Used-Car Dealer Reputation: Pricing Evidence from the Wholesale Market

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Abstract

We examine the determinants of used-car prices in a dealer-to-dealer wholesale market using a large proprietary database of transaction-level data. One unique feature of this database is the inclusion of post-sale arbitration records that allows us to match buyer-initiated complaints to the selling dealer. We use these arbitration records to construct a dealer-specific reputation measure that is inversely related to the probability of entering into post-sale arbitration. Our main empirical results show that buyers are willing to pay a statistically and economically significant price premium for an equivalent used car when transacting with a high-reputation seller. We investigate the dynamics of reputation building and find that, while reputations are relatively sticky, they can be altered substantially over the course of several weeks. Overall, our study provides new evidence on an effective counteracting mechanism that reduces the social costs of asymmetric information.

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Akerlof's (1970) seminar paper on the lemons problem set in motion a highly-productive stream of research that examines the causes, dynamics, and consequences of asymmetric information and adverse selection. Although a lemons problem exists in many diverse environments, no setting is more central to the original 1970 paper, or to subsequent research, than that of the used-car market. Used-car sellers have privileged, price-sensitive information about the quality of their cars that cannot be credibly conveyed to potential buyers. This asymmetric information structure is combined with an adverse selection incentive caused by the application of a common price to the average-quality used car. Akerlof (1970) shows that sellers with higher-than-average quality cars systematically withdraw from the process, leaving the marketplace dominated by sellers with lower-than-average quality cars. Without an effective counteracting mechanism (or "counteracting institution" in the words of Akerlof (1970)) to impede this cycle, the resetting of common prices and average qualities can lead to a downward spiral toward market failure.

The extent to which a specific market or overall economy is afflicted by a lemons problem has significant social welfare consequences. Information frictions and perverse incentives prevent market participants from fully realizing utility-maximizing transactions that would have occurred in their absence. Although we have learned much about the susceptibility of markets to information and incentive problems over the past four decades, there remain many unanswered questions about the effectiveness of specific mechanisms to help reduce the impact of the lemons problem. The main purpose of this paper is to examine in detail one such mechanism – dealer reputation in the used-car market.

We obtain proprietary data from one of the nation's largest wholesale auction companies. Our database includes 71,486 observations of used-car transactions from 1,604 professional used-car dealers during 2010 and 2011. We examine the determinants of transaction prices in completed sales (or highest bids in uncompleted sales) by including several independent variables from previous studies that have been shown to be significant (e.g., vehicle age, mileage, condition). We also control for vehicle identification numbers (VINs) and auction locations since our auction company maintains wholesale markets at several geographic locations.

Our main variable of interest, dealer reputation, is constructed from buyer-initiated arbitration records. Buyers have seven days following the auction to lodge a complaint about the condition of the purchased vehicle. After a complaint is issued, the auction house acts as final arbiter between the buying and selling dealers. The arbitration can result in a cash settlement paid by the seller to the buyer with the buyer then taking title and possession of the car. However, in some cases the arbitration process fails to reconcile dealer differences and the sale can either stand or be repudiated. These arbitration records provide a unique opportunity to measure and quantify the reputations of used-car dealers. The data reveal a wide variation in dealers' reputations as observed in their previous-six-month arbitration rates (i.e., the number of arbitration cases divided by dealer sales over the previous six months). While the average dealer has roughly 13% of his sales challenged by post-sale arbitration, dealer arbitration rates range from a low of zero to a high of 67%, with a standard deviation of 7.9%.

After constructing our dealer reputation measure, we estimate a series of regressions to determine the role (if any) of this particular mechanism in mitigating the lemons problem in the used-car market. If used-car buyers are unable to rely on dealer reputation to reduce their

exposure to asymmetric information and adverse selection, then our dealer reputation variable will not be a significant determinant of the used-car's selling price. If, on the other hand, dealer reputation acts as an effective counteracting mechanism, then used-car buyers will be willing to pay a premium for cars brought to the market by high-reputation sellers. In the latter case, we should find a significant relationship between used-car prices and selling-dealer reputations, holding all else equal. To the best of our knowledge, no previous study has used such a detailed database to quantify and examine the effectiveness of dealer reputation in mitigating the lemons problem.

Our empirical results confirm that buyers are willing to pay a significant price premium for an equivalent car offered for sale by a high- versus low-reputation dealer. In fact, the dealer reputation coefficient is the largest in magnitude among all of our price determinants. Using the baseline regression (Model 1 in Table 3) as an example, buyers pay roughly $198 more for an average car if the selling dealer has a reputation one standard deviation above the mean (i.e., an arbitration rate one standard deviation below the mean). Additional results show that dealer reputation affects the prices of used-car sales but not the probability a successful sale. More specifically, we find no significant relationship between dealer reputation and the probability that the auction will lead to a sale using on a logistic regression framework. So while buyers are willing to pay a premium for the car of their interest if it is being offered by a high-reputation dealer, the pricing of reputation does not impede buyers and sellers from consummating a deal.

After establishing the importance of dealer reputation in reducing information and incentive problems in the used-car market, we turn to analyzing the dynamic properties of reputation capital. Our results show that dealer reputations established in the most recent three-month period have significantly stronger effects on current used-car prices than do dealer

reputations established during the three-month period beginning six months ago. We find similar reputation "recency effects" when comparing the one-month arbitration rates (i.e., reputations) over the past three months; that is, last month's arbitration rates have a significantly stronger impact on prices than one-month arbitration rates between months -3 to -2 and between months -2 to -1.

In the last section of our dynamic analysis, we construct transition matrices for dealer reputations from 2010 to 2011. Consistent with expectations, we find that dealer reputations are relatively sticky, especially for high-volume dealers relative to low-volume dealers. For example, a high-volume dealer in the top-third reputation category in 2010 has a 73% probability of remaining in the top-third category during the subsequent year, and a 25% (2%) probability of dropping down to the middle-third (lowest-third) category in the subsequent year. In contrast, a low-volume dealer in the top-third reputation category has a 61% probability of remaining in the top-third category, and a 26% (13%) probability of dropping down to the middle-third (lowest-third) category.

Overall, our study makes several contributions to the literature on lemons and counteracting mechanisms to the lemons problem. First, our proprietary database allows us to construct a credible measure of dealer reputation based on arbitration rates. The results show that reputations vary considerably across dealers. Our reputation measure overcomes many of the problems discussed in previous studies (e.g., Melnik and Alm (2005), Jin and Kato (2006), Andrews and Benzing (2007)) that rely on seller ratings from voluntary online surveys. Such surveys are based on feedback requiring little time commitment on the part of anonymous buyers whose typical purchase is a relatively low cost item. Several studies have also shown that sellers with low-quality online reputations simply re-enter the market using a different identity (Cabral

and Hortacsu (2010)). In our wholesale car market, buyers incur real costs when requesting an arbitration hearing and sellers cannot simply change their identities to escape past actions.

