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**Essays on the Economics of Organization**

By

Victor Manuel Bennett

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Committee in charge:
Professor Steven Tadelis, Chair
Professor Catherine Wolfram
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## Abstract

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This dissertation is comprised of three studies that investigate the implications and determinants of firms' choice of organizational form.

In the first study, I present a model of a negotiated sales production process with two variations, whether the firm has a parallel or serial allocation of tasks, and whether they have a process for accounting for customers' return to the system. I predict, first, that a hierarchal sales process allows firms to capture profitable low valuation sales that are ignored by firms with a parallel process. Second, I predict that an information tracking process will allow firms to capture additional value from transactions that would have been completed anyway. I find support for these predictions in a dataset combining data on organizational details collected from a survey I conducted of 500 US auto dealers and transaction-level data on auto sales at those dealerships.

The second study investigates the allocation of control rights by firms. I present a model of a multidivisional firm faced with a choice relating to its divisions. The managers of those divisions have more information about the most productive choice for their division, but there is value to coordinating the choices. I predict that tasks with high coordination values will be more likely to be centralized and that for tasks with lower coordination values, delegation is more likely when the manager has a greater information advantage, which manifests in the volatility of the environment.

The third study proposes that vertical integration between manufacturers and lessors can generate externalities that improve the competitiveness of competing independent lessors. Often, manufacturers provide warranties in the sales market to inspire confidence in their customers. Because they are unable to observe the identity of customers, however, these same warranties can be used to recondition cars returned to independent lessors from leases shorter than the warranty. The ability to free-ride on maintenance cost in this segment of the market allows independent lessors to overcome some of the captives' informational advantage. I find support for this proposal in a dataset of 200,000 leases from 1997-2002.

To the giants...

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Economics is a science of choices. A lot of people affected the choices that led this document to come to fruition. I'd like to acknowledge some of them.

I didn't always realize Stanford could be in my choice set. A set people made me realize that it could be, and then helped me make sure it was.

Once there, Ken Arrow accepted an undergrad who didn't know anything about Economics and tried to give me a more ethically nuanced picture than what classes offered. Zach Pincus, Bob McGrew, and David Garfield made doctoral study seem like a thing that reasonable people do and whetted my appetite for scholarly thought. Bhaven Sampat suggested I pursue a doctorate in Business when I, like most, didn't know such a thing existed and encouraged me to pursue it.

Google, Inc provided me first hand experience with the subject and a view into some pathologies of organization. This, combined with Prof. Arrow's insights that a fixed set of people organized differently could make different decisions, informed my eventual choice of area of study.

Within about a week of my arrival at Berkeley, Steve Tadelis took me under his wing and along with Catherine Wolfram and Florian Zettelmeyer, whom I met later, undertook the ponderous challenge of teaching me to do research. Steve has been a tireless mentor and a *mensch*. Florian also provided the data used herein, and this could, very literally, not have been done without him. Meghan Busse taught me how to teach. Any mistakes, of course, remain my own.

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# Chapter 1

# Introduction

The fundamental question in the study of firms is why we observe persistent performance differences among seemingly similar enterprises. One strand of literature suggests that firms' internal organization is an important determinant of performance. Different internal organizations, therefore, may explain differential performance. This dissertation contributes three empirical studies of firm organizational form in the US auto industry to that literature. I study three different aspects of organizational form: the importance of organizational choices to performance, the determinants of organizational choices, and the unintended consequences of organizational choices on the competitive ecosystem. The combination of these works sheds light on the complementary and interrelated aspects of firms' organizational choices.

In the first chapter, I propose that organizational form can affect firm performance. Specifically, I model two different common variations in organizational form amongst US auto dealers and demonstrate those variations' correlation with ability to capture value through negotiations. The first variation is whether firms have a parallel of hierarchal sales process. In a parallel sales process, customers are randomly assigned to sales people, regardless of ability, who conduct the entire sales negotiation. In the hierarchal sales process, customers begin negotiations with a less experienced salesperson. If that salesperson has difficulty completing the sale, the customer is handed off to a more experienced salesperson. I predict that a hierarchal sales process allows the dealership to capture all the sales that would have been made by a parallel dealership, but also to capture low price deals that would are ignored by the parallel structure dealerships. The second variation I study is whether the firm has a process for tracking whether a particular customer has been to that dealer before. In dealerships that do not have this process, salespeople risk the possibility that they will invest a lot of effort in a customer who will exogenously leave, and then return to complete the sale with a second salesperson. The second salesperson then receives all the compensation but has a considerably easier transaction. I predict that this will drive salespeople to begin the negotiation at lower prices in hopes of completing the transaction before the customer leaves. The result will be the same number of sales, but capturing less value. I find support for these predictions using a unique combination of three data sets. The first is a set of transaction-level data on auto sales during 2007. This data is combined

with demographic information from the US census to control for market composition. Organizational details come from a survey I conducted during 2007-8 of over 500 auto dealers of all makes in California, Oregon, Washington, New York, Pennsylvania, and Connecticut.

The second chapter investigates the determinants of a different aspect of firm organization: the allocation of control rights. Assigning tasks to different agents with different information or different incentives can result in dramatically different choices. I begin by modeling a scenario in which a multidivisional firm is confronted with a choice to be implemented at the division level. The managers of the individual divisions have a better understanding of the right choice for their division, but the cost of implementing either choice is decreasing marginally, so there is value to coordination. I predict, first, that firms are more likely to centralize decisions with higher values of coordination. Second, I predict that for tasks with lower values of coordination, the propensity of the firm to delegate a control right is increasing in the information advantage of the divisional managers as embodied by the volatility of the environment. I test these predictions by looking at the allocation of control rights by chains of auto dealerships, called "auto groups", to their constituent dealers. I find that software purchase decisions, which have a very high value of coordination because of software's low marginal cost of implementation, are very likely to be centralized. Hiring decisions, on the other hand, are much less likely to be centralized. Furthermore, when dealerships face a more heterogeneous customer population, as measured by income and college education, the auto group is more likely to delegate hiring.

The third chapter looks at competitive externalities of organizational form choices. Specifically, I investigate the competitive effects of vertical integration between auto manufacturers and their captive financing arms. Captive financing arms of auto manufacturers have considerable competitive advantages over their independent competitors. First, they have knowledge of the firm's product road map, which allows them to better predict the depreciation of leased models. Second, they are empowered to lose money on some transactions in the interest of subventing less popular models. This raises the question of how independent lessors are able to remain competitive. I propose that the are able to be profitable due to an externality from the vertical integration: warranties. Manufacturers offer warranties on their products to inspire confidence in their customers. When a car is leased, what technically occurs is that the lessor purchases the car and loans it to the lessee in exchange for a stream of payments. At the end of the predetermined term, the lessee returns the vehicle to the lessor who bears the cost of reconditioning it and resells it. When the lessor is independent, if the term of the lease is shorter than the warranty, the lessor can defray some of the cost of reconditioning by filing warranty claims and having the manufacturer pay. As such, independent lessors can free ride on manufacturers to remain competitive in the market for leases shorter than the warranty. I find support for these predictions using a data set of 200,000 individual car leases between 1997-2002.

# Chapter 2

# Organization and Firm Performance: Hierarchy, Information, and Negotiated Pricing at Auto Dealerships

## 2.1 Introduction

An open question in the study of firms is why we observe such heterogeneous performance among similar firms. A large theoretical literature suggests that heterogeneity in organizational form may be one source of that variation. Different forms of internal organizational can provide different incentives or information to employees, resulting in different choices. Different forms can also result in different matchings of employees to tasks. These different matchings can affect performance when employees have different levels of ability and tasks have different levels of difficulty.

This paper empirically documents the effect of two variations in organizational form, hierarchy and information tracking, on performance, as measured by negotiated pricing, amongst auto dealers, a $700B industry in the US in 2007.

Studying the impact of organizational form on performance requires a setting in which firms have identifiable organizational forms and comparable measures of performance. Automotive dealerships provide an excellent setting; because dealers have a mature and relatively well-defined business, there exist a few well-defined organizational forms. Furthermore, performance effects of these form choices can be identified thanks to comparable products and regional markets.

I use negotiated price outcomes as measure of performance. Dealerships' success hinges on their ability to capture value from transactions. Once a customer has selected a product, whether the dealer or the customer captures the value from that transaction is determined by a negotiation. Furthermore, negotiators often have significant discretion in establishing prices, and the choices they make can be affected by their incentives, the information available to them, or the matching of their "negotiating ability" and the difficulty

of the negotiation at hand.

I begin by modeling the negotiation process between an auto salesperson and a customer under two common variants of organizational form amongst car dealerships[1]. This modeled transaction, when aggregated to the total number of firm sales, provides predictions about the dispersion of prices we should expect to observe at the firm level. I test the predictions of the model using a combined data set of transaction-level auto sales, customer data from the US Census, and a survey I conducted of firm-level organizational features.

The matched survey and transaction data provide a rare opportunity to combine measures of organizational form and measures of performance. Also, because the sample was drawn from the firms represented in the transaction data, I am able to verify the representativeness of both the sample and the set of respondents. The survey was administered to 511 dealerships in six states. The questionnaire collected information on organizational details like size, ownership, delegation and task assignment, hierarchy, and compensation.

The two common variations in organizational form among auto dealers I investigate in this paper are, first, whether they have a hierarchal or parallel sales structure, and second, whether they track information about previous potential customer visits. As the model predicts, the data show that both a hierarchal sales process and information tracking improve a firm's ability to price discriminate, and thereby capture more value from each transaction. I find that a hierarchal sales process allows the firm to capture low-value sales that would otherwise be missed. Information tracking increases the margin earned from customers who would have bought anyway.

This paper contributes to a number of literatures. The first is that which investigates the performance effects of organizational form. One strand within that literature focuses on identification of the performance effect by looking within a single firm. For example, Lazear (2000) is able to document performance effects of compensation changes at an auto glass installation firm that switched to a piece rate compensation system. He documents higher productivity and higher profits. Larkin (2007) looks within a single enterprise software firm at salespeople's responses to accelerating bonus compensation plans. The paper demonstrates that salespeople's response to the firm's compensation mechanism has a direct effect on realized prices. These papers connect organizational form to performance and shed light on the mechanism by which it operates, but look only within a single firm.

A second strand within the literature on the performance implications of organizational form looks across firms. Bloom and Van Reenen (2007) investigates the performance implications of a broad set of managerial practices among a set of firms in different industries. They find significant variation in management practices and tie that to variation in productivity among 732 firms in four countries. They do not investigate the mechanism by which these practices affect performance. My paper is most similar to this second strand in that I look across firms. It is different, however, in that focusing on a single industry and only two variations in organizational form allows me to look within the black box of the firm and explicitly model the mechanism by which the organizational forms affect performance.

Another literature uses theory to demonstrate that different organizational forms

[1]The model is an extension of the standard Fudenberg and Tirole (1991) model of single sale intertemporal price discrimination extended to allow heterogeneous negotiating ability of salespeople.

can be optimal under different conditions. The empirical suggestion, then, is that if firms are optimizing, we should observe certain correlations between environmental conditions and the prevalence of the corresponding organizational form. For example, Baker and Hubbard (2004) look at monitoring and asset ownership. They use an exogenous technology development shock to study how an improvement in monitoring from on-board computer adoption led to changes in asset ownership and the boundary of the firm. Similarly, Garicano and Hubbard (2007) look at degree of specialization required by a particular law field and how that affects the depth of firms' hierarchies and the breadth of a manager's span of control. Acemoglu, Aghion, Lelarge, and Van Reenen (2007) also use exogenous technology development to study how changes in the importance of local knowledge change the centralization and tendency to delegate in multi-unit firms. My approach provides a complementary view of organizational form by looking at the implications of the organizational form. I also use theory to model the implications of different organizational forms. Instead of assuming that firms are optimizing perfectly, however, I explicitly assume that the observed heterogeneity of organizational form is due in part to some identifiable errors and noise in the decision process. I exploit those random errors to identify the differences in performance across organizational forms.

Third, it contributes to the literatures on negotiations and bargaining. Brandenburger and Stuart (2007) and Ryall and MacDonald (2004) formally separate value creation and value appropriation and highlight negotiations as important to contributing to a firms success through the latter. Recognizing the importance of negotiation to firm's success, a wide literature investigates the effect of individual factors on negotiation outcomes. These factors include individual biases (Neale and Bazerman 1985, Bazerman, Magliozzi, and Neale 1985), affect (Anderson and Thompson 2004), and beliefs (Kray and Haselhuhn 2007) of negotiators. A second literature investigates market-level factors. These forces include information (Busse, Silva-Risso, and Zettelmeyer 2006) and competition, both against other firms (Bester 1989) and against one's self (Coase 1972, Stokey 1979, von der Fehr and Kühn 1995). Grennan (2009) documents that, in addition to individual- and market-level effects, there is firm-level variation in ability to bargain in pricing negotiations between medical device manufacturers and hospitals. This paper demonstrates how organizational form may be one factor in firm-level negotiating ability.

This chapter continues as follows. Section 2.2 describes the institutions of automobile sales, which is my empirical setting. Section 2.3 describes a simple stylized model from which empirical predictions are derived. Sections 2.4-2.6 comprise the main body of the paper. Section 2.4 describes my data. Section 2.5 discusses my strategy for identifying my predictions and describes the main results. Section 2.6 investigates the robustness of the main results and section 2.7 concludes.

## 2.2 Empirical Setting: New automobile retail sales

Auto dealerships are an excellent venue for investigating effects of organizational choice as they vary in a few well-defined ways. They are largely regional and sell a homogenous product. Furthermore, franchise laws at a federal-level make the relationship between the manufacturer and the dealer consistent. Also, dealerships are very similar businesses

with consistent terminology for variations in organizational form. These features of the industry allow me to isolate variation to differences in organizational form.

In addition to the setting's strength in contributing to internal validity, automotive dealerships are a significant portion of the US economy. According to the National Automobile Dealers Association, the country's 20,700 dealerships accounted for $693 billion in sales in 2007, 18% of all retail sales. Wages and salaries of car salespeople comprise 13% of the nation's retail payroll[2].

### 2.2.1 The process of selling cars

This section explains, at a micro-level, the process by which a car salesperson negotiates a price on a new car purchase in which the customer does not have a trade-in, and the choices he has in doing so. I proceed to look at how the salesperson's incentives may affect the terms the customer receives[3].

In car sales, a prospective customer is referred to as an "up". There are a few different assignment schemes for determining which available salesperson gets to serve the next up, but the most common, appearing in 67% of dealers, is simply "calls". Each dealership has a spot inside the dealership with a view of the lot called the "point." Typically, salespeople not currently serving a customer wait at the point and make claims on cars passing by. If the car turns into the lot, the salesperson who claimed it gets to serve the customer. Dealers interviewed suggested that there was no evidence that this scheme led to anything resembling specialization among salespeople. The second most common scheme is simply an equal rotation of available salespeople. Schemes in which salespeople were allocated to customers by performance were very rare, only representing about 1% of surveyed dealerships.

Suppose the customer has found a car she likes and consented to begin negotiations with the salesperson. At this point, the customer is aware of a sticker price posted on the vehicle which will serve as a starting point for negotiations, however she will generally expect to pay less. The sticker price is a price at which the dealership would be willing to sell the car, but certainly not the lowest price at which they would be willing to do so.

At this point, the salesperson will, take the customer into a glass-walled office and make a show of calling the extension of the sales manager and asking whether the car in question is still available. The call is made to instill a sense of urgency in the client. He will then take out a worksheet on which he writes a set of numbers detailing the cars total price, and, if the car is to be financed, the total amount financed, and a preliminary financing rate. This first offer is referred to in industry jargon as the "first pencil." The first pencil is a price the dealer is willing to accept, but is not the lowest such price.

If, as is usually the case, the customer does not accept the first offer, the salesman will try to find an offer the customer will accept with as little reduction of the price as possible. Without a trade-in, consideration of lease, or bundling dealer-added parts, his options are restricted to price reduction. The salesman's task is to lower the price as slowly

[2](Linebaugh 2008) available at: http://online.wsj.com/article/SB122515313773474407.html

[3]An excellent review of the emotional experience of being a salesperson was produced by Edmunds.com who paid a writer to work as a salesperson for two dealerships for 3 months and write about the experience. It is available at: http://www.edmunds.com/advice/buying/articles/42962/article.html.

as possible to maximize profit for the dealer while giving the customer the impression that enough progress is being made that she should not abandon the transaction. This is often accomplished through "remembering discounts" that might apply to the car or making calls to the sales manager to "ask permission" to go lower on price. The salesperson must also contend with external reasons for the negotiation ending prematurely. A customer might have time constraints they haven't announced, receive a call, or decide that they need to consult their spouse about the sale. Customers who leave before the transaction is closed, but promise to "be back" to finish the transaction are termed "bebacks."

Essentially, the salesperson's goal is to extract additional rents from those customers who are unable or unwilling to go through lengthy negotiations. Salepeople are aligned with the dealership in their interest in price discriminating by very high powered incentive contracts. More than 80% of dealerships use some form of margin pay, and 50% use only margin pay to compensate salespeople. These salespeople's only source of income is the profit margin, so a "skinny" deal means less pay for a lot of work, plus the opportunity cost of not being able to serve another customer.

## 2.3 A model of negotiated pricing with heterogeneous ability of salespeople

In order to generate predictions about the performance effects of variations in organizational form, this section describes a simple stylized model of a negotiation process. The model has a lot in common with the simple single sale model of intertemporal price discrimination in section 10.2 of Fudenberg and Tirole (1991), but with one major addition. The only heterogeneity in the standard model is in the customers' willingness to pay. I add two additional forms of heterogeneity. First, I allow for heterogeneous ability of salespeople. Second, I add a second dimension to the customer that effectively represents the difficulty of selling to them. This allows the model to highlight the effect organizational form can have on performance through improving matching of employees to tasks. Aggregating the outcomes of this single negotiation up to the total number of sales at the firm level yields predictions about the distributions of outcomes we might expect to see under each organizational form variant.

### 2.3.1 Setup

Consider a negotiation between a potential purchaser of a car and a salesperson employed by the dealership to maximize the dealership's profit.

