating costs. We calculate the net price using a present value approach that incorporates the various terms and conditions of the contract. We determine the cost of maintenance by how long the vehicle is held and determine operating costs by how much a consumer drives. We estimate the model on transaction data for new vehicle sales from the entry-luxury segment of the U.S. automobile market.

The empirical results yield several notable findings. First, we estimate the rate at which consumers discount future payments to be higher than the prevailing market rate, which implies that contracts with smaller payment streams are preferred to those with larger payment streams, even if their total financial cost is higher. Second, our estimate of the annual distance that consumers drive implies that many consumers incur significant penalties if they lease. This explains why purchasing or financing continues to be the more popular option, despite a high individual discount rate. Finally, we find that cars that have higher maintenance costs are more likely to be leased than bought. In other words, consumers prefer to buy, rather than lease, cars that are more reliable, and vice versa. In contrast, previous research has shown that a firm’s incentive for leasing increases with the durability or reliability of its products (Desai and Purohit 1999).

Automobile manufacturers use promotional instruments, such as cash rebates, interest rate subsidies, and residual value increases (for leases), to stimulate vehicle sales. To assess the effectiveness of a promotional instrument, we quantify its impact in three ways: (1) the total incremental volume it generates, (2) the extent to which the incremental volume cannibalizes other contracts of the promoted brand, and (3) its overall profitability. We find that different promotions of the same nominal cash value may not be equally profitable. For example, although the volume increase in response to a cash incentive on a lease is greater than an equivalent residual value increase, the latter yields higher profits.

We organize the remainder of the article as follows: The next section develops the theoretical model; this is followed by a section that describes the empirical application. We then show how a car manufacturer can use the model for promotional planning. Finally, we summarize the conclusions, discuss the limitations, and suggest directions for further research in this area.

**MODEL**

**Contracts in the Automobile Market**

Table 1 summarizes the major components of leasing and financing contracts in the automobile market and highlights the main differences between the two. As is the case with most other financial contracts, these contracts specify a price, \( P \); an annual percentage interest rate, \( APR \); an initial or up-front payment, or down payment, \( D \); and a payment period or term, \( T \). Together, these elements translate into a series of monthly payments, \( MP \). These components can vary widely across contracts for the same vehicle. For example, in our data set, contracts for the Cadillac Catera had APRs that ranged from 0% on 24-month contracts to 3.9% on 60-month contracts and sometimes also included cash rebates.

In addition to these terms, leases include a component known as the residual value. The residual value is a firm’s estimate of a vehicle’s value at the end of a lease contract and can be set independently of its market price. Monthly payments for leases are based on the price less the residual value, which means that a lessee pays only for the estimated reduction in value of the vehicle over the term of the lease. This results in monthly payments that are typically lower than those for financing contracts. For example, typical lease payments for the 2000 Cadillac Catera averaged approximately $333 per month, whereas the monthly payments for financing contracts ranged from $377 to as high as $1,200. Moreover, leases also stipulate a per-mile penalty, \( \omega \), that applies if a prespecified mileage allowance, \( \tau \), is exceeded, which means that the cost of a lease also depends on how much a consumer drives.

In addition to these explicitly stated components, the contracts have other implicit characteristics that can affect their cost. First, leases typically last from three to four years, whereas buyers tend to own their vehicles for an average of six years (Sattler 1995). As a result, lessees tend to drive newer vehicles and incur lower maintenance costs than buyers. Second, it is easier to dispose of a used car that is leased because the lessee can return it to the manufacturer.
Table 1
COMPONENTS OF FINANCING AND LEASING CONTRACTS

<table>
<thead>
<tr>
<th></th>
<th>Financing</th>
<th>Leasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
<td>Duration of contract (T_B) (ranges from 24 to 60 months)</td>
<td>Duration of contract (T_L) (ranges from 36 to 48 months)</td>
</tr>
<tr>
<td>Price</td>
<td>Price of vehicle (P)</td>
<td>Price of vehicle (P)</td>
</tr>
<tr>
<td>Annual percentage rate</td>
<td>APR</td>
<td>APR</td>
</tr>
<tr>
<td>Down payment</td>
<td>Up-front or initial payment (D_B) (on average, 25% of purchase price)</td>
<td>Up-front or initial payment (D_L) (on average, 9% of purchase price)</td>
</tr>
<tr>
<td>Cash incentives</td>
<td>Cash rebate (C_B) (direct cash incentive to customer, usually used to lower the down payment)</td>
<td>Lease cash (C_L) (direct cash incentive to customer, usually used to lower monthly payments)</td>
</tr>
<tr>
<td>Residual value</td>
<td>None</td>
<td>A firm’s estimate of a car’s value at T_L (R)</td>
</tr>
<tr>
<td>Monthly payments</td>
<td>Function of P – D_B, APR, and T_B(MP_B)</td>
<td>Function of P – D_L – C_L – R, APR, and T_L (often much lower than in financing contracts)</td>
</tr>
<tr>
<td>Annual mileage allowance</td>
<td>None</td>
<td>Number of miles above which penalty is imposed (τ_L)</td>
</tr>
<tr>
<td>Penalty</td>
<td>None</td>
<td>Per mile charge for every mile driven above τ_L (ω_L)</td>
</tr>
<tr>
<td>Ownership</td>
<td>Yes</td>
<td>Optional</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

and avoid the inconvenience and risk associated with selling the used vehicle. Finally, a disadvantage of leases relative to financing is lack of ownership; a consumer does not own the vehicle, even after making all the required payments. Note that insurance costs do not differ across leased and purchased vehicles and therefore are irrelevant.

Acquisition Costs

**Net price.** The terms discussed in Table 1 result in a down payment and a series of monthly payments over the duration of the contract, the net present value (NPV) of which represents the contract’s financial cost to the consumer. To compare the costs of different contracts accurately, however, the NPV expressions must be modified to accommodate the differences between the contracts. One modification is related to the difference in wealth position between a lessee and a buyer: namely, the latter owns his or her vehicle at the termination of the contract, whereas the former does not. Another modification is required to ensure that contracts of different terms are comparable. In what follows, we explore these issues in greater detail and specify the modified NPV expressions for both financing and leasing contracts, which yields what we call “the net price of a contract.”

Consider a consumer who finances a vehicle with contract F, where D_F is the initial cash outlay or down payment on the vehicle and MP_F^t is the monthly payment in period t, which stays the same for the duration of the contract; that is, MP_F^t = MP_F. Let T_F be the duration or term of the contract (in months) and C_F be a cash rebate offered by the manufacturer, which lowers the consumer’s out-of-pocket down payment for the vehicle. Finally, T is the time at which the consumer expects to sell the used vehicle at its market price, V_T. Then, the present value of the net cash outflow to the consumer (i.e., the net price) is

\[
NP_F = (D_F - C_F) + \sum_{t=0}^{T_F-1} \frac{1}{(1 + k)^t} MP_F - \frac{1}{(1 + k)^T} V_T
\]

where k is the opportunity cost of capital or discount rate. This expression reflects the consumer making the first payment along with the down payment, then making the remaining payments over T_F − 1 months, and finally obtaining a cash inflow by selling the car at time T.

