Organizational Structure and the Limits of Knowledge Exploitation: Evidence from Consumer Automobile Leasing

Lamar Pierce

Washington University in St. Louis, Olin Business School, Washington University in St. Louis, Campus Box 1133, One Brookings Drive, St. Louis, MO 63130. E-mail: pierce@wustl.edu

This paper explores the impact of vertical integration on knowledge exploitation and coordination. Vertically integrating one activity with another improves the capacity to transfer between them knowledge that is important for solving complex problems. This improved information transfer is facilitated by governance and incentives that focus on corporate profit considerations. The imposition of these broader incentives, however, does not fully eliminate agency problems, as subunits may still attend to parochial interests in ways that negate the benefits of greater information transfer. I study these competing mechanisms in consumer car leasing, where lessors attempt to solve the complex problem of predicting vehicle depreciation. Using a dataset of nearly 200,000 lease contracts, I find evidence that the residual value subsidization and signaling considerations of manufacturers overwhelm most knowledge-based benefits for their captive lessor subsidiaries, and that agency problems may further limit the captive lessor’s ability to predict vehicle depreciation.

Key words: knowledge-based view, signaling, leasing, agency theory, automotive industry

1 Introduction

Consumer automobile leasing, a common financial service, is provided to consumers through two distinct organizational structures. Captive lessors, which are owned by automobile manufacturers, compete directly with banks and other independent lessors. The principal problem in establishing a profitable leasing operation is forecasting residual values (RV), or the lease-end values of cars. Overestimating residual value yields losses when vehicles are sold by the lessor at lease-end, while underestimating residual values makes the lease more expensive and thus uncompetitive with other
offered leases. Industry-wide failures in effectively solving this residual value problem led to losses of $10-11 billion between 2000 and 2001 (Rauschenberg 2001) and losses of $3,269 on the average lease-returned vehicle in 2002.¹

Accurately predicting residual value (RV) is a difficult problem, as it requires the lessor to gain a deep understanding of the product and market characteristics that influence vehicle depreciation, such as future market conditions, competition, customer preferences, new product pricing, and detailed design and manufacturing decisions. Moreover, much of this knowledge is rather tacit in nature. The difficulty in acquiring this information is exacerbated by the distribution of this knowledge across different subunits of a typical manufacturer’s organization. Leasing managers at both captive and independent lessors who wish to accurately predict a lease-end residual value must acquire and integrate knowledge from multiple groups within the vehicle manufacturer: design and durability knowledge from engineering, future product knowledge from strategic planning, and pricing and promotion data from marketing. While some of this knowledge is publicly available, much of it is proprietary and accessible only to those within the manufacturing firm.

The knowledge-based view (KBV), building on Arrow (1973) and Williamson (1975), highlights the advantages of vertical integration in solving complex problems—problems not easily decomposable at the division level (Langlois 2002; Nickerson and Zenger 2004; Macher 2006). The RV problem is precisely of this nature. Common ownership of the divisions possessing critical information for solving such problems improves the coordination of knowledge transfer (Teece 1992; Kogut and Zander 1996; Monteverde 1995; Grant 1996) and reduces the risk of appropriation by partners who would otherwise possess incomplete contracts (Nahapiet and Ghoshal 1998; Nickerson and Zenger 2004; Macher 2006; Williamson 1999).

Indeed, independent lessors such as GE Capital, Wells Fargo, Chase, Wachovia, and National City Bank suffered serious RV losses and led a mass-market exodus in 1999 and 2000, with RV losses forcing Bank of America and Bank One to charge $257 million and $518 million respectively to their earnings

¹ Association of Consumer Vehicle Lessors
(Salinas 2000a). In 1999, 84% of all car leases lost money (Keller 2001), with independent lessors suffering average RV losses approximately $700 larger than captives. Yet, surprisingly, captive lessors, despite their knowledge transfer advantages, may have performed no better and even worse than independents on certain types of vehicles (Salinas 2000b), such as newly introduced models, vehicles with low durability ratings, and underperforming cars in the top quartile of inventory levels. The knowledge-based logic seems to provide no obvious explanation for these results.

In this paper, I explore both the knowledge-based benefits and organizational costs of integration. I argue that although vertical integration may indeed improve captive lessor knowledge transfer, the RV forecasting problem is but one input in a more complex problem for the vertically-integrated manufacturer. Consequently, the knowledge advantages that might allow the captive lessor to optimally solve this RV problem remain underexploited. Vertical integration fundamentally alters the residual value problem to one of coordinating the complex impact of residual values on the price, sales and inventory, and quality signaling of the manufacturer. Unlike independents, captive lessors not only face the problem of forecasting the residual value, they also must consider the impact of the residual value on the parent corporation’s need to signal high product quality and to manage sales and inventory through discounted consumer financing. Captives must decide when to disregard otherwise valuable knowledge because the pricing and signaling implications of the RV are more important for corporate profitability. Captive lessors may therefore write leases with residual values they know to be wrong, with the resulting RV losses reflecting inter-divisional transfers to manufacturing and marketing functions rather than actual corporate losses.

While the above discussion of vertical integration merely articulates a standard coordination advantage of integration, vertical integration does not preclude agency problems or political behavior by subunit or subunit managers that compromise optimal organizational outcomes. Thus, while some decisions to overstate residual values may represent optimal decisions at the corporate level, others may represent

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2 Comparison data between independents and captive lessors are from Kelley Blue Book and my proprietary data source, and do not control for portfolio differences, which will be controlled for in the empirical analysis.
strategic decisions by managers that are inefficient for the firm. Because career outcomes and financial rewards may be tied to local performance or social capital, managers may selectively use only that knowledge which personally benefits them or their division. As both Williamson (1985) and Nickerson and Zenger (2008) have argued, such behavior may produce net profitability losses and reduce the efficiency of a hierarchical structure. Product or brand managers in automotive firms may exert internal political pressure or use subterfuge to alter product, marketing, and consumer demand information that reflects negatively on them. Manipulating these data or pressuring the leasing division’s decision-makers can lead to residual values on some vehicles that not only fail to reflect superior internal knowledge, but are also inconsistent with maximizing overall corporate profitability. The limits of corporate management to selectively intervene and shape incentives may make these costs unavoidable (Williamson 1985).

I am able to test these costs and benefits of vertical integration using a unique dataset of nearly 200,000 individual lease contracts from both captive and independent car lessors. I first show that manufacturers use captive leasing subsidiaries to discount vehicles through high residual values in order to gain market share or to reduce existing inventory. This subsidization appears to limit the captive lessor’s ability to exploit private knowledge about future vehicle depreciation, since captive lessors must write residual values above estimates in order to lower lease prices. I also show that high residual values are used to signal high quality or confidence in new model designs, consistent with the economics literature on prices and signaling (Schmalensee 1978). In the first year of new models, captive lessors are loath to exploit proprietary knowledge in order to write accurately low RVs, due to market awareness of their access to this knowledge. Fearing low RVs might signal low quality or confidence in the model’s future sales, captives are discouraged from exploiting this information when it reflects poorly on the product.