The timing of the game is as follows. First, the salesperson makes an offer to the customer. The customer can then accept the price, which ends the game, and realize payoffs, or can reject the price. If the customer rejects the price the game repeats a second, and final, time. Indifferent customers buy in the second period.

There are two types of customers, strategic and truthful. Truthful customers exist in proportion $t$ in the population. They not strategic and will accept any price offered them weakly below their value[4]. Strategic customers exist in proportion $(1-t)$. Strategic

[4]One way to think of these customers is as discounting the future at a sufficiently high rate to be unwilling

customers are rational profit maximizers and will reject prices below their valuation if they believe they can get a lower price.

Each customer has a valuation for the good $\theta \in \{H, L\}$ which takes the low value, $L$, with probability $\gamma$ and the high value, $H$, with probability $1 - \gamma$. The salesperson's contract is such that he receives $h$ for selling a vehicle at the $H$ price and $l$ for selling the vehicle at the $L$ price. The high value is high enough that it is worth offering as a take-it-or-leave-it offer, $(1 - \gamma)h > l$.

There are two types of salespeople, good and bad. One way to model better salespeople would be to suggest that they know the valuation of the customer. This doesn't seem terribly persuasive, however. Were that the case, we wouldn't observe negotiations at all, but simply diviners naming prices and never yielding. A more intuitive definition of a good salesperson is one who knows when to lower the price, and when to hold the line. This salesperson doesn't have any magic powers, but is more experienced at determining whether a customer who rejects a high price is bluffing and would actually eventually accept it, or simply is not willing to pay that price. In the language of the model this can be formalized as follows. Good salespeople exist in the population with proportion $g$ and can tell whether a customer is strategic or truthful. Bad salespeople exist in proportion $1 - g$ and cannot tell truthful from strategic customers.

Another possible definition of a good salesperson might be one who initially has the same signal of the customer's valuation as any other to begin, but refines their belief more quickly. In the next section, we'll see that, in equilibrium, this formulation can have that interpretation as well.

### 2.3.2 Parallel sales structure

One variant of organizational form is the parallel sales structure. In the parallel sales structure, each customer meets a random salesperson who conducts the entire negotiation. In the industry, these dealerships are referred to as being a "straight sell" dealership. Here I derive the equilibrium offer schedules for salespeople in such a structure.

Suppose the negotiator is a good salesperson, and he knows he is facing a truthful customer, a scenario which occurs $tg$ of the time. Since the customer will accept any price weakly below her valuation for the good, we know that offering any price outside of $H$ and $L$ is dominated. Since any customer will accept an offer of $L$ at any point in the process, the salesperson's payoff from any strategy beginning with $L$ is $l$. A strategy of offering $H$ and then $L$ in the second round yields $(1-\gamma)h+\gamma l > l$. Offering $H$ twice, in other words holding the line at $H$, nets $(1 - \gamma)h$ and is dominated. Thus, with non-strategic customers, we can see that the salesperson's dominant strategy is to offer a high price, and then lower it if it is rejected. Of course, it is obvious that, in this situation, a strategic customer with a high value would benefit from waiting for the anticipated lower price and capture $(H - L) > 0$. Therefore, the price schedule must be different for strategic customers.

Now suppose that the good salesperson is facing a strategic customer, a scenario that occurs $g(1 - t)$ of the time. Again, offering $L$ immediately will assure that the price is immediately accepted by all types of customers and yields payoff $u(L) = l$. If the salesperson

to wait or that they may simply have great disutility for negotiating.

were to offer the same declining price schedule to a strategic type as he offers to the truthful type, the customer will wait to the second period, regardless of her valuation. Essentially, the high-valuation strategic type attempts to pool with the low-valuation strategic types. The payoff from this strategy is $u(HL) = l$. If the salesperson holds the line at a high price, offering $HH$, he fails to sell to any low-valuation types, but earns $u(HH) = (1-\gamma)h$. This is similar to the standard information economics result of distortion at the bottom to prevent an information rent to high types.

Given customers' responses, we can see how this model is analogous in equilibrium to one in which the better salespeople update more quickly about the customer's valuation. Both good and bad salespeople's prior belief that a customer's valuation is high is $1-\gamma$. In equilibrium, both good and bad salespeople offer $H$ first. If the customer refuses, the bad salesperson knows that she is not a truthful high type, but thats all. As such, the bad salesperson's posterior after the first period that the customer's valuation is high is $1-(t(1-\gamma))$. The good salesperson, after seeing the customer refuse $H$, is in one of two states. If the customer is truthful, the salesperson knows with probability 1 that the customer does not have a high valuation. If the customer is strategic, the good salesperson is in the same position as the bad salesperson. In other words, both types of salespeople have the same prior beliefs, but the good salesperson has, in expectation, a tighter posterior on the customer's valuation.

A bad salesperson knows the population distribution of truthful and strategic customers, but not which one he is facing. If a salesperson were to offer $HL$, only the truthful high-valuation types will accept the high price. The strategic high types will wait for the low price to buy and receive $(H-L) > 0$. The payoff to the salesperson from offering $HL$, therefore, is $u(HL) = t(1-\gamma)h + (1-(t-t\gamma))l$. Again, offering $L$ immediately yields $u(L) = l$ and is dominated. The salesperson offers $H$ in the first period. Offering a high price and refusing to drop it leads to no sales to low-valuation customers of any type. Because we assume that indifferent customers will buy in the second period, the payoff to the salesperson would be $u(HH) = (1-\gamma)h$. Lowering the price in the second period opens the door for the high-valuation strategic types to masquerade as low-valuation types. The condition for when it is preferable for the salesperson to reduce prices is,

$$\begin{aligned} u(HH) &< u(HL) \text{ iff} \\ t &< \frac{-h+l+h\gamma}{-h+l+h\gamma-l\gamma} \end{aligned} \tag{2.1}$$

Intuitively, when there are sufficiently many truthful types, the dealership allows the strategic type an information rent rather than forgo the earnings from all the low type sales. When there are too many strategic types the gains from forcing them to pay their true valuation are sufficient to forgo sales on low valuation customers.

Assume that $t$ is sufficiently low to meet condition 2.1[5]. In other words, salespeople are willing to forgo low but profitable sales to prevent strategic high types from pooling

[5]Appendix C shows the range of values of $t$ in which condition 2.1 is met. Note that when $h$ is large relative to $l$ the condition is not particularly restrictive.

with low types. Assuming a unit mass of customers, the sales volume under a parallel sales structure will be

$$v_P = (1-\gamma) + \gamma t g$$

Because good salespeople exist in the firm with proportion $g$ and customers are assigned uniformally randomly, the firm's expected revenue from a customer is

$$\begin{aligned} E_P[\rho] &= g[t((1-\gamma)H + \gamma L) + (1-t)(1-\gamma)H] \\ &+ (1-g)[(1-\gamma)H] \end{aligned} \tag{2.2}$$

From this formula two things become obvious. First, the added value of a good salesperson is the ability to capture the willingness to pay of low-valuation types. In a sense, they improve their firm's ability to price discriminate. Second, in this parallel sales system, the good salespeople only have marginal value $\gamma$ of the time. Another way to think about this is that $t(1-\gamma)$ of the time, the good salesperson did exactly what the bad one would have done with no improvement in revenue. It seems, then, that we should be able to find a a sales process in which dealerships are able to get more value from their fixed number of good salespeople.

### 2.3.3 Hierarchal sales structure

One of the most prominent variations in dealership structure is whether or not they feature a serial sales process with a second hierarchal level of salespeople referred to as "closers." At a dealership with closers there are usually only a few closers on the sales floor at any given time waiting to be called into negotiations by salespeople. The salesperson will generally make the call to request that a closer take over the negotiation if he is having difficulty making the sale. If the closer makes the sale, the commission is split between the closer and the salesperson. The share to the salesperson $s$ is high enough that $(1-\gamma)hs > l$.

Under the hierarchal sales setting, bad salespeople endogenously forgo selling below a certain threshold, in this case $H$, and thus we observe endogenous handoffs to the more skilled negotiators. A bad salesperson making the initial uninformed offer would offer $H$ because, as specified above, $(1-\gamma)hs > l$. If the customer is a truthful high type, she accepts the deal, otherwise she rejects it. The bad salesperson now hands the transaction off to a good salesperson. The good salesperson now has improved information about the type of the customer. If he observes her to be a truthful type, he knows to immediately offer $L$ and complete the transaction. If he observes her to be strategic, he offers $H$ because $(1-\gamma)h > l$.

Because truthful types are now sold to with probability 1, the volume of sales under the hierarchal structure is

$$v_H = (1-\gamma) + \gamma t$$

The expected revenue to the dealership from the transaction is

$$E_H[\rho] \quad = \quad (1-\gamma)H + \gamma(tL) \tag{2.3}$$

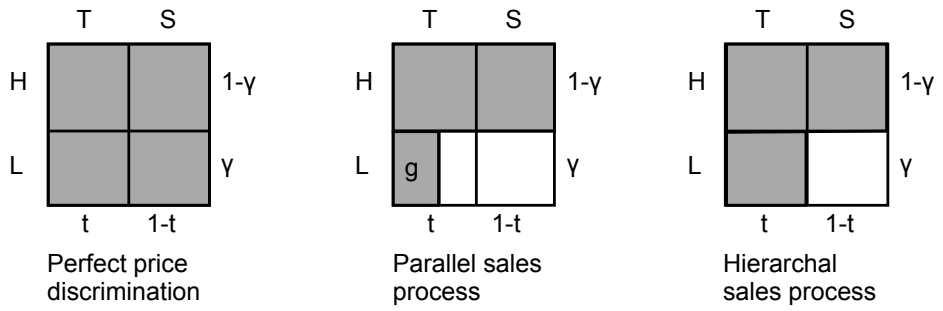
The reason behind equation 2.3 being greater than equation 2.2 is straightforward. In a parallel structure, the firm loses all deals to all low valuation customers from bad salespeople and from low strategic types facing good salespeople to prevent pooling from strategic types. In the serial structure, the firm still forgoes deals with low valuation strategic types to prevent pooling, but is able to capture low valuation truthful types with probability 1. In other words, when the customer is legitimately a low valuation type, the regular salesperson will not lower the price sufficiently. Though a good salesperson will offer a sufficiently low price, the dealership only gains when a low valuation customer is matched to a good salesperson. With closers in a hierarchal sales process, low prices will always be offered to low valuation truthful customers.

### 2.3.4 Predictions

Figure 2.1 summarizes the model's predictions about the effect of organizational form on the observed distribution of prices. There exists a distribution of customer valuations. If the firm was perfectly price discriminating we would expect the distribution of observed prices to have the same support, given enough transactions, as the distribution of valuations. We can expect the supports to match if the customers are all truthful about their valuation.

When there exists an asymmetry of information about the customers' valuations, which allows high valuation strategic customers to pool with lower valuation types, salespeople will optimally refuse to offer prices below a certain threshold. This distortion at the bottom is displayed in the scenario entitled "Parallel sales process". Note that few sales are made at low prices. This is because low prices only occur when good type salespeople face truthful customers with low valuations. Moving to the hierarchal sales model, the firm still loses some low valuation sales, specifically those to low valuation strategic types. Fewer sales are lost, however, because now all truthful low valuation customers receive a price they are willing to pay, instead of just those facing good salespeople.

Figure 2.1: Summary of Predictions




If looked at two dealerships, one with a parallel sales process and one with a hierarchal sales process, the dealership with the parallel sales process would have sales at

high prices, but would have very few sales at low prices, because low prices only occur when a good salesperson meets a truthful customer.

**Hypothesis 1** *Price dispersion is higher under a hierarchal sales structure than a parallel sales structure*

If we were to look at the price quartiles, low quartile prices would be shifted up towards high prices. We would observe low prices from the dealership with the hierarchal process, on the other hand, every time a low valuation truthful customer appears. Looking at price quartiles, the low percentage prices would be much less skewed upwards, or, in other words, would be lower than at the dealership with a parallel sales process.

**Hypothesis 2** *Low percentile prices are lower under a hierarchal sales process than under a parallel sales process*

Now consider the volume of sales. Note that $v_H > v_P$. These firms are improving their ability to capture low valuation customers, not leaving more rents to customers with lower prices. As such, the hierarchal organizational form will also be accompanied by an increase in sales volume.

**Hypothesis 3** *Volume of sales is higher under a hierarchal sales process than a parallel sales process*

The next subsection discusses a second variation between dealerships, whether the firm tracks in formation about customers, allowing them to account for "bebacks", customers who leave and return.

### 2.3.5 Information tracking

Alchian and Demsetz (1972) pointed out that the unobservability of an individual contribution to a team project can lead to shirking. The sales process is typically a solitary one in which the salesperson is solely responsible for the outcome, the price at which the sale closed. However, this is not always the case. As mentioned before, it is not uncommon that a customer begins negotiations with a salesperson, leaves before completing the sale, and then returns on a day when the original salesperson is not working. If this occurs at a dealership that does not have an information tracking system for tracking potential customers (leads), the new salesperson is able to sell with a shorter sales process but will recover all of the compensation from the sale[6].

In essence, there is a probability that any given transaction will become a team task. If the individual contribution of the first salesperson is not observable, and hence appropriately compensated, he will have suboptimal incentives. Salespeople whose effort is more likely to be compensated are more aligned with the dealership and more likely to invest the effort to price discriminate. Even without constructing a formal model, it

[6]Information tracking systems need not be sophisticated technology. Many dealerships simply have a log book in which they write down the name of each customer with whom they've spoken.

is straightforward to predict the effect of an information tracking system that aligns the incentives of salespeople with those of the dealer[7].

Essentially, the salesperson is facing a trade off in the length of the negotiation. A longer negotiation means that the salesperson can make more offers. More offers means that each decrease can be smaller, which assures that when an offer is finally accepted it is closer to the customer's valuation. In other words, more offers means less rent for the customer. In the limit, the salesperson could make an infinite number of offers and perfectly price discriminate. On the other hand, the longer the negotiation goes on, the more likely that the customer will become a "beback" before the deal is closed. If the customer leaves and returns, the sale still happens, but salesperson makes nothing. The optimal price schedule for the dealership's interest is the one the salesperson would offer if he captured the value from the extended negotiation. Since he won't, however, his interests are not aligned with the dealership, and he may be willing to compromise the dealership's price discrimination to increase the probability that he will be compensated for the sale.

**Hypothesis 4** *Price dispersion is higher at firms with information tracking than at those without.*

When there is a chance of the customer becoming a "beback", it is in the salesperson's interest to rush the negotiation to try and close the deal before the customer leaves. The means by which the customer moves the negotiation faster is to make fewer offers. In practice, this means offering lower prices sooner. The result of this is that customers with high valuations may end up paying a lower price than they would have been willing to accept.

**Hypothesis 5** *High percentile prices are higher at firms with information tracking than at firms without*

Information tracking doesn't result in sales being made that would not otherwise have been made. As such, there is no reason to expect that information tracking will have an effect on sales volume. The same customers are buying who would have bought if the dealership did not have information tracking. The difference is that firm is that firms with information tracking are better able to price discriminate. Customers with high valuations will receive offers that are closer to their valuation, leaving them less rent. By allowing the firm to capture more of the value from the transaction, information tracking improves performance.

## 2.4 Data

The data for this survey is a matched set of three data sources. The first source is a survey I conducted of a 25% sample of auto dealerships of all makes in six states: California, Connecticut, New York, Oregon, Washington, and Pennsylvania. The second is transaction-level data on auto sales from a data supplier to the auto industry, hereafter DSA. The third is demographic data from the US Census.

[7] Appendix B details a simple formal model with the same intuition as what follows.

### 2.4.1 Survey data

#### Questionnaire

The survey instrument contains questions about, among other things, the dealership's ownership, authority in setting its own organizational form, compensation and training practices, hierarchy, information tracking and monitoring, and size[8]. The instrument itself is included as an appendix.

#### Sample

The survey was administered to a total of 871 dealerships in six states. The states were selected to represent urban and rural areas in new and old cities on both coasts. We sought to include both urban and rural areas because customers needs with respect to cars are different across these two settings. Urban areas are more likely to have public transportation, which changes the outside option of negotiators. In addition, the geographic distribution of dealerships would be different across the two types of areas and across old and new cities because of land costs and zoning regulations. This difference in geographic distribution leads to variation in competition among firms, search costs for customers, and input costs for dealers. Having selected those six states, I set the sample to be the entire population of dealerships in those states included in the DSA data. This amounted to a total of 871 dealerships locations. A dealership which sells three nameplates is technically three separate franchises, but I aggregate data to the "rooftop" or location-level as the distinction is purely administrative.

#### Procedure

Having determined the sample, I collected contact information, both phone and physical mailing address from data provider InfoUSA. For cases in which InfoUSA did not have the dealer's contact info, I collected it by hand using Internet searches. Afterwards, each dealership was called to collect the names of the senior staff. Switchboard operators were asked the names of the "Owner/Dealer Principle", "General Manager", and "General Sales Manager." In only one case did the operator refuse to provide the names of staff, and in that case information was collected from the dealer's web site. For firms with a general manager, the name on mailings was that of the general manager. Where one didn't exist, the name was that of the most senior manager provided. In the few cases with no general manager, the name was generally that of the Dealer Principal or General Sales Manager.

Each potential respondent was contacted a minimum of three times. They first received a mailing tube containing a University-branded golf ball and a signed letter on University letterhead alerting them that they would receive a call within a few days to schedule an appointment for a 15-minute interview. The letter noted that they would receive a baseball hat with the same branding as the golf ball upon completion of the survey. Within two weeks, they received a call to schedule the interview. The interview itself was then performed at the pre-specified time. When prospective respondents did not answer

[8]The survey also includes questions exploring other aspects of organizational form explored in Scott Morton, Silva-Risso, Zettelmeyer, and Bennett (2009)

the initial scheduling call or missed their interview time, they were called at minimum twice more, but in general as many as ten times until they could be reached. In some cases, the initial person we contacted provided the name of someone else we should speak to. In those cases we spoke with the alternate manager. In most cases, west coast dealerships received communications marked with the logo of University of California, Berkeley and east coast dealerships received Yale University branded communications. A small set of dealerships randomly received the opposite coast's marked communications to test for bias in response rates. I found no significant difference in response rates due to branding.