Now, consider a lease that lasts T_L months. Let D_L be the initial cash outlay, and let MP_L^t = MP_L be the monthly payments. Unlike financing contracts, cash incentives for leases, C_L, known as lease cash, conventionally do not apply to the down payment but directly lower the capitalized cost of the leased vehicle and result in lower monthly payments (see www.intellichoice.com/lease/Leasing Glossary). Thus, the net price of the leased vehicle can be written as

\[
NP_L = D_L + \sum_{t=0}^{T_L-1} \frac{1}{(1 + k)^t} MP_L
\]

Because the lessee returns the vehicle at the end of the contract, V_T does not appear in Equation 2. This implies that after T_L months, the lessee will not have the use of the car nor make any further payments. Note that because the monthly payment incorporates C_L, it does not appear directly in Equation 2.

However, the net price expression in Equation 2 does not capture other differences among contracts of different durations. For example, a three-year lease contract allows a lessee to drive a vehicle for a year less than permitted by a four-year lease contract, but the cost of this loss of use is
To Lease or to Buy?

An alternative approach would be to compare all contracts over a time horizon of three years. However, this is infeasible when there are multiple contracts of varying lengths. For a three-year time horizon, the net price expression for a purchase would consist of payments over three years plus the three-year market value of the car. Although this would allow us to compare three-year leases with purchases, it would result in an overestimation of the cost of a longer-term lease (e.g., a 48-month lease) because in a 48-month lease, a car is held for four years, and thus accounting for only three years of ownership does not accommodate the costs of holding for the additional year.

Therefore, we make two additional assumptions that enable us to evaluate the contracts over the same time horizon and account for behavior over the entire period, not just the duration of the contract. This makes the net price of the different contracts comparable by ensuring that the consumer has access to the vehicle over the entire time horizon, regardless of the contract.

To account for vehicle replacement time and differences in contract length, first, we assume that a financed vehicle is sold after 72 months. This assumption is supported by Sattler (1995), who finds that, on average, buyers replace their vehicle every six years. Second, we assume that lessees enter into another lease at the end of the contract. This is based on the findings of CNW Marketing Research Inc. (2003) that 84% of all lessees lease again and approximately 50% return to the same dealer for their next vehicle. Because most leases last for three to four years, these assumptions imply that a consumer will drive two new vehicles over the six-year holding period. In other words, not having access to a vehicle can be captured by the cost of leasing another vehicle over the remaining period; that is, $6 - 3 = 3$ years for a three-year lease, or $6 - 4 = 2$ years for a four-year lease. This guarantees that the consumer drives the vehicle over the entire ownership period (six years), regardless of the contract. The modified net price expressions are now

$$\text{NP}_F = (D_F - C_F) + \frac{\tau_F}{(1 + k)^1} \text{M}_F + \frac{1}{(1 + k)^T} V_T$$

and

$$\text{NP}_L = D_L + \frac{\tau_L}{(1 + k)^1} \text{M}_L + \frac{1}{(1 + k)^T} D_L + \sum_{t = T}^{T-1} \frac{1}{(1 + k)^t} \text{M}_L$$

where F and L denote finance and lease contracts, respectively; $\tau_F$ and $\tau_L$ are the durations of the respective contracts (in months); and $T = 72$ is the holding time. Figure 1, Panel A, graphs the annual cash outflows over a six-year period for a typical 60-month financing and a three-year lease contract for the Acura 3.2TL. The higher down payments make the initial cash outflows of the financing contract higher than those for the lease, but these are significantly reduced in subsequent years and drop to zero in Year 6, when the consumer finally owns the vehicle. However, the cash outflows from the lease remain relatively steady over the six-year time frame.

Maintenance costs. Another type of acquisition cost is the cost of maintenance, which depends on how long a consumer holds a vehicle. Figure 1, Panel B, graphs the annual maintenance costs for financed and leased versions of the same vehicle, the Acura 3.2TL. Because a consumer drives two new leased cars over the same period, maintenance costs for the first three years for the financed vehicle (solid line) are the same as those for the leased vehicle (dashed line) but then increase sharply.

Operating costs. Operating costs are determined by the price of gasoline, $f$, the fuel efficiency of the vehicle, $e$, and, for leases, the penalty specified in the contract, $\omega_L$. All consumers incur a per-mile driving cost, $fe$, but lessees incur an additional cost of $\omega_L$ per mile if they exceed the mileage allowance, $\tau_L$. Thus, the marginal cost of driving a leased vehicle above the mileage allowance is $fe + \omega_L$.

Utility Specification

Let contract $j$ for vehicle $i$ be defined by the vector $[\text{NP}_{ij}, \text{M}_{ij}, \tau_{ij}]$, where $\text{NP}_{ij}$, $\text{M}_{ij}$, and $\tau_{ij}$ represent the net price, the annual maintenance cost, and the marginal cost of driving, respectively. Consider a consumer $h$ with an annual income of $y_h$ to be spent on car services and other goods. The
annual expenditure on car services consists of three elements: (1) the “annualized” net price of the car, \( p_h \pi y_{ij} \); (2) the annual maintenance cost, \( M_{ij} \); and (3) the annual operating cost, \( \theta_{ij} \), where \( \theta_{ij} \) represents the number of miles that consumer \( h \) drives every year. We can write the income remaining for expenditure on the composite good, \( z_h \), after car services are paid for as

\[
\begin{align*}
    z_h &= y_h - p_h \pi y_{ij} - M_{ij} - \theta_{ij} \pi y_{ij}.
\end{align*}
\]

Because the net price reflects the total price paid over the six-year period, we must annualize it to make it comparable to the other terms (i.e., income, maintenance costs, and operating costs, all of which are annual quantities). We do this by multiplying it by \( \rho_h \), which is known as the “annualization coefficient” (Dreyfus and Viscusi 1995), the derivation of which we provide in Part A of the Web Appendix (see http://www.marketingpower.com/content84062.php):

\[
\begin{align*}
    \rho_h &= \frac{r_h}{1 + r_h} \times \frac{1}{1 - (1 + r_h)^{-q}}.
\end{align*}
\]

The term \( r_h \) is consumer \( h \)’s discount rate, and \( q \) is the number of years after which he or she replaces the vehicle. This expression implies that a person whose discount rate is \( r_h \) and expected replacement time is \( q \) years will be indifferent to paying $1 every \( q \) years or $\( \rho_h \) every year. Note that because \( 0 < r_h < 1 \), it follows that \( 0 < \rho_h < 1 \).