Second, we directly examine the degree to which dealer reputation is priced in the wholesale auction market. Since this dealer-to-dealer market is made up exclusively of knowledgeable car dealers, a significant price impact suggests that the lemons problem is pervasive in the used-car market. This is an important finding because the presence or absence of a lemons problem is a long-standing, open empirical question. While some researchers find empirical evidence for the existence of a lemons problem in the used-vehicle market (e.g., Pratt and Hoffer (1984), Genesove (1985), Lacko (1986), Emons and Sheldon (2009)), other researchers find no support for such a lemons problem (e.g., Bond (1982, 1984), Kim (1985), Sultan (2008, 2009, 2010)). As summarized by Hendel and Lizzeri (1999), "The empirical evidence on the presence of adverse selection in used cars is inconclusive (p. 1112)." A decade later, Sultan (2009) confirms that "The empirical evidence of the lemons hypothesis is still inconclusive (p. 46)."

Our study adds to this literature by showing that dealer reputations are priced in the marketplace. Buyers would pay a premium to purchase used cars of uncertain quality from high-reputation dealers only if they believe the marketplace to be susceptible to a lemons problem. These buyers are willing to pay for high reputation in an effort to reduce asymmetric information costs. Therefore, our transaction-level results add considerable weight to this unsettled empirical question in favor of the lemons hypothesis.

Third, our empirical results offer the only findings to date that examine the dynamic properties of reputation capital. We show that while dealer reputations tend to be persistent, significant changes can occur in a matter of weeks. Buyers weigh recent evidence (i.e., the past

one to three months) of seller transgressions and honest dealings much more heavily than they weigh earlier evidence of a similar nature. Our results raise the question of whether buyer updates of seller reputations are overreactions or underreactions to changes in arbitration rates. Although this is a topic for future research, our current results show that buyers react quickly to such changes while still putting some weight on the reputation established in earlier periods.

Fourth, our study adds to the previous literature that analyzes the effectiveness of counteracting institutions to mitigate various forms of the lemons problem. Some of these mitigating mechanisms include an active role for government regulation, such as state-mandated certifications (Pratt and Hoffer (1986)). In contrast, we examine the ability of an endogenously-generated mechanism to reduce information asymmetry and adverse selection by pricing dealer reputation for completeness of disclosure. Negative spillover effects to the broader society are minimized to the extent that individual sellers internalize the costs of their dishonesty through a reduction in current and future car prices. Our results document just such a reduction for low-reputation dealers.

The rest of this study proceeds as follows. We discuss the related lemons literature in Section I, and explain the used-car auction market process in Section II. In Section III, we describe our proprietary database, and in Section IV, we present and analyze the empirical findings. We conclude the study in Section V.

I. Literature Review

The literature on asymmetric information, adverse selection, and lemons problems is far too voluminous to fully summarize in this review section. Our primary objective is to highlight the key findings that are directly related to the lemons problem within the context of the used-car

(and used-truck) market. In Subsection A, we review the used-car lemons literature in roughly chronological order beginning with Akerlof (1970) and ending with contemporaneous research. In Subsection B, we briefly discuss the growing literature on seller reputation in context of internet auctions.

A. *Lemons in the Used-Car Market*

Akerlof (1970) sets the stage for a productive stream of research that continues to this day. Although he applies his "Lemons Principle" to a variety of contexts (e.g., insurance contracts, minority employment, underdeveloped credit markets), his first example and primary focus is the market for used cars. An asymmetric information environment prevails in the used-car market because sellers know more about the quality of their cars than do potential buyers. The buyers apply a common price to their estimate of average-quality cars. While buyers are unable to distinguish above-average from below-average quality, sellers can and do make this distinction. This underlying asymmetric information structure leads directly to an adverse selection condition as sellers bring only below-average quality cars to the market. Without some sort of intervention through a "counteracting institution," the downward spiral between common price and average quality can lead to market failure with bad cars driving out good cars – a vehicular analogy to Gresham's law where bad money drives out good money.

In addition to establishing the underlying problem of asymmetric information and adverse selection, Akerlof (1970) also discusses the social welfare costs of such externalities (i.e., costs of dishonesty), as well as their potential solutions (i.e., counteracting institutions). Social welfare is reduced when the threat of dishonest transactions drives honest transactions out of the market. As summarized by Akerlof, "The cost of dishonesty, therefore, lies not only in the amount by which the purchaser is cheated; the cost also must include the loss incurred from

driving legitimate business out existence (p. 495)." Several counteracting institutions are then proposed to mitigate these social costs, including producer guarantees, the establishment of brand names and chain stores, and various forms of professional licensing. In our paper, we argue that dealer-specific reputations can reduce the social costs of asymmetric information and adverse selection by forcing the selling dealer to bear some of the costs of his dishonesty.

After overcoming the initial difficulty in finding a journal to publish the paper,[1] Akerlof faced both theoretical and empirical challenges to his lemons hypothesis. On the theoretical side, Heal (1976) argues that under certain restrictive conditions dealer reputation would prevent dishonest sellers from taking advantage of naïve buyers. Kim (1985) constructs a formal model showing that a lemons problem need not exist in the used-car market. In contrast to Akerlof (1970) and Wilson (1980),[2] Kim's model (1) allows each agent (dealer) to freely choose between being a buyer or a seller, and (2) converts the quality of the used car into an endogenous variable. Under these conditions, Kim shows that bad cars need not drive out good cars.

On the empirical side, a series of studies has generated decidedly mixed results from 1982 to the present. Bond (1982) is the first study to provide a "direct test" of Akerlof's predictions based on the frequency of maintenance costs from the used-pickup-truck market. His main finding is that there is no significant difference in the frequency of maintenance costs between traded used trucks and non-traded used trucks, holding constant vehicle age and mileage. This result "leads to a rejection of the hypothesis that bad products have driven out good, since there is no evidence of an overabundance of lemons among used trucks (p. 836)."

[1] Gans and Shephard (1994) provide an interesting and entertaining summary of seminal articles, many by subsequent Nobel Laureates and Clark Medalists, that had originally been rejected by leading economics journals. Their discussion of Akerlof's (1970) paper under the subheading of "More Remarkable Rejections" describes three initial rejections before finally obtaining an acceptance.