Calling for the final interviews was conducted by a market research firm that conducts surveys of car dealerships exclusively. When managers didn't know the answer to a particular question, or declined to answer, we continued the survey. The data used in this study only includes observations for which all relevant answers were provided. After completing the survey, managers received the promised baseball hat via US mail.

**Response**

The combination of a phone-based survey with multiple calls, the original inducement of the golf ball, and the reward of the baseball hat resulted in an encouraging response rate. Of the 871 dealerships contacted, we received 511 responses for a 58.6% response rate. Of those 511, 327 are usable for this study after restrictions I describe below.

It is, in general, difficult for researchers conducting survey work to validate the representativeness of their sample. In this case, however, as I began with the transaction data, I am able to compare the demographics of the customers at the usable responding dealerships. Table 2.4 displays these comparisons and shows that there is no economic difference between responding dealerships and the general population.

### 2.4.2 Transaction Data

The DSA data is the set of all sales outcomes at the included dealerships from Q1 2007 through Q2 2008. The data include features of the vehicles sold, census block of the purchasers' home, the cost of the car to the dealership, and price paid by the consumer. In order to restrict variation to my phenomena of interest, I restrict my data to cash transactions on new cars. "Cash transactions" are those in which the dealer does not provide financing and does not receive a trade-in. If the customer took out a loan from a bank, and brought a check to the dealership, I still identify the transaction as cash.

For the empirical specifications detailed below, there are three levels of units of observation. I define the three here. As mentioned above, a "dealership" refers to a physical location, which may actually comprise several "franchises." The second is the "car." In order to investigate variation in prices for the same product, it is imperative that the product be well defined. I follow Busse, Silva-Risso, and Zettelmeyer (2006) and define a car as all vehicles sharing nameplate, model, model year, trim level, body type, number of doors, transmission, number of cylinders, and engine displacement. Even at this level, there is some variation in vehicles from dealer-added options. Though I do not observe those particular options, my measure of the cost to the dealership includes the cost of adding those features. As such, in my regressions below, I control for the difference in cost to the dealership for

the focal vehicle from the average of others that are the same "car." [9] Because the object of interest is the distribution in prices for a particular product from a particular retailer, the third unit of observation is the car-dealer pair. A car-dealer pair is defined as the set of all transactions in which the focal car was sold by the focal dealer. In order to prevent pairs that are too rare and have observed price distributions very different from the underlying distribution, I restrict the data to transactions in pairs that occur at least 10 times in the data. In other words, a pair only appears in the data if the focal dealer sold the focal car at least 10 times during the 6 quarters. This restriction limits the number of dealers included in this study from the original 511 respondents to the final 327 included dealerships. Results are not qualitatively different at different levels of restriction.

These restrictions result in a data set of 108,060 transactions of 683 cars at 327 dealers. These transactions represent 3510 car-dealer pairs.

### 2.4.3 Census Data

In order to account for variations that come from variations in the customer base, I include demographic information from the census. DSA merges in aggregate demographic data from the US census at the level of the Census Block Group (CBG). A census block group contains between 600 and 300 residents with an optimal size of 1500. For each transaction, I observe average demographic data for the CBG in which the customer lives. As such, the information is not at the level of the individual customer, but, because of the relative size of the group, is informative about the customer.

## 2.5 Main Results

The ideal means for identifying the hypothesized effects of organizational form would be an experiment in which firms are randomly assigned to have the various organizational forms. In that case, a simple test of means would be sufficient to identify the effect. That experiment, however, is not feasible, so identification requires a strategy that will account for possibly confounding features of the dealerships including different transactions, different markets, and other correlated organizational details.

The following subsections describe the methods by which I identify the phenomena of interest for testing the hypotheses derived in section 2.3.

### 2.5.1 Price dispersion

The predictions of section 2.3 suggest that the first phenomenon we should investigate is differences in price dispersion across dealerships with different organizational forms. The model predicts that when two dealerships selling the same product have different organizational forms, these forms will result in systematic differences in the spread of prices across dealerships. In other words, we are seeking to identify a difference between dealerships in within-product variation. As such, the variable of interest is a measure of dispersion at the car-dealership pair level.

[9] This approach is also taken by Busse, Silva-Risso, and Zettelmeyer (2006)

The simplest means to verify this is to simply run the following regression of dispersion of price for car $k$ at dealership $d$ on features about the dealership's organizational form ($X^{OF}$), other dealership features ($X^{D}$), product features ($X^{C}$), and features specific to the pair ($X^{P}$):

$$dispersion_{kd} = \alpha_0 + \alpha_1 X_d^{OF} + \alpha_2 X_d^{D} + \alpha_3 X_k^{C} + \alpha_4 X_{kd}^{P} + \eta \tag{2.4}$$

I follow Borenstein and Rose (1994) and use the gini coefficient as my measure of dispersion. The gini coefficient is convenient for both its intuitive interpretation and its sensitivity to variation at both the top and bottom of the price distribution. To interpret the gini, we can double its value and we get the expected difference between two random draws, as a percentage of the mean. In other words, suppose that two different customers bought a car $k$ with average price of \$20,000 from dealership $d$, and the gini coefficient for that car-dealer pair was measured as .04. We could then expect that the difference in price between the prices paid by those two customers would be $2(.04) * \$20000 = \$1600$. Higher ginis suggest that the prices that customers are paying for that car at that dealership are more variable. In section 2.6, I demonstrate the robustness of my results to choice of dispersion measure.

In order to control for other features which might be correlated with the firm's organizational form, I include an extensive set of controls. The first and most obvious set to include are features of the product. This strategy uses differences in within-product, within-dealership variation to identify the effect. For that reason, we need to control for features of the specific product that may impact variation. Rather than flooding the regression with features of the car, however, I include a car fixed effect to capture all the car-specific variation.

At the dealer level, the two factors that seem most likely to affect our results are dealership size and competition. From a probability theoretic standpoint, it seems clear that a larger dealership will have a wider dispersion of prices naturally. To control for that effect, I use two different measures of size. First, I include the number of full-time equivalent salespeople the dealership employs (FTEs). Second, I include the log of the count of the number of cars that the dealership keeps in its inventory on average. I compute this average using Little's law from the time to sale of the dealership's cars. Also important is the size of the market for the focal dealership. If a dealership draws customers from a much wider area, we might expect that customers would be more different and thus prices would be more different. I account for this effect by include the average distance between the census block in which a customer lives and the dealership and the square of that distance. Lastly, I include an indicator for whether a dealership advertises itself as a "one price" dealership. Customers at these dealerships still negotiate, but the perception is that they do not, or they do so less, so this must be accounted for.

Borenstein and Rose (1994) and Busse and Rysman (2005) demonstrated that competition can affect dispersion of prices, so I also include controls for a dealership's level of competition. One way the degree to which another dealership is competitive with the focal dealership can be thought of is the ease with which a customer at the focal dealership could leave and purchase at the other. As such, I use the distance to the nearest competitor, and the square of that distance, as measures of competition. I define a competing dealership

at the transaction level. For a sale of a Ford, I define the competing dealerships as any other dealerships selling Fords within the Neilsen Designated Market Area (DMA). This means that the set of relevant competitors for the focal dealership is different for every sale. I use the DMA because this is the area by which advertisements are generally sold. When a customer in the "San Francisco-Oakland-San Jose,CA" DMA watches television or listens to the radio, they will be exposed to advertisements for al the dealerships in the DMA. As such, this designation seems appropriate for the set of other venues they would consider leaving the focal dealership to visit.

At the car-dealership pair level, I address the variation in audience for a particular car at a particular dealership and how that might affect the dispersion of prices. For example, if one dealership sells many more of car $k$ than another, then that dealership will likely have a higher variation in prices for that same car. I include a measurement of the number of sales of this car at this dealer. If negotiation is leading to price discrimination, as is generally believed in the literature, then a more varied audience for a particular car at a particular dealership will lead to more variation in the prices paid for that car. To control for differences in market, I include both the first and second moments of distributions of income, and commute time among buyers of this car at this dealership. Customers may also vary in their willingness to bargain, which could obviously affect price distributions. Zettelmeyer, Scott Morton, and Silva-Risso (2006) shows survey data in which recent car buyers reported their taste for negotiation and the demographic details most correlated with this taste was college education. In order to account for this variation, I control for both the percentage of residents from the customers' census blocks who have college education and those who are unemployed. Variation in the circumstances of the transaction will also affect the observed prices. As such, I include measures of the variation of time a vehicle spent on the lot, days since the model was launched, and cost to the dealership. This will control for the fact that dealers may be more motivated to sell older models, or models that have been on the lot for a long time.

Lastly, one might be concerned that the nature of the search process may affect the results. A customer opting to buy a car at a particular dealership is implicitly making the decision not to buy that car at another dealership near her. If her valuation is particularly high, for example, the price we observe for her transaction is one we didn't observe on the same car elsewhere in the DMA. As such, we might be concerned that the errors in the regression may be correlated within the car (k)-region(r) pair. I allow for this correlation by clustering errors at the car-DMA level.

Including these changes, I estimate the following equation:

$$gini_{kd} = \gamma_0 + \gamma_1 Closers_d + \gamma_2 Info\_tracking_d + \gamma_3 X_d^D + \gamma_4 X_k^C + \gamma_5 X_{kd}^P + \eta_{kr} \qquad (2.5)$$

The results of this regression are listed as specification 2 in table 2.5. The data seem to support both hypothesis 1, that employing a second level of negotiators improves firms' ability to price discriminate, and hypothesis 4, that information tracking will improve the firms' ability to price discriminate.

Recall that the gini coefficient of prices of a particular car at a particular dealership, can be interpreted as follows: double the gini coefficient and that is the percentage of the mean value that we can expect between two randomly drawn transactions. The mean gini

for the population of car dealer pairs is .04. This means that the expected difference between two randomly drawn transactions is about 8% of the mean price. For a car with a mean price of $20,000.00, that translates to an expected difference of $1,600.00 between two randomly drawn transactions of the same car at the same dealership. Looking at specification 2 in table 2.5, the addition of closers increases the gini by .002, which corresponds to an increase in expected dispersion of 0.4% of the mean price, or about $100.00 on a car with a mean price of $25,000.00. Also in specification 2, we see that implementing information tracking corresponds to a .0017 increase in gini, a 0.034% of the mean price increase in dispersion. For the $25,000.00 car mentioned earlier, this information tracking means a $85.00 increase in expected difference between two randomly selected transactions.

In section 2.6 I revisit these results and demonstrate their robustness to account for the endogeneity of organizational form, selection of customers, and other features.

### 2.5.2 Price quartiles

Section 2.5.1, suggests that both of the variations in organizational form of interest, hierarchal sales process and information tracking, increase the dispersion of prices we observe at a particular dealership for a particular car. There are a number of possible forms this variation increase could take, however. An increase might come from increases in either the top and/or bottom prices, or changes in spread and skewness within the extant price range. Hypothesis 2 predicts that the increase in dispersion associated with a hierarchal sales process will come from a decrease in low quartile prices. Hypothesis 5 predicts that the increase from information tracking will come from an increase in high quartile prices.

The simple regression we would run for each of high and low percentiles is:

$$log(percentile\_price_{kd}) = \gamma_0 + \gamma_1 Closers_d + \gamma_2 Info\_tracking_d + \gamma_3 X_d^D + \gamma_4 X_k^C + \gamma_5 X_{kd}^P + \eta_{kr} \tag{2.6}$$

For the dependent variable, we would like a measure that captures the intention of measuring the range of prices, but without being as susceptible to random anomalies as the maximum and minimum prices. A set of measures used frequently in the literature is the log of the upper and lower price quartiles. In this scenario, the high price quartile is the price of the transaction such that 75% of transactions for that car at that dealership were lower. Similarly, the low quartile prices is the 25% price.

Covariates at the car-dealer pair level must now account for the fact that we are measuring a particular portion of the distribution. Instead of including standard deviations of days on the lot, the cost to the dealership, and model age, I include the appropriate quartile value. For example, because a model that was released more recently will likely have a higher price, I include the 25% model age. These results are robust to inclusion of both 75% and 25% values for each pair. Aside from these three, the car-dealer pair covariates are the same as described in section 2.5.1. I also include the same set of dealer-level covariates with the exception of the standard deviations. Again, because the object of interest is a particular segment of the distribution, these total variance measures have little explanatory power. Car-level effects are controlled using car-fixed effects, and errors are clustered at the car-DMA level.

The results of the high percentile price regression support hypothesis 5 and can

be found in specification 2 in table 2.6: information tracking improves a dealership's ability to capture more rents from high valuation customers. The predicted increase in higher prices of about .8% accounts for an increase of $216 on a car for which the 75% price is $27,000. The model also predicts no impact on high percentile prices from implementing a hierarchal sales process with closers. This specification provides no evidence of an effect at conventional levels, as predicted.

The results of the low percentile price regression support hypothesis 2 and can be found in specification 2 in table 2.7: employing closers increases a dealership's ability to capture low price deals. The decrease in low percentile prices of about .5% corresponds to about $120 on a car whose 25% price is $24,000. Again, recall that the model predicts no effect of information tracking on low percentile prices. As predicted, table 2.7 shows no evidence of an effect at conventional levels.

### 2.5.3 Volume

Having confirmed that the source of increased price dispersion is as predicted by the model, we can move to investigating what this price change means for the business' ability to capture value. Hypothesis 3 predicts that a hierarchal sales process allows the firm to capture value from sales they wouldn't otherwise have made. The increase in price dispersion comes from completing sales at prices that would otherwise not be offered. If this is the case, then along with the increase in price dispersion from employing closers, we should expect to see an increase in sales volume. If this weren't the case, and the decrease in prices came from the same sales being made, but at lower prices, we would expect no effect on volume from having closers.

The model predicts that the effect of information tracking will be to increase value captured from existing customers. The dealership's sales volume doesn't increase, but higher prices are charged to those customers willing to bear the additional cost. If this is the case, we wouldn't expect to see any change in sales volume associated with information tracking.

As with the other regressions, one might be concerned that the search process consumers undertake might result in errors being correlated with the DMA. To account for that possibility, but at the dealership level, I use standard errors robust to correlation with the DMA.

I measure volume at the dealership level:

$$volume_d = \gamma_0 + \gamma_1 Closers_d + \gamma_2 Info\_tracking_d + \gamma_3 X_d^D + \gamma_4 X_d^D + \eta_r \qquad (2.7)$$

Because the mechanism driving the change in volume is the same as that driving the price effects, I include the same set of dealership-level covariates. I also include the demographic controls that in previous sections were at the car-dealership pair-level, but aggregated to the dealership level. For example, average income of customers' census blocks is computed across all the dealership's sales. In addition, I include a fixed effect for the modal nameplate sold by the dealership to absorb average nameplate effects.

Specification 1 of table 2.8 lists results for the volume regression. As predicted, closers are associated with an increase in sales volume at the dealer-nameplate level of more than 83 cars per year. Also as predicted, the effect on volume associated with information tracking is indistinguishable from zero at conventional levels.

## 2.6 Robustness and limitations

In this section I investigate the robustness and limitations of the results in section 2.5. First, I demonstrate the robustness of the results to selection of alternate measures of the constructs of interest. Second, I discuss the limitations of attempting to attribute causality to the, admittedly robust, findings of correlations of organizational form with cross-sectional data. Third and fourth, I investigate the possibility that the effect may be driven by selection of employees or customers correlated to organizational form.

### 2.6.1 Robustness to alternate measures

#### Alternate measure of dispersion

The Gini coefficient was specifically chosen for the measures above because it measures dispersion around the middle of the distribution (or, more precisely, the modal value). Alternate dispersion measures that are often used, like Atkinson coefficients, like the Theil index, or General Entropy coefficients, are less appropriate for my uses because they are more sensitive to variance at one end or the other of the distribution. Percentile ratios, however, exist as a suitable alternate measure of dispersion. To demonstrate that my above results are not driven by the measure of dispersion, table 2.12 replicates the results of table 2.5 with the ratio of the 95th to the 5th replacing the gini coefficient. The fact that the results are still present suggests that the observed increase in dispersion is not an artifact of the construction of the gini coefficient. Rather, it seems that the prices for a given car at a given dealership are, in fact, more disperse when that dealership has either closers or information tracking.

#### Alternate measures of price distribution

We would like to verify that the measures of the effects of the organizational forms on extremes of the price distribution are not driven by the portions of the distribution selected for measurement. Table 2.13 repeats the price quartile regressions but instead measured at the 95th and 5th percentiles, respectively. These numbers were selected to demonstrate the effect persists at more extreme values, but still eliminating outliers at the extrema. The predictions about the coefficients on the internal organizations are robust to this alternate definition. Under this specification, closers are associated with an increase in higher percentile prices not predicted by the model. This may result from another dimension of salesperson ability not captured by the improved price-discriminating ability of more experienced salespeople in the model.

#### Alternate measure of volume

I selected total dealer volume as the dependent variable to test the hypothesis that hierarchal sales systems correspond to higher volumes because it captures the total effect of the organizational form on the dealers volume. If the organizational form corresponded to shifting sales, we would not see an overall increase in volume. The model is, however, much more specific. It predicts that the volume increase will come from a particular portion of

the price distribution. In order to verify that that volume increase is, in fact, a product of increased sales at low prices, I repeat the volume regressions with sales volume at low prices as the dependent variable. In order to calculate this value, I calculate the unconstrained mean price for each car across all sales during the time period. I then sum for each dealership the number of sales they made that fell below that value. The results from these regressions are in specification 2 of table 2.8. As predicted by the model, a hierarchal sales system seems to correspond to higher volume of low priced sales.

### 2.6.2 Interpreting the results

Due to the cross-sectional nature of the data, obtaining measurements with a causal interpretation is difficult. It is nevertheless a valuable exercise to consider what forms endogeneity may be present, and how causal measures may differ.

There are two main forms of endogeneity that are of concern in empirical work with cross-sectional data, simultaneous causation and omitted variable bias. Because firms are not able to constantly adjusted their internal organization, simultaneous causation does not seem to be much of a concern.