Next, we specify consumer utility to consist of (1) the income left over to spend on the composite good, \( z_h \); (2) the mean intrinsic utility from vehicle \( i \) and contract \( j, \hat{\xi}_{ij} \), (3) the value or pleasure derived from driving the vehicle \( \theta_{ij} \) miles, \( f(\theta_{ij}) \); and (4) a stochastic term, \( \xi_{ij} \), which represents the portion of unobserved utility that is not captured by \( \hat{\xi}_{ij} \). Thus,

\[
\begin{align*}
    \pi_{ij} &= y_h - p_h \pi y_{ij} - M_{ij} - \theta_{ij} \pi y_{ij} + \hat{\xi}_{ij} + f(\theta_{ij}) + \xi_{ij}.
\end{align*}
\]

Following Verboven (2002), we assume that the number of miles a consumer drives in a year is insensitive to operating costs, \( \pi_{ij} \), or that demand is inelastic. This implies that consumers drive a fixed number of miles every year (i.e., \( \pi_{ij} = \pi_0 \)), which in turn implies that the value or pleasure derived from driving is also fixed (i.e., \( f(\theta_{ij}) = k^h \)). Prior studies have shown that when gasoline prices are fairly stable, elasticities are low, varying from 0 to \(-.2 \) (Dahl and Sterner 1991a, b; Goldberg 1998). The data we analyze come from a 57-week period during which gasoline prices ranged from a low of $1.28 to a high of $1.83, with a standard deviation of only $.16, a fairly stable pattern that supports our assumption of an inelastic demand for driving distances.

Given that consumer \( h \) drives a fixed number of miles, the maximum utility associated with a given vehicle–contract combination (i.e., the conditional indirect utility from acquiring vehicle \( i \) with contract \( j \)) is

\[
\begin{align*}
    \hat{\pi}_{ij} &= y_h - p_h \pi y_{ij} - M_{ij} - \theta_{ij} \pi y_{ij} + \hat{\xi}_{ij} + k^h + \xi_{ij}.
\end{align*}
\]

**Specification of the Discrete Choice Model**

Consumer \( h \) chooses combination \( (i, j) \) if and only if the indirect utility from this combination is higher than for any other combination; that is,

\[
\begin{align*}
    \hat{\pi}_{ij} > \hat{\pi}_{i'j'}. & \quad \forall i, j, (i, j) \neq (i', j').
\end{align*}
\]

Consequently, the probability of choosing \( (i, j) \) is

\[
\begin{align*}
    P_h(i, j) &= \text{Pr}[\hat{\pi}_{ij} > \hat{\pi}_{i'j'}], \quad \forall i, j, (i, j) \neq (i', j').
\end{align*}
\]

Without loss of generality, we partition the observed component of utility into two parts: (1) a part labeled \( \hat{\pi}_{ij} \) that is constant for all contracts of a particular vehicle and (2) a part labeled \( \hat{\pi}_{ij} \) that varies over these contracts. In light of this specification, we rewrite the indirect utility from the vehicle/contract combination \( (i, j) \) as

\[
\begin{align*}
    \hat{\pi}_{ij} &= \hat{\pi}_{ij} + \hat{\pi}_{ij} + \hat{\xi}_{ij}.
\end{align*}
\]

We specify the observed components of utility as

\[
\begin{align*}
    \hat{\pi}_{ij} &= \alpha_{ij} + \alpha_{ij}X_h \quad \text{and} \\
    \hat{\pi}_{ij} &= \mu_{ij} + y_h - p_h \pi y_{ij} - M_{ij} - \theta_{ij} \pi y_{ij}.
\end{align*}
\]

Note that we have broken the intrinsic utility from the vehicle–contract combination, \( \hat{\pi}_{ij} \), into two components: (1) the utility from the vehicle, which consists of a vehicle specific constant, \( \alpha_{ij} \), and a linear combination of vehicle and individual characteristics, \( X_h \), and (2) a component that is intrinsic to the contract, \( \mu_{ij} \), which captures the impact of unobservable features of the contract, such as the transaction cost or risk associated with selling a purchased vehicle or, in the case of leases, the utility from being able to drive a new car at regular intervals. The constant, \( \mu_{ij} \), scales the utility and drops out of the final contract choice probability expression.

If we now assume that \( \epsilon_{ij} \) is i.i.d. generalized extreme value, this yields a nested logit structure in which the choice of contract is nested within the choice of vehicle.\(^4\) The joint probability of vehicle and contract choice is now

\[
\begin{align*}
    P_h(i, j) &= P_h(i)P_h(j),
\end{align*}
\]

and the individual probability expressions are given by

\[
\begin{align*}
    P_h(i) &= \sum_j \exp(\hat{\pi}_{ij} + \gamma IV_{ij}), \quad \text{and} \\
    P_h(j) &= \sum_i \exp(\hat{\pi}_{ij} + \gamma IV_{ij}).
\end{align*}
\]

The expression \( IV_{ij} \), known as the “inclusive value term,” links the two nests and represents the expected utility that decision maker \( h \) receives from the choice among the alternatives in nest \( i \). We express this as

\[
\begin{align*}
    IV_{ij} &= \ln \sum_j \exp(\hat{\pi}_{ij}).
\end{align*}
\]

\(^4\)Anecdotal evidence supports the notion that the majority of consumers choose the vehicle and then choose from a menu of contracts. Because the alternative specification—vehicle choice nested within choice of contract—cannot be ruled out completely, we also estimated this model on the same data. We found that the coefficient of the inclusive value term was less than zero, which is inconsistent with utility maximizing behavior.
EMPIRICAL APPLICATION

Data

We apply our model to a data set of individual new car acquisitions from the entry-luxury segment. The data were collected by the Power Information Network (an affiliate of J.D. Power and Associates) from participating dealers in the Southern California region. The data set consists of 18,154 transactions for 15 vehicle models over a period of 57 weeks from September 1999 to October 2000. For each record, we have details such as the price the individual negotiated with the dealer, the APR, cash incentives, the residual value of the vehicle if it was leased, and the trade-in value if a vehicle was traded in.

We categorized transactions as leased, dealer financed, or “cash” (cash purchases were most likely financed elsewhere rather than actually being paid for in cash). Of the leased transactions, 36- and 48-month leases were the most popular, constituting 77% of all leases. The 24-, 36-, 48-, and 60-month terms were the most frequently chosen among financing contracts, accounting for 88% of all dealer-financed transactions. Because we have no information on how cash purchases were financed, we treat them as transactions financed over a period of 60 months at the prevailing market rate; this is consistent with the Consumer Expenditure Survey reports of 60-month loans being the most common form of auto credit. Together with the most popular lease and financing contracts, this yielded an estimation sample of 15,556 records. Of these transactions, 24.2% were leases, 35% were dealer-financed transactions, and the rest were cash transactions. Table B1 in the Web Appendix (see http://www.marketingpower.com/content84062.php) provides details of the share of leases and purchases for each model and the average price paid.