[2] Wilson (1980) provides a more general framework for Akerlof's (1970) uncertain quality model. One important implication of Wilson's generalization is that the average quality of non-traded used vehicles should be higher than the average quality of traded used vehicles.

Bond (1982) conjectures that counteracting institutions (e.g., warranties, dealer reputations) might explain the lack of lemons in the used-truck market.

Pratt and Hoffer (1984) challenge Bond's (1982) findings by highlighting that they are based on the frequency of maintenance costs and not on the dollar value of maintenance costs. Pratt and Hoffer (1984) obtain dollar values for maintenance costs and compare traded used-truck maintenance costs to non-traded used-truck maintenance costs. Their main empirical test rejects the null hypothesis of no significant difference in average maintenance costs across the two samples. The authors conclude that the used-truck market is susceptible to a significant lemons problem and that any counteracting institutions that might be present in the marketplace are insufficient to overcome this adverse selection effect.

Bond (1984) argues that Pratt and Hoffer's (1984) maintenance cost results are subject to truck age and usage; specifically, he finds no significant difference in maintenance costs of traded versus non-traded used trucks that are less than ten years old. Since significant differences in the maintenance costs of traded versus non-traded used trucks are limited to relatively old trucks, Bond (1984) concludes that the used-truck market is not subject to a significant lemons problem.

In a related study, Pratt and Hoffer (1986) examine whether state-mandated disclosure requirements in Wisconsin and Iowa are able to increase the proportion of good-quality vehicles in the used-truck market. They show that state-mandated disclosure requirements do not alter the mix of high-quality and low-quality vehicles, and therefore conclude that such requirements do not serve as an effective counteracting institution in preventing lemons problems. They also argue that empirical results from the used-pickup-truck market are likely to understate the

lemons problem in the used-car market since the former is composed of more "automotive-knowledgeable" individuals (buyers and sellers) than the latter.

As this initial series of papers (as well as subsequent studies) makes clear, the extent to which the used-vehicle market suffers from a lemons problem is an unsettled issue. Our empirical results address this controversy by showing that sophisticated dealer-buyers pay substantial price premiums when transacting with high-reputation dealer-sellers. It is difficult to image a scenario other than a lemons market that would justify such behavior.

In addition to post-sale maintenance records, Lacko (1986) and Genosove (1993) analyze differences in car sellers' propensities to sell as another way to test the lemons hypothesis. Lacko (1986) examines differences in buyer perceptions of used cars purchased from friends and family members versus used cars purchased through newspaper advertisements. The underlying hypothesis is that differences in seller motivation (or propensity) should lead to differences in post-sale used-car quality; specifically, buyers should find fewer lemons among cars purchased from friends and family members than among cars purchased through anonymous advertisements. The empirical results provide weak evidence in support of the lemons hypothesis. Similar to Bond's (1984) used-truck results, significant quality differences are limited to the older vehicles only.

Genosove (1993) examines the relationship between seller type and the lemon problem by focusing on differences between new- and used-car dealers. He argues that new-car dealers have a greater propensity to sell their trade-ins in the wholesale market than do their used-car dealer counterparts.[3] New-car dealers agree to accept used-car trade-ins to support their primary business activity of selling new cars. Used-car dealers, in contrast, are engaged in buying and

[3] Hendel and Lizzeri (1999) develop a theoretical model of adverse selection for the durable goods market (e.g., cars and trucks). Their model suggests that the simultaneous existence of a market for both used and new durable goods should reduce the negative effects of adverse selection in the used-good market.

selling used cars in the wholesale market as a part of their primary line of business. These differences in seller types lead to significant differences in the propensity to sell. New-car dealers' higher propensities to sell suggest that potential buyers are subject to lower adverse selection costs. These potential buyers are therefore willing to pay relatively higher prices for new-car dealer trade-ins. Genosove (1993) tests these implications using a survey of new- and used-car dealer wholesale behaviors and prices. He finds mixed (weak) evidence of adverse selection in the used-car market. Relative to used-car dealers, new-car dealers receive significantly higher prices for their 1984 model cars, but not for their 1987 or 1988 model cars. So, similar to the studies based on post-sale maintenance costs, studies based on differences in seller propensities have produced mixed results regarding the lemons problem.

Other studies address the lemons problem by focusing on specific counteracting institutions. Sultan (2008, 2010a, 2010b) examines the impact of Certified Pre-Owned (CPO) programs on the lemons problem. CPO programs have become much more widespread in the used-car market as the popularity of car leases increased over the past two decades. A typical auto manufacturer CPO program applies to off-lease cars that are less than five years old, have less than 100,000 miles, and have no major defects (e.g., bodywork from previous accidents). For qualifying vehicles, the CPO program inspects and refurbishes off-lease cars following a multi-step procedure (including 75 to 305 inspection points) and then issues extended warranties. The CPO contract is one possible form of a counteracting institution that is expected to reduce adverse selection costs in the used-car market. Consistent with expectations, Sultan (2010b) shows that CPO-covered cars require less maintenance than non-CPO-covered cars of a similar age.

Sultan (2010a) extends Kim's (1985) theoretical framework by modeling adverse selection costs in the presence of CPO-type contracts. The resulting model suggests that CPO contracts can mitigate (or even eliminate) the lemons problem. This theoretical result is consistent with earlier empirical results in Sultan (2008) showing that used-cars do not require higher maintenance costs than new cars of a similar age. Sultan (2008) interprets these results as a rejection of the lemons hypothesis for the used-car market.

Emons and Sheldon (2009) use data on Swiss vehicle inspections (another type of counteracting institution) to investigate the lemons problem. They argue that "adverse selection alone does not necessarily imply information asymmetry (p. 2868)," and therefore partition the lemons problem into an asymmetric information component and an adverse selection component. They then examine each component separately. Their empirical results confirm the presence of adverse selection by showing that cars sold in the used-car market have more inspection-related defects than similar cars not sold in the used-car market. Next, they present evidence of asymmetric information by showing that buyers of lemons are more likely to resell their cars in the first few months of ownership than buyers of higher quality cars – suggesting that the buyers of these lemons had been unaware of their low quality at the time of initial purchase. They conclude that there exists a significant lemons problem in the used-car market since used-car buyers are susceptible to both asymmetric information and adverse selection.