As with any empirical work, if an important variable is omitted, it may result in bias and lead to incorrect interpretation of the results. An exhaustive set of controls has allowed me to control for many of the factors that have been shown in research to affect price discrimination, like sophistication of negotiators and information available to both parties, competition, and features of the durable good. What may remain, however, is factors associated with the firms' selection of the organizational form. Though a full analysis of the source of these choices is well beyond the scope of this paper, I conducted subsequent interviews with dealers to gain some preliminary insight into the determinants of their choices. These interviews suggested that customers dislike the experience of being passed to a closer. The dealers believe, therefore, that when it is important to maintain relationships with customers, because repeat business is important, that dealers should select the "straight sell" form. As shown by the results, however, in the short run, closers result in the ability to capture additional value. Using current data, I've done my best to control for these factors. The measure of the average number of vehicles per home address the fact that when there is a high probability a buyer will be buying another car soon, perhaps because they are replacing family members' cars, reputation is more important. The measure of the percentage of homes which are owned addresses the notion that the reputation of dealers in areas with greater churn of residents will have less value. Cross sectional data makes it impossible to control for the environmental conditions at the time of the dealerships' choice, but to the extent that these factors change relatively slowly, this form of endogeneity does not seem to be of great concern.

#### Selection of employees

Even understanding the choices of dealerships, interpretation of these results still requires care because they measure the conditional correlation of the left hand side variable with all factors that are perfectly correlated with the variable of interest.

Suppose that the results could be considered as causal. The results would represent the effect on performance we might predict if the marginal firm were to adopt the organizational form of interest. The effect on performance of adoption by the inframarginal may be less. Suppose, for example, that salespeople were not allocated randomly to dealerships, but selected where to work based on organizational form. Suppose that better salespeople chose to work at dealerships with closers, all things being equal. If this were the case, then one additional dealership adopting a hierarchal sales system would attract more good salespeople then they had previously. Their performance would increase by the estimated amount, but that performance increase would be a combination of the inherent benefit of having closers and the benefit of attracting more good salespeople. The estimates, therefore, are correct, but might not apply to firms that adopt closers after supply of good salespeople is exhausted.

Separating the pure organizational and sorting effects requires formally modeling the complete labor market, and is well beyond the scope of this paper. It suffices to say, however, that the estimated effects are a correct representation of the marginal effect, and may, but do not necessarily, apply to inframarginal cases as well.

**Selection of customers**

Similar to the issue of selection of employees, if customers selected based on organizational form, the results would be biased. Using the distance traveled by customers, however, I am able to test for whether customers' selection criteria is substantially based on the dealers' organizational form.

If customers are aware of which firms have closers or information tracking and select which dealer to go to based on that, or something correlated, then a simple regression would yield biased coefficients. To reassure ourselves that this is not the case, we'd like to control for features of the customer.

The most intuitive means for doing so is simply to add controls for the relevant features of the customer base. These should encompass the features that would effect the price outcome. In section 2.5 I describe the demographic covariates included in the regressions. While these controls cover the features I would expect to govern bargaining, if a relevant feature is omitted, the estimates are still susceptible to bias. We'd like to know that a customer's decision to buy at a particular dealership is not correlated with the firm's organizational form.

Empirically, a means of observing this endogenous sorting is to look at whether a customer shopping for nameplate $x$ finally bought from a dealership that was not the closest dealer of $x$ to her home. That would suggest that she chose to drive the extra distance to purchase her vehicle based on some characteristic of the dealership. Lets describe buying a car at a dealership other than the closest one selling that car as "passing" that near dealer in favor of the farther one. For each focal dealership, I compute the percentage of their customers who passed another dealership to shop there. The unconditional mean of the percentage of customers who passed a dealership is 73%. The mean for dealers with closers is 75% and for straight sell dealers is 72%. The difference between the populations is not

significant at conventional levels[10] which suggests that customers are no more likely to go out of their way for a dealership with closers than a straight sell dealership. For dealerships with information tracking, the pass rate is 73% and for those without the rate is 72%. Again, this difference is not significant at conventional levels[11].

This result seems to suggest that customers are not selecting into dealerships based on their organizational form. The sorting of customers, therefore, seems to not be a great threat to identification. Though customers are clearly not randomly selecting dealerships, the factors on which they are deciding appear to not be correlated with the organizational forms of interest. Regressing the measures on the previous set of controls as well as this measure of customer sorting demonstrates whether the sorting of customers is conditionally correlated with the output measure. These regressions appear in tables 2.9-2.11. The fact that closers seem to have an effect on low percentile prices, even controlling for the sorting of customers, seems to suggest that the sorting is not solely responsible for the observed effect of organizational form on prices.

## 2.7 Conclusion

This paper helps to address the question of why we observe heterogeneous performance amongst firms. I demonstrate that firms have heterogeneous ability to capture value in negotiated transactions, and propose that, at a micro-level, organizational form has a role in that capture.

This paper discusses two discrete classes of organizational changes which can affect the ability of a firm to price discriminate through negotiated prices. A system of information tracking that allows the firm to observe when a customer has been served by two salespeople improves the upper bound of the support of the feasible pricing distribution. A hierarchal sales process improves the lower bound.

This work has important implications of the literature on firm performance, suggesting that reliable attribution of firm performance requires understanding internal firm dynamics. It also demonstrates that firms can vary in ability to capture value through negotiations even with identical average talent of negotiators and that initial firm organization can have important implications for long term performance.

Future work can aid in obtaining causal measures of the effects of different organizational forms by further exploring the sources of these choices and integrating features of the labor market to these analyses.

## Tables

[10] The difference is significant at only a 74% level.

[11] From introspection, this makes sense. I considered many things when selecting a dealership from which to buy a car, but, before this project, was not aware of the different organizational forms, let alone which dealership was of which type and the implications for pricing.

Table 2.1: Dealer-level Summary statistics

| Variable | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Volume | 520.502 | 615.005 | 35 | 4901 |
| Avg dist to customer | 53.004 | 17.329 | 26.521 | 130.718 |
| Closers | 0.391 | 0.489 | 0 | 1 |
| Information Tracking | 0.872 | 0.335 | 0 | 1 |
| Avg avg customer income | 57656.263 | 14257.993 | 31130.992 | 122307.906 |
| Avg commute time | 27.536 | 3.991 | 15.689 | 43.425 |
| Avg % unemployed | 0.055 | 0.02 | 0.023 | 0.136 |
| Avg avg vehicles per home | 1.843 | 0.198 | 0.996 | 2.266 |
| Avg % homes owned | 0.702 | 0.083 | 0.445 | 0.869 |
| Dist to closest competitor | 19.133 | 16.381 | 0.035 | 113.277 |
| One price | 0.043 | 0.203 | 0 | 1 |
| FTEs | 14.829 | 22.955 | 1 | 281 |
| log dealer inventory | 3.685 | 0.857 | 1.165 | 5.978 |
| N | | 327 | | |

Table 2.2: Transaction-level Summary statistics

| Variable | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Price | 24929.033 | 10237.042 | 5498 | 125584 |
| Avg income in cust's CBG | 61523.157 | 28941.17 | 0 | 200001 |
| Avg minutes of travel time to work | 28.353 | 6.962 | 1.667 | 89.049 |
| % unemployed in cust's CBG | 0.056 | 0.05 | 0 | 1 |
| % some college in cust's CBG | 0.39 | 0.2 | 0 | 1 |
| Dist customer traveled | 34.577 | 168.819 | 0 | 4901.514 |
| N | | 99550 | | |

Table 2.3: Car-Dealer pair Summary statistics

| Variable | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Gini | 0.041 | 0.02 | 0.003 | 0.178 |
| Sales of car at dealer | 28.362 | 40.398 | 10 | 1035 |
| Avg price | 25698.123 | 10504.666 | 8718.62 | 113998.45 |
| 75% price | 26924.04 | 11030.009 | 8990 | 115795 |
| 25% price | 24319.68 | 10041.041 | 6988 | 110000 |
| N | | 3510 | | |

Table 2.4: Average demographics of dealers' customers' census block

| | Surveyed and included | Unsurveyed | $t$-statistic | $p$-value |
|---|---|---|---|---|
| N | 297 | 521 | | |
| Avg pop. density | 0.0022684 | 0.0026818 | 2.165 | 0.0307 |
| Avg avg customer income | 57358.58 | 59434.04 | 1.9611 | 0.0502 |
| Avg % some college | 0.3632777 | 0.3835067 | 2.7435 | 0.0062 |
| Avg commute time | 27.59846 | 27.74019 | 0.4523 | 0.6512 |
| Avg % unemployed | 0.0565175 | 0.0556662 | 0.5569 | 0.5777 |

Table 2.5: Price dispersion - Gini Coefficient

| | (1) Gini | | (2) Gini | |
|---|---|---|---|---|
| Closers | 0.00308*** | (0.000516) | 0.00239*** | (0.000432) |
| Information Tracking | 0.00255*** | (0.000921) | 0.00167** | (0.000766) |
| SD days on lot | | | 2.13e-05** | (1.04e-05) |
| SD days since model release | | | 8.13e-06 | (9.76e-06) |
| SD cost to dealer | | | 1.20e-05*** | (5.00e-07) |
| Sales of car at dealer | | | 1.39e-05* | (7.16e-06) |
| Dist to closest competitor | | | -9.07e-05 | (5.84e-05) |
| Dist to closest competitor$^2$ | | | 1.20e-06 | (8.20e-07) |
| Avg dist to customer | | | 0.000150* | (8.78e-05) |
| Avg dist to customer$^2$ | | | -1.04e-06* | (6.23e-07) |
| One price | | | -0.00421*** | (0.00158) |
| FTEs | | | -5.31e-06 | (6.21e-06) |
| log dealer inventory | | | 0.00161*** | (0.000431) |
| SD customer income | | | 7.45e-08** | (3.60e-08) |
| SD commute time | | | -1.26e-06 | (0.000136) |
| Avg % unemployed | | | 0.00426 | (0.0218) |
| Avg commute time | | | 0.000369*** | (9.08e-05) |
| Avg avg customer income | | | -1.10e-07* | (5.78e-08) |
| Avg % some college | | | 0.0137** | (0.00639) |
| Avg median home value | | | -1.25e-08* | (6.64e-09) |
| Avg avg vehicles per home | | | 0.0101*** | (0.00215) |
| Avg % homes owned | | | -0.0201*** | (0.00583) |
| Car Fixed Effects | Y | | Y | |
| Constant | 0.0371*** | (0.000842) | -0.00512 | (0.00522) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.703 | | 0.809 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.6: log 75th percentile prices

| | (1) log(75%price) | | (2) log(75%price) | |
|---|---|---|---|---|
| Closers | -3.90e-05 | (0.00210) | 0.00163 | (0.00169) |
| Information Tracking | 0.0147*** | (0.00381) | 0.00770*** | (0.00284) |
| 25% days on lot | | | -0.000198*** | (6.00e-05) |
| 75% cost to dealer | | | 2.60e-05*** | (2.46e-06) |
| 25% model age | | | -7.08e-05*** | (1.74e-05) |
| Sales of car at dealer | | | -5.42e-05** | (2.47e-05) |
| Dist to closest competitor | | | 0.000291 | (0.000276) |
| Dist to closest competitor$^2$ | | | -4.87e-06 | (4.09e-06) |
| Avg distance to customer | | | 0.000726 | (0.000473) |
| Avg distance to customer$^2$ | | | -5.97e-06* | (3.46e-06) |
| One price | | | -0.0117** | (0.00556) |
| FTEs | | | 5.25e-05** | (2.41e-05) |
| log dealer inventory | | | -0.00882*** | (0.00193) |
| Avg % unemployed | | | 0.144 | (0.0913) |
| Avg commute time | | | 0.000554 | (0.000368) |
| Avg avg customer income | | | 6.69e-07** | (2.80e-07) |
| Avg % some college | | | -0.0344 | (0.0304) |
| Avg median home value | | | -1.17e-07*** | (2.69e-08) |
| Avg avg vehicles per home | | | 0.00488 | (0.0104) |
| Avg % homes owned | | | -0.0860*** | (0.0270) |
| Car Fixed Effects | Y | | Y | |
| Constant | 10.12*** | (0.00369) | 9.493*** | (0.0719) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.984 | | 0.991 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.7: log 25th percentile prices

| | (1) log(25%price) | | (2) log(25%price) | |
|---|---|---|---|---|
| Closers | -0.00742*** | (0.00218) | -0.00633*** | (0.00178) |
| Information Tracking | 0.0109*** | (0.00349) | 0.00464 | (0.00294) |
| 75% days on lot | | | -7.20e-05*** | (2.18e-05) |
| 25% cost to dealer | | | 2.60e-05*** | (1.08e-06) |
| 75% model age | | | -6.41e-05*** | (1.80e-05) |
| Sales of car at dealer | | | -6.62e-05** | (2.76e-05) |
| Dist to closest competitor | | | 0.000552** | (0.000277) |
| Dist to closest competitor$^2$ | | | -7.13e-06* | (4.27e-06) |
| Avg distance to customer | | | 0.000676 | (0.000465) |
| Avg distance to customer$^2$ | | | -6.21e-06* | (3.38e-06) |
| One price | | | 0.00111 | (0.00725) |
| FTEs | | | 5.04e-05* | (2.88e-05) |
| log dealer inventory | | | -0.0103*** | (0.00181) |
| Avg % unemployed | | | 0.136 | (0.0849) |
| Avg commute time | | | -0.000418 | (0.000396) |
| Avg avg customer income | | | 7.61e-07*** | (2.64e-07) |
| Avg % some college | | | -0.0659** | (0.0303) |
| Avg median home value | | | -6.88e-08*** | (2.62e-08) |
| Avg avg vehicles per home | | | -0.0158* | (0.00927) |
| Avg % homes owned | | | -0.0372 | (0.0255) |
| Car Fixed Effects | Y | | Y | |
| Constant | 10.02*** | (0.00332) | 9.493*** | (0.0350) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.984 | | 0.991 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.8: Volume

| VARIABLES | (1) Volume | | (2) Volume below avg price | |
|---|---|---|---|---|
| Closers | 83.75* | (43.25) | 38.78* | (19.00) |
| Information Tracking | 18.71 | (25.94) | -18.89 | (12.07) |
| Dist to closest competitor | -1.672 | (2.432) | -2.883 | (1.744) |
| Dist to closest competitor$^2$ | 0.0397 | (0.0298) | 0.0427* | (0.0220) |
| Avg distance to customer | 2.775 | (3.314) | 0.244 | (2.124) |
| Avg distance to customer$^2$ | -0.0258 | (0.0230) | -0.00430 | (0.0151) |
| FTEs | 0.961 | (0.658) | 0.704* | (0.404) |
| log dealer inventory | 487.1*** | (64.30) | 243.5*** | (41.42) |
| One price | 64.16 | (69.35) | 41.40 | (45.95) |
| Avg avg customer income | 0.00239 | (0.00549) | 0.00365 | (0.00436) |
| Avg % some college | -105.7 | (412.1) | -324.9 | (326.4) |
| Avg commute time | -1.559 | (3.967) | -2.624 | (2.725) |
| Avg % unemployed | -3,317** | (1,411) | -2,594*** | (803.7) |
| Avg median home value | 0.000689 | (0.000473) | 0.000427 | (0.000337) |
| Avg avg vehicles per home | -309.5*** | (108.3) | -170.7** | (67.01) |
| Avg % homes owned | -358.1 | (334.0) | -339.8* | (170.4) |
| Modal Nameplate Fixed Effects | Y | | Y | |
| Constant | -594.9** | (280.6) | -39.58 | (156.8) |
| Observations | 327 | | 327 | |
| R-squared | 0.760 | | 0.689 | |

