Indirect Costs of Financial Distress in Durable Goods Industries: The Case of Auto Manufacturers[+*]

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Abstract

Financial distress can disrupt a durable goods producer's provision of complementary goods and services like warranties, spare parts, maintenance, and upgrades. The threatened loss of these valued amenities reduces in turn consumers' demand for the firm's core product, resulting in indirect cost of financial distress. We test whether this hypothesis holds in one of the largest durable goods markets, automobiles. We use data on prices of millions of used cars sold at wholesale auctions around the U.S. during 2006-8. We find that an increase in an auto manufacturer's financial distress (as measured by an increase in its CDS spread) does result in a statistically and economically significant contemporaneous drop in the prices of its cars at auction. Furthermore, cars with longer expected service lives see larger price declines than those with shorter remaining lives. We use our estimates to calculate the implied size of the indirect costs of financial distress borne by car manufacturers, find that they are substantial, and have occasionally even exceeded the benefits of tax savings on the margin for General Motors and Ford.

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1. **Introduction**

Since Titman (1984), researchers have frequently appealed to indirect costs of financial distress to explain firms' limited use of debt despite its tax advantages (Graham (2000)). Yet there is little *direct* evidence of such indirect costs (Hotchkiss et al. (2008)).

In this paper, we show that financial distress decreases demand for the distressed firm's products. Further, we pinpoint a previously unexplored source of these indirect costs for durable goods producers. Financial distress can disrupt a durable goods producer's provision of goods and services that complement its core product, such as warranties, the availability of spare parts, maintenance, and upgrades. The threatened loss of these valued amenities reduces consumers' willingness to pay for the firm's core product. Thus, by taking on debt and exposing itself to financial distress, the firm reduces demand for its product, which in turn leads to diminished cash flows.

As a case in point, consider car manufacturers. A car owner relies on warranties to cover malfunctions early in the car's life, on car parts to be available when the car breaks down, and on the presence of a dealer who can service the car. In autos, as in many other durable goods industries, the provision of these and similar services is frequently vertically integrated into the manufacturer.[1] If a car manufacturer were to go bankrupt, it may not honor the warranties or provide parts and services in the future, reducing the consumption of the durable goods owner.[2] Thus the mere possibility of bankruptcy

[1] Vertical integration of car warranty provision is natural; it solves the asymmetric information problem present because car manufacturers are best informed about likely future claims on the cars they make. Furthermore, it effectively makes manufacturers the residual claimants on the effort expended toward increasing car durability.

[2] In bankruptcy, warranties are general unsecured claims having priority after secured claims and other priority claims. Additionally, companies that buy assets sold in bankruptcy are typically not legally obligated to assume warranty liability for products made by the predecessor company. A stark example of this is currently being played out in court, with the post-bankruptcy "new" GM seeking to dismiss a class-action lawsuit over widespread suspension problems with 2007 and 2008 Chevy Impalas, arguing that the cars were made by its predecessor, the "old" GM, now called Motors Liquidation Co (Chicago Tribune, August 19, 2011). Yet another example of this was seen in the marine engine industry with the Chapter 11 bankruptcy of former industry stalwart Outboard Marine Corp. in 2000. According to an article on the case (http://my.boatus.com/consumer/OMCBankruptcy.asp), the federal trustee assigned to the case said she had "never seen funds set aside in other bankruptcy cases for possible warranty claims in the future" and that while consumers with currently outstanding warranty claims would be able to file proof of claim forms with the court, even they would probably not be paid in full.

reduces the expected value of durable goods to a forward-looking consumer, with higher probabilities of bankruptcy corresponding to greater reductions in demand.

The durable goods channel is a potentially important source of indirect costs of financial distress. Domestic durable goods manufacturers alone account for about 7 percent of U.S. value added, and many other products and services have long-lived "durable-like" elements in their provisions, making them subject to the mechanism described above. Automobiles, the specific subject of our study, represent a significant fraction of household wealth. They account for about 5 percent of consumption in the U.S. and are the nonfinancial asset most commonly held by households (Bucks et al. (2009)). Prima facie evidence suggests the mechanism does in fact operate in the auto industry: In a 2006 survey, 23 percent of consumers who avoided the "Big 3" (more recently referred to as the "Detroit 3") brands listed those companies' financial conditions as a reason for avoidance (J.D. Power (2006)). Moreover, despite the lack of evidence, policy programs aimed at helping U.S. car manufacturers were based on the premise of large indirect costs of financial distress, through warranties in particular.[3]

Measuring the size of any such effect is empirically challenging, however. While financial distress can reduce the demand for durable goods, causality can also operate in the opposite direction: negative demand shocks affect firms' cash flows and therefore can induce financial distress. This generic problem has plagued the literature on the effects of financial distress and indirect costs of bankruptcy, whether these indirect costs are from the consumer, supplier, or employee side.