We also collected data from Edmunds.com and the U.S. Department of Energy on vehicle characteristics, such as horsepower (HP), number of cylinders (CYLIN), drive type (DRIVE), displacement (DISPL), and fuel efficiency (FE). These appear in Table B2 of the Web Appendix (see http://www.marketingpower.com/content84062.php).

Computation of net price. As we discussed previously, we compute the net price of a contract as the NPV of outflows and asset position (Equations 3 and 4). We take the purchase price of a vehicle to be the median price paid for a vehicle calculated over all transactions in a given week. We calculate the mean down payment across all financing (leasing) contracts in our sample to be 25% (9%) of the transaction price. Therefore, we apply these percentages to the purchase prices to obtain the down payments on finance and lease contracts. We calculate monthly payments as a function of the purchase price less the down payment, the APR, and the term of the contract, and, in the case of leases, the residual value. Because individual discount rates are unavailable, we use the market rate to discount the payments. Finally, we assume that the terms for a follow-up lease contract are the same as the initial contract.

Maintenance costs. We obtained information on the annual maintenance costs for each vehicle from “true cost of ownership” data published by Edmunds.com. For financing contracts, we obtained the average annual maintenance cost by averaging yearly costs over a five-year period for each vehicle.\(^5\) For leases, we calculate the average over a period of three years, (or four, if the lease was a four-year one); we assume that a lessee re-leases after the termination of the initial lease. We report these costs in Table B2 of the Web Appendix (see http://www.marketingpower.com/content84062.php). Because maintenance costs for all models increase with vehicle age, the average maintenance cost for leased cars is consistently lower than that for bought cars. Furthermore, for most vehicles, costs jump sharply after the third year. This is probably because certain costs are covered during the warranty period, which is usually three years. For example, the Toyota Avalon had the maintenance costs for each of the first five years of $367, $592, $580, $1,242, and $1,614, respectively, which implies that the average annual maintenance cost for leasing is $513 and for financing is $879.

Operating costs. We obtained data on fuel prices, f, over the 1999–2000 period from the Energy Information Administration of the U.S. Department of Energy. We assumed the annual mileage allowance to be 12,000 miles and the driving penalty on all leases to be $.15 per mile, typical for lease contracts in the Southern California market during this period.

Model Variables and Estimation Procedure

We identify seven variables in the vehicle and individual characteristics vector, \([X_{hi}]\), and rewrite the indirect utility from vehicle choice (Equation 12) as

\[
\hat{V}_{ii}^{h} = \alpha_{0i} + \alpha_{1i} HP_{i} + \alpha_{2i} CYLIN_{i} + \alpha_{3i} DISPL_{i} + \alpha_{4i} DRIVE_{i} + \alpha_{5i} ZIP_{i} + \alpha_{6i} LMK_{i} + \alpha_{7i} LMD_{i},
\]

where

\[ HP_{i} = \text{horsepower of vehicle } i, \]
\[ CYLIN_{i} = \text{number of cylinders in vehicle } i, \]
\[ DISPL_{i} = \text{displacement of vehicle } i, \]
\[ DRIVE_{i} = \text{drive type of vehicle } i, \]
\[ ZIP_{i} = \text{share of vehicle } i \text{ in the three-digit zip code in which individual } h \text{ lives,} \]
\[ LMK_{i} = \text{vehicle made traded in by consumer } h \text{ (equal to 1 if this is the same make as } i \text{ and 0 if otherwise),} \]
\[ LMD_{i} = \text{vehicle model traded in by consumer } h \text{ (equal to 1 if this is the same model as } i \text{ and 0 if otherwise).} \]

We calculate ZIP\(^3\)\(_i\) over all transactions over the sample period of 57 months for every three-digit zip code. Because we have only one transaction per consumer, this share is analogous to the brand loyalty measure used in brand choice models to capture observed preference heterogeneity. The variables LMK\(^3\)\(_i\) and LMD\(^3\)\(_i\) also capture inertia in consumer choice (i.e., the tendency for consumers to repeat buy the same make or model).

The conditional utility from the contract is given by Equation 13, in which the parameter for maintenance costs,

\(^5\)Costs beyond the fifth year are not available. Note that an alternative method is to aggregate costs over a six-year period. However, although maintenance costs increase nonlinearly, the annual maintenance costs calculated using the annualized approach are identical to those we obtained from an aggregate cost approach.
M_{ij} is equal to one. However, the estimation procedure does not impose any restriction on this parameter, allowing it to be free. This is because the parameters in a logit model are estimated relative to the variance of the error term, or the scale parameter of the Gumbel distribution, which is unknown but traditionally fixed at one for estimation purposes. As a result, as Part C of the Web Appendix (see http://www.marketingpower.com/content84062.php) shows, the structural parameters, ϕ and θ^0_h, can be retrieved from the ratio of the parameters of this unrestricted model. Furthermore, for estimation purposes, the net price and maintenance cost variables are scaled by a factor of 10,000.

To account for consumer heterogeneity, we express the choice probabilities as

\[ P_{ij} = \int p^h_j g(B|ϕ)dB, \]

where \( g(B|ϕ) \) is the joint distribution of the vector of model coefficients, in which B and ϕ are vectors containing the mean and standard deviation of this distribution. Because Equation 19 involves the evaluation of higher-order integrals, which is computationally burdensome, we use a simulation-based approach (Train 2003) to maximize the following log-likelihood function:

\[ \ln L(B) = \sum_{h=1}^H \sum_{i=1}^I \sum_{j=1}^J d^h_{ij} \ln(p^h_{ij}), \]

where H is the total number of individuals, I is the total number of vehicle models, and J is the total number of contract types. In addition, \( d^h_{ij} = 1 \) if alternative (i, j) is chosen and 0 if otherwise. The term \( p^h_{ij} \) is the average simulated probability,

\[ p^h_{ij} = \frac{1}{R} \sum_{r=1}^R p^h_{ij}(B_r), \]

where \( B_r \) refers to the rth draw from the distribution and R is the total number of draws. We assume that each coefficient is independently and normally distributed. Therefore, we draw each consumer’s coefficient from a normal distribution whose mean and standard deviation we estimate by maximizing the simulated maximum likelihood function. We use 100 Halton draws to estimate the model parameters.

The total operating cost for the leased vehicle is

\[ \theta_{0ji} = \theta_{0ij} + \omega_{0li} (\theta_{0i} - \tau_{li}), \]

where D is a dummy variable, which we define as

\[ D = \begin{cases} 1 & \text{if } \theta_{0i} > \tau_{li} \\ 0 & \text{if otherwise} \end{cases} \]

Thus, a consumer faces a nonlinear budget curve, and how much he or she chooses to drive determines the marginal cost of a lease. This slightly complicates the estimation of the mean and standard deviation of the number of miles driven, \( \theta_{0i} \), because it raises the question of how to determine the relevant marginal cost, \( \pi_{li} \), for the consumer. We adopt the approach that Hall (1973) proposes and assume that the marginal cost for people who drive less than the mileage limit is \( f_e \) and \( f_e + \omega_{0li} \) for those who exceed the limit. In the simulated maximum likelihood approach, this implies that if a draw from the distribution of miles is greater than 12,000, \( \pi_{li} \) is set to \( f_e + \omega_{0li} \) but is \( f_e \) otherwise.