Robust standard errors in parentheses - Errors clustered at DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.9: Price dispersion controlling for customer selection

| VARIABLES | Gini | |
|---|---|---|
| Closers | 0.00240*** | (0.000433) |
| Information Tracking | 0.00173** | (0.000770) |
| % of customers passed | -0.00127 | (0.00118) |
| SD of days on lot | 2.05e-05** | (1.04e-05) |
| SD of days since model release | 7.98e-06 | (9.75e-06) |
| SD of cost to dealer | 1.20e-05*** | (4.98e-07) |
| Sales of car at dealer | 1.43e-05** | (7.20e-06) |
| Dist to closest competitor | -9.31e-05 | (5.78e-05) |
| Dist to closest competitor$^2$ | 1.19e-06 | (8.20e-07) |
| Avg distance to customer | 0.000153* | (8.77e-05) |
| Avg distance to customer$^2$ | -1.09e-06* | (6.23e-07) |
| One price | -0.00428*** | (0.00158) |
| FTEs | -5.30e-06 | (6.21e-06) |
| log dealer inventory | 0.00155*** | (0.000434) |
| SD customer income | 7.08e-08** | (3.60e-08) |
| SD commute time | 5.31e-06 | (0.000137) |
| Avg % unemployed | -0.00328 | (0.0241) |
| Avg commute time | 0.000368*** | (9.08e-05) |
| Avg avg customer income | -1.09e-07* | (5.80e-08) |
| Avg % some college | 0.0139** | (0.00637) |
| Avg median home value | -1.37e-08** | (6.80e-09) |
| Avg avg vehicles per home | 0.00995*** | (0.00215) |
| Avg % homes owned | -0.0209*** | (0.00600) |
| Car Fixed Effects | Y | |
| Constant | -0.00255 | (0.00595) |
| Observations | 3510 | |
| R-squared | 0.809 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.10: Prices controlling for customer selection

| | (1) log(75%price) | | (2) log(25%price) | |
|---|---|---|---|---|
| Closers | 0.00152 | (0.00170) | -0.00645*** | (0.00179) |
| Information Tracking | 0.00716** | (0.00286) | 0.00394 | (0.00295) |
| % of customers passed | 0.0106** | (0.00456) | 0.0143*** | (0.00485) |
| Sales of car at dealer | -5.77e-05** | (2.49e-05) | -7.06e-05** | (2.77e-05) |
| Dist to closest competitor | 0.000305 | (0.000278) | 0.000573** | (0.000276) |
| Dist to closest competitor$^2$ | -4.71e-06 | (4.17e-06) | -6.95e-06 | (4.29e-06) |
| Avg dist to customer | 0.000693 | (0.000476) | 0.000629 | (0.000467) |
| Avg dist to customer$^2$ | -5.57e-06 | (3.50e-06) | -5.66e-06* | (3.40e-06) |
| One price | -0.0112** | (0.00544) | 0.00178 | (0.00706) |
| FTEs | 5.25e-05** | (2.39e-05) | 5.04e-05* | (2.85e-05) |
| log dealer inventory | -0.00833*** | (0.00194) | -0.00972*** | (0.00182) |
| Avg % unemployed | 0.209** | (0.102) | 0.223** | (0.0951) |
| Avg commute time | 0.000553 | (0.000369) | -0.000418 | (0.000397) |
| Avg avg customer income | 6.69e-07** | (2.79e-07) | 7.62e-07*** | (2.64e-07) |
| Avg % some college | -0.0354 | (0.0303) | -0.0673** | (0.0301) |
| Avg median home value | -1.07e-07*** | (2.73e-08) | -5.59e-08** | (2.75e-08) |
| Avg avg vehicles per home | 0.00581 | (0.0104) | -0.0146 | (0.00936) |
| Avg % homes owned | -0.0793*** | (0.0273) | -0.0282 | (0.0263) |
| 25% days on lot | -0.000199*** | (6.01e-05) | | |
| 75% cost to dealer | 2.59e-05*** | (2.46e-06) | | |
| 25% model age | -7.04e-05*** | (1.74e-05) | | |
| 75% days on lot | | | -6.94e-05*** | (2.19e-05) |
| 25% cost to dealer | | | 2.58e-05*** | (1.09e-06) |
| 75% model age | | | -6.23e-05*** | (1.80e-05) |
| Car Fixed Effects | Y | | Y | |
| Constant | 9.476*** | (0.0736) | 9.470*** | (0.0365) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.991 | | 0.991 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.11: Volume controlling for customer selection

| | Volume | |
|---|---|---|
| Closers | 91.92* | (45.27) |
| Information Tracking | 1.316 | (21.80) |
| % of customers passed | 281.9** | (110.1) |
| Dist to closest competitor | -0.319 | (2.342) |
| Dist to closest competitor$^2$ | 0.0265 | (0.0244) |
| Avg dist to customer | 2.000 | (3.310) |
| Avg dist to customer$^2$ | -0.0169 | (0.0212) |
| FTEs | 1.055 | (0.683) |
| log dealer inventory | 493.4*** | (65.53) |
| One price | 100.0 | (70.31) |
| Average average customer income | 0.00307 | (0.00563) |
| Average % some college | -267.3 | (491.7) |
| Average commute time | -1.922 | (3.563) |
| Average % unemployed | -2,430** | (1,140) |
| Average median home value | 0.000933** | (0.000427) |
| Average average vehicles per home | -243.4** | (92.74) |
| Average % homes owned | -421.0 | (277.0) |
| Modal Nameplate Fixed Effects | Y | |
| Constant | -973.7** | (366.2) |
| Observations | 327 | |
| R-squared | 0.767 | |

Robust standard errors in parentheses - Errors clustered at DMA level

*** p<0.01, ** p<0.05, * p<0.1

Table 2.12: Alternate measure of price dispersion - Ratio of the logged 95th percentile price to the logged 5th

| | (1) log(95%price)/log(5%price) | | (2) log(95%price)/log(5%price) | |
|---|---|---|---|---|
| Closers | 0.00183*** | (0.000350) | 0.00139*** | (0.000308) |
| Information Tracking | 0.00144** | (0.000622) | 0.00105* | (0.000567) |
| SD days on lot | | | 1.36e-05* | (7.15e-06) |
| SD days since model release | | | 7.77e-06 | (6.85e-06) |
| SD cost to dealer | | | 6.62e-06*** | (3.96e-07) |
| Sales of car at dealer | | | 2.57e-06 | (3.96e-06) |
| Dist to closest competitor | | | -3.59e-05 | (3.85e-05) |
| Dist to closest competitor$^2$ | | | 4.83e-07 | (5.06e-07) |
| Avg dist to customer | | | 0.000113* | (6.17e-05) |
| Avg dist to customer$^2$ | | | -8.02e-07* | (4.28e-07) |
| One price | | | -0.00162 | (0.00121) |
| FTEs | | | -4.95e-06 | (4.11e-06) |
| log dealer inventory | | | 0.00117*** | (0.000298) |
| SD customer income | | | 2.78e-08 | (2.66e-08) |
| SD commute time | | | -9.35e-05 | (9.87e-05) |
| Avg % unemployed | | | 0.00589 | (0.0148) |
| Avg commute time | | | 0.000243*** | (6.30e-05) |
| Avg avg customer income | | | -4.98e-08 | (4.18e-08) |
| Avg % some college | | | 0.00913** | (0.00435) |
| Avg median home value | | | -9.06e-09* | (4.63e-09) |
| Avg avg vehicles per home | | | 0.00625*** | (0.00147) |
| Avg % homes owned | | | -0.0113*** | (0.00401) |
| Car Fixed Effects | Y | | Y | |
| Constant | 1.023*** | (0.000563) | 0.995*** | (0.00364) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.675 | | 0.757 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

*** p<0.01, ** p<0.05, * p<0.1

Table 2.13: Alternate measure of price distribution - logged 95th percentile price to the logged 5th

| | (1) log(95%price) | | (2) log(5%price) | |
|---|---|---|---|---|
| Closers | 0.00407** | (0.00200) | -0.00924*** | (0.00223) |
| Information Tracking | 0.0132*** | (0.00345) | 0.00555 | (0.00384) |
| Sales of car at dealer | -3.65e-05 | (2.69e-05) | -6.67e-05** | (3.14e-05) |
| Dist to closest competitor | -3.25e-05 | (0.000302) | 0.000438* | (0.000266) |
| Dist to closest competitor$^2$ | -2.16e-07 | (4.26e-06) | -7.26e-06* | (3.72e-06) |
| Avg dist to customer | 0.000766 | (0.000482) | -0.000251 | (0.000498) |
| Avg dist to customer$^2$ | -6.59e-06* | (3.46e-06) | 1.32e-06 | (3.44e-06) |
| One price | -0.0124 | (0.00759) | 0.00118 | (0.0104) |
| FTEs | -1.41e-05 | (2.71e-05) | 2.67e-05 | (3.31e-05) |
| log dealer inventory | -0.00193 | (0.00220) | -0.0126*** | (0.00223) |
| Avg % unemployed | 0.177* | (0.105) | 0.112 | (0.103) |
| Avg commute time | 0.00159*** | (0.000433) | -0.000930* | (0.000478) |
| Avg avg customer income | -2.27e-08 | (2.98e-07) | 4.05e-07 | (3.16e-07) |
| Avg % some college | 0.0349 | (0.0361) | -0.0388 | (0.0355) |
| Avg median home value | -1.11e-07*** | (3.33e-08) | -4.22e-08 | (3.38e-08) |
| Avg avg vehicles per home | 0.0429*** | (0.0109) | -0.0190* | (0.0113) |
| Avg % homes owned | -0.129*** | (0.0317) | -0.00711 | (0.0307) |
| 5% days on lot | -0.000491*** | (0.000183) | | |
| 95% cost to dealer | 2.47e-05*** | (1.10e-06) | | |
| 5% model age | -4.75e-05** | (2.20e-05) | | |
| 95% days on lot | | | -7.52e-05*** | (1.65e-05) |
| 5% cost to dealer | | | 2.01e-05*** | (1.01e-06) |
| 95% model age | | | -1.72e-05 | (1.69e-05) |
| Car Fixed Effects | Y | | Y | |
| Constant | 9.471*** | (0.0458) | 9.631*** | (0.0395) |
| Observations | 3510 | | 3510 | |
| R-squared | 0.986 | | 0.984 | |

Robust standard errors in parentheses - Errors clustered at car-DMA level

*** p<0.01, ** p<0.05, * p<0.1

# Chapter 3

# Delegation and Coordination: An empirical study of US Auto Dealers

## 3.1 Introduction

A tremendous number of decisions must be made each day for a firm to function. Who, within the firm, is empowered to make those decisions has been an active areas of interest recently in Economics. The allocation of decision rights can have a number of effects on observed outcomes. It can put the decision in the hands of people with different knowledge, skills, or incentives, but can also affect those individuals desire to further cultivate and develop them (Aghion and Tirole 1997). These decisions are so important that researchers have gone so far as to base theories of the firm on the allocation of decision rights within the firm (for example, Hart and Moore (1990)).

One important aspect of the allocation of decision rights is the trade-off between adaptability that comes from delegating decisions to the most informed employees and the potential cost savings that come with coordination. Despite the wealth of theoretical literature on the subject, there has been little in the way of empirical validation. This paper empirically investigates how firms make that choice in the setting of US auto dealerships.

I begin with a simple model of a decision process in which a multi-divisional firm must decide whether to make a decision on behalf of its divisions, or allow them to make the choice. The cost of each option is decreasing marginally in the number of implementations, but which option is "correct" may not be the same for both divisions. The division managers have a better signal of which is correct than the principal. The model predicts that firms will centralize decisions that have high values of coordination. Among other decisions, the likelihood that they will be delegated is increasing in environmental volatility. I then test these predictions using a survey I conducted of auto dealerships in 2007 combined with transaction-level data from a provider of data to the auto industry. I find that auto groups are more likely to centralize tasks, like software purchases, with high coordination value, and their tendency to delegate tasks sensitive to environmental conditions, like hiring, is increasing in customer heterogeneity. These results are robust to selection of alternate tasks that meet the model's criteria.

The chapter continues as follows. Section 3.2 describes related literature on the

subject of delegation and centralization. Section 3.3 introduces a simple model of firm decision making that yields predictions about the propensity of tasks to be delegated. Section 3.4 describes the data I use to test these predictions and the implementation and results of those tests. Section 3.5 describes the robustness of these results to alternate tasks for measuring each construct. Section 3.6 concludes.

## 3.2 Related Literature

One common thread in the theoretical literature is the value of delegating to employees "on the ground." Employees with more hands-on exposure to the day-to-day operations of certain portions of the business may be better informed about the needs of their market. This could represent local offices of multi-national firms, or simply managers who devote all their time to understanding one particular portion of the firm's product portfolio. The more volatile the environment in which that manager operates, the more likely her signal will be better than central management with a more holistic purview. This information advantage of front-line employees and its increase with the volatility of the environment is a common feature of much of the work on delegation (Bolton and Farrell 1990, Alonso, Dessein, and Matouschek 2008, Acemoglu, Aghion, Lelarge, and Van Reenen 2007, Rantakari 2008).

The gains from delegation do not come without cost, however. Allowing better informed front-line employees to make decisions compromises the firm's ability to coordinate choices. When choices have non-constant returns to scale, coordination can be extremely important, potentially even more so than making the right choice. Bolton and Farrell (1990) highlight the trade-off between coordination and delegation. Bolton and Farrell (1990)'s model, which rules out horizontal communication between the agents, demonstrates that delegation can improve selection of approaches, but can result in inefficient duplication of effort[1]

Fostering coordination is an important responsibility of management. Hart and Moore (2005) model a firm with two types of employees, generalists and specialists, and analyze the conditions under which the generalists, whose task is to coordinate the use of assets, should be superior to specialists. Qian, Roland, and Xu (2006) highlight the importance of coordination in the the firm's decision between U-form and M-form organizational structures.

Despite the extensive theoretical literature on delegation and coordination, the empirical work has been relatively sparse. One study which empirically analyzes the delegation decision, but not the coordination decision, is Acemoglu, Aghion, Lelarge, and Van Reenen (2007). Acemoglu, Aghion, Lelarge, and Van Reenen (2007) study the propensity to delegate as a function of the information gap between the central firm and the division. As technology evolves, more of the details of the technology become common knowledge, which reduces the information asymmetry between the principal and agent and allows firms to be-

[1]Alonso, Dessein, and Matouschek (2008) have a different setting in which they allow cheap talk between misaligned agents and show that its possible that centralization doesn't always dominate delegation, even when coordination is important. Rantakari (2008) also investigates this trade-off and highlights the sensitivity of optimal organizational structures to the relative need for coordination across divisions.

come more bureaucratic. In other words, firms at the vanguard of technology are more likely to delegate. Also, as in this study, firms in more heterogeneous environments will be more likely to delegate. Finally, older firms are more likely to centralize, all else equal. Their definition of a division being delegated authority is based on how the business is organized into profit centers. This study is an important first step in empirical study of delegation. This study builds on their work in two primary ways. First, my measure of delegation is more direct. By focusing on a single industry, I am able to identify specific types of tasks and specifically ask whether the division has been delegated the decision. Second, I observe different tasks at the same firm, which allows me to look at task-level determinants of delegation in addition to market- and firm-level determinants.

## 3.3 Model

### 3.3.1 Set-up

Two divisions $i \in \{1, 2\}$ within a larger firm are faced with two possible strategies, $s_i \in \{L, R\}$, of which one will be implemented. These strategies could represent a choice of implementing competing technological standards, product designs, hiring strategies, technology purchases, or many other firm decisions. The principal of the firm faces the decision of whether to delegate the decision of which strategy to pursue to the manager of each division, or to make the selection centrally.

Based on environmental factors there is a "correct" decision $s_i^*$ for each division. Each strategy, $L$ or $R$, is equally likely to be correct. If a division pursues the correct strategy the revenue to that division will be $g$, and it will be 0 otherwise.

The manager of each division has a signal of which is the correct strategy for his division $\hat{s_i}$. Because there is no misalignment of incentives, if the division is delegated the choice, the action will always be the signal, $s_i = \hat{s_i}$. Managers' signals are correct some percentage of the time $p > 1/2$. The principal only knows the population average of the likelihood of success. In other words, the divisions' managers are better informed than the principal. The percentage with which they are correct $p$ is a measure of how much better informed.

The cost of either strategy is the same, but diminishing in the number of divisions implementing it. The firm suffers cost $k < 0$ for the first division implementing a strategy, and $0 > mk > k$ for the second. In other words, there are benefits to coordination and $1/m$ is a measure of those benefits.

The timing of the game is as follows. First the principal decides whether she will delegate the decision to the managers of the divisions or make the decision centrally on their behalf. If she centralizes, she then selects the two strategies simultaneously. If the decision has been delegated, the two managers make their decisions simultaneously. There are no agency misalignments nor possibilities of communication.

### 3.3.2 Strategies

We begin by solving for outcomes with backwards induction. Suppose that the principal delegates the decision to the managers. Each manager will make the decision that

best suits his division. If the signals are the same, the firm will benefit from the decreased cost of implementation. Otherwise, the firm pays the full cost.

$$\begin{aligned} \pi_d &= P(s_1 = s_2)2k + P(s_1 \neq s_2)(1+m)k + p(g+pg) \\ &= \frac{3}{4}2k + \frac{1}{4}(1+m)k + p(g+pg) \end{aligned} \tag{3.1}$$

The principal can compare that value to her two possible strategies, selecting different strategies for the two divisions, or choosing the same strategy for the two. If she elects to centralize, but select different strategies for the divisions, she guarantees paying the full implementation price for both, but is no more likely to be correct on even one division.

$$\pi_{cd} = 2k + \frac{1}{2}(g + \frac{1}{2}g) \tag{3.2}$$

Centralizing but selecting different strategies for the two divisions is clearly dominated. The principal will suffer the loss of information from centralizing if there are sufficient gains from coordination. If the principal centralizes and opts to select the same strategy (without loss of generality $L$) for the two divisions, her payoffs are as follows.

$$\pi_c = (1+m)k + l(g+lg) \tag{3.3}$$

### 3.3.3 Predictions

We can determine whether the principal will centralize by comparing equations 3.1 and 3.3. The condition under which the principal will delegate are intuitive.

The first factor of relevance is the potential gains from coordination. When the signal of the agent is not too strong and the gains from choosing the correct strategy are not too great, an increase in the potential gains from coordination can swing the balance in favor of centralizing[2]. As such, under these conditions we would expect to see centralization more often on decisions in which the gains from coordination are greatest.

**Hypothesis 6** *Firms are more likely to centralize tasks for which there is a large gain from coordination.*

Second, if the managers' signals are strong enough, then delegation dominates. A more informed manager makes the firm more likely to select the the correct the strategy. In a setting where the benefits of coordination are fixed, an increase in the informational advantage of the agent, and by extension the expected gains from delegation, makes delegation more attractive. As such, we would expect that decisions affected by more variable environmental conditions, those in which the manager has a much larger information advantage, will be those that are much more likely to be delegated.

**Hypothesis 7** *Firms are more likely to delegate tasks for which the agent has a significant information advantage.*

In the next section, I describe the data I use to test these hypotheses.

[2]In this model, "not too strong" and "not too high" are defined as $p < \frac{1}{2}(\sqrt{7}-1)$ and $g < \frac{-3k}{4p^2+4p-3}$, respectively.

## 3.4 Data and Results

The data I use to test the aforementioned hypotheses come from two sources. The first source is a set of transaction-level data from a provider of data to the auto industry. Included in this data is an identifier of the census block group (CBG) in which the customer lives. These data are then merged with census data at the CBG level. Due to the relatively small size of CBGs, the average values of certain variables can be used as an approximation of data about the customer themselves. For example, rather than observing the income of the customer, we observe the average income of residents of the customer's CBG. This approach has been used elsewhere, including (Busse, Silva-Risso, and Zettelmeyer 2006).

The second data source is a survey I conducted of auto dealerships during 2008. The survey was administered to 871 dealerships in Washington, Oregon, California, New York, Connecticut, and Pennsylvania. The states were chosen to represent urban and rural areas as well as older cities and newer cities. The survey yielded 511 responses of which 327 contained fully populated data for the variables of interest to this study. Because the subject matter of this paper is delegation choices by firms, I restrict the sample to the 138 dealerships that are members of chains of dealerships called "autogroups." The survey methodology is described in more depth in section 2.4. The survey itself is included as an appendix.