B. *Internet Markets and the Role of Seller Reputation*

Much of our understanding of seller reputation to date comes from research on various Ebay auctions including coins, comic books, computers, and automobiles (Melnik and Alm (2005), Dewally and Ederington (2006), and Cabral and Hortacsu (2010). Most of the studies using Ebay auctions have noted, however, that given the extent of information asymmetry it is

surprising that reputation does not have a stronger effect on prices than found empirically (Dewan and Hsu (2004), Houser and Wooders (2006), Lucking-Reiley et al. (2007), and Resnick et al. (2003)). Similarly, Jin and Kato (2006) find that price discounts for low reputation do not fully compensate buyers for expected losses due to seller dishonesty in the collectible baseball cards market using self-reported seller grades. One potential explanation for these weak pricing results is that the measure of seller reputation is simply inadequate for the potential buyers. That is, buyers over the internet might not place much credibility on anonymously-posted seller ratings.

In some auction settings, third-party certification is a primary mechanism to overcome information asymmetry, and certification can reduce the effects of reputation (Dewally and Ederington (2006)). These findings are important, but are not necessarily applicable to auctions that do not fit Ebay's auction setting that includes published seller ratings, a large proportion of retail buyers, and a relatively small value for most auction items. Additionally, in the Ebay auction setting, a deteriorating reputation score has been shown to increase the likelihood of the seller exiting the market and potentially re-entering with a different identity (Cabral and Hortacsu (2010)).

More relevant to our study, Andrews and Benzing (2007) examine how used cars are traded over the internet on eBay's platform. Unlike the wholesale market which is the exclusive domain of professional car dealers, eBay's market includes both dealers (60% in their sample) and non-dealers. The authors find that when an internet posting leads to an actual sale, buyers pay a premium for cars with clear titles and cars that are sold by dealers. The reputation of the seller has no significant effect on the selling price in successful auctions, although it does appear to increase the highest bid price in unsuccessful auctions. Similar to the Ebay studies mentioned

above, seller reputation is a ratings score based on anonymously-posted comments from buyers in previous transactions with the same seller. Most seller ratings are positive since "a seller with negative feedback is likely to change identity and resume trading with a new name and a new reputation (p. 51)."

Lewis (2011) examines the role of credible, enforceable disclosures in overcoming the lemons problem in the eBay used-car market. Without such disclosures, asymmetric information and adverse selection would be especially severe in online transactions because buyers and sellers do not meet face to face, buyers do not inspect the car before making a purchase, and 75% of the vehicles are sold to out-of-state buyers, thus increasing the transaction costs of any subsequent disputes. Unlike the large proportion of dealers in the Andrews and Benzing (2007) sample, private individuals (non-dealers) make up roughly 70% of the transactions in this later sample. Lewis (2011) argues that since seller-created Web pages constitute a contract with buyers, and since potential buyers prefer detailed disclosures of verifiable car attributes, sellers have both the incentive and the ability to reduce information asymmetries between themselves and potential used-car buyers.

Properly designed, online car auctions can create an effective counteracting institution. Lewis' (2011) empirical results provide consistent support for such effectiveness. He concludes that "disclosure costs—whether caused by technology, bandwidth, or time costs—are an important determinant of the extent to which parties can create well-defined contracts online, and therefore of the success of online goods marketplaces (p. 1536)." In our study, we argue that dealer reputations in the (physical) dealer-to-dealer wholesale market play a similar role in reducing lemons problems as disclosure enforcement does in the online market.

II. Used-Car Auction Market

The auctions are physical locations and dealer-only, and it is against auction house rules for dealers to bring retail customers to the auction. Auctions are held on a regular basis, typically once per week but sometimes more frequently depending on the location. Prior to the auction, participants have access to and can print out a list of used vehicles that will be for sale at the auction, basic information about each vehicle such as the make, model, year, miles, VIN, an auction-assigned condition score if available, and lane in which the vehicle will be auctioned. The cars can be visually inspected by potential buyers prior to the auction, but they cannot be test driven or mechanically inspected by potential buyers. If the seller brings the car to the auction house sufficiently in advance of the auction (approximately three days), the auction house will perform a mechanical inspection and assign a condition score to the vehicle ranging from 1.0 to 5.0 (highest quality), and approximately 20% of the vehicles at auction have a condition score assigned by the auction house. Sellers may choose to have the auction house certify a vehicle for a flat fee of approximately $170, which consists of a more thorough inspection and auction house certification.

Numerous auction lanes run simultaneously, and the sales are ordered by seller and the identity of the selling dealer is known to potential buyers. Once a selling dealer's inventory has run through the auction lane, the next set of vehicles to auction will be from a different selling dealer. Each car spends approximately one minute on the auction block before the next one is driven in. The selling dealer typically has a reserve price but it is not disclosed. On the auction block, it is indicated whether the car being sold has negative disclosures such as, "engine light on," "engine noise," a/c not working, etc. The car is sold to the highest bidder, subject to the seller's reserve price being met. For typical sales, if a buyer discovers a problem that he believes

should have been disclosed, there is a seven day window to open an arbitration proceeding with the auction house.

III. Data and Variables Description

As discussed above, our data comes from a large used car auction house that conducts physical location dealer-to-dealer auctions. The data covers all auctions, both completed sales and unsuccessful auctions, for 2010 and 2011. We restrict our sample to vehicles sold by dealers because rental sales and fleet sales are likely to have different dynamics related to reputation and arbitration. Because the pricing of different used car models can vary by geography, we restrict our sample to auction locations in the North East. We focus our analysis on the top 20 selling models during 2010 and 2011 as determined by the first eight digits of the Vehicle Identification Number, or VIN. These top sellers are likely to be more homogeneous in quality than less frequently sold cars and also have well-known attributes. We also exclude vehicles from our analysis that are sold at the auction "as is" and are not subject to the standard arbitration mechanism. Our data includes the make, model, year, number of miles, condition score when available, date and location of the auction, selling price, highest bid, and whether the vehicle was certified by the auction house as described below. We include additional variable descriptions in Appendix A. For auctions that do not culminate in a sale because the seller's reserve price has not been met, we use the highest bid as a proxy for the sale price.

We measure seller reputation as the proportion of sold vehicles that enter arbitration post-sale for a given dealer. The standard reason why a vehicle enters arbitration is that the buyer believes the purchased vehicle has a problem that was not disclosed by the seller. For each selling dealer, in each month we measure reputation as the number of arbitrated vehicles divided

by the number of total vehicles sold, so that a higher score is indicative of a more negative reputation. We consider dealer reputation established over different time intervals, although our baseline specification is dealer reputation in the six full months immediately prior to the month of sale. We also analyze dealer reputation in the three months immediately prior to the sale month, and in the individual months leading up to the sale with aggregation using a weighted average based on the number of vehicles sold. The arbitration/reputation measure is based on all of a dealers's sold vehicles over the given time interval, not only those car models represented by the top 20 selling VIN models.