### Results

Table 2 reports only the results for the contract choice nest and the inclusive value term because this is the main focus of the article. In the vehicle choice nest, we find that only the brand intercepts, \( \beta^0_{hi} \), and the coefficients of ZIP3^h and LMK^h are statistically significant. Because the other characteristics are relatively homogeneous in this category and the brand constants already capture the component of utility that is common across consumers, this lack of statistical significance of the mean and standard deviation of the number of miles driven, \( \theta_{0i} \), because it raises the question of how to determine the relevant marginal cost, \( \pi_{li} \), for the consumer. We adopt the approach that Hall (1973) proposes and assume that the marginal cost for people who drive less than the mileage limit is \( f_e \) and \( f_e + \omega_{0li} \) for those who exceed the limit. In the simulated maximum likelihood approach, this implies that if a draw from the distribution of miles is greater than 12,000, \( \pi_{li} \) is set to \( f_e + \omega_{0li} \) but is \( f_e \) otherwise.

### Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net price coefficient</td>
<td>-1.69</td>
<td>-23.34</td>
</tr>
<tr>
<td>Standard deviation of net price coefficient</td>
<td>.19</td>
<td>1.22</td>
</tr>
<tr>
<td>Maintenance cost coefficient</td>
<td>-7.47</td>
<td>-3.01</td>
</tr>
<tr>
<td>Operating cost coefficient</td>
<td>-3.27</td>
<td>-3.54</td>
</tr>
<tr>
<td>Standard deviation of operating cost coefficient</td>
<td>1.43</td>
<td>2.99</td>
</tr>
<tr>
<td>Inclusive value</td>
<td>.23</td>
<td>2.46</td>
</tr>
<tr>
<td><strong>Contract Specific Constants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>.00</td>
<td>—</td>
</tr>
<tr>
<td>24-month finance</td>
<td>-6.02</td>
<td>-96.43</td>
</tr>
<tr>
<td>Standard deviation of 24-month finance</td>
<td>1.84</td>
<td>3.95</td>
</tr>
<tr>
<td>36-month finance</td>
<td>-3.35</td>
<td>-36.63</td>
</tr>
<tr>
<td>Standard deviation of 36-month finance</td>
<td>1.93</td>
<td>.48</td>
</tr>
<tr>
<td>48-month finance</td>
<td>-2.93</td>
<td>-15.76</td>
</tr>
<tr>
<td>Standard deviation of 48-month finance</td>
<td>.58</td>
<td>1.76</td>
</tr>
<tr>
<td>60-month finance</td>
<td>-17.67</td>
<td>-21.31</td>
</tr>
<tr>
<td>Standard deviation of 60-month finance</td>
<td>.29</td>
<td>1.72</td>
</tr>
<tr>
<td>36-month lease</td>
<td>-0.18</td>
<td>-2.34</td>
</tr>
<tr>
<td>Standard deviation of 36-month lease</td>
<td>.08</td>
<td>.59</td>
</tr>
<tr>
<td>48-month lease</td>
<td>-1.19</td>
<td>-5.09</td>
</tr>
<tr>
<td>Standard deviation of 48-month lease</td>
<td>.62</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Notes: Cash purchase constant is set to zero.
tical significance is not surprising. The inclusive value term is significant, confirming that vehicle choice and contract choice are indeed interrelated decisions.

The contract intercepts, $\mu$, which represent the common components of contract utility not picked up by the net price, maintenance, and operating cost variables, implicitly capture the impact of contract length. The estimated coefficients show that among financing options, longer-term contracts are preferred to shorter-term contracts, reflecting the impact of factors other than net price that influence the choice of contract. Although the net price variable captures the impact of the overall financial cost on contract choice, consumers may face affordability constraints, leading them to prefer lower monthly payments. For example, a consumer’s monthly income may impose cash flow constraints that make it difficult for him or her to make the larger monthly payments associated with shorter-term contracts. Thus, even if the total financial cost of a 24-month contract is less than that of a 60-month contract, its monthly payments may still be too high relative to the consumer’s monthly income, making it less attractive.

Conversely, the intercept for the 36-month lease is higher than that of the 48-month lease. Because the monthly payments on the former are not much greater than those for the latter, these coefficients probably reflect the fact that the shorter lease provides the lessee the benefit of driving a newer car.

Lease contracts not only result in monthly payments that are significantly lower than financing contracts of the same duration but also provide consumers the additional advantages of driving two new vehicles over the ownership period and of incurring lower disposal costs. The larger values for the 36- and 48-month lease intercepts than for the financing contract of the same duration likely reflect these advantages. Similarly, the higher intercept for the 36-month lease than the intercept of the 60-month financing contract also seems to capture these same benefits because the monthly payments on the two contracts are fairly similar.

As expected, we find that the net price coefficient is negative, though its standard deviation is not statistically significant. Previous studies on automobile demand using disaggregate data (Berry, Levinsohn, and Pakes 2004; Train and Winston 2007) have also found it difficult to identify price response heterogeneity on the basis of choice data alone. Furthermore, because we have only 15 vehicle models from a single product segment, a relatively homogeneous choice set, it is difficult to detect nonproportional substitution patterns and identify price response heterogeneity. The operating cost parameter is negative, which implies that as the lease penalty increases, the probability of leasing decreases.

We also find that the maintenance cost parameter is negative, which implies that cars that are more costly to maintain (i.e., those with steeper maintenance cost schedules) have a greater lease penetration. For example, although the Toyota Avalon and the Cadillac Catera have similar maintenance cost schedules for their leased vehicle ($513 and $521, respectively), the annual cost of holding the car for a longer period is much higher for the Cadillac Catera ($1,047) than for the Avalon ($879). Thus, the relative cost of buying the Catera (versus leasing it) is much higher, which may explain why the Catera tends to be leased more often than the Avalon.

During the period of analysis, however, the Catera received significant promotional support in the form of residual value enhancements, which resulted in payments that were lower than those that would have been obtained from setting the residual value to reflect the true reliability of the car. Thus, the greater lease penetration of the Catera may have been due to the promotional activity and not to higher maintenance costs. As a robustness check, we simulated market shares after allowing the monthly payments on leases to reflect the true market value, but we still found that the Catera’s lease share was higher than that of the Avalon.