Finally, in identifying leases for which subsidization and signaling are unnecessary, I show that while captive lessors appear to exploit some knowledge advantages in anticipating redesigns, they also continue to support low quality vehicles even while less-informed independent lessors reduce the RV. While I

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3 The importance of market share in this industry is well stated by Jim O’Connor, Ford’s group vice president for North American marketing. “You either stay in the game or you lose [market] share, and share is your long-term health” (Brown 2002).
cannot observe the internal mechanisms driving this finding, these results are consistent with agency explanations from anecdotal field research, models of multitasking in financial services (Holmstrom and Milgrom 1991; Kanatas and Qi 1998; Puri 1999; Ross 2007), and studies of internal politics and transfer pricing within hierarchies (Eccles and White 1988).

This paper provides several important contributions to our understanding of the costs and benefits of vertical integration. First, this paper outlines limitations of knowledge-based benefits from vertical integration. As Nickerson and Zenger (2004) point out, knowledge-based views of vertical integration usually emphasize the benefits of hierarchy, rarely examining its limitations. Furthermore, insufficient empirical evidence exists on the scope and limitations of knowledge-exchange advantages of vertical integration (Nickerson and Silverman 2003; Macher and Richman 2008; Novak and Stern 2009), a shortfall common to the broader literature on vertical integration (Lafontaine and Slade 2008). Second, this paper provides evidence on some of the internal agency costs theorized in organizational economics. While I am unable to directly observe how career incentives drive individual workers to politick, trade favors, or make other suboptimal decisions, the persistent RV support of low-quality vehicles is certainly consistent with an agency explanation. Finally, this paper is the first to empirically demonstrate that captive lessors, driven by the sales needs of their parent companies, subsidize residual values, suggesting existing models of lease contracting exclude critical predictors of optimal pricing.

2. Industry Background

Consumer automobile leasing, like leasing in many industries, has experienced dramatic recent growth. While automobile leasing used to be a rare substitute for ownership, its use expanded rapidly from 9.8% in 1984 to 36% in 1997 before settling at 23% in 2002 (Vertex Consultants 1997; Finlay 2002). Manufacturers initiated much of this growth in the early 1990s, raising consumer awareness of leasing
from 22% in October 1990 to 72% in October 1992.\textsuperscript{4} The many firms in the automobile leasing industry include major captives, pure lessors, banks, and even some dealer lessors. The dominant industry lessors over the past decade have been manufacturer subsidiaries, which held a 46% leasing market share in 2000.\textsuperscript{5} Much of this market share has been gained through subsidization, where manufacturers seek to support low-demand models through elevated residual values (Vertex Consultants 2000).

When a consumer leases a car, she pays the lessor for the right to drive it for a certain period of time while vehicle ownership remains with the lessor. The lessee pays a monthly fee that covers the two principal costs of the lease: vehicle depreciation and interest. Consider a model where a car manufacturer offers customers leases for car model \( a_i \) of term length \( T \) months. Due to the Federal Consumer Leasing Act, these leases must include explicit values for the contracted residual value \( r \), the money factor \( f \) (the annual interest percentage rate (APR) divided by 2400), the capitalized cost \( c \) (the new car price), and the monthly payment \( p \). A consumer wishing to lease this car must pay the manufacturer \( p \) at the beginning of each of \( T \) months. After \( T \) months, the consumer lessee can either return the car to the manufacturer or purchase it for the contracted residual value \( r \). With uncertainty about vehicle depreciation, there will exist a residual value error \( e \) that displaces \( r \) from the actual residual value \( v \). Under these conditions, the lessor writes the contract:

\[
p = \frac{(c-r)}{T} + (c+r)f
\]

where \( r = v + e \)

such that

\[
p = \frac{(c-(v+e))}{T} + (c+(v+e))f
\]

For a three-year lease on a $30,000 vehicle with a residual value of $10,000, the consumer must pay two components: 1. the $20,000 depreciation, and 2. three years of interest on the average value of the car during the term of the lease (calculated as the average of the $30,000 capitalized cost and the $10,000 RV). A consumer signing such a contract pays the depreciation and interest over the lease term and then

\textsuperscript{4} Data from CNW Marketing/Research.
\textsuperscript{5} Data from CNW Marketing/Research.
typically returns the car to the lessor. The consumer also typically has the option to purchase the vehicle at lease-end for a price equal to the contracted RV. The consumer automobile lease is typically originated through a dealership. Once a customer has chosen the vehicle, the dealership’s finance manager will solicit bids from lessors, frequently using computer automated systems such as LeaseProphet and LeaseLink. The lessors that bid in the market include captive lessors, which are subsidiaries of manufacturers, and independent lessors that include banks, pure lessors, and other financial institutions.

3. Theoretical Background

The economics literature on leasing has primarily focused on how monopolists and oligopolists use durable-goods leasing to control the competition of goods sold in previous periods with their new offerings. Much of this work has examined how manufacturers with market power can control used goods by scrapping them, a practice absent in the automotive industry. Other work has focused on manufacturers’ lease/sell ratio as a function of time inconsistency concerns (Choi 1994; Waldman 1993, 1996b) durability (Desai and Purohit 1998), adverse selection (Guha and Waldman 1997; Hendel and Lizzeri 2002; Johnson and Waldman 2003), or moral hazard (Mann 1992; Johnson and Waldman 2010). This literature illustrates the importance of the used good’s competition with its manufacturer’s new offerings, a concept critical in RV forecasting. In each study, however, the authors model manufacturers as having exclusive rights to lease their own vehicles, which ignores the role of vertical integration in competition between lessors with different organizational structures. It has also largely ignored how severe uncertainty about depreciation can create a wide variance in financial performance across these lessors, even on identical products. While Pierce (2009) demonstrates the impact of manufacturer

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decisions on independent lessor performance, he does not examine the source of these decisions nor their implications for vertical integration.

3.1 The Complex Problem of Residual Value Estimation

Lessors must solve two main problems in lease contracting: evaluating credit risk and predicting residual values. The credit risk problem is resolved relatively easily by using credit reports and FICO scores to set interest rates in the lease, thereby making residual value prediction the principal problem of the lessor. Predicting residual values is complex due to the many factors influencing depreciation, including general economic conditions, competition, customer preferences, new product pricing, and innovation and new product development. The information and knowledge of these factors resides throughout the industry and with key individuals and groups within the manufacturer. A market research group possesses knowledge about early consumer reactions to the product, while product testing engineers understand the likelihood of failure for many of the key parts. Production engineers may best understand quality control in production facilities, while design groups know the likely timing and nature of future redesigns. A RV manager must locate, identify, and acquire this knowledge from each place, often without cooperation from the knowledge owners.