Included in the survey are a series of questions regarding different strategic decisions and whether the general manager of the dealership feels they are made centrally by the autogroup or are delegated to the dealership. Two of these decisions are of particular relevance. The first of these decisions, whether to purchase software and which software to purchase, is a decision for which the gains to coordination are great. Because the marginal cost of implementation is relatively low for software, it is often the case that the price of implementation at multiple outlets is decreasing marginally. If this is the case, then the autogroup could save substantially by imposing a choice of software on its dealerships over allowing them to each select their own preferred product.

The second decision of particular relevance is the choice of whom to hire. Interviewing and selecting hires is a task for which there are little, if any economies of scale at the scale at which autogroups operate. Furthermore, the suitability of a particular prospective employee for the task of selling to the particular customers of a particular dealership is much better assessed by the dealerships' management than by central autogroup staff. In other words, this is a task for which the autogroup has a significant information advantage over the autogroup. This information advantage increases the more varied the dealer's customers are. When customers are more heterogeneous, it is even more difficult for the autogroup to centrally select hires successfully. In the language of prior work on delegation, a more varied customer base is analogous to the environment the dealership is operating in being more volatile.

Testing hypothesis 6, that tasks with higher value of coordination are more likely to be centralized, can be done by comparing autogroups' propensity to centralize the software purchase decision to their propensity to centralize the hiring decision. Table 3.1 shows the unconditional means of autogroups' propensity to centralize each decision. Consistent with hypothesis 6 the high coordination value task, software purchases are very likely to be centralized. Also consistent with the hypothesis, the task for which agents have a large

information advantage, hiring, is very likely to be delegated. Table 3.2 shows the results of a binomial test of the two means. The p-value suggests that if the probability of software being centralized were not greater, the probability of observing data with that probability being as much higher as we observe would be less than one hundredth of one percent. This finding is consistent with hypothesis 6.

The ideal experiment for testing hypothesis 7, that propensity to delegate tasks increases in the information advantage of the agent, would be to take a set of firms similar in every dimension but the heterogeneity of the clientele, and comparing their propensity to delegate the hiring decision.

One potential measure of the heterogeneity of clientele is the standard deviation of the average incomes of customers. Customers with widely varying incomes are likely to have widely varying needs, and as such, it would be difficult for the autogroup to centrally select salespeople appropriate to selling to them. In section 3.5 I introduce an alternate measure of heterogeneity and demonstrate the robustness of the results to its use instead. Table 3.4 shows a series of regressions estimating a linear probability model of the conditional correlation between a dealers propensity to be have its hiring choice centralized and the standard deviation of that dealership's clientele. The coefficient in specification 1 is positive and significant. We would like to validate, however, that the coefficient does not conflate the effect of that heterogeneity of customers with other correlated factors.

The three factors most likely to be correlated with heterogeneity of the customer base, which could also be correlated with the delegation decision are firm size, market size, and competition. I control for firm size using the number of full time equivalent (FTE) salespeople the dealership reported in the survey. Specification 2 adds the firm size control. To control for the number of customers served by the dealership, I compute the average of the distance between the home CBG of every customer in the designated market area (DMA) that bought a car that the focal dealership also sells and the location of the focal dealership. This covariate should address the fact that a customer base could be more diverse probabilistically simply from size, and that size could drive other considerations. For competition, I measure the distance between the focal dealership and the nearest competitor, where a competitor is defined as another dealership that sells cars of at least one nameplate sold by the focal dealer. Specification 3 includes the set the full set of these controls. In order to control for other invariant effects at the nameplate level, Specification 4 includes a fixed effect for the modal nameplate sold by the dealer. If a dealer has franchise agreements with both Mazda and Ford, but sells more Ford, it will receive the Ford fixed effect. The coefficient on the measure of customer heterogeneity in specification 4 suggests that for a one standard deviation increase in the standard deviation of income among a dealer's clientele the probability of the hiring decision being delegated increases by nearly 10%. This suggests support for hypothesis 7 that the likelihood of delegation of decisions with low coordination value is increasing in the heterogeneity of the customer base. A further prediction of the model is that the delegation of decisions with high values of coordination will not be similarly responsive to variability of customer base. Table 3.5 shows that, consistent with that prediction, there is no evidence, at conventional levels, of the decision to delegate the high coordination value task being affected by this measure of customer variation.

## 3.5 Robustness

In order to verify the effects are as predicted by the model, it behooves us to verify the robustness of the aforementioned results to selection of other proxies that meet the model's criteria. In the following subsections I reestimate the linear probability models from section 3.4 with alternate measures.

### 3.5.1 Alternate tasks with high values of coordination

Hypothesis 6 suggests that decisions with a high value of coordination are more likely to be centralized. In addition to software purchases, another decision that has this quality is that of marketing expenditures. Because the goal of marketing of dealerships is often to maintain visibility of the brand, all outlets of an autogroup gain visibility from one anothers' advertisements. Given this, coordinating advertising decisions can reduce the risk of superoptimal expenditure. Table 3.1 shows the likelihood of the marketing decision being centralized, while not as high as the software purchase decision is still above 60%. Table 3.2 shows that results of binomial tests that the probability of the marketing decision being centralized is greater than the hiring decision. The results are consistent with hypothesis 6.

Table 3.8 repeats the estimation of the linear probability model in table 3.5. Again, consistent with the model, we see that there is no evidence, at conventional levels, that the likelihood of delegating the marketing decision is affected by the heterogeneity of the dealership's clientele.

### 3.5.2 Alternate measures of environmental volatility

In section 3.4 I use the standard deviation of the dealership's clientele as the measure of heterogeneity. Another possible measure is the the standard deviation of the percentage of adults with college education across the customers' CBGs. Zettelmeyer, Scott Morton, and Silva-Risso (2006) show that controlling for many other demographic effects, college education seems to be correlated with price. This seems to be driven by customers with college education being significantly more likely to use the Internet for research before purchasing a car. As such, customers who vary significantly in education must be sold to very differently than homogenous customers and dealers are likely to be better at selecting the appropriate salesperson for their mix of customers than the autogroup is. Table 3.6 repeats the estimation of the linear probability model from table 3.4 but with the standard deviation of the percentage of adults in the CGB with college education as the measure of heterogeneity. Specifications 1-3 show support for hypothesis 7, that decisions with low value of coordination will be more likely to be delegated with the agent has a larger informational advantage. The coefficient in specification 4 maintains the predicted sign but loses significance at conventional levels. Tables 3.7 and 3.9 show that, as predicted, the decision to centralize high coordination value tasks, software purchases and marketing expenditures respectively, are seemingly unresponsive to this measure of heterogeneity.

## 3.6 Conclusion

Studying allocation of decision rights is an active field of research in Economics. One area of particular interest has been the trade-off between gains in adaptability from delegating authority to more informed agents and savings from coordination by centralizing authority. Despite a wealth of theoretical literature, this is, to the best of my knowledge, the first study to investigate this question.

I obtain data on delegation from direct questions to general managers in a survey I conducted of 511 auto dealerships, 138 of which are members of chains of dealerships called "autogroups." I find support for the hypothesis that tasks with greater gains from coordination are more likely to be centralized by comparing the propensity to centralize software purchase decision to the propensity to centralize hiring decisions. This result is robust to the selection of alternate exemplars of tasks with high coordination value. My second hypothesis is that tasks that do not have high coordination values are more likely to be delegated when the environment is volatile. In this setting, I equate environmental volatility with heterogeneous customer bases. I obtain measures of customer heterogeneity by using a set of transaction-level data from a major provider of data to the auto industry that includes the census block group (CBG) in which customers lived. Merging those geographies with demographic data from the census provides data on the compositions of each dealers' customer base. The data support the hypothesis using either standard deviation of mean income or standard deviation of percentage of college education at the CBG level.

These results seem to offer support for common assumptions in models of the decision rights allocation process in the organizational economics literature.

## 3.7 Tables

Table 3.1: Delegation summary statistics

| **Decision centralized** | **Mean** | **Std. Dev.** | **Min.** | **Max.** | **N** |
|---|---|---|---|---|---|
| Training | 0.457 | 0.5 | 0 | 1 | 138 |
| Hiring | 0.225 | 0.419 | 0 | 1 | 138 |
| Marketing | 0.601 | 0.491 | 0 | 1 | 138 |
| Software purchases | 0.833 | 0.374 | 0 | 1 | 138 |
| Facilities upgrade | 0.732 | 0.445 | 0 | 1 | 138 |
| Organizational structure | 0.521 | 0.502 | 0 | 1 | 119 |
| Internet strategy | 0.521 | 0.502 | 0 | 1 | 119 |
| Inventory strategy | 0.353 | 0.48 | 0 | 1 | 119 |

Table 3.2: Propensity of high coordination value tasks to be centralized versus a high information difference task

| | | H: mean(x-Hiring)>0 p-values |
|---|---|---|
| x | P(Centralized) | 0.225 |
| Software | 0.833 | 0.0000 |
| Marketing | 0.601 | 0.0000 |

Table 3.3: Summary statistics

| **Variable** | **Mean** | **Std. Dev.** | **Min.** | **Max.** |
|---|---|---|---|---|
| SD customer income | 22006.906 | 8002.771 | 3785.599 | 54797.902 |
| SD college | 0.162 | 0.033 | 0.046 | 0.239 |
| FTEs | 13.087 | 6.877 | 2 | 40 |
| Dist to closest competitor | 19.851 | 15.88 | 0.035 | 94.368 |
| Avg dist to customer | 53.429 | 17.232 | 26.521 | 120.604 |
| N | | 138 | | |

Table 3.4: Propensity to delegate hiring as a function of environmental volatility as measured by variance of customers' income

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | | hiring centralized | | |
| SD customer income | -8.02e-06** | -8.30e-06** | -9.04e-06** | -1.22e-05* |
| | (3.57e-06) | (3.55e-06) | (3.63e-06) | (6.23e-06) |
| FTEs | | 0.00698 | 0.00661 | 0.0106 |
| | | (0.00583) | (0.00585) | (0.00690) |
| Avg dist to customer | | | 0.000311 | 0.000702 |
| | | | (0.00276) | (0.00309) |
| Dist to closest competitor | | | -0.00159 | -0.00111 |
| | | | (0.00273) | (0.00367) |
| Constant | 0.401*** | 0.316** | 0.352* | 0.339 |
| | (0.0957) | (0.127) | (0.193) | (0.214) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.023 | 0.037 | 0.039 | 0.166 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: Propensity to delegate software purchase as a function of environmental volatility as measured by variance of customers' income

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | software purchasing centralized | | | |
| SD customer income | 1.57e-06 | 1.63e-06 | 2.91e-06 | -2.20e-06 |
| | (3.40e-06) | (3.41e-06) | (3.60e-06) | (6.43e-06) |
| FTEs | | -0.00132 | 0.000228 | 0.00137 |
| | | (0.00477) | (0.00461) | (0.00589) |
| Avg dist to customer | | | -0.00474** | -0.00316 |
| | | | (0.00227) | (0.00242) |
| Dist to closest competitor | | | 0.00590*** | 0.00312 |
| | | | (0.00185) | (0.00280) |
| Constant | 0.799*** | 0.815*** | 0.903*** | 0.971*** |
| | (0.0837) | (0.101) | (0.174) | (0.250) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.001 | 0.002 | 0.048 | 0.133 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Propensity to delegate hiring as a function of environmental volatility as measured by variance of percentage of customers with college education

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | hiring centralized | | | |
| SD college | -2.300** | -2.311** | -2.888** | -2.932 |
| | (1.084) | (1.132) | (1.286) | (1.791) |
| FTEs | | 0.00661 | 0.00614 | 0.0104 |
| | | (0.00587) | (0.00591) | (0.00714) |
| Avg dist to customer | | | -0.000864 | -0.000535 |
| | | | (0.00275) | (0.00303) |
| Dist to closest competitor | | | -0.00201 | -0.00105 |
| | | | (0.00268) | (0.00354) |
| Constant | 0.596*** | 0.512** | 0.697** | 0.612* |
| | (0.188) | (0.209) | (0.301) | (0.366) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.032 | 0.044 | 0.052 | 0.171 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: Propensity to delegate software purchase as a function of environmental volatility as measured by variance of percentage of customers with college education

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | software purchasing centralized | | | |
| SD college | 0.719 | 0.721 | 0.997 | 0.675 |
| | (0.848) | (0.852) | (0.953) | (1.180) |
| FTEs | | -0.00126 | 0.000385 | 0.00141 |
| | | (0.00475) | (0.00461) | (0.00595) |
| Avg dist to customer | | | -0.00433* | -0.00294 |
| | | | (0.00234) | (0.00250) |
| Dist to closest competitor | | | 0.00607*** | 0.00391 |
| | | | (0.00183) | (0.00262) |
| Constant | 0.717*** | 0.733*** | 0.778*** | 0.785*** |
| | (0.145) | (0.145) | (0.238) | (0.287) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.004 | 0.004 | 0.051 | 0.134 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.8: Propensity to delegate marketing decisions as a function of environmental volatility as measured by variance of percentage of customers' income

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | marketing decisions centralized | | | |
| SD customer income | -5.23e-06 | -4.43e-06 | -4.90e-06 | -6.79e-06 |
| | (5.43e-06) | (5.14e-06) | (5.33e-06) | (8.34e-06) |
| FTEs | | -0.0199*** | -0.0194*** | -0.0194** |
| | | (0.00532) | (0.00530) | (0.00745) |
| Avg dist to customer | | | -0.00283 | -0.00280 |
| | | | (0.00281) | (0.00289) |
| Dist to closest competitor | | | 0.00122 | -0.00120 |
| | | | (0.00293) | (0.00412) |
| Constant | 0.717*** | 0.959*** | 1.091*** | 1.178*** |
| | (0.124) | (0.127) | (0.194) | (0.235) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.007 | 0.084 | 0.091 | 0.219 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.9: Propensity to delegate marketing decisions as a function of environmental volatility as measured by variance of percentage of customers with college education

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | marketing decisions centralized | | | |
| SD college | -0.320 | -0.287 | -0.635 | -1.674 |
| | (1.265) | (1.307) | (1.467) | (1.873) |
| FTEs | | -0.0201*** | -0.0196*** | -0.0195*** |
| | | (0.00539) | (0.00537) | (0.00731) |
| Avg dist to customer | | | -0.00303 | -0.00351 |
| | | | (0.00288) | (0.00291) |
| Dist to closest competitor | | | 0.00149 | -0.00119 |
| | | | (0.00299) | (0.00406) |
| Constant | 0.653*** | 0.911*** | 1.093*** | 1.339*** |
| | (0.208) | (0.221) | (0.319) | (0.372) |
| Modal nameplate FE | | | | y |
| Observations | 138 | 138 | 138 | 138 |
| R-squared | 0.000 | 0.079 | 0.087 | 0.220 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# Chapter 4

# Warranties, Vertical Integration, and Leasing in Durable Goods Markets: Explaining the Existence of Independent Lessors

## 4.1 Introduction

Leasing is an increasingly important feature of many durable goods markets. Consumer automobile leasing, in particular, 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[1] before settling at 23% in 2002 (Finlay 2002). Manufacturers initiated much of this growth in the early 1990s, raising consumer awareness of car leasing from 22% in October 1990 to 72% in October 1992[2]. Academic interest in the subject has increased commensurately. Areas of academic interest have included, among others, explaining the contractual benefits of leasing, explaining the coexistence of leasing and sales, and exploring a firms' lease-or-buy decision. What hasn't received significant attention, however, are the competitive interactions between firms in durable goods markets in which leasing is prevalent.

In the automobile leasing industry, in particular, there are a number of major players, including major captives, pure lessors, banks, and even some dealer lessors. The dominant industry lessors over the past decade have been the captives, which held a 46% leasing market share in 2000[3]. The fact that many of the largest players in the industry are vertically integrated has significant implications for the nature of competition. Pierce (2008) shows that captives have advanced knowledge of the manufacturer's product timeline that independents do not have and that it affects the lease terms they offer. Pierce (2010)

[1]Data from CNW Marketing/Research, cited in Bank Participation in U.S. Retail Automobile Leasing: An Overview. Toronto: Vertex Consultants, Inc. 1998. Page 8.

[2]CNW Marketing/Research. Leasetrak 1995.

[3]Data from CNW Marketing/Research, reported by Federal Reserve Bank of Cleveland Supervision and Regulation Department, Volume Three, Issue One.

shows that captives are also empowered by their manufacturer to subsidize, or subvent, unpopular models, which independents are not able to do. It is believed in the industry that this practice has significantly contributed to the captives' market share growth[4].

The significant competitive advantages of the vertically integrated lessors raise the question of how independent lessors are able to remain competitive. Significant effort has gone into explaining the coexistence of leases and sales. This paper seeks to explain the coexistence of vertically integrated and independent lessors.

We propose that the existence of warranties in the sale market allows independent lessors to free-ride on maintenance costs. This reduced exposure to durability risks for leases shorter than the term of the warranty makes independents more competitive in this segment of the market. As such, we predict that independents will have greater market share among leases with terms shorter than the warranty. We find support for our empirical predictions using data from 200,000 individual car leases between 1997-2002.

These results contribute to our understanding of leasing in durable goods markets in several ways. First, we acknowledge the importance of organizational form in leasing terms, and demonstrate the puzzle of this heterogeneity among firms. Second, we highlight the importance of warranties, which had not been integrated into formal models of durable goods leasing, and describe their implications for the competitiveness of independent firms in the market. Third, we are able to test these predictions and demonstrate that firms' product offerings are consistent with our explanation of heterogeneity in the market.

This paper also contributes to the literature on the theory of the firm and vertical integration. Empirical studies of vertical integration have typically looked at firms' choice of whether or not to vertically integrate. This paper takes a complementary approach. We take as given that some firms are vertically integrated and investigate the existence of independent firms. In essence, we look at the choice of large firms that do not compete with the manufacturer to enter the leasing market. This can also be described as the effect of vertical integration on lateral entry.

The remainder of the chapter continues as follows. Section 4.2 describes related literature on leasing in durable goods markets, warranties, and vertical integration. Section 4.3 describes choices of lessors in durable goods markets, the competitive advantages of captives over independents, and the proposes that warranties may be the source of independents' competitiveness. We derive predictions and then describe the data we use to test them in section 4.4. In section 4.5 we test our predictions, section 4.6 verifies the robustness of those predictions, and section 4.7 concludes.