Our study, besides focusing on an inherently interesting set of products and firms, can avoid many of these identification issues. We study the effect of financial distress on the prices of used cars in car auctions conducted by a major car auction house in the United States from January 1, 2006 to November 14, 2008. We compare shifts in the prices of a manufacturer's cars to a measure of that manufacturer's likelihood of bankruptcy. As we discuss below, we believe our data is rich enough to provide sources of

[3]On March 30, 2009, the U.S. Treasury Department announced the Warranty Commitment Program, which guaranteed warranties of new General Motors and Chrysler cars were the manufacturers to go bankrupt. They started the program to "help provide much needed certainty to consumers, and a boost to the auto industry, during the restructuring period." We evaluate this assertion in this paper.

identification of the links between cars' values and their manufacturer's financial distress that are unlikely to be driven by reverse causation, where price drops lead to distress rather than vice versa.

Looking for such effects in used car auctions holds several advantages over new car markets. Wholesale car markets are very liquid; prices can rapidly adjust to changes in the economic environment. Their decentralized nature makes them less exposed to strategic pricing, and their participants are auto-dealers who are knowledgeable about the product and the final demand environment. Additionally, unlike a drop in new car prices, a decrease in used car prices does not directly affect manufacturers' cash flows, decreasing the potential for reverse causality.

To measure firms' financial distress levels, we use credit default swaps (CDS) spreads. These are securities whose payoffs are conditional on the firm defaulting on its debt, so their price reflects the expected probability that a firm enters bankruptcy. Because they are much more liquid than the bonds of the respective companies, they provide the most current measure of companies' financial distress.

We use several sources of variation to further address the identification issues plaguing efforts to measure the effect of financial distress on product demand. Our core specification estimates the car price-CDS spread relationship using variation within detailed model-by-region-by-week categories. For instance, we compare the price difference between a 2005 Ford Focus ST sold at an Atlanta auction on Monday and a 2005 Ford Focus ST sold in Ft. Lauderdale later that same week (Atlanta and Ft. Lauderdale are in the same geographic region in our classification scheme) to the change in Ford's CDS spread during the intervening days. Using high-frequency variation makes it less likely that shifts in consumers' views of a particular manufacturer, which presumably operate at a lower frequency, create simultaneous price shifts and financial distress. That said, we observe the negative correlation between a manufacturer's CDS spread and its used car prices at lower frequencies as well. Our basic specification indicates that a 1000-point increase in a manufacturer's CDS spread (a large change, but some firms experience even larger ones in the data) drops the average price of its used cars by $68, or about 0.5 percent.

A further testable prediction of our setting is that financial distress should not affect all cars to the same degree. For example, if car owners worry that their warranties will not be honored upon bankruptcy, then the value of these warranties (capitalized into the price of the car) will fluctuate with manufacturers' financial distress. These effects will imply that value of cars that are still covered under manufacturer warranty should be more affected by financial distress. We find these patterns in the data: the CDS effect is significantly larger for cars in warranty.

It is, of course, possible that changes in manufacturer CDS spreads could affect the supply of used cars. In their analysis of a similar used car auction data set to identify how fluctuations in gasoline prices are reflected in the prices and market shares of cars, Busse, Knittel, and Zettelmeyer (2009) point out that both the demand and supply of used cars with different fuel efficiencies may respond differentially to such shocks. Our specifications therefore include controls for supply-side movements. In particular, we show that the effect is not driven by manufacturers' fire sales of new cars, by the expectation of fire sales of new cars, or by the financial distress of the dealers. We also explicitly incorporate proxies for high-frequency demand shocks and find our results to be robust.