Manufacturers, financial institutions, and consumers are all highly uncertain about the future value of a newly-manufactured car. Automobile lessors offer consumers closed-end leases, where the lessee can return the vehicle at lease-end without liability if at the end of the lease term, the vehicle is worth less than the contracted residual value. Because the lessor is responsible for any discrepancy between residual value and the vehicle’s actual lease-end market value, accuracy in residual value prediction is critically important to the firm’s financial performance. Lessors must anticipate and react to characteristics and events that increase the residual value risk to its portfolio.

Given the complex problem of predicting the value of vehicles 3-5 years in the future, the knowledge-based view (KBV) suggests that vertical integrated captive lessors should possess proprietary knowledge to help solve the residual value problem by anticipating depreciation from future strategic choices, initial product testing, and the ability of employees associated with the vehicle. Two critical types of knowledge
play roles in depreciation: model redesigns and durability. Purohit (1992) found that the magnitude and timing of used car depreciation strongly depend on the timing and nature of model introductions and redesigns. Manufacturers, in planning model redesigns, can inform captive subsidiaries and thereby help them anticipate the consequential depreciation.\(^7\) While automobile magazines and other sources routinely publish anticipated new model introductions in advance, this information is imperfect, as manufacturers disguise vehicles during testing and protect design information. If manufacturers have such a knowledge-based advantage over independent lessors, we should observe them better anticipating future model introductions by adjusting residual values as redesigns approach. While some of this information may leak to independent lessors, we would not expect their response to be as accurate or as strong.

Likewise, durability influences used vehicle values through increased rates of deterioration. Closed-end leases with purchase options, standard in the automobile industry, only exacerbate this risk for the lessor due to problems of adverse selection and moral hazard (Hendel and Lizzeri 2002; Johnson and Waldman 2003; Gilligan 2004; Johnson and Waldman 2010). As with model redesigns, the KBV suggests that the manufacturer’s proprietary durability knowledge about part design and testing results could provide captive lessors advantages over independent competitors in anticipating depreciation. While magazines such as Consumer Reports publish durability ratings for existing models, this information is imperfect across models and model-years. Thus while we may expect all lessors to account for durability variation across nameplates, variation within brands and models may be predictable only to the captive lessor. If this is true, the KBV suggests we should observe vertically integrated captive lessors reacting more strongly to variation in durability than independent lessors, as they correctly anticipate its impact on future deterioration and depreciation.

3.2 Lease Subsidization in Vertically Integrated Lessors

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\(^7\) A residual value manager at a captive car lessor confirmed that he has access to proprietary knowledge on production planning and model redesigns. When asked if he had an information advantage over outside finance companies, he replied that “he certainly hoped so” or else the manufacturer was not protecting vital planning information from competitors.
While the KBV suggests that captive lessors possess advantages in solving the problem of RV prediction, it does not address how vertical integration might influence lease contracts in ways that limit the firm’s ability to exploit these benefits. A broad literature shows that vertical integration can have numerous effects on economic activity (Lafontaine and Slade 2008), both in improving and reducing efficiency. For the captive lessor, vertical integration introduces additional considerations that change the fundamental RV problem. Whereas the problem for the independent lessor is to forecast residual values, the problem for the integrated lessor is to set residual values that maximize profits across the divisions of the manufacturer parent. Although these considerations may be profit-maximizing for the corporation, they limit the captive lessor’s ability to exploit knowledge-based advantages in RV prediction.

One reason captive lessors may not exploit knowledge advantages in forecasting is because subsidizing vehicles through higher residual values improves sales and reduces inventory. This practice, whereby the manufacturer directs the captive subsidiary to intentionally write a RV above estimates, increases product sales but nullifies any knowledge advantage over independent lessors. Busse et al. (2006) show that automobile manufacturers indeed use captive finance arms to meet goals of reducing inventory, provide financial accessibility to consumers, and increase market share. Car manufacturers rarely lower retail prices during the course of a model year due to the negative signal this sends to the market, while promotions also facilitate price discrimination based on geography and customer financing preference.

Busse et al. (2006) focused on loan subsidization, but lease subsidization specifically targets a different set of consumers, many of whom lease because they have short vehicle replacement cycles or are cash constrained. Lease subsidization is primarily accomplished through increasing residual values, which the industry refers to as subvention. While manufacturers could alternatively subsidize leases by reducing the capitalized cost or the interest rate, RV subsidization is preferable because it allows losses to reported at the end of the lease, rather than at the point of sale. While it is unclear if delaying such losses improves profits, it could benefit managers seeking improved short-term financial statements.⁸

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⁸ The Financial Accounting Standards Board (FASB) Rule 13 is intended to prevent this practice, requiring manufacturers to account for subsidized operating leases and lending in financial statements. Yet lending and
The implementation of lease subsidization can be demonstrated in the lease price structure. Suppose that in the previous period \( t_{k-1} \), the captive lessor behaved exactly like its independent competitors, with no need to subsidize its leases. But in period \( t_k \), inventory increases (or sales decrease) and the manufacturer wishes to reduce this to an optimal level by reducing the lease price \( p \). Even though the manufacturer’s beliefs about \( v \) have not changed, the manufacturer now raises \( r \) from \( v + e \) to \( v + e + a \), where \( a > 0 \) represents the amount of subsidy needed to lower \( p \) from the old optimal \( p_{k-1} \) to \( p_k \). Then:

\[
p = \frac{(c-(v+e+a))}{T} + (c+(v+e+a))f
\]

While \( a \) may achieve the optimal lease price \( p_k \) for the vertically integrated firm, it limits the ability of the captive lessor to capitalize on knowledge advantages in predicting residual value. While the knowledge exchange advantage of vertical integration may still exist, it is subsumed by larger corporate concerns. While RV prediction may remain the principal problem for the lessor, it may for certain vehicles shift to a secondary concern.

The empirical implications of subsidization are clear. If captive lessors, like independents, solely focus on the problem of RV prediction, we should observe them reacting similarly to independents. If they are instead pursuing subsidization, we should observe them setting higher residual values than independents specifically on low market share and high inventory vehicles. We should also expect to observe them raising residual values as new model designs approach, particularly for major redesigns. Subsidization does not propose strong predictions on captive response to unrevealed durability, nor does the KBV propose strong predictions for response to market share or inventory, but a conflict exists in the KBV and subsidization stories for how captives might respond to model redesigns. If captive lessors, despite anticipating the timing and nature of redesigns, must instead maintain or raise residual values to support leasing are bundled and independently unobservable. While promotions based in interest or rebates would be immediately observable and verifiable in an audit, residual value subsidies would not, and are therefore viable ways to manipulate profitability across years. A high residual value representing non-declared subsidization could always be justified as confidence in the vehicle’s future success.