Similar to Dewally and Ederington (2006), we incorporate how much is known about a particular seller into our analysis. There is a wide distribution of the number of cars for sale by different dealers, with many dealers selling intermittently and in very small volumes. We use a "low volume seller" indicator variable to identify cars sold by dealers whose reputation is expected to be relatively unknown or only weakly established at the auction. This indicator variable equals one if a dealer sells fewer than 10 cars per month, on average. As an additional consideration, we also calculate the monthly standard deviation of the arbitration rate over the six months prior to the sale to examine whether the month-to-month variation in reputation also affects selling prices.

In addition to variables for vehicle age, miles, reputation, and auction house certification variables, we construct variables to capture other factors expected to influence selling price. We define a potential lemon as a car that returns to the auction between three and twenty-four months after the initial sale and has at least 3,000 more miles on the odometer than at the time of the initial sale. The lower bound restriction of three months and 3,000 miles is intended to exclude cars that sat on the purchasing dealer's lot and were then brought back to auction. The

twenty-four month upper-bound is to identify cars that end-user customers were dissatisfied with under the assumption that most people do not buy cars with the expectation of owning them for fewer than two years.

We also include an indicator variable for "re-runs" to identify vehicles that were recently auctioned but not successfully sold and are now up for auction again within 10 days of the prior no sale auction. If the selling dealer's reserve price is not met, the dealer can wait until the subsequent auction to re-auction the vehicle.

For the subset of newer model cars within the top 20 sellers that we analyze, some vehicles may be within the full factory warranty period based on age and miles at the time of sale. We gather warranty information for each of the top 20 selling models, and for those models with the potential to be still covered by the full factory warranty we run a separate sub-sample. This newer model sub-sample includes a "has warranty" variable for the vehicles that, based on car age and miles, are still covered by a full factory warranty.

Other control variables include a publicly available monthly index of used car prices to account for supply and demand dynamics in the used car market[4], the vehicle condition (1.0 to 5.0) assigned by the auction house, an indicator variable if the auction resulted in a no sale, and an indicator variable if negative disclosures of car defects are made by the selling dealers prior to the auction. Throughout our regression analysis, we use indicator variables for each of the 20 VIN models in our sample, and also use indicator variables for each different selling locations in our sample.

[4] https://www.manheim.com/content_images/content/ManheimUsedVehicleValueIndex-WebTable0314.jpg

IV. Method of Analysis and Empirical Results

A. *Descriptive Statistics*

Table 1 presents the summary statistics for our sample. Panel A indicates that 2010 to 2011 auctions of the 20 highest volume vehicle models totaled 71,486 vehicles that were subject to standard auction arbitration procedures, and these auctions spanned 1,604 unique selling dealers. The average sale price, or high bid in cases of no sale completion, was $13,999 (median $11,900). The average vehicle had 68,979 miles (median 64,867 miles) and was 5.67 years old (median 5 years). For vehicles with an auction assigned condition score, the average condition was 3.67 out of 5 (median 3.70).

Panel B of Table 1 indicates that 53.7% of the auctions in our sample resulted in a sale, and that 38.9% of the auctions were for re-run vehicles that were auctioned but unsold within the prior 10 days. The auction house's certification is obtained for only 1.4% of vehicles auctioned, and 0.9% of the sample vehicles fit the potential lemon designation as described in Section III. Panel B also shows that 7.8% of the vehicles auctioned have negative disclosures relating to the vehicle. Panel C provides the proportion of auctioned vehicles that fall within warranty eligible models (45.1%) and non-warranty eligible models (54.9%). Of the models that contain warranty eligible vehicles, based on mileage and estimated car age, 45.9% of this subset are covered by full factory warranty.

Table 2, Panel A shows summary statistics on auction house arbitration by vehicle attributes. Since arbitration is only possible if a sale occurs, the proportions for arbitration are relative to completed sales, not total auctions. For all vehicles sold in our sample, 12.8% are arbitrated by the auction house. Among vehicles we flag as potential lemons because they are being re-auctioned within two years, the arbitration proportion is 15.9%. Sales of vehicles that

did not arrive at the auction in time to receive a condition score from the auction house are arbitrated 14.5% of the time. Vehicles that are re-run at the auction and sold within 10 days of a prior unsuccessful auction are arbitrated at a rate of 13.7%. Vehicles for which the seller has made negative disclosures are arbitrated at a rate of 9.5%, and vehicles under factory warranty are arbitrated 5.1% of the time. The lowest arbitration rate is for vehicles that are certified by the auction house where arbitration occurs at a rate of only 3.7%.

Panel B of Table 2 shows the arbitration rates by dealer, where dealers' arbitration rates are averaged over 2010 and 2011. The mean dealer arbitration rate is 12.9% of all vehicles sold,[5] and the median dealer experiences a 11.1% rate of arbitration. The minimum, maximum, and standard deviation of dealer arbitration are 0%, 66.7%, and 7.9%, respectively.

B. *Regression Analyses*

Table 3 presents our baseline specification for regression analysis of vehicle price. The dependent variable is the natural logarithm of the sale price or, for auctions that do not result in a sale, the natural logarithm of the high bid instead. Our measure for seller reputation is the proportion of arbitrated sales for the seller over the past six months, which is negatively related to price and significant at the 1% level in both specifications. Because the dependent variable is the natural logarithm of the sale price, the arbitration variable coefficient of -0.179 in the first specification indicates that a one standard deviation (7.9%) increase to the mean dealer arbitration rate (12.9%) will reduce the selling price by approximately 1.41%. Applying this price differential to the average selling price of $13,999 indicates an approximate $198 selling price discount to a seller whose reputation is one standard deviation worse than average based on our arbitration-based measure of seller reputation.

[5] We exclude vehicles sold "as-is" because they are not subject to auction house arbitration.