We use our estimates to approximate the effect that financial distress has on manufacturers through a decrease in demand for new cars. Using GM as an example, we find the potential size of the effect to be substantial: even the most conservative estimates imply a 6 percent decrease in GM's car margins (or alternatively, a 10 percent drop in the value of the General Motors North America vehicles division) for a 3000 CDS point increase relative to Ford, which is what we observe in the data. Ex ante, these costs are similar to the cost of financial distress computed from bond yields for a large sample of firms in Almeida and Philippon (2007). A calibration in a simple static trade-off model suggests that GM and Ford's leverage frequently departs from the optimum on a year-to-year basis. Over longer periods, however, the simple model performs reasonably well, suggesting optimal leverage for GM and too much leverage for Ford, the latter of which is consistent with statements from Ford's CEO.

1.1 Related Literature

Our paper touches on the previous literature in two distinct ways. First, it directly contributes to the literature on firm capital structure and the indirect cost of financial distress. Since Titman (1984), indirect costs have been used to rationalize the reluctance of firms to use debt financing despite large tax benefits of debt. While we do not provide direct evidence that firms take indirect costs of financial distress into account when choosing capital structure, our study provides evidence regarding the existence and magnitude of indirect costs of financial distress on consumers. In their classic paper, Andrade and Kaplan (1998) study thirty-one leverage transactions to try to identify the cost of financial distress. They estimate financial distress cost to be from 10 to 20 percent of firm value. Our paper is closest to Chevalier (1995a, 1995b) and Chevalier and Scharfstein (1996). They also use transaction-level data to study the interaction between financial distress and market outcomes. Their focus is the relationship between supermarkets' financial structures and the pricing decisions in the industry, and in particular the strategic effects of financial distress on entry and markups. Berk et al (2009) explore the effect of firm leverage on labor.

Second, the paper delves into the nature of durable goods markets. Most of the literature on these markets has focused on the interaction between the market for new and used goods, trying to understand the competition a monopolist faces from used goods she sold in the past.[4] Our paper instead highlights the fact that much of the consumption stream from durable goods depends on future commitments from the manufacturer and other providers of complementary services. To understand the behavior of durable goods suppliers and consumers, we have to understand the complex structure of services that accompany the consumption of durable goods. To our knowledge, we are the first paper to provide direct evidence of the effect that financial distress has on the demand for durable goods.

The paper is structured as follows. In Section 2, we describe the market for used cars and how it is organized though wholesale auctions. We then describe the data we are using and provide descriptive statistics. In Section 3, we discuss our empirical specification. Section 4 presents and discusses our

[4] See Coase (1972), Bulow (1982), and Stokey (1981) for early work on the Coase conjecture.

estimates. In Section 5, we discuss the implications of our estimates for the indirect cost of financial distress on the case of GM. Section 6 concludes.

2. Institutional Background and Data

Each year, consumers in the United States buy close to 40 million used vehicles, three times the number of new cars sold. In 2010, for example, there were 36.9 million used vehicle sales (~$324 billion in revenues) and 11.6 million new vehicle sales (~$311 billion in revenues). While some of the used vehicles are traded via private party transactions, a large share is transacted via the dealer networks. Of the 80,000 auto dealerships in the U.S., nearly 60,000 sell only used cars, while the remaining dealers trade both new and old cars.

These dealers acquire the bulk of their used car inventory via weekly used car auctions conducted at various locations. The auctions are typically wholesale buyers only—they exclude the end consumer.[5] In general, these transactions occur between purchasing dealers and other firms that are car suppliers. Sellers include other dealers, auto manufacturers, rental car agencies, and corporate fleet resellers. Dealers often rely on such auctions to adjust their used car portfolios to changing local market conditions. Manufacturers use these auctions in order to sell returned fleet and program cars. Car rental agencies use these auctions to trade-in their used cars before they get out of factory warranty. Sellers may also be financial institutions who use the wholesale auction to reduce their inventory of program and repossessed cars.

The top five auctioneers cumulatively command approximately an 80 percent market share in the U.S. While each auctioneer varies in terms of regional distribution and size of operations at each location, physical auction sites managed by major auctioneers are quite large. Each can have between 10 and 100 lanes where automobiles are wheeled through as auctions take place.

[5] Only licensed buyers and sellers who register with the auctioneer can participate in the auction.

Our wholesale auction data comes from a large multinational auctioneer. The firm is the world's largest provider of vehicle remarketing services and is one of the largest wholesale automobile auctioneers in the U.S., operating eighty-three geographically dispersed auction sites. We use data on over 6 million successfully completed transactions from January 1, 2006 through November 14, 2008. The total value of these sales was about $89 billion, with an average transaction price of $13,000 per car. The auctioneer runs one or two auction sessions per week at each site, each lasting approximately five hours. Our auctioneer's sites are quite large. Table 3 lists select sites and their respective traded volumes. They vary in size from one dozen to several dozen lanes and in their volume of successful transactions.