9 While extremely low inventory might tempt a manufacturer to set \( a < 0 \) in order to profit from the car’s popularity, such a strategy would likely fail, as the increased lease price would become uncompetitive with independent leases.
soon-to-be obsolete vehicles, we will not observe them exploiting any knowledge advantages. Rather than seeing increased anticipation of redesigns through lowered RVs, we would instead see a decreased response in order to subsidize these vehicles as their popularity wanes.

3.3 Residual Values and Quality Signals

Vertical integration may provide other profit-based incentives that limit knowledge exploitation in residual value forecasting. Much like advertising (Milgrom and Roberts 1986), branding (Rao et al. 1999), pricing (Cooper and Ross 1984), and warranties (Balachander 2001), a low RV from a captive lessor sends a signal about both its quality and the expected success of the vehicle. Even if a manufacturer knows a car to be of low durability, it may be unwilling to let the leasing subsidiary signal these attributes through a low RV. Consumers, industry experts, and financial institutions, recognizing the captive’s private information, interpret low residual values as a quality revelation, motivating scrutiny by industry and press and encouraging independent lessors to lower their own residual values further. If the industry perceives high RVs as a credible quality signal, manufacturers may selectively write high residual values on low durability products so long as such actions do not significantly reduce the credibility of future signals. This signaling, however, would provide less benefit after the first year of a model design. By the second year, industry and press would have identified and reported low-quality and unpopular vehicles in publications like Consumer Reports or J.D. Power. While some quality aspects may remain unrevealed after one year, as with recent quality problems at Toyota, attempts at quality signaling with captive residual values would likely be cheap talk. Consequently, captives are unlikely to try to signal high residual values after the initial model design year due to its cost and inefficacy.

The potential signaling value of captive residual values conflicts with the KBV prediction that captives, possessing superior durability knowledge, will more accurately reflect anticipated (but not yet revealed) durability in residual values. While KBV predicts captives will drop RVs more in anticipating low durability cars, the signaling explanation suggests they cannot because of adverse impacts on broader sales. As signaling grows less useful as durability is publicly revealed over time, knowledge-based
advantages also weaken. If signaling is indeed important, we should not expect to observe the KBV prediction of captives better anticipating depreciation from low-durability cars.

### 3.4 Potential Agency Issues in Residual Value Forecasts

Vertical integration may indeed help firms such as car lessors solve the greater problem of how to set optimal residual values through knowledge exchange and coordinating the impact on financial losses, signaling and subsidization. But vertical integration may also generate internal agency problems that limit knowledge exploitation in ways that are not net profitable for the firm. Internal agency concerns, where self-interested actors under imperfect information act in economically inefficient ways (Grossman and Hart 1983), are a common problem within firms. While vertical integration can reduce agency problems through low-powered incentives and improved monitoring (Baker and Hubbard 2003; Azoulay 2004), remaining incentives and imperfect information within firms make agency problems a continuing concern. Employees may misrepresent information for internal political purposes (Prendergast 1999) while managerial limitations may make efficient selective intervention impossible (Williamson 1985).

Car manufacturers and their captive subsidiaries potentially suffer from such agency problems in the RV prediction process. While the RV manager in an independent lessor is ultimately responsible only for accurately predicting residual values, a captive RV manager must deal with internal political as well. Product sales teams have strong incentives to encourage high residual values on their cars, as RV affects their product’s affordability. Residual values are particularly important to luxury vehicles, which have much higher leasing rates due to both high demand for leasing from high-income customers as well as cash constraints from those seeking increased social status from luxury cars. Expensive lease rates would cripple these products, and most potential lessees would choose to lease a different vehicle rather than buy the car. While the RV manager at an independent lessor would lower residual values to account for the increased risk of a low durability vehicle, their counterparts at captive lessors may be unable or unwilling to do so, despite recognizing the eventual cost of this inaction several years later.

This explanation is consistent with the literature on agency problems in transfer pricing. Under perfect information, the first-best solution (Hirshleifer 1956) is for the manufacturer parent to pay the captive
subsidiary the marginal cost for lease financing. With information asymmetry, transfer pricing can include adverse selection (Vaysman 1996) and holdup through underinvestment (Holmstrom and Tirole 1991; Williamson 1985), where agents and divisions within the firm may negotiate transfer prices in ways leading to suboptimal pricing (Eccles and White 1988). Managers may engage in behavior that benefits divisions or groups and supports managerial career prospects (Bradach and Eccles 1989).

Within an automobile manufacturer, the RV manager at a captive lessor may face a difficult decision. While the costs or rewards of avoiding RV losses may not be realized for up to five years, the political costs of displeasing sales teams and executives are immediate. With the focus of the manufacturer on market share and immediate earnings, RV managers may simply find it easier to relieve internal political pressure now and suffer residual value losses later. Since there is information asymmetry about whether the contracted RV represents actual beliefs about depreciation, the optimal set by the manager can be much higher than v. This problem would be exacerbated by managers expecting to change positions or companies within the term of the lease. Such managers may have strong incentives to curry favor with other divisions, believing this would improve their job mobility.

Captive lessors may suffer worse performance than independent competitors in adjusting residual values to durability concerns due to the unwillingness of residual value managers to punish low-quality vehicles. While quality signaling may explain high captive residual values in the first design year, continued high RVs after the first year are more likely to reflect agency concerns. Like the signaling argument, the agency explanation therefore conflicts with the KBV prediction that captive residual values will be more sensitive in anticipating future revelation of durability. But it further suggests that captives will maintain RVs on low durability cars long after durability is known to independent lessors.

Manufacturers cannot avoid these internal agency problems by outsourcing RV forecasting to independent lessors, since the manufacturer would have strong incentives to misrepresent information in order to understate expected depreciation in order to reduce lease prices and increase manufacturer sales. Such understatement is difficult to verify in a contractual setting without full access to manufacturer operations, which would create opportunities for independent lessors to sell proprietary information to
competing manufacturers, similar to appropriability concerns in the literature on subcontracting (Pisano 1990; Oxley 1997; Mayer and Nickerson 2005). Exclusive relationships with manufacturers cannot mitigate this risk because they would produce insufficient portfolio diversification for independent lessors, who would be highly susceptible to brand-based shocks such as manufacturer bankruptcy (Chrysler), safety scandals (e.g. Firestone/Ford, Toyota), or brand cancellations (e.g. Buick). Since contracting residual values across firms exposes independent lessors to considerable hazards, the most efficient way to coordinate lease residual values with marketing and other manufacturer goals is through hierarchy (Williamson 1985), despite internal agency costs.