The other variable related to reputation in the first specification of Table 3 is a low volume seller indicator variable to account for the effect of being a relatively unknown seller at the auction. The indicator variable equals one for dealers that sell fewer than 10 vehicles per month, on average. The coefficient on the low volume seller variable of -0.026, significant at the 1% level, indicates an approximate 2.6% price discount for vehicles sold by dealers without an established seller reputation at the auction.[6] Other variables in the first specification come in with the expected signs and are significant at the 1% level, with the exception of the potential lemon designation which is significant at the 10% level and implies a sale price discount of approximately 1%. Certified vehicles sell at significantly higher prices than non-certified vehicles, and vehicles with higher condition scores similarly sell at higher prices. As expected, higher car age and mileage result in lower selling prices, as do cars re-run through the auction within 10 days and cars that are accompanied by negative disclosures at the auction. Vehicles that do not have a condition score assigned by the auction also sell at lower prices, and for auctions that result in no sale the high bid is significantly lower than the prices obtained for auctions that result in a sale. Finally, to account for the fluctuations in supply and demand of used vehicles in general, we include a publicly available monthly index of used car prices,[7] which is also positively related to selling price. Both specifications in Table 3 also include indicator variables for each 8-digit VIN model and each selling location in our sample.

The second specification in Table 3 is similar to the first, but also includes a variable to account for the seller's standard deviation of monthly arbitration rates over the six months prior to the auction. The baseline specification demonstrated that reputation, as proxied for by the proportion of arbitrated sales, is priced and we also investigate whether buyers who we assume

[6] Adjusting the cutoff point slightly up or down for the low volume seller designation yields similar results.
[7] https://www.manheim.com/content_images/content/ManheimUsedVehicleValueIndex-WebTable0314.jpg

to be risk averse are also sensitive to the fluctuations of this reputation measure. This second specification indicates that the standard deviation of monthly arbitration is also negatively related to sale price and is significant at the 1% level. Other coefficients in the second specification remain virtually unchanged from those in the first specification, except for the coefficient on the main prior six month arbitration variable which has a slightly lower point estimate than in the first specification.

Table 4 presents a logistic regression for the probability of a completed sale, where the dependent variable equals one if the auction results in a sale. The coefficients are the marginal effects of a one standard deviation increase in a given variable while holding all other variables at their mean values, and in the case of indicator variables the effect of a change from zero to one. Because sellers have undisclosed reservation prices, the auction sale completion is contingent on the highest bid being acceptable to the selling dealer. Our primary measure of seller reputation, the six month proportion of arbitrated sales, is insignificant and has a t-statistic of only 0.32. This result combined with those in the preceding table indicates that a good or bad seller reputation significantly affects selling price but does not impede transactions between buyers and sellers. The indicator variable for low volume sellers, however, is negative and significant at the 1% level, and the marginal effect indicates that low volume sellers are 7% less likely to have auctions that result in sales. This result implies that an unestablished reputation at the auction makes it more difficult for buyers and sellers to agree on prices, perhaps because of information asymmetry problems related to buyer uncertainty relative to seller beliefs about seller and vehicle quality.

Other variables associated with a lower likelihood of a sale are missing vehicle condition, vehicles that previously did not sell and are being re-run through the auction within 10 days,

negative vehicle disclosures, and a higher index of used car prices. The negative relation between the used car price index and the probability of a sale may be because a seller, if unsatisfied with the highest auction bid, has the option to return the vehicle to his lot and sell to the retail market. The propensity to use this option may be higher when used car demand relative to supply, is higher. Vehicle attributes that are positively related to the likelihood of a sale are car age and vehicle condition, both significant at the 1% level, and certification, significant at the 10% level. A vehicle's miles and our construction for potential lemons is not significantly related to the likelihood of a sale.

Table 5 presents sub-sample regression analysis of vehicle price for models that contain warranty eligible vehicles and models that do not have warranty eligible vehicles. For example, auctions in 2010 of a model that includes vehicles from 2005 to 2008 and that have 3-year, 36,000 mile factory warranties would have warranty eligible vehicles. Warranty eligible models are the newer, and also more expensive, subset of auction vehicles. The first specification includes only the warranty eligible vehicle models and also includes an indicator variable for whether the vehicle has a factory warranty based on both the vehicle age and miles at the time of auction. As expected, vehicles that have a factory warranty experience higher selling prices, even after controlling for car age, miles, and other factors. Seller reputation, as measured by prior six month arbitration rate remains significantly negative in this sub-sample, as does the low volume seller indicator variable. Interestingly, among these newer, warranty eligible models the effect of auction house certification is no longer significantly related to sale price and the coefficient, although very close to zero, switches signs. The significance of other variables is similar to that in our baseline analysis in Table 3.

The second specification in Table 5 contains only VIN models that are not warranty eligible based on the model years covered. Two primary differences appear in this sub-sample compared with the warranty eligible sub-sample. The first difference is that auction house certification is significant and positive at the 1% level, and the coefficient of 0.028 indicates that certification for these non-warranty eligible models is associated with an approximately 2.8% higher sale price. Thus, the positive effect of certification is restricted to this subset of non-warranty eligible models. The second notable difference in this non-warranty eligible sub-sample is that the coefficient on the primary reputation variable, prior six month arbitration proportion, is -0.195 compared with -0.132 for the warranty eligible sub-sample. One explanation for this result is that these older, non-warranty eligible vehicles are likely to have a greater variation in quality, and thus the impact of reputation may be greater in percentage terms. An alternative explanation is that the potential absolute costs of repairing undisclosed mechanical problems or entering into arbitration to have them resolved may be relatively constant, and therefore the percentage discount to poor reputation is higher for lower priced vehicles and lower for higher priced vehicles.

C. *Analysis of Dynamic Properties of Reputation*

Table 6 considers the impact of more recent versus distant reputation. In the first specification, the prior six-month arbitration proportion is separated into two variables – the arbitration proportion in months four to six prior to the auction and the arbitration proportion in months one to three prior to the auction. The results show that while both the older and the more recent reputation are negative and significantly related to sale price, the more recent reputation has an impact that is approximately twice as large as the more distant reputation. These two coefficients are significantly different from one another at the 1% level (unreported).

The second specification in Table 6 further separates the more recent reputation into three monthly arbitration variables – the proportion of sales arbitrated one month prior to the auction, two months prior, and three months prior, respectively. The reputation variables measured for each interval are negatively related to sale price and each is significant at the 1% level. The most recent reputation, however, measured as the arbitration proportion in the month prior to the sale has a coefficient that is approximately twice the magnitude of the reputation measures from either the period two months or the period three months prior to the auction. The reputation measure one month prior to the auction is also statistically different at the 1% level from either the two month prior or three month prior measures (unreported). Overall, the results from Table 6 point to the effect of seller reputation on price being more heavily influenced by the most recent reputation.