## 4.2 Related Literature

This paper contributes to two threads of active work: leasing in durable goods markets and vertical integration and the boundary of the firm.

Leasing has been of great interest in the literature since Coase (1972) suggested that it could be a solution to the problem that durable goods monopolists will be forced

[4]An explanation of the history and practice in the automobile industry can be found in "Bank Participation in U.S. Retail Automobile Leasing: An Overview". Toronto: Vertex Consultants, Inc. 1998. Page 8.

to charge competitive prices because they are, in effect, competing with themselves. The subsequent literature on the subject sought to characterize the optimal behavior of durable goods producers (Bulow 1982, Kahn 1986). These models, however, did not explain the fact that, in many markets, leasing coexists with sales. Desai and Purohit (1998) highlight this fact and demonstrate that the durability of the good is central to whether leasing or sales are more profitable. Furthermore, they show that when leased and sold goods depreciate at different rates, it is in the best interest of the manufacturer to mix the two. Later works, many focused specifically on the automotive industry, featured models that allowed both sales and leasing contemporaneously. Many of these models focused on the role of adverse selection of the quality of goods returned after the lease term (Hendel and Lizzeri 1999, Hendel and Lizzeri 2002, Johnson and Waldman 2003).

These models contributed a more nuanced picture of the interaction between leases and sales, but because they features a single producer, can't address competition. To the best of our knowledge, the first model to address competition in the leasing market is Desai and Purohit (1999), which investigates the optimal mixture of sales and leasing as a function of competition in the market. Including competition adds significant nuance and makes progress towards describing many of the markets for durable goods that we observe in the real world. Further progress, however, requires accommodating a type of heterogeneity we observe in the automotive, and many other, markets; organizational form. As noted previously, the automotive market is characterized by both vertically integrated captive lessors and independent lessors. The work that has investigated differences between these two types has shown significant competitive advantages for the vertically integrated firms. This paper builds on this previous work by further elucidating this previously neglected dimension of heterogeneity in the market. Furthermore, we highlight how warranties, which have not been modeled in the previous literature, can allow independents to flourish in one segment of the leasing market. In addition, we provide empirical evidence supporting evidence of this conjecture.

The second literature to which this work contributes is the that on vertical integration and the boundaries of the firm. The literature on the boundary of the firm can be roughly divided into three categories: theoretical work on the determinants of vertical integration, theoretical work on the implications of vertical integration, and empirical tests of the aforementioned theories.

The first group seek to predict firms' decision to vertically integrate. A number of different potential determinants have been investigated. Williamson (1971), among others, highlights contractual difficulties and transaction costs. Grossman and Hart (1986) and Hart and Moore (1990), among others, focus on agency problems revolving around the allocation of property rights.

The second group investigates the implications, in terms of prices and welfare, of vertical integration. For example, Spengler (1950) highlights the fact that vertical integration may improve prices by solving the double marginalization problem. In a subsequent model by Salinger (1988) model, however, the effect of vertical integration on prices set by oligopolists in Cournot competition is ambiguous because integration can raise the costs of unintegrated downstream firms. Salinger (1988) also raises the issue of vertical integration also raising rivals' costs, which is also explored by Salop and Scheffman (1987). The result

of much of this literature is that the implications of vertical integration, for both rivals and consumers, are sensitive to features of the industry. We contribute to this literature by raising another feature of interaction between integrated and independent firms. Market externalities of strategic decisions by the downstream integrator, in this case the fact that offering warranties is a dominant strategy by manufacturers, can generate competitive advantages for independent rivals.

This paper also contributes to the empirical literature testing theories of the implications of vertical integration. LaFontaine and Slade (2007) provides a valuable summary of that literature, and of the empirical work testing theories of the predictors of vertical integration.

## 4.3 Durable goods leasing

A wide literature has addressed the role of leasing in the business of durable goods firms. At its most basic, offering leases allows the firm to discriminate between customers that have a very high value for having a new product. With leases, these customers are able to frequently replace their item without going through the effort of reselling it. Customers that are not constrained by that high value will instead purchase and hold the item for a longer term.

Leases, however, should also be viewed as risky investments. When a firm offers a lease, they are effectively betting that the combination of the resale value of the returned good and the income stream from the lease will be sufficient to balance out the cost, and cost of capital, associated with the original good. This bet could go awry a number of different ways. The first is that the lessee could default and the income stream from the lease will cease. In this case, the good will be returned to the lessor, but if the lease payments are constant, the rents they've received will be insufficient to cover the depreciation of the good up to that point.

A second possible risk is that the value of the good at the end of the lease is not what was originally anticipated. This low value could be because the good was returned in poor condition. Lease contracts are able to specify some requirements that can make the lessee compensate the lessor for returning the good in poor condition. Uncontractible quality dimensions, however, can be a source of risk. Even if the good is returned in the expected condition, the value of the good may be lower than expected if the demand for it is lower than expected or the supply of supplementary goods is higher than expected.

The magnitude of all three of the aforementioned risks, payment stream, condition, and value, are increasing in the length of the lease term. All things equal, a customer with a very long lease term is more likely to face a shock to their finances that would prevent them from being able to pay the remainder. Customers with longer term leases are also more likely to have an event, like an accident, that would damage the condition of the item. Thirdly, it is harder to predict the market conditions the returned good will face at the end of a long term lease than at the end of a short one. Further inflating this risk is that the risk of multiple loans is not independent. Common economic shocks can make it difficult for many lessees to pay off their leases. Common shocks can also affect the value of returned goods. As such, the risk associated with leases is correlated across leases. An undiversified

firm, therefore, is quite exposed to these shocks if it offers long term leases. As such, we might expect that, all else equal, diversified firms would be better able to write leases with longer terms.

**Hypothesis 8** *Longer term leases are more likely to be written by more diversified firms.*

In order for this prediction to be useful, however, we must understand why some firms may be less diversified. One possible reason is that financial transactions are an ancillary portion of their business. As mentioned previously, leasing has often been viewed as a mechanism of price discrimination to be offered by manufacturing firms. In the automotive industry, for example, nearly 50% leases are underwritten by captive arms of the auto manufacturers. Since these firms' primary business is manufacturing, it is understandable that they might be less diversified than a financial services firm, like a bank, that is offering leases.

Captive leasing arms that are vertically integrated into manufacturing firms, however, may also have substantial advantages over independent lessors, however. Captive lessors may have access to product line decisions by the manufacturer, for example. To the extent that future versions of the product may be a substitute for the current product, understanding the product roadmap of the manufacturer can substantially reduce the risk of value variability at the end of the lease term. A second possible advantage is incentives within the vertically integrated firm may be such that the leasing arm is empowered to subsidize, or subvent, certain products to reduce the manufacturers inventory[5]. An additional potential advantage of captives is that manufacturers often have mechanics on staff. This allows them to recondition products returned from leases at a relatively low price, compared to diversified financial firms.

Given the aforementioned competitive advantages the captive firms have over their independent competitors, it might seem that independent lessors would not be able to compete for shorter term leases. A second instrument used by the durable goods manufacturers, warranties, may provide a competitive advantage to independent lessors.

When product quality is uncertain, manufacturers may promise to provide repairs that arise under certain circumstances for a limited period of time. These warranties serve two purposes. First, warranties insure customers against certain types of failure of the product, thereby making the product more attractive. Second, the warranty can serve as a signal to customers of the products quality. In the automotive industry, for example, warranties on purchased cars are the norm. Manufacturers, however, are not able to determine whether the product's purchaser is the final consumer or an independent lessor who intends to lease the vehicle to the final consumer[6]. The fact that leased cars are warrantied may be the source of competitiveness for the independent lessors.

The process by which a lessee of a car is matched to a lease is as follows. A customer enters a car dealership and selects a model. Conferring with a salesperson, the

[5]Pierce (2008) demonstrates that captive arms of auto manufacturers have both of these advantages in writing leases.

[6]Even if the manufacturer could distinguish the two, it may be the case that the value of the signaling component of product quality enticing customers to lease, even if through and independent lessor, would be sufficient to make it worth it for the manufacturer to extend warranties to these vehicles as well.

customer explains their requirements and shares personal information the salesperson uses to look up their FICO score. The salesperson, in another rooms, enters the details into a software program from one of several lease platform vendors. This platform has what amount to a set of bidding rules from a set of potential lessors. Based on the details of the customer, the price of the vehicle, and the desired term of the lease, the salesperson is presented with a set of possible leases from multiple potential lessors. The salesperson selects one to present to the customer. In many cases, the salesperson can actually mark up the terms before presenting the lease. For example, suppose the best option presented by the lease software had an interest rate of 4%. Now suppose that the monthly payment the customer had indicated she was willing to pay combined with the capitalized cost of the automobile corresponded to a rate 5%. In that case, the salesperson could present the rate as being 5%, and if the customer accepted, the lessor would receive 4% and the dealer 1%. When the customer accepts a lease, the lessor purchases the car from the dealer and loans it to the customer at the specified rate. At the end of the term, the customer can opt to purchase the car at a pre-specified price, or return the car to the lessor. If the car is returned, the lessor prepares the vehicle for resale and then sells it, typically through an auction house called an automotive liquidator.

It is because the lessor bares the cost of reconditioning prior to liquidation that they are exposed to condition risk. Manufacturers' fleets of mechanics that service warranty claims also allow them to recondition vehicles from leases very inexpensively. The same process and cost applies to vehicles under lease sent in for warranty repairs versus those returned at the end of the lease. For manufacturers and their captive leasing arms, therefore, condition risk is ameliorated. This means that manufacturers are largely indifferent between issuing a lease longer or shorter than the duration of the warranty.

Independent lessors, on the other hand, are not indifferent with regard to the length of the lease and the length of the warranty. When a vehicle is returned from a lease after the warranty is over, the lessor bares the full cost of reconditioning. If the vehicle is returned before the end of the warranty, the lessor can submit a warranty claim with the manufacturer. In that case, some portion of the cost of reconditioning will be borne by the manufacturer. Independent lessors, therefore, bare an artificially low condition risk on leases with terms shorter than the length of the warranty. This low risk allows independent lessors to be more competitive on short leases, specifically those shorter than the term of the warranty. As such, independent lessors will more aggressively pursue leases with terms shorter than the vehicle's warranty.

Recall that manufacturers are equally exposed to condition risk for leases shorter and longer than the warranty because they bear the full cost of reconditioning either way. Independent lessors are exposed to the full condition risk of the product when they write a lease longer than the warranty. We should, therefore, expect that a independents hold a larger market share of leases shorter than the warranty than they do of leases longer than the warranty.

**Hypothesis 9** *Leases with terms longer than the associated warranty are more likely to be written by vertically integrated firms.*

The next section describes the data we use to test the aforementioned hypotheses about the sources of independent lessors' competitive advantage.

## 4.4 Data

The primary dataset for this study involves approximately 1 million individual consumer vehicle transactions from the years 1997-2001. Approximately 200,000 of these are leases, with another 800,000 being loans. These data come from a major supplier of marketing research information and include information identifying the vehicle by model, model year, and detailed options. Most importantly, each case lists the the name of the lessor, down payment, and other variables involved in the transaction. Each contract specifically identifies the type of vehicle and the terms and writer of the financing. The data are all from vehicle transactions in California, and are biased toward larger dealerships in urban areas. 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.

## 4.5 Methodology and Results

The ideal experiment for testing our hypotheses about the portions of the lease market in which independents are competitive would be to provide independent and captive lessors with a series of random leases and compare their bids. This exact strategy isn't feasible, but car choices and terms are made before the bids, and salespeople are aligned to select the most competitive bids. Therefore, we can compare the market shares of independents and lessors, where a market is defined as leases of a particular term length $t$ for car $k$ in a particular month $m$. For example, one market would be leases of 2000 Toyota Camrys with 24-month terms starting in February 2001.

For hypothesis 8, that more diversified, i.e. independent, firms will have a larger share of longer leases, we estimate the following linear relationship:

$$captive\_share_{ktm} = \alpha + \beta_1 * term_t + \gamma * controls_{km} + \epsilon_k \tag{4.1}$$

In order to limit variation to that of interest, we include fixed effects at the segment and nameplate levels as controls as well as a linear monthly time trend and the mean capitalized cost of vehicles in that market. Segments are, roughly defined, types of cars and include compact, subcompact, convertible, etc. Nameplates correspond roughly to brands. For example, General Motors manufacturers several nameplates including Chevrolet and Buick. Capitalized cost is included to assure that variation is not conflated with lessor specialization in high- or low-priced vehicles. The time trend absorbs variation from secular trends in market share by captives over time.

Because of the bidding process, selection of one lease precludes selecting another lease for the particular car. Its possible, therefore, that errors may be correlated within car $k$. As such, we allow errors to cluster at the ca level, where car is defined as the cross of the make, model, model year.

As predicted, the coefficient on the term of the lease in specification 1 in table 4.1 suggests that independent lessors, which are more diversified, have a higher share of longer leases than of shorter. Specifically, independents' market share seems to increase roughly 1.7% with each additional month of lease term.

To test hypothesis 9, that independent lessors will have a higher market share of leases with terms shorter than the warranty, we estimate a similar equation, but add a dummy variable of whether the lease term is such that there is less than 1 full month of warranty when the car is turned in. This variable corresponds to the percentage of cases where, by the time the vehicle is booked internally by the lessor, the warranty will have expired.

$$captive\_share_{ktm} = \alpha + \beta_1 * term_t + \beta_2 * warranty\_expired_{ktm} + \gamma * controls_{km} + \epsilon_k \quad (4.2)$$

As predicted, the coefficient on the term of the lease in specification 2 in table 4.1 suggests that independent lessors have a 5% higher share of leases where the warranty is active than of those where it is not.

## 4.6 Robustness

One effect that we demonstrate in section 4.5 is that independent lessors' market share is greater among leases shorter than the term of the warranty. We attribute this effect to the market externality of warranties that allows independents to free ride on the reconditioning by manufacturers. One might be concerned, however, that the warranty itself is a representation of the manufacturers' prediction of the vehicles' durability. To the extent that this is the case, our results are biased by the omission of a measure of the vehicles' durability.

To confirm the robustness of the results in table 4.1, we repeated the final regression with 4 alternate measures of durability collected from Consumer Reports. The measures we present are scores representing durability on a scale of 1-5 that represent the number of "major" repairs required by owners in their early years of ownership. The first measure is an overall score, and the subsequent three address repairs to the engine, transmission, and electrical system, respectively.

In order to allow the maximum flexibility, the durability measure is include non-parametrically as indicators for each level, with one, the lowest level of durability, omitted.

$$\begin{aligned} captive\_share_{ktm} = \alpha \quad &+ \quad \beta_1 * term_t + \beta_2 * warranty\_expired_{ktm} \\ &+ \quad \beta_3 * durability_{ktm} + \gamma * controls_{km} + \epsilon_k \end{aligned} \quad (4.3)$$

The results of estimating the linear relationship in equation 4.3 are presented in table 4.2. The first thing to note is that the predicted relationships between both lease term and the expiration of the warranty are robust to controlling for durability of the vehicle.

The second notable fact is that, controlling for warranty expiration, durability seems to have a negligible effect on the difference in market share between independents and captives. A few of the coefficients on durability of electrical systems are significant at low levels, and those all share a negative sign. This is consistent with two possible explanations. The first is, as demonstrated by Pierce (2008), that the captive lessors actively seek to subvent undesirable vehicles, and as such have a high market share in leases of those

vehicles. Vehicles with a reputation for low durability likely fall into this category. The second explanation is the idea that independents are exposing themselves to condition risk and, therefore, are more likely to participate in markets in which that is less of a concern.

## 4.7 Conclusion

A vast literature is dedicated to the study of leasing of durable goods. The reality in many durable goods markets, including the US auto market, is competition between independent and captive vertically integrated lessors. Prior work has shown that the captive lessors have significant competitive advantages over independents and raised the question of how independent lessors are able to compete. This work builds on that prior work by investigating a type of competition more representative of the empirical reality in the auto industry, proposing the addition of warranties to extent models, and demonstrating that the existence of these warranties improves the competitiveness of independent lessors.

First, we find that in the market for US auto leases, independent lessors compete more heavily in markets for longer term leases. This is consistent with the fact that, as generalized financial institutions, they are more diversified than captive lessors. Second, we find that independent lessors are more competitive in markets for leases that are shorter than the term of the warranty. This is consistent with possibility that independent lessors, for whom reconditioning is more expensive, are able to free ride on reconditioning by manufacturers when the vehicle is returned under warranty.

These results also contribute to the literature on the boundary of the firm and vertical integration. Whereas a significant portion of this literature has focused on the possible anticompetitive effects of vertical integration, there results demonstrate how externalities of the main business of the upstream firm can improve competitiveness of lateral competitors of the downstream firm.