4. Empirical Analysis

My empirical analysis focuses on identifying how captive lessors react differently than independents to factors influencing residual values. Subsidization, knowledge advantages, signaling, and agency issues provide conflicting predictions about how captives and independents will respond to the factors of durability, sales, and model redesign. Identifying differences in these responses will therefore shed light on the importance of these issues in captive lessors’ contracting.

I present the basic RV difference between captive and independent lessors in Figure 1, which represents the RV percentage (of new car price) for all 48-month leases by captive (20,408 leases) and independent (13,768) lessors. While these graphs do not control for many other contract and vehicle factors, they demonstrate considerable differences in how captive and independents set residual values. Consistent with subsidization, captives increase RV as market share falls, and do not reduce RV as redesigns approach. In response to durability, captives keep RV high even on the lowest durability cars, despite independents lowering RV. These apparent responses are in sharp contrast to a knowledge-based argument, where vertically-integrated captive lessors should exploit superior knowledge to anticipate

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10 I use 48-month leases because they are the most common leases in my dataset and thus present sufficient observations for comparison. The lines represent simple linear predictions without controls. I will compare leases across different term lengths in later regression analysis.
durability and model redesigns through residual values, and suggest both signaling and agency issues as possible explanations. While independent RV is on average higher than captive RV, this difference largely represent the quite different samples of 48-month leases written by independents and captives. Furthermore, Pierce (2009) showed that most independent lessors overestimated residual values during this period. Regardless of why independent lessors have higher residual values in Figure 1, the change in this RV difference as a function of durability, model redesign, and market share is consistent with captive subsidization.

Despite this evidence, we cannot empirically separate strategic and performance differences here because pervasive lease subsidization by captive lessors obscures other ways in which vertical integration may influence residual value prediction. I therefore first identify subsidization using all leases in my sample. I then take a sample of vehicles where no subsidization should occur, and test for signaling and knowledge-based explanations for differences in forecasting performance. I also study this sample for behavior consistent with agency problems in transfer pricing.

4.1 Data

The primary dataset for this study involves approximately 200,000 consumer lease transactions from California dealerships between 1997 and 2001. These data come from a major supplier of marketing research and identify vehicles by model, model year, and detailed options. Most importantly, each case lists detailed terms of the vehicle’s financing, including the annual percentage rate (APR), capitalized cost, trade-in value, and residual value. The data include details on all components of the lease payment, including the lessor name, down payment, term, residual value, APR, monthly payment, manufacturer rebate, capitalized cost, and buyrate. The buyrate is the interest rate financial institutions offer dealers on the loans and leases for their customers. Dealers will sometimes mark up this rate and offer the consumer a higher APR, pocketing the difference. Because the data are based on information collected at the
dealership, we cannot observe off-dealership financing. Leases written away from dealerships, like loans written away from dealerships, appear only as cash transactions in the database.\textsuperscript{11}

Vehicle durability data is from Consumer Reports online service for each vehicle model in years 1997-2002. These data include ex-post measures of reliability for 14 vehicle characteristics on a 5-point scale, and are used to represent vehicle quality. Consumer Reports constructs these measures based on the number of necessary repairs reported by survey respondents. A high rating of 5 indicates few reported problems, while a rating of 1 represents a high problem rate.\textsuperscript{12} The durability measure for each vehicle is taken from the date of lease termination, and is publicly known at that point. This durability information is imperfectly and asymmetrically known, however, at the time of lease origination, with private information on this durability likely known only inside the manufacturer. Vehicle sales and market share data are taken from the Automotive News Market Data Books, years 1999-2002. Using these data, I calculated total segment sales and market share for market segments defined by the supplier of the transaction data. Monthly vehicle inventory data are also taken from Automotive News. These data represent the number of sales days worth of inventory for a given model in the preceding month. Low inventory represents high demand relative to production capacity. High inventory represents under-performing sales. Unfortunately, these data are only available at the model level for American manufacturers.

Finally, I use new model introduction and redesign data from Intellichoice.com. These data identify when a car manufacturer redesigned or introduced a model as well as the characteristics of this change.

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\textsuperscript{11} These data represent leases originated at dealerships. Consequently, they do not include leases arranged directly with banks, and may not constitute an entirely representative sample of independent leases. Given the 45% national market share of captives, and the 60% market share in my California sample, one can infer that a significant number of independent leases are missing from the data. The difference between independent leases originated at dealerships and those arranged directly with the lessor is unknown. If anything, the competitive bidding environment of the dealership should reduce differences between captive and independent lease terms, as consumers are able to instantly compare competing finance offers at the dealerships. Consequently, one might expect the differences between the lessors in the data to be less than would occur in the total population of leases, thereby understating the effect of ownership structure on contracting behavior.

\textsuperscript{12} The principal complaint with this measurement is that owners of one brand may treat their vehicles more harshly than others, or may have different standards in identifying a problem with their car. While these are certainly valid concerns in measuring product quality, this paper will address within-brand and within-model variation in product durability and firm-level bias in the durability measurements should thus be controlled for.
\end{footnotesize}
These data included dummy variables identifying if the model change involved a new platform, which I designate as a major update. Minor updates involved primarily cosmetic changes. The individual contract data identifies the date when the first car of a new model or model update was sold, which allows me to identify the number of days between lease origination and the model redesign. For example, if a lease was originated March 1, 2000, and the first redesigned vehicle appeared March 1, 2001, the number of days until redesign for this lease would be 365. These datasets were compiled with the unit of analysis as the individual lease contract. Thus for each of approximately 200,000 vehicles, the data include the contract terms, lessor, the realized durability of the model-year, and the timing and nature of the next redesign.

**Summary Statistics:** I present summary statistics for two samples in Table 1. The primary sample, which will be used in the larger market share model, includes 178,979 leases. The mean capitalized cost of the leased vehicles is $30,201, with a mean residual value of $15,216 or roughly 61% of the mean invoice price of $24,938.\(^{13}\) This capitalized cost is higher than the national average sales price for new vehicles, consistent with consumers leasing more expensive cars. The average lease term was 44.5 months. 52% of the leased vehicles were either trucks or sports utility vehicles. Leases were originated on average 2.5 years before a model redesign, with major redesigns accounting for 83% of these changes.

The second sample, which will be used in the smaller inventory model, includes 31,578 American cars from 2000-2001. This sample has considerably more trucks, lower residual values and slightly shorter term lengths. The most important difference between these samples, however is that the inventory model includes only American captive lessors (Ford, General Motors, and Chrysler). The captive lessors in this sample are therefore a unique subset of the larger set of vertically-integrated lessors.