Table 7 shows the transition matrices for the proportion of arbitrated sales from 2010 to 2011. Dealers are first ranked into terciles based on proportion of arbitrated sales in 2010, and then re-ranked into terciles based on proportion of arbitrated sales in 2011. The lowest third corresponds to low arbitration and therefore high reputation, and the highest third corresponds to high arbitration and therefore low reputation. Panel A indicates that the dealer reputation for both the high and low reputation groups is reasonably stable across time. Sixty percent of firms categorized as high reputation (lowest third of arbitration) in 2010 remained as high reputation in 2011, and only 10 percent of firms categorized as high reputation in 2010 fell to low reputation in 2011. The results are similar for firms with a low reputation in 2010; 64% are also in the low reputation (high arbitration) category in 2011, and only 11% switch from having a low reputation in 2010 to a high reputation in 2011.

Panel B looks at the reputation transition matrix only for high volume dealers, which are classified as auctioning an average of at least 10 vehicles per month. The results are similar, but more pronounced, to those in Panel A. Specifically, 76% of dealers who have a high reputation (lowest third of arbitration) in 2010 continue to be in the highest tercile of reputation in 2011. More strikingly, among these high volume sellers, there are none categorized in the highest tercile of reputation in 2010 that fall to the lowest tercile of reputation in 2011. The reputations are similarly sticky for high volume dealers in 2010 that are categorized in the low reputation tercile (highest third of arbitration). Seventy-three percent of these high volume, low reputation dealers in 2010 are likewise categorized as low reputation (highest third of arbitration) in 2011. Only 2% of the high volume dealers categorized as low reputation in 2010 transition to high reputation in 2011.

The transition matrix in Panel C is for low volume dealers, categorized as auctioning fewer than 10 vehicles per month on average. This sub-sample of low volume dealers exhibits considerably more switching between reputation tercile groups than does the high volume dealers. For example, only 55% of the low volume sellers in the highest reputation (lowest arbitration) tercile in 2010 are also in the highest reputation tercile in 2011, and 13% switch from the highest reputation tercile in 2010 to the lowest reputation tercile in 2011 (compared with 0% of dealers who make this switch among the high volume group). Among the low volume sellers categorized in the middle reputation tercile in 2010, 33% end up in the high reputation tercile in 2011, 37% in the middle reputation tercline in 2011, and 30% end up in the low reputation tercile in 2011. Overall, for these low volume sellers, the greater propensity for reputation to switch from good to bad, bad to good, and average to either direction provides a better understanding of why a price discount is associated with low volume sellers in the sale price regressions. If a

seller's reputation is relatively unknown and unstable, risk averse buyers are apt to discount prices paid for vehicles.

V. Conclusion

Our study examines the determinants of used-car prices in a dealer-to-dealer wholesale market. We use the unique features of a large proprietary database with post-sale arbitration records to match buyer-initiated arbitration cases to specific selling-dealers. This process allows us to construct a credible reputation measure for each selling-dealer based on arbitration records. Our main result is that buyers are willing to pay a statistically and economically significant price premium for an equivalent used car when transacting with a high-reputation seller. We interpret this finding as evidence for the existence of a lemons problem among knowledgeable dealers in the wholesale used-car market. We also examine the dynamic properties of reputation building. To the best of our knowledge, these results represent the first empirical evidence of the time dimension of reputation creation and destruction. We show that reputations are relatively sticky from one year to the next, but are also capable of being altered substantially over the course of just a few weeks. Taken as a whole, our results suggest that dealer reputation acts as an effective counteracting mechanism capable of reducing the social costs of asymmetric information.

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Appendix A. Variable definitions

Proportion arbitrated:	For each dealer, the proportion of sold vehicles that go into arbitration over the prior six months (or three months or monthly, depending on the specification).
Low volume seller:	Indicator variable that equals one if the dealer auctioned fewer than 10 vehicles per month, on average.
Stdev of arbitration:	Monthly standard deviation of the arbitration rate over the six months prior to the auction.
Car age:	Car age in years at the time of auction. The assumed service date is May 1st of the model year.
Miles:	Mileage on vehicle at the time of auction.
Certified:	Indicator variable that equals one if the selling dealer obtained auction house certification for the vehicle.
Re-run w/in 10 days:	Indicator variable that equals one if the vehicle for sale was auctioned in the prior 10 days with a no sale result.
Monthly index:	Publicly available index of used vehicle prices to capture supply and demand variation in the used car market.
Vehicle condition:	Condition of vehicle, if present. If vehicle condition is not present, the average vehicle condition for the selling dealer is used.
Condition missing:	Indicator variable that equals one if the vehicle for auction does not have a condition score.
Potential lemon:	Indicator variable that equals one if the vehicle is back at the auction within two years but after at least three months and 3,000 miles after previous auction that resulted in a sale.
Negative disclosure:	E.g., engine noise, runs rough, engine light is on, A/C is warm, etc.

Table 1. Summary statistics
Our sample consists of vehicles sold in the northeast region wholesale dealer auctions from 2010 to 2011. We restrict our sample to sales by dealers of the top 20 highest sales volume models based on 8-dight vehicle identification numbers (VIN) for auctions subject to standard arbitration procedures.

Panel A. Dealers and vehicle attributes

Number of cars for sale by dealers	71,486
Number of unique selling dealers	1,604

	Mean	**Median**
Sale price or high bid	$13,999	$11,900
Vehicle Condition (1 to 5)	3.67	3.70
Car Age (in years)	5.67	5.00
Mileage	68,979	64,867

Panel B. Auction information and outcomes

Proportion sold	0.537
Proportion re-run through auction w/in 10 days	0.389
Proportion certified	0.014
Proportion quick resales (potential lemon)	0.009
Proportion with negative disclosures	0.078

Panel C. Factory warranty information

Proportion with model years warranty eligible	0.451
Proporiton non-warranty eligible	0.549
Proportion with warranty, given warranty eligible	0.459

Table 2. Arbitration – conditional on sale

Panel A. Arbitration by vehicle attributes

Attributes	Proportion
Proportion arbitrated - all sample vehicles	0.128
Proportion arbitrated - potential lemons	0.159
Proportion arbitrated - missing condition	0.145
Proportion arbitrated - re-run with 10 days	0.137
Proportion arbitrated - negative disclosures	0.095
Proportion arbitrated - with warranty	0.051
Proportion arbitrated - certified	0.037

Panel B. Arbitration by dealer

Number of unique selling dealers	1,604
Mean dealer proportion arbitrated	0.129
Median dealer proportion arbitrated	0.111
Minimum dealer proportion arbitrated	0
Maximum dealer proportion arbitrated	0.667
Standard deviation of dealer arbitration	0.079

Table 3. OLS regression analysis

The dependent variable is the natural log of the selling price or the high bid (if car does not sell)