An objective of this research is to examine whether consumers evaluate contracts efficiently. To shed light on this question, we estimate the average discount rate, $r$, which is obtained by solving Equation 6, and compare it with the prevailing market rate. This calculation yields an average discount rate of 15.2%, which is significantly higher than the prevailing market rate of approximately 9%. Although economic theory predicts that consumers should discount the future at the market rate, our findings seem to suggest that consumers are often unable to make the efficient trade-off between the various costs associated with acquiring a vehicle. The high discount rate also explains why consumers often prefer contracts that offer lower up-front payments, such as leases and longer-term loans, even if net prices are higher than those of shorter-term contracts. Although this estimate seems to suggest consumer myopia, high individual discount rates can also be a result of credit constraints, uncertainty about the future, and expectations about changing utility (Frederick, Loewenstein, and O’Donoghue 2002). It may even be that the prime rate is not the consumer’s opportunity cost of money. Instead, it may be the interest rate on credit cards, which is usually much higher than the market rate, through which a substantial amount of credit is obtained (Hausman 1979).

Notably, however, this estimate is much lower than those reported in prior studies of durable goods. For example, Hausman’s (1979) study of air conditioner purchases estimates an average discount rate of 25%. Ruderman, Levine, and McMahon (1986) compute the discount rates for various appliances: air conditioners (17%), gas water heaters (102%), electric water heaters (243%), and freezers (138%). Structural features of the automobile market, such as the liquidity due to a well-established capital market for car financing and the notion that consumers receive fairly detailed information about their “investment opportunities” (Verboven 2002), may explain why this estimate is more reasonable. Furthermore, unlike energy costs for household appliances, consumer awareness of fuel costs is particularly high, and they also have perfect information regarding the per-mile penalty for leases. Compared with other markets, therefore, consumers in the automobile market are better equipped to make relatively efficient decisions.

A feature of our model is that we can determine the mean and standard deviation of annual driving distance across consumers. We obtained these estimates from the ratio of the operating cost to the maintenance cost parameters (see Part C of the Web Appendix at http://www.marketing
power.com/content84062.php). We find that the average annual driving distance is 16,380 miles and the standard deviation is 1914 miles. These estimates indicate that many consumers are likely to drive above the annual mileage allowance of 12,000 miles and incur penalties if they lease the vehicle of their choice. This may be a reason financing continues to be more popular than leasing.

**Managerial Implications**

Promotional planning is an important component of the marketing plan for manufacturers, which spend more than $40 billion per year on various promotions, such as cash rebates and APR subsidies. Our model provides a framework to evaluate the relative impact of different promotions, thus providing a better understanding of how to allocate promotion budgets effectively. In the next section, we examine the volume impact of two commonly used promotional instruments that are widely used to stimulate purchases and leases—cash rebates and lease cash, respectively—and we follow up with a similar analysis for two types of promotions offered on leases—lease cash and residual value increases.

**Cash Incentives on Purchases and Leases**

In this subsection, we compare a $1,000 cash rebate offered on all purchases of a brand (cash and financing contracts) with a $1,000 lease cash offer on all its leases (36- and 48-month leases). As we mentioned previously, the cash rebate typically results in a reduction in the down payment, whereas lease cash lowers the monthly payments by reducing the capitalized cost of the vehicle. The first two columns of Table 3 report the percentage increase in brand volume for both promotions and show that the cash rebate has a greater impact across all brands. Because a promotion may not only steal share from other brands but also cannibalize share from other contracts of the same brand, we decompose the incremental volume into two components: (1) the volume from competing brands and (2) the volume from other contracts of the same brand. We use a unit sales decomposition approach (Van Heerde, Gupta, and Wittink 2003) in which both vehicle and contract choice probabilities are allowed to change. The first component incorporates the positive aspects of the promotion—namely, the volume drawn from competitors—and the second component captures the cannibalization effect.

For the cash rebate, we find that the majority of share is drawn from competitors (approximately 66%), whereas the lease cash promotion draws only approximately 34% from other brands. Thus, in light of both the volume response and the decomposition results, because the lease promotion cannibalizes a significant proportion (approximately 65%) of its own contracts, it seems to be the less attractive of the two promotions.

Finally, we compare the two types of promotions using a profitability analysis that accounts for the costs associated with each instrument. To do this, we calculate the average wholesale price of the vehicle, which is the average retail price less the dealer margin, and we compute the percentage increase (decrease) in profits relative to baseline profits (for details, see Part D of the Web Appendix at http://www.marketingpower.com/content84062.php). Because we have no data on manufacturer profitability, we assume that the manufacturer margin is 25% of the wholesale price.

The percentage change in profits for both promotions (see Table 3) shows that compared with the baseline, both promotions yield negative profits for most brands. Exceptions are the Mitsubishi Diamante and the Mazda Millenia, for which both promotions generate higher profits, and the Volvo S70, the Cadillac Catera, and the Chrysler 300M, for which the lease promotion alone is more profitable.

Because the $1,000 discount applies to both incremental and original units, the higher number of purchasers in the data set (accounting for 76% of the total transactions) increases the cost per incremental unit for the cash rebate and decreases its profitability. In other words, the incremental revenue generated by the cash rebate does not compensate for these additional costs, making lease cash the more efficient of the two promotions.

**Table 3**

<table>
<thead>
<tr>
<th>Model</th>
<th>Percentage Increase in Brand Volume</th>
<th>Decomposition</th>
<th>Percentage Gain/Loss in Profitsb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash Rebate</td>
<td>Lease Cash</td>
<td>Cash Rebate</td>
</tr>
<tr>
<td>Acura 3.2TL</td>
<td>3.4</td>
<td>1.3</td>
<td>68.0</td>
</tr>
<tr>
<td>Chrysler 300M</td>
<td>3.6</td>
<td>1.5</td>
<td>67.7</td>
</tr>
<tr>
<td>BMW 323i</td>
<td>3.3</td>
<td>1.9</td>
<td>61.5</td>
</tr>
<tr>
<td>Audi A4</td>
<td>3.5</td>
<td>2.2</td>
<td>61.6</td>
</tr>
<tr>
<td>Oldsmobile Aurora</td>
<td>4.0</td>
<td>2.1</td>
<td>69.0</td>
</tr>
<tr>
<td>Toyota Avalon</td>
<td>3.3</td>
<td>0.9</td>
<td>72.4</td>
</tr>
<tr>
<td>Mercedes-Benz C2</td>
<td>4.1</td>
<td>1.9</td>
<td>71.1</td>
</tr>
<tr>
<td>Cadillac Catera</td>
<td>3.3</td>
<td>3.3</td>
<td>57.5</td>
</tr>
<tr>
<td>Lincoln LS</td>
<td>2.9</td>
<td>2.2</td>
<td>54.4</td>
</tr>
<tr>
<td>Mitsubishi Diamante</td>
<td>4.5</td>
<td>1.4</td>
<td>76.5</td>
</tr>
<tr>
<td>Lexus ES300</td>
<td>3.4</td>
<td>1.3</td>
<td>66.3</td>
</tr>
<tr>
<td>Infiniti J30</td>
<td>2.7</td>
<td>1.8</td>
<td>53.2</td>
</tr>
<tr>
<td>Mazda Millenia</td>
<td>4.3</td>
<td>1.2</td>
<td>78.5</td>
</tr>
<tr>
<td>Volvo S40</td>
<td>3.2</td>
<td>1.7</td>
<td>61.6</td>
</tr>
<tr>
<td>Volvo S70</td>
<td>4.0</td>
<td>1.6</td>
<td>72.9</td>
</tr>
</tbody>
</table>

ab“Others” refer to competitor brands.
bcCalculated relative to baseline profits.
Lease Promotions