### 4.2 Identifying Lease Subsidization

I first identify subsidization by how captive lessors raise residual values relative to independent lessors, as redesigns near, market share falls, and inventory rises. Using a manufacturer fixed-effects OLS model with robust standard errors I examine the difference between captive and independent contracts for all

\(^{13}\) The capitalized cost reflects dealer-based price negotiations, while the invoice price, the price paid by dealers to manufacturers, is constant across all dealers. For this reason, residual value percentage is more accurately reflected by using the invoice.
vehicles in the population. The key to identifying subsidization in this model is to interact market share
and inventory variables with a captive lessor dummy. The coefficients on the non-interacted market share
or inventory represent independent lessor behavior. The coefficients on the interacted variables represent
the difference in captive lessor behavior. This model is:

\[
\text{residualvalue}_i = \alpha_i + \beta K_i + \gamma N_i + \phi X_i + \psi P_i + \omega D_i + \epsilon_i
\]

K represents a set of car variables, including vehicle invoice, dealer sales price, a truck dummy, and
vehicle durability. Historical evidence of extremely large residual value losses on light trucks and existing
models suggests this vehicle class has unique leasing losses (Desai and Purohit 1998). N contains new
product introduction variables: time until model redesign and redesign significance dummy. X consists of
the car model’s market share in its vehicle segment. P includes variables describing the lessor’s portfolio
of leases, measured in total vehicle portfolio size, annual portfolio, and specific make/model/model-year,
as well as a consumer credit proxy that is the average interest rate offered on (non-lease) loans at the
dealership of lease origination. D represents interaction terms from the captive dummy variable for
identifying the effect of organizational structure on the coefficients of the independent variables. The
interaction terms are included to separate the variables’ effects on captive lessors from their effects on
independent lessors. Also included in the model are year and term-length dummies. The variable
definitions are listed in Table 2. The unit of analysis is an individual vehicle lease contract, of which I use
178,809. Due to the dummy variables and manufacturer fixed-effects, all variation in the model is within
leases of a specific term length written in a specific year on vehicles from a specific manufacturer.

**Independent Lessor Behavior:** Independent lessors serve as a baseline from which to compare captive
lessor behavior. Their contracting behavior is identified by coefficients on variables not interacted with
the captive dummy. I expect to find several relationships between residual values written by independent
lessors and the explanatory variables. Trivially, the RV is higher for vehicles with higher capitalized
costs. To reflect increased depreciation, independent lessors should lower RV as durability decreases.
Similarly, as model redesigns near, independents should lower RV to reflect the effect of redesigns on
used car values. If the magnitude of the redesign is anticipated by independent lessors, we should also expect forthcoming major redesigns to lower residual values. Furthermore, vehicles with higher market share should suffer less depreciation for two reasons. First, high market share reflects the popularity of the current design, and the expected popularity of the design on the future used-car market. Second, high market share reflects that the vehicle was not overpriced. An overpriced vehicle would depreciate more quickly on the used market, as used car prices are not fixed in the same way that invoice price is.

Table 4, column 1 presents the results from the OLS fixed-effects regression. All errors are clustered at the lender/model/year combination.\textsuperscript{14} As expected, the coefficients on durability (259.6) and days until redesign (.294) are both positive and statistically significant, indicating independent lessors raise residual values in response to increases in these factors. The coefficients indicate that these variables are not only statistically significant, but also economically significant as well. An increase from low durability (3) to high durability (5) on average increases the RV by $519. This is a considerable effect given the imperfect information held by lessors when writing contracts. Moving one year closer to the model redesign would decrease the RV by $107. The coefficient for the major redesign dummy (6.24) is approximately zero and not statistically significant. The coefficient on market share is positive (2422) and highly significant.\textsuperscript{15}

**Manufacturer Subsidization:** In order to identify captive RV subsidization, we must observe the interaction between the captive dummy variable and market share, inventory, and days until redesign. If subsidization is occurring, manufacturers should set higher residual values than independents as the days until redesign decrease, when market share is low, inventory is high, and when major redesigns are pending.

The results on subsidization are also presented in Table 4, column 1 as the coefficients on the captive dummy variable.

\textsuperscript{14} Lessors do not continuously change residual values across time. In other words, there is some stickiness in the residual values set, such that Lessor A’s residual value on a 48-month lease for a 1998 Taurus written March 12 is likely to be the same as the one written on March 16. This suggests that using 178,979 individual contracts may overstate the actual number of decisions made by firms. An example of a lessor/model/group would be Bank of America leases on 1998 Tauruses.

\textsuperscript{15} Alternate models that included a control for the Herfindahl index of model segment concentration have no impact on the primary variables of interest, but do create volatility across models in the coefficient for independent lessor market share due to high correlation (.67) between these variables.
interaction variables. The coefficient of -.358 for the days until redesign/captive interaction variable shows that as the time until redesign decreases by one day, captives raise the RV by $0.36 relative to independent lessors. The market share/captive interaction coefficient of -3486 indicates that as market share increases 10%, captives lower their RV by $348 relative to independent lessors. Both of these results are consistent with manufacturers subsidizing poor-selling and increasingly obsolete models. Subsidization is not reflected in the magnitude of the redesign. In fact, manufacturers write comparatively lower residual values on vehicles with pending major redesigns, with the captive/redesign interaction having a coefficient of -424. This result is consistent with the knowledge-based predictions and may reflect that details of redesigns are not widely known to independent lessors or consumers. While industry publications provide information on the expected timing of redesigns, manufacturers may ultimately succeed in keeping details of these redesigns secret.

Table 4, column 2 uses year dummies in place of the linear days-until-redesign variable. Each year is defined by the redesign date, where Year 1 represents a vehicle leased within one year of its successor. Year 0, or those vehicles leased after the introduction date, serves as the baseline. The year dummy coefficients, which are not reported, are consistent with the linear days until redesign model, with independent lessors increasing RV as time until redesign increases and captives subsidizing by raising RV in the last years of the design. Columns 3-4 repeat columns 1-2, using logged residual values and logged dealer invoice. These results are generally consistent with the primary specification.16

**Subsidization to Reduce Inventory**

While market share may be the principal objective of the car manufacturer, annual data provides little variation within car model; a manufacturer may be content with a 10% market share in one segment while viewing equivalent market share for another vehicle as insufficient. Inventory data instead reflect model sales relative to the production capacity of the manufacturer. Models that sell above expectations exhibit low inventory while underperforming sales will result in excess inventory. We therefore expect high

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16 An alternative measure for days until redesign, which measures the days from the end of the lease until the new model is introduced, is also consistent with prior models.
inventories to motivate sales incentives, including lease subsidization through inflated residual values. The inventory level is measured in the number of days of sales for a model in the preceding month. For a vehicle leased in February, 2001, this value would be the inventory of that model from February 1.17

The results of the inventory model, presented in Table 4, column 5, also show strong evidence of subsidization. While the coefficients on inventory are not statistically significant across models, captive lessors raise RVs relative to independent lessors as inventory rises, as demonstrated by the positive coefficient (6.67) on the inventory/captive interaction. Furthermore, coefficients on the redesign variables are similar to those in the market share model, further supporting subsidization. The primary explanatory variables remain consistent across alternative specifications in columns 6-8, with some control variables losing statistical significance across models.