## 4.8 Tables

Table 4.1: Captive lessor market share as a function of lease and product characteristics

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | Captive market share | | |
| Capitalized cost | 1.01e-06** | -1.09e-06** | -1.02e-06* |
| | (4.92e-07) | (5.54e-07) | (5.53e-07) |
| Lease term | -0.0189*** | -0.0179*** | -0.0187*** |
| | (0.000282) | (0.000318) | (0.000377) |
| Warranty expired | | | 0.0442*** |
| | | | (0.0144) |
| Time trend | Y | Y | Y |
| Nameplate fixed effects | | Y | Y |
| Segment fixed effects | | Y | Y |
| Constant | 1.153*** | 1.189*** | 1.192*** |
| | (0.0254) | (0.0228) | (0.0227) |
| Observations | 6447 | 6447 | 6447 |
| $R^2$ | 0.398 | 0.522 | 0.523 |

Robust standard errors in parentheses - Errors clustered at car-level

*** p<0.01, ** p<0.05, * p<0.1

Table 4.2: Robustness of captive lessor market share results to product durability

| VARIABLES | Captive market share | | | |
|---|---|---|---|---|
| Durability measure | Overall | Engine | Transmission | Electrical |
| Capitalized Cost | -1.25e-06*** | -0.0000012* | -1.22e-06* | -1.24e-06* |
| | (0.000000653) | (0.000000649) | (0.000000652) | (0.000000653) |
| Lease term | -0.0188975*** | -0.0189014*** | -0.0189181*** | -0.0188933*** |
| | (0.0004125) | (0.0004125) | (0.0004135) | (0.0004136) |
| Warranty exp. | 0.0453592*** | 0.0450289*** | 0.045719*** | 0.0445849*** |
| | (0.0154954) | (0.0155) | (0.015516) | (0.0155177) |
| Durability=2 | | -0.0611986 | | -0.0645586** |
| | | (0.0587002) | | (0.0325494) |
| Durability=3 | -0.0150271 | 0.0433885 | 0.0534713 | -0.0510921 |
| | (0.0128324) | (0.0711058) | (0.0339641) | (0.0336878) |
| Durability=4 | 0.0145872 | -0.0330387 | 0.0347487 | -0.0595837* |
| | (0.0161035) | (0.0620156) | (0.0312224) | (0.0357171) |
| Durability=5 | | -0.041546 | -0.0015084 | -0.0726344* |
| | | (0.0618771) | (0.0329091) | (0.041401) |
| Time trend | Y | Y | Y | Y |
| Nameplate FE | Y | Y | Y | Y |
| Segment FE | Y | Y | Y | Y |
| Constant | 1.190598*** | 1.221939*** | 1.160306*** | 1.23881 |
| | (0.026837) | (0.065254) | (0.0386423) | (0.0392546) |
| Observations | 5169 | 5169 | 5169 | 5169 |
| $R^2$ | 0.5382 | 0.5384 | 0.5385 | 0.5389 |

Robust standard errors in parentheses - Errors clustered at car-level

*** p<0.01, ** p<0.05, * p<0.1

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# Appendix A

University of California, Berkeley – Yale University
Study on High Performing Dealerships

## About you

1. Your Name (This will only be used for sending you a gift to thank you for your help. We will delete your name as soon as we have sent the gift.)

   _____

2. Your position at the dealership

   - ❑ A) Owner/Dealer Principal
   - ❑ B) General Manager
   - ❑ C) General Sales Manager
   - ❑ D) Sales Manager
   - ❑ E) Other _____

3. How many years have you worked with this dealership?:_____

## About Your Dealership

4. How many years has the dealership been in operation?: _____

5. How many years has the dealership been under its current owner?: _____

6. Is your dealership part of a larger auto group or set of dealerships?

   - ❑ Yes
   - ❑ No → (SKIP to question 9)

7. (If you answered Yes to question 6) What is your auto group or dealership group called?

   _____

8. (If you answered Yes to question 6) Which of the following decisions are made centrally by the auto group? (MARK ALL THAT APPLY)

   - ❑ A) Salesperson Compensation
   - ❑ B) Training
   - ❑ C) Hiring
   - ❑ D) Marketing and Promotions Strategy
   - ❑ E) Software purchase (CRM, etc.)
   - ❑ F) Facilities upgrades
   - ❑ G) Structure/Org Chart (whether you have a BDC, using ISMs or regular salespeople for Internet sales)
   - ❑ H) Internet Strategy
   - ❑ I) Inventory

9. Which of the following can a prospective customer do on your website? (MARK ALL THAT APPLY, ESTIMATE YEAR IF YOU DON'T KNOW)

| | Yes | Since? |
|---|---|---|
| View Hours, Phone number, Address | ❑ | ___ |
| Submit contact info and request an appointment with a salesperson | ❑ | ___ |
| Receive a quote on a particular car | ❑ | ___ |
| Browse Real-Time Inventory | ❑ | ___ |
| Complete a Purchase | ❑ | ___ |

10. How many salespeople are on your payroll at one time (on average): _____

11. How many salespeople do your HIRE per month (on average): _____

12. Of the salespeople you hire each month how many are (on average) (MUST ADD TO 100%):

    a. Growth _____
    b. Replacing previous staff _____

13. Of the salespeople you are replacing each month how many were (on average) (MUST ADD TO 100%):

    a. Dismissed/Fired _____
    b. Resigned/Quit _____

14. Does your dealership have a Business Development Center or office of sales or follow-up staff who don't work on the showroom floor?

    ❑ Yes
    ❑ No → (SKIP to question 17)

15. How many staff do you have in you Business Development Center: _____

16. Which of the following does your Business Development Center staff or office of sales or follow-up staff do (MARK ALL THAT APPLY):

    ❑ A) Provide Initial contact with customers and scheduling
    ❑ B) Provide follow-up with customers
    ❑ C) Other (Please explain)
    _____

17. What is your advertising budget for NEW cars per month, on average (not including buying leads): _____

18. What is your advertising budget for USED cars per month, on average (not including buying leads): _____

19. If you buy leads, what is your budget for leads per month (on average): _____

20. What percent of the units on your lot are used cars: _____

21. What percent of your used cars are the same nameplate as your new cars: _____

22. How many FLEET cars do you sell on average, each month: _____

23. How many non-fleet NEW cars do you sell on average, each month: _____

24. How many non-fleet USED cars do you sell on average, each month: _____

25. Do you provide formal sales training to sales staff when they are first hired? (MARK ALL THAT APPLY)

    ❑ A) Internally-designed (for example, by a sales manager) class
    ❑ B) Internally-designed reading materials
    ❑ C) Third-Party reading materials
    ❑ D) Third-Party (for example, consultant) class
    ❑ E) Shadowing or Mentorship
    ❑ F) No formal training (ONLY IF NO OTHERS MARKED)

26. Do you provide any training specific to selling over the Internet? (MARK ALL THAT APPLY)

    ❑ A) Internally-designed (for example, by a sales manager) class
    ❑ B) Internally-designed reading materials
    ❑ C) Third-Party reading materials

- ❑ D) Third-Party (for example, consultant) class
- ❑ E) Shadowing or Mentorship
- ❑ F) No formal training

27. How are your facilities compared to competing dealerships of the SAME nameplate

- ❑ A) Much Nicer
- ❑ B) Nicer
- ❑ C) About the Same
- ❑ D) Less Nice
- ❑ E) Much Less Nice

28. How are your facilities compared to competing dealerships of COMPETING nameplates

- ❑ A) Much Nicer
- ❑ B) Nicer
- ❑ C) About the Same
- ❑ D) Less Nice
- ❑ E) Much Less Nice

## About Your Sales Process

29. About how many salespeople do you have on the floor on a given Saturday?: _____

30. What determines which salesperson is responsible for a walk-up customer or "up" (MARK ONLY ONE)

- ❑ A) Whichever salesperson approaches the "up" first or "calls" their car on approach
- ❑ B) Equal rotation among sales reps on the floor
- ❑ C) According to recent sales performance of rep

31. Do you have any of the following systems for tracking customers - including walk in, Internet leads, phone or any combination of the above? (MARK ONLY ONE)

- ❑ A) Log book of leads
- ❑ B) Excel Spreadsheet or Axess or Filemaker Database of leads
- ❑ C) CRM Software ( for example Dealersocket or Autobase)
- ❑ D) We don't need a system for tracking leads

32. How detailed is your lead tracking?

- ❑ A) We don't need to track leads, we only track sales
- ❑ B) We count leads to the dealership, but not which salesperson was responsible for them.
- ❑ C) We track leads to the dealership and which salesperson helped them. We don't distinguish Internet leads from other leads.
- ❑ D) We track leads to the dealership, which salesperson met them originally, and if those leads were handed off to another salesperson. We can distinguish leads that originally came from the Internet.

33. Which of the following best describes your sales process:

- ❑ A) A "Closer" system - customers are greeted by someone different from the person who ultimately negotiates the sale price → (SKIP to question 35)
- ❑ B) A "Straight-Sell" system - the salesman greeting a customer negotiates the sale price → (SKIP to question 39)
- ❑ C) A "Hybrid" system – some salespeople have to hand customers off to a closer, but others can negotiate the sale price themselves
- ❑ D) "No Haggle/One Price" system – the price is preset and not subject to negotiation (though financing options may be negotiable) → (SKIP to question 39)

34. (Answer only if you answered C to question 33) What determines which salespeople have closers (MARK ONLY ONE):

- ❑ A) New salespeople have closers
- ❑ B) Poor performers have closers

- ❑ C) Non -Internet salespeople have closers
- ❑ Closers are available if salesperson needs help or need to negotiate a price lower than they are allowed
- ❑ D) Other _____

35. How many Closers do you have in on an average Saturday: _____

36. Which of the following types of compensation do Closers get? (MARK ALL THAT APPLY):

- ❑ A) Base Salary
- ❑ B) % of gross
- ❑ C) Flat amount per unit or Volume
- ❑ D) Performance matrix (For example: X amount for each appointment showed, CSI scores etc.)

37. How many deals does an average Closer participate in, in an average month: _____

38. How much does an average Closer make in an average month, including all sources (including commission, bonuses, spiffs, etc.):

- ❑ A) Less than $3,000
- ❑ B) $3,000-$4,000
- ❑ C) $4,000-$5,000
- ❑ D) $5,000-$6,000
- ❑ E) $6,000-$7,000
- ❑ F) More than $7,000

39. How do you handle sales to Internet Leads?

- ❑ A) We have dedicated Internet Sales managers and Internet Sales people who **only** handle Internet leads
- ❑ B) Internet Sales are handled by our FLEET department → (SKIP to question 45)
- ❑ C) Internet Sales are handled by our regular floor sales staff → (SKIP to question 45)

40. How many dedicated Internet Sales Staff do you have: _____

41. What determines which staff are dedicated to only Internet Sales:

- ❑ A) They are hired specifically for the position
- ❑ B) Strong sales floor performance
- ❑ C) Expressed interest in the position

42. Which of the following types of compensation do Internet Sales Staff get (MARK ALL THAT APPLY):

- ❑ A) Base Salary
- ❑ B) % of gross
- ❑ C) Flat amount per unit or Volume
- ❑ D) Performance matrix (For example: X amount for each appointment showed, CSI scores etc.)

43. How many deals does an average Internet Sales person do in an average month: _____

44. How much does an average Internet Sales person make in an average month, including all sources (including commission, bonuses, spiffs, etc.):

- ❑ A) Less than $3,000
- ❑ B) $3,000-$4,000
- ❑ C) $4,000-$5,000
- ❑ D) $5,000-$6,000
- ❑ E) $6,000-$7,000
- ❑ F) More than $7,000

45. (ANSWER ONLY IF YOU ANSWERED B or C TO QUESTION 39 AND D TO QUESTION 33) If you DON'T have dedicated Internet Sales Staff, How are Salespeople who make Internet Sales compensated for an Internet Sale (MARK ONLY ONE):

- ❑ A) The Same as their regular sales
- ❑ B) Higher % of gross than non-Internet sales
- ❑ C) Lower % of gross than non-Internet sales

- ❑ D) Flat amount per unit
- ❑ E) No commission on Internet sales

46. Which of the following types of compensation do Floor Sales people get for **non-Internet floor** sales? (MARK ALL THAT APPLY)

- ❑ A) Base Salary
- ❑ B) % of gross
- ❑ C) Flat amount per unit or Volume
- ❑ D) Performance matrix (For example: X amount for each appointment showed, CSI scores etc.)

47. About how many cars does an average Floor Sales Person sell in an average month: _____

48. How much does an average Floor Sales Staff make in an average month, including all sources (including commission, bonuses, spiffs, etc.):

- ❑ A) Less than $3,000
- ❑ B) $3,000-$4,000
- ❑ C) $4,000-$5,000
- ❑ D) $5,000-$6,000
- ❑ E) $6,000-$7,000
- ❑ F) More than $7,000

49. About how much do you give out per month in Spiffs and Bonuses to Floor Sales staff, (on average): _____

50. Do you have a dedicated Fleet sales staff?

- ❑ Y
- ❑ N→ (DONE!)

51. Which types of compensation do FLEET Car Sales people get for **non-Internet sales** (MARK ALL THAT APPLY)?

- ❑ Base Salary
- ❑ % of gross
- ❑ Flat amount per unit or Volume
- ❑ Performance matrix (For example: X amount for each appointment showed, CSI scores etc.)

52. How many cars does an average Fleet salesperson sell in an average month: _____

53. How much does an average Fleet Sales Staff make in an average month, including all sources (including commission, bonuses, spiffs, etc.):

- ❑ A) Less than $3,000
- ❑ B) $3,000-$4,000
- ❑ C) $4,000-$5,000
- ❑ D) $5,000-$6,000
- ❑ E) $6,000-$7,000
- ❑ F) More than $7,000

# Appendix B

Revisiting the model with a continuum of customer types provides insight into the firms' ability to attribute effort to employees. Now suppose that the distribution of customer valuations $\Theta$ is such that the payoffs to the salesperson from making a sale $\theta$ is distributed uniformally $[0, 1]$.

As described above, each sale is handled by a single salesperson, and, as such, the principal can attribute the outcome directly to that salesperson. Suppose that after the first offer is made the customer leaves with probability $(1 - \lambda)$ ending the negotiation, then returns another day to negotiate, but is matched with a different salesperson. When the customer returns, the customer can present a quote to the new salesperson allowing him to begin the negotiation from the second period. The first salesperson receives no compensation.

To solve for the optimal prices for the salesperson to offer, we begin with the second period. Consider a customer who returns in period 2 after being offered $p_1$ in period 1. Because all customers know that the second offer $p_2$ is the final offer, all who would receive positive utility from purchasing,$\theta > p_2$, will do so, regardless of whether they are truthful or strategic. The firm's objective function for the second period is:

$$\pi_2 = t\frac{p_1 - p_2}{p_1}p_2 + (1 - t)\frac{1 - p_2}{1}p_2 \tag{.4}$$

Solving the first order condition yields the optimal second period price as a function of the first.

$$p_2^*(p_1) = \frac{p_1}{2(p_1(1 - t) + t)} \tag{.5}$$

Equation .5 makes intuitive sense. If all customers were truthful, then the salesperson would simply offer half of the previous price, the expected value of the remainder of the game, conditional on all the truthful types with valuations $\theta > p_1$ having purchased in the first round. We know that strategic types wait for the second period, so if there were no truthful types the entire distribution remains in the second period and the salesperson offers $p_2 = \frac{1}{2}$, the expectation of the remaining types.

Given the optimal second period price $p_2^*(p_1)$, we can derive the optimal first period price. First we write the profit function for the first period.

$$\pi_1 = tp_1\frac{1 - p_1}{1} + (1 - (t\frac{1 - p_1}{1}))\lambda\pi_2 \tag{.6}$$

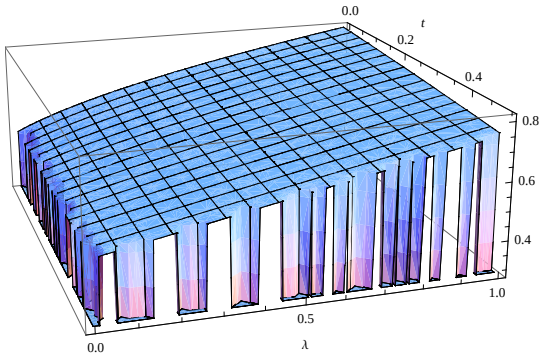
Looking at equation .6 we can see that setting $p_1$ has two effects. The first effect is determining the profit in the first period. The second effect is in determining the option value of the second period. Raising the first period price increases the likelihood of the second period happening at all, but it also increases the range of customer valuations left in the second period, thereby raising the expected value.

The probability of staying, $\lambda$, has a moderating effect on the option value of the second period. When the customer is sure to leave, $\lambda = 0$, then the game collapses to a

single offer game. When that happens, the proportion of truthful types drops out because strategic types are no longer able to pool by waiting, and the optimal price is $p = \frac{1}{2}$.

A salesperson whose contribution to a team effort cannot be observed has the incentive to shorten the negotiation process by lowering prices too quickly. In the context of the model, this means that the option value from the second period is artificially low for a salesperson when the firm can't attribute a returning customer to him. When the option value of the second period decreases, the first period price will decrease. Another way to think of this is that the choice the salesperson is making in choosing the first period price involves making a deviation from the one period optimal price in such a way that the loss from deviating from that optimal is superseded by the gain in option value from the second period. Intuitively, therefore, if $\lambda$ were to decrease, the option value of the second period would decrease and the first period price would also decrease. One way to think of this is that the salesperson is concerned about losing the sale and drops his first period offer to increase the probability of making the sale in the first period before the customer disappears. This intuition is confirmed by figure .1, which shows the optimal $p_1$ is a function of $\lambda$ and $t$.

Figure .1: Optimal $p_1^*$ as a function of $\lambda$ and $t$




We can think of this model as describing a situation where, with probability $(1-\lambda)$, the sales effort becomes a team problem unbeknownst to the firm. The ability to observe a customer is equivalent to a lower probability $\lambda$ of the negotiation ending exogenously after each period. An information tracking system that would improve the firm's ability to observe when a customer had left and then returned would improve their ability to price discriminate by aligning the interests of the salesperson, who was concerned about losing the sale, with the firm, which profited from the sale anyway.

Ideally the firm would always know when a customer had returned, but the technology for this is costly. The dealership must maintain a log of customers that uniquely identify individuals who return. More importantly, the dealership must enforce that salespeople check this system when they meet a new customer despite the possible cost of a portion of the compensation for the sale. When this system is in place, and used, then the dealership can observe, and correctly compensate salespeople for starting a transaction that is closed by another salesperson.

# Appendix C

The implication of the model in section 2.3 is that firms with closers' gain in performance comes from being able to complete sales to all truthful low valuation types. As a comparison, dealers with a parallel sales system only sell to low valuation truthful customer when such a customer happens to face a good salesperson. The economic magnitude of the gains from a hierarchal sales system are limited by the size of $t$. On the other hand $t$ is capped, by the assumption that condition 2.1 holds. This raises the question of how high $t$ can be, and by extension, how big can the gains from closers be, under condition 2.1. Define $k$ to be the ration of the payment from selling at $H$ to the payment from selling at $L$, $h/l$. Figure .2 demonstrates that $t$ need not actually be that small to meet condition 2.1.

Figure .2: Region in which the salesperson does not offer $L$