Next, we examine the impact of a $1,000 promotion offered on a 36-month lease, either through a direct cash incentive, better known as “lease cash,” or through equivalent increases in the residual value of the vehicle. Both these promotions go toward lowering the monthly payments on the lease, but the lease cash results in a larger reduction in payments than the residual value. Table 4 shows that the incremental volume of 36-month leases with the $1,000 lease cash is greater than the equivalent residual value promotion for all vehicles.\footnote{We do not report the decomposition results, because they are similar across the two promotions. On average, 32.5% of the volume increment comes from competing brands.}

From a volume response perspective, these results seem to imply that manufacturers would be better off offering lease cash promotions rather than residual value increments. However, although the two promotions offer the consumer nominally equal price discounts of $1,000, their cost to a manufacturer and, consequently, the profits generated will be different.

We identify two reasons the cost of a residual value promotion may be lower than that of a cash incentive. First, the residual value promotion reduces monthly payments by $24.60. From the firm’s perspective, these payments must also be discounted to determine the overall cost of the promotion. We assume that the firm discounts future payments at market rate \(i\) because this represents its opportunity cost of capital. Then, because of time discounting, the true cost of a $1,000 residual value promotion is

\[
(24) \\
\text{Cost of Residual Value Promotion} = \sum_{t=1}^{36} \frac{1}{(1+i)^{t-1}} \times 24.6 \\
\]

which is approximately equal to $781 at the prevailing 9% market rate. However, the cost of the lease cash promotion is still $1,000.

\[9\] We do not report the decomposition results, because they are similar across the two promotions. On average, 32.5% of the volume increment comes from competing brands.

### Table 4

$1,000 LEASE PROMOTION ON 36-MONTH LEASES: CASH INCENTIVE VERSUS RESIDENTIAL VALUE

<table>
<thead>
<tr>
<th>Model</th>
<th>Cash Incentive</th>
<th>Residual Value</th>
<th>Threshold Retention Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acura 3.2TL</td>
<td>29.5</td>
<td>21.8</td>
<td>17.2</td>
</tr>
<tr>
<td>Chrysler 300M</td>
<td>28.0</td>
<td>21.4</td>
<td>16.8</td>
</tr>
<tr>
<td>BMW 323i</td>
<td>27.0</td>
<td>19.9</td>
<td>20.9</td>
</tr>
<tr>
<td>Audi A4</td>
<td>26.9</td>
<td>19.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Oldsmobile Aurora</td>
<td>26.3</td>
<td>20.0</td>
<td>17.1</td>
</tr>
<tr>
<td>Toyota Avalon</td>
<td>30.4</td>
<td>22.2</td>
<td>21.9</td>
</tr>
<tr>
<td>Mercedes-Benz C2</td>
<td>28.7</td>
<td>21.0</td>
<td>24.8</td>
</tr>
<tr>
<td>Cadillac Catera</td>
<td>22.7</td>
<td>18.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Lincoln LS</td>
<td>24.5</td>
<td>19.7</td>
<td>12.5</td>
</tr>
<tr>
<td>Mitsubishi Diamante</td>
<td>30.2</td>
<td>22.5</td>
<td>16.9</td>
</tr>
<tr>
<td>Lexus ES300</td>
<td>28.9</td>
<td>21.4</td>
<td>22.6</td>
</tr>
<tr>
<td>Infiniti I30</td>
<td>26.6</td>
<td>20.2</td>
<td>15.0</td>
</tr>
<tr>
<td>Mazda Millenia</td>
<td>29.1</td>
<td>22.3</td>
<td>14.5</td>
</tr>
<tr>
<td>Volvo S40</td>
<td>27.2</td>
<td>20.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Volvo S70</td>
<td>27.0</td>
<td>20.3</td>
<td>17.2</td>
</tr>
</tbody>
</table>

Second, at the end of the contract, the lessee has the option either to purchase the vehicle at the promoted residual value or to return it to the manufacturer. As a result, manufacturers effectively avoid paying out the residual value promotion to those lessees who keep their vehicle at the end of the lease. Conversely, a cash incentive is paid out directly to the consumer regardless of whether he or she keeps the vehicle. In this respect, a residual value promotion may work like a coupon that remains unredeemed by a fraction of consumers. If this fraction is high enough, cost savings from the residual value may offset the higher volume response generated by the cash incentive.

To complete the analysis, we introduce the term “retention rate,” which is defined as the percentage of lessees who retain the leased vehicle at the end of the contract (for its derivation, see Part E of the Web Appendix at http://www.marketingpower.com/content84062.php). For each vehicle, we calculate the “threshold” retention rate, which is defined as the rate at which the profit from the residual value promotion is equal to the profit from the cash incentive. We do this by equating the profits from the two promotions using the same 25% manufacturer margin as previously. Comparing the actual retention rate with the threshold rate enables us to evaluate the relative profitability of these promotions; values greater than the threshold rate imply that the residual value promotion is more profitable than the cash incentive.

The threshold rates for each vehicle appear in Table 4; they range from a low of 7.2% for the Cadillac Catera to a high of 24.8% for the Mercedes-Benz. Although information regarding actual retention rates would be easy for a manufacturer to obtain, these are unavailable to us. However, an examination of publicly available, industrywide retention numbers enables us to draw some general conclusions about the relative profitability across the different vehicles in our sample. According to the Association of Consumer Vehicle Lessors (2002), the industry retention rate was roughly 38% in 2000, whereas CNW Marketing Research (2003) reports a somewhat lower rate of about 20%–25%. Our results suggest that because most vehicles fall below the industry average, manufacturers would be better off offering a residual value promotion rather than a cash promotion. Possible exceptions to this strategy are the Mercedes-Benz C2 (24.8%), the Lexus ES300 (22.6%), and the Toyota Avalon (21.9%), which have relatively high retention rates that indicate a possibly lower profitability.

## CONCLUSIONS

Although financial contracts are the dominant means of acquiring durable goods, there has been scant research on how consumers evaluate such contracts. Our research attempts to fill this gap by developing a structural model of brand and contract choice for the automobile market. The model captures both financial and nonfinancial aspects of a contract and highlights the distinctions between financing and lease contracts.

First, we show that brand and contract choice are interrelated decisions. To our knowledge, this is the first study to document this link empirically and to show the critical role of contracts in the demand for durable goods.