5 Residual Value Losses in the Absence of Subsidization

Evidence from the total population of leases shows that captives indeed subsidize leases, suggesting that vertical integration leads them to choose corporate goals over exploiting the knowledge advantages. Given the widespread use of lease subsidization, identifying other implications of vertical integration is difficult. Consequently, I sample only those vehicles for which there should be no reason to subsidize the leases—vehicles with high dealer profit. High dealer profit indicates that demand for the vehicle is high relative to supply, allowing the dealer to charge high markups over vehicle invoice. Since manufacturer invoice prices are fixed over the year (Busse et al. 2006), dealers reap most profits when vehicles are in short supply, which allows them to sustain high retail prices to customers.18 One concern with this sample is that dealers may trade lower lease prices for higher sales prices, but since dealers have no control over the residual values offered in the lease contracts, RVs are independent of dealer action. Another concern is that the discounted financing provided by high residual values is captured by dealers who might negotiate differently, leading to higher prices and thus higher dealer profits. Yet given that Busse et al.

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17 Unfortunately, these data are only available at the model-level for American cars, and are limited in this paper to the years 2000 and 2001. These limitations reduce the sample using annual market share from 178,809 to 31,578 vehicles, but provide much greater variation in the independent variable.

18 Interviews with captive lessors and dealers verified that using high dealer profit as a sampling criterion was appropriate.
(2006) found that 70% to 90% of customer rebates pass through to customers, dealer profits are unlikely to be highly impacted by consumer subsidies.

I calculate the average dealer profit on all vehicles and selected the top 10% of transactions. Summary statistics from this sample are listed in Table 3. As expected, the sample has major differences from the general population. The price level of the vehicle is higher, with the mean invoice rising to $30,331 from $24,938. The mean durability is slightly lower (4.06 to 4.296), perhaps reflected by the higher proportion of trucks (.62 to .48). While the average term length from the two groups is nearly identical, the mean residual value percentage (of invoice) is much higher in the high-profit sample (67.7% to 61.0%). This is consistent with earlier findings on higher market share vehicles having higher residual values.

Using the high-profit sample, I repeat my OLS fixed-effects analysis for 19,021 contracts. The results from the OLS model, presented in Table 5, column 1, show evidence that captive lessors are able to exploit at least some knowledge-based advantages in predicting residual values, but these appear to be limited to knowledge surrounding redesign timing. While independents appear to anticipate redesigns by lowering residual values as days until redesign decreases, captives are more sensitive to new model timing. I observe no knowledge-based advantage for captive lessors in anticipating the magnitude of the redesign. This could reflect the inability of manufacturers to keep knowledge on redesign proprietary due to press coverage anticipating these events.

While captives appear to have some knowledge-based advantages over independents regarding model redesign timing, they react very differently to variation in the durability of their products. Independents do not appear to raise the RV as durability increases except in the first year, represented by the first year/durability interaction. Captives, however, show a very different response to durability variation. The captive/durability interaction coefficient of -178 indicates that captives raise RV as durability falls. This difference also exists in the first design year. In fact, in the first design year, captives lower RV by considerably less than independents (β = 1894). This result suggests captive lessors are unwilling to lower residual values on low-quality vehicles due to signaling concerns. The continued effect after the first year is also consistent with agency concerns, although we cannot rule out continuing value in signaling.
Results from the logged function are presented in column 2, and are generally consistent.

I used a second sampling criterion for unsubsidized vehicles consisting of cars for which no customer cash rebate was offered on vehicle purchases. Manufacturers who subsidize lease are also likely to subsidize sales through manufacturer rebates. Those vehicles without manufacturer rebates through the course of a year are likely to have no need for lease subsidization. Table 3 presents summary statistics for the no-rebate sample, which is heavily correlated (p=.43) and similar to the high-profit sample, although more heavily dominated by foreign producers. Results using the no-rebate sample, listed in columns 3-4 of Table 5, are mostly consistent with those from the high-profit sample, supporting signaling and agency considerations. One difference is the captive/durability interaction coefficient of -1,938, which shows that captives actually decrease residual values as durability increases, even stronger evidence that captive lessors are unwilling to set low residual values on low durability vehicles.

When we eliminate subsidization by using only vehicles in high demand, we still see stark differences in how captives and independents write residual values. In the first year, manufacturers release high residual values even on their lowest durability cars, consistent with a signaling explanation. Although such signaling could potentially be effective to some parties, independent lessors react quite accurately to the first-year models. If the rest of the market responds to durability like independent lessors do, then the signaling may be ineffective. Regardless of this efficacy, it may still be unacceptable to the corporation for the captive lessor to admit the low quality of the vehicle.

The continued residual value support of low durability vehicles beyond the first year suggests that signaling may not be the sole explanation for this difference. Durability variation after the first year may provide some continued justification for signaling, but we would expect this effect to be weak. While we cannot observe the internal mechanisms of the manufacturers, the continued captive lessor support of low-durability vehicles is consistent with the agency explanation presented here. We might, in fact, believe that the large difference in year one reflects stronger pressure from product managers to make new introductions successful, although we cannot differentiate this from profit-improving signaling.
6 Discussion and Conclusion

The knowledge-based view of the firm argues that vertical integration can provide considerable benefits to knowledge exchange and transfer within the firm. Car leasing, where lessors face the principal problem of predicting residual values, seems an ideal place for the hierarchical form of captive lessors to present knowledge-based advantages over independent competitors. Proprietary knowledge on future vehicle redesign, quality, and future market choices can be shared across divisional boundaries to assist in the problem-solving process. But the results of this paper also show that many of the knowledge-based benefits of vertical integration may become secondary to other corporate goals, such as product pricing and quality signaling. Vertical integration makes the leasing division’s residual value problem part of a much larger and more complex problem involving multiple profitability implications. Large residual value losses on vehicles can reflect both subsidization and signaling that may be profit-maximizing for the firm, where the costs of residual value losses are made up by gains to the manufacturing parent. And although many of these captive leasing losses may reflect optimal corporate decisions, they may also reflect true costs of vertical integration from agency problems yielding inefficient internal transfer prices across divisions.