Variable	Model 1	Model 2
Car age	-0.102 (-180.90)***	-0.102 (-182.05)***
Miles	-4.5 E-6 (-145.43)***	-4.5 E-6 (-145.69)***
Certified	0.022 (5.57)***	0.022 (5.49)***
Re-run within 10 days (after no sale)	-0.018 (-15.96)***	-0.018 (-15.83)***
Monthly index of used car price level	0.010 (53.50)***	0.010 (53.35)***
Vehicle condition 1 to 5 (or avg. dealer condition)	0.024 (24.59)***	0.024 (24.56)***
Vehicle condition missing	-0.004 (-3.00)***	-0.004 (-2.60)***
Potential lemon	-0.010 (-1.69)*	-0.010 (-1.65)*
Negative disclosure by seller	-0.098 (-36.12)***	-0.097 (-36.01)***
No Sale	-0.028 (-24.98)***	-0.028 (-24.84)***
Low volume seller (<60 for sale past 6 mo.)	-0.026 (-16.41)***	-0.022 (-11.27)***
Seller proportion arbitrated in prior 6 months	-0.179 (-16.64)***	-0.161 (-13.88)***
Standard deviation of monthly arbitrage proportion		-0.041 (-3.33)***
VIN model indicators	Yes	Yes
Auction location indicators	Yes	Yes
Observations	70856	70638
R-squared	0.95	0.95

Table 4. Logistic regression analysis

The dependent variable equals one for a sale and zero for a no-sale.
Marginal effects are given

Variable	
Car age	0.048 (29.01)***
Miles	-1.3 E-7 (-1.53)
Certified	0.031 (1.74)*
Re-run within 10 days (after no sale)	-0.227 (-56.15)***
Monthly index of used car price level	-0.004 (-5.25)***
Vehicle condition 1 to 5 (or avg. dealer condition)	0.047 (13.59)***
Vehicle condition missing	-0.061 (-12.27)***
Potential lemon	0.019 (0.94)
Negative disclosure by seller	-0.087 (-11.21)***
Low volume seller (<60 for sale past 6 mo.)	-0.070 (-12.44)***
Seller proportion arbitrated in prior 6 months	0.012 (0.32)
VIN model indicators	Yes
Auction location indicators	Yes
Observations	70856
Pseudo R-squared	0.07

Table 5. OLS regression analysis – subsamples warranty eligible and ineligible

The dependent variable is the natural log of the selling price or the high bid (if car does not sell)

Variable	Model 1	Model 2
Car age	-0.078 (-125.46)***	-0.107 (-151.22)***
Miles	-3.7 E-7 (-89.61)***	-4.7 E-6 (-115.98)***
Certified	-0.005 (-0.80)	0.028 (6.08)***
Re-run within 10 days (after no sale)	-0.006 (-5.28)***	-0.027 (-14.69)***
Monthly index of used car price level	0.011 (61.23)***	0.010 (32.29)***
Vehicle condition 1 to 5 (or avg. dealer condition)	0.027 (29.96)***	0.027 (16.54)***
Vehicle condition missing	-0.008 (-6.80)***	-0.007 (-3.34)***
Potential lemon	-0.016 (-2.60)***	-0.020 (-2.37)**
Negative disclosure by seller	-0.072 (-18.49)***	-0.099 (-30.65)***
No Sale	-0.012 (-10.75)***	-0.039 (-21.95)***
Low volume seller (<60 for sale past 6 mo.)	-0.018 (-11.12)***	-0.028 (-11.90)***
Seller proportion arbitrated in prior 6 months	-0.132 (-11.42)***	-0.195 (11.95)***
Has factory warranty	0.037 (23.12)***	
VIN model indicators	Yes	Yes
Auction location indicators	Yes	Yes
Observations	31956	38900
R-squared	0.94	0.90

Table 6. OLS regression analysis – recent versus more distant reputation

The dependent variable is the natural log of the selling price or the high bid (if car does not sell)

Variable	Model 1	Model 2
Car Age	-0.101 (-180.39)***	--.101 (-177.16)***
Miles	-4.5 E-6 (-144.29)***	-4.5 E-6 (-142.60)***
Certified	0.022 (5.60)***	0.023 (5.74)***
Re-run within 10 days (after no sale)	-0.018 (-15.77)***	-0.018 (-15.69)***
Monthly index of used car price level	0.010 (53.47)***	0.010 (51.85)***
Vehicle condition 1 to 5 (or avg. dealer condition)	0.024 (24.22)***	0.024 (23.88)***
Vehicle condition missing	-0.004 (-3.07)***	-0.003 (-2.63)***
Potential lemon	-0.011 (-1.75)*	-0.013 (-1.98)**
Negative disclosure by seller	-0.092 (-35.74)***	-0.096 (-34.53)***
No sale	-0.028 (-24.80)***	-0.027 (-24.01)***
Low volume seller	-0.026 (-15.86)***	-0.024 (-13.08)***
Seller proportion arbitrated in 4 to 6 months prior	-0.062 (-6.48)***	
Seller proportion arbitrated in 1 to 3 months prior	-0.122 (-11.45)***	
Seller proportion arbitrated in 3 months prior		-0.034 (-4.71)***
Seller proportion arbitrated in 2 months prior		-0.042 (-5.71)***
Seller proportion arbitrated in 1 months prior		-0.078 (-9.27)***
VIN and Location indicators	Yes	Yes
Observations	69808	67846
Adjusted R-squared	0.96	0.96

Table 7. Transition matrix of dealer arbitration terciles from 2010 to 2011

Panel A. All dealers

		2011		
		Low 1/3rd	*Mid 1/3rd*	*Hi 1/3rd*
2010	*Low 1/3rd*	0.60	0.30	0.10
	Mid 1/3rd	0.30	0.44	0.27
	Hi 1/3rd	0.11	0.26	0.64

Panel B. Hi volume dealers (≥10 cars for sale per month, on average)
High volume dealers are approximately 25% of total dealers

		2011		
		Low 1/3rd	*Mid 1/3rd*	*Hi 1/3rd*
2010	*Low 1/3rd*	0.76	0.24	0.00
	Mid 1/3rd	0.21	0.59	0.20
	Hi 1/3rd	0.02	0.25	0.73

Panel C. Low volume dealers (<10 cars for sale per month, on average)
High volume dealers are approximately 75% of total dealers

		2011		
		Low 1/3rd	*Mid 1/3rd*	*Hi 1/3rd*
2010	*Low 1/3rd*	0.55	0.32	0.13
	Mid 1/3rd	0.33	0.37	0.30
	Hi 1/3rd	0.13	0.26	0.61