Second, we show how financial contracts require consumers to make trade-offs among financial elements, such
as interest rates, monthly payments, and contract length, and nonprice components, such as maintenance costs and operating costs. The structural approach that we adopt enables us to calculate the distribution of the discount rate, \( \rho \), in the population. The empirical results show that the average discount rate is higher than the prevailing market rate, which economic theory predicts as the rate that consumers should use to discount the future. To our knowledge, this is the first empirical study that shows that this prediction is often violated in the evaluation of financial contracts. This finding explains why consumers often prefer longer-term contracts with lower up-front and monthly payments, such as leases and longer-term loans, even if the net prices for these contracts are higher than those for shorter-term contracts. It also implies that consumers are often unable to make the efficient trade-off between net price and operating costs and may incorrectly choose to lease, despite the substantially higher costs of operation, thus further aggravating the inefficiency problem.

Third, we show that cars that are more costly to maintain (i.e., those with steeper maintenance and repair cost schedules) have a greater lease penetration because leasing permits the consumer to return the car before the cost of maintenance becomes too high. In other words, consumers prefer to buy cars that are more reliable rather than lease them. In contrast, a firm's incentive for leasing increases with the durability or reliability of its products (Desai and Purohit 1999). Our findings indicate that manufacturers of highly durable vehicles may need to offer relatively greater incentives to consumers to stimulate leasing of their products. Furthermore, whereas affordability or the lower payments afforded by leases can explain the variation in the proportion of leases across vehicles that belong to different price ranges, our model provides a novel answer as to why these proportions may differ even among vehicles that have similar prices and lease payments.

Fourth, our study demonstrates how the distribution of the annual driving distances in the population can be estimated without using any information on individual driving behavior. We find that the mean distance is significantly greater than the typical mileage allowance on leases, which implies that most consumers may expect to incur significant penalty costs if they lease. Thus, although consumers have a high discount rate, the expected operating cost of a lease continues to be high and may partially explain why a large proportion of consumers still prefer to buy rather than lease.

Fifth, our research provides managers a means by which to evaluate the effectiveness of various promotional programs based on their relative profitability. For example, we find that because of time discounting and because certain consumers keep their vehicles at the end of a lease, the cost of a residual value promotion is often much lower than a nominally equivalent cash incentive. Thus, although the incremental volume of the cash incentive is higher, its cost disadvantage relative to the residual value promotion can result in its being a less profitable promotional tool.

Finally, our framework is generalizable to several contexts and consumption situations. For example, consumers must make the same kind of trade-offs (i.e., among price, maintenance costs, and operating costs) for many other durable goods. If consumer myopia persists in these contexts, people are likely to choose a product that is, for example, less energy efficient, not realizing that a more expensive product with higher quality may result in substantial cost savings in the future. This may explain why a large number of inefficient products (and contracts) continue to exist (Loewenstein and Thaler 1989), and it is consistent with observed firm pricing strategies, such as “no-payment-for-a-year” programs on household appliances and other consumer durables. Indeed, this may point to the desirability of leases as a means to encourage consumers to acquire more expensive products that are more energy efficient, such as hybrid cars or diesel-operated vehicles. Thus, our research also has public policy implications, such as whether the government should take steps to educate consumers about the trade-off between future and current costs or even offer tax subsidies to encourage purchase of efficient products.

**LIMITATIONS AND FURTHER RESEARCH**

Our study has some limitations. First, because we use the market rate to construct the net price, we recognize that our estimate of the net price coefficient and, consequently, the discount rate may be biased. If the actual discount rate is higher than the market rate (as our results suggest), we are overestimating the net price of all the alternatives, which implies that the net price coefficient, \( \rho \), and the discount rate will be biased downward. Thus, the actual discount rate is likely to be even greater than the market rate. However, we believe that despite this bias, our approach represents a significant step forward from previous approaches that simply use the manufacturer’s suggested retail price of the vehicle and ignore other financial costs associated with the acquisition of the vehicle.

Second, our approach requires that we assume that a consumer’s lease payments for the second lease remain unchanged after the initial lease ends. Although we believe that this is a reasonable approach, it may be useful to analyze data that contain information on subsequent transactions.

Third, we are unable to quantify explicitly certain benefits provided by leasing, such as easy disposal and utility from driving newer vehicles. This would require survey data that measure consumers’ perceptions of the benefits of these contracts, which we would need to match to our transaction data. Because we do not have such data, explicitly modeling these effects is beyond the scope of this article.

There are several directions in which this research could be extended. First, the generalizability of our results to other product segments remains to be examined. Discount rates and driving distances could vary widely, not only across geographic regions but also across different vehicle segments.

Second, although our research is limited to understanding contract choice behavior within a segment, it may be of particular interest to understand this behavior across different segments. Leasing is popularly regarded in the industry as a means for consumers to afford more expensive cars. Examining contract choice behavior over a wider range of vehicles would enable us establish whether consumers use leases to “trade up” to more expensive cars.

Third, our model does not explore whether and how the components of financing contracts can affect a consumer’s purchase timing decision, which raises the related question...
whether promotional offers cause consumers to adjust the timing of their purchase. Although purchase timing behavior has been extensively studied for packaged goods, in general, findings for durables are confined to anecdotal reports that the recent flood of 0% APR offers and cash rebates may have stimulated households to accelerate their purchases.

Fourth, we do not account for the benefit of leasing that arises from its call option value. Most automobile leases are closed-end leases, providing the lessee with the right but not the obligation to purchase the leased good at the end of the contract at the prespecified residual value. This may be an attractive feature for risk-averse consumers because it eliminates the uncertainty associated with selling a used vehicle. In our current model formulation, this benefit is not explicitly accounted for in the net price expression. Instead, it is captured (along with other benefits) by the contract specific constant, \( \mu_i \). However, not accounting for the call option explicitly also implies that we may be overestimating the net price of a lease (Miller 1995), particularly for vehicles for which the used-car value is highly uncertain. Developing an approach to account for this factor may provide additional insights into why certain types of cars are leased more often than others.

Fifth, the impact of moral hazard remains unexplored. Because the lessee does not own the car, he or she may use it less carefully, which in turn may lead to higher depreciation of the leased vehicle than cars that are owned. A reverse argument is that the restrictions imposed on lease contracts may induce drivers with better driving records to lease, resulting in cars coming off lease that are of higher quality than sold cars of the same vintage. Because these off-leased cars are sold by manufacturers in the used market, understanding the behavior induced by leasing is of great interest to both researchers and managers.

Finally, a related area is to understand the supply-side implications of various leasing and selling strategies with formal models of firm behavior. In particular, the strategic role of residual values is not well understood. For example, our results show that consumer driving patterns are an important source of heterogeneity and that, on average, consumers expect to incur penalties if they lease. Firms can then use the mileage allowance on leases to exploit consumer heterogeneity and charge a higher price for vehicles that are bought. This behavior seems consistent with the recent increase in residual value promotions, which have resulted in a lower effective price for leased vehicles. In summary, the analysis of leasing and financing decisions for consumer durables represents a rich area for further research.

REFERENCES


CNW Marketing Research (2003), “Leasing in the Wake of 0% APRs,” industry article.