Since lease subsidization is so pervasive, it is difficult to identify the other effects of vertical integration on firm behavior. In this paper, I have tried to demonstrate these other implications through samples of unsubsidized vehicles. In observing the major residual value losses observed on low quality cars, the goal was to understand whether these losses were due to strategies meant to improve overall profitability such as signaling, or whether they reflect costs from agency problems. The results from the unsubsidized sample suggest that residual value losses reflect both signaling and agency concerns, but I cannot definitively prove this. The much higher captive residual values on low durability vehicles in year one suggests attempts by captives to signal higher quality, but we can’t understand if this signaling is effective. In fact, the observation that independent lessors differ dramatically in their depreciation forecasts on these vehicles suggests at the very least that informed sources are not fooled by these signals.
Instead, these “signals” may reflect internal pressure for first-year designs to “win” in the market.

Without data on internal labor markets or networks, it is difficult to prove an agency explanation. Furthermore, this market represents only thirteen corporations, with limited across- or within-firm variation. While interviews with two corporate residual value managers have verified that internal political pressure can drive up residual values, this field research in no way represents a proof generalizable across all firms. It does suggest, however, why we observe captive lessors writing unprofitably high residual values on their worst vehicles, long after signaling has its greatest effect.

I find some evidence of knowledge-based advantages from vertical integration. Captive lessors appear to be more sensitive to redesign timing when subsidization is unnecessary. Yet I find no evidence that captive lessors benefit from knowledge about vehicle quality or redesign characteristics. While these benefits may exist, I would argue that for car lessors these benefits are overwhelmed by the other implications of vertical integration. Indeed, interviews with captive lessors suggest that knowledge is indeed being exchanged, and that those needing to predict residual values can indeed benefit from access to others within the firm. But the freedom to use this knowledge to solve the leasing division’s forecasting problem is limited due to conflicts with the corporation’s greater problem of coordinating residual value implications for sales and marketing. The findings of this paper are consistent with those of Mullainathan and Scharfstein (2001). Like the subsidiaries of PVC producers in their paper, captive lessors appear to primarily focus on the parent company and are thus unable to exploit other benefits from vertical integration. This behavior appears consistent with what they call “organizational focus”, where the sales focus of the manufacturing parent overrides the leasing subsidiary’s focus on residual value prediction. Yet these new results provide evidence for the internal mechanisms (both profitable and inefficient) that might be driving this behavior, and compares potential costs and benefits from the vertical integration decision.

This paper has implications well beyond the automotive industry, showing that while vertical integration may improve knowledge exchange, firms may be unable to exploit these gains due to the many other implications from a hierarchical organizational form. Marketing, signaling, and other profit-
related concerns may take precedence in the corporation over a division’s activities. Although vertical integration may help the subsidiary acquire the knowledge necessary to solve complex problems, it may also render those problems secondary to greater corporate concerns. Furthermore, costly internal agency problems across divisions and functional groups may provide incentives to distort knowledge in ways that benefit them but are costly to the firm. This paper suggests that such behavior is of particular concern to the firm when outcomes such as RV accuracy are not observed or accounted for until years after the decision. When the incubation period for such outcomes is even longer, such as in home mortgages, the financial impact of these agency costs may be even more severe. This paper suggests that average job tenure and the delay of performance revelation are critical to any model of agency.

Ultimately, the residual value risk manager of a captive automobile lessor is like an umpire—no matter what call he makes, someone will vocally question his judgment. High residual values move cars, and low residual values signal lack of confidence by the manufacturer and hurt product teams by making vehicles unaffordable. In markets like this, where there are strong managerial incentives to sell now and pay later, costly conflicts may occur. The agency problems presented in this paper are similar to those observed in financial services such as sub-prime lending, where sales commissions and ex-ante financing fees are paid for later in high default rates. Nor are they different from mergers and acquisitions that produce short-term fees for investment bankers but long-term costs from diseconomies of scale and scope. Whenever the costs of agents’ rent-seeking behavior are not revealed until years later, the potential for catastrophic losses, whether they be from residual values or housing market defaults, remains substantial.
References


Figure 1: Variation in 48-Month Residual Values by Organizational Structure

Table 1: Full Sample Summary Statistics

<table>
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<tr>
<th></th>
<th>Market Share Model</th>
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<th>Inventory Model</th>
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RV as Percentage of New Car Price

Lessor Responses to Market Share

Lessor Responses to Pending Model Redesigns

Lessor Responses to Vehicle Durability

Lessor Responses to Pending Model Redesigns

Captive 
Independent
Table 2: Variable Definitions

- **Residual Value**: The estimated value of the vehicle at lease-end. Also the price at which the lessee can purchase the vehicle at lease-end.
- **Capitalized Cost**: The negotiated new price of the vehicle. The total amount financed.
- **Truck Dummy**: 1 if the vehicle is a light truck or SUV. 0 otherwise.
- **Invoice**: The fixed price paid by the dealership for the vehicle.
- **Term**: The length in months of the lease.
- **Durability**: The Consumer Reports durability score measured at lease-end through consumer repairs.
- **Month**: The calendar month.
- **Market Share**: The model family market share in its vehicle segment.
- **Captive Dummy**: 1 if the lessor is captive. 0 otherwise.
- **Days Until Redesign**: The number of days until the model redesign is introduced.
- **Redesign Dummy**: 1 if the redesign is major. 0 otherwise.
- **Credit Risk**: The credit risk proxy calculated at the dealership level.
- **Total Portfolio Size**: Total number of vehicles leased by the lessor in the dataset.
- **Yr Portfolio**: Total number of vehicles leased by the lessor of that model-year.
- **Model Portfolio**: Total number of that model/model-year held by the lessor.
- **Monthly Inventory**: Number of sales-days in the national inventory for that model in the preceding month.
- **First Dummy**: 1 if the vehicle is the first design year.

Table 3: No-Subsidization Summary Statistics

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Table 4: Tests for Lease Subsidization

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<td>-3263.6**</td>
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<td>0.231*</td>
<td>-0.521**</td>
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<td>(1.928)</td>
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<td>(0.138)</td>
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<td>Days until Redesign</td>
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<td>0.00004**</td>
<td>-0.521**</td>
<td>-0.00004**</td>
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<td>(49.69)</td>
<td>(0.00500)</td>
<td>(101.6)</td>
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<td>(176.7)</td>
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<td>Yes</td>
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<td>0.929</td>
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<td>0.863</td>
<td>0.867</td>
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Note: ** indicates statistical significance at the 1% level, * at the 5% level.
Table 5: Unsubsidized Leases

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<th>Sample:</th>
<th>(1) Hi-Profit RV</th>
<th>(2) Hi-Profit Log(RV)</th>
<th>(3) No-Rebate RV</th>
<th>(4) No-Rebate Log(RV)</th>
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<td>Dealer Invoice</td>
<td>0.671**</td>
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<td>Log (Invoice)</td>
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<td>-0.0763**</td>
<td>-626.3*</td>
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<td>0.0000680**</td>
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<td>0.225**</td>
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<td>0.970</td>
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