On average, about 3000 cars sell at each auction location in a given day. Buyers can inspect the car in the parking lot prior to the auction session. Each car is provided with a car condition report issued by the auctioneer. This and other vehicle details are prominently displayed in the windshield of each vehicle. Professional auctioneers lead the bidding process, often in the presence of the seller's representative. When bidding ends, the auctioneer consults the seller's representative or some previously communicated reservation price to determine whether the winning bid is accepted or rejected. Sold or not, the car is then wheeled out and a new vehicle is wheeled in. The entire process takes about thirty seconds per car. Sometimes cars that aren't sold are wheeled back in later in the day. Others are re-auctioned on a future date or even transferred to another site. We observe in the data how many times a car was wheeled in at any auction location before it is sold, as well as sequence in which it was wheeled in (i.e., its run number).

For buyers and sellers who cannot travel to the physical auction site, the firm also uses a proprietary web-based technology that enables both sides of the market to participate in the live physical auctions via real-time audio and video. Physical auction lanes are equipped with video cameras that allow online users to view the vehicle as it gets wheeled in, observe the physical bidding activity and place their bids via the web. Online users' bids are displayed on the screen located in the physical lane. Large seller consignors like manufacturers and financial institutions can also chose to sell their vehicles via an "upstream" channel that is operated and managed by our market maker. This service gives sellers the ability to remarket their inventory earlier in the remarketing cycle than physical auction lanes. Buyers save on time and travel expenses with desktop access to “Bid or Buy Now” from the largest nationwide selection of wholesale inventory available. Any unsold cars are moved to the physical auction site and sold through the original process.

In our data, we know whether the winning bid was placed by an online bidder or in-lane bidder or if the car was purchased in the upstream channel. As can be seen in Table 3, approximately 82 percent of the transacted cars were sold to in-lane bidders, 15 percent via the upstream channel, and the remaining to online bidders. Sometimes consignors restrict their sales to select buyers only, referred to as “closed” sales. Closed marketplaces often serve to benefit a manufacturer’s franchise dealer network. Unrestricted or open auctions attempt to allow for maximum buyer participation. 76 percent of the transacted cars in our data were sold in unrestricted auctions (Table 3).

67 percent of the completed transactions are fleet/lease sales, 28 percent factory owned sales, and 5 percent are dealer-to-dealer sales (Table 3). Each automobile is identified by a manufacturer issued unique vehicle information number (VIN). For each VIN we collected information on a large set of vehicle characteristics including car make (Ford, Toyota, Honda, etc.), model (Taurus, Explorer, Altima, etc.), body style (SUV V6, Midsize 4dr V6, 1500 Pickup V8, etc.), and model year. Our data also include the odometer mileage reading and quality condition of each vehicle as certified by the market maker. See Table 2 for details on the quality rating scale.

We obtain the daily time-series of credit default swap spreads with five year maturity (CDS) from Thompson Financial DataStream for all publicly traded automobile manufacturers during the corresponding time period as our auction’s data. Figure 3 plots the CDS time series for four manufacturers: General Motors, Ford, Honda, and Toyota. The prices are in basis points, which can be interpreted under risk neutrality as default probability. For example, a CDS of 1000 basis points corresponds to 10 percent default probability.

We then match the appropriate CDS series to the auction transaction data using the manufacturer identities in the auction database.[6] The matching of CDS data and transactions yields a matched database containing 6,188,759 auto sales. Table 4 contains the descriptive statistics of select variables for our final matched data. The data reflect significant variation in price (mean = $13,062, median = $12,300, and s.d. = $7,560) and CDS (mean = 643.1 and s.d. = 856.1). The cars vary by mileage, age, and quality condition—from relatively pristine to useful only for salvage. Table 5 describes the price and CDS variation by quality condition (with 0 being salvage ready and 5 being very good), while Table 6 contains descriptive statistics by mileage tiers.[7] As expected, transacted prices fall with quality and age. Note, however, that significant variation exists in the cross-conditions of these two variables; there is significant mileage variation within quality tiers and quality variation within mileage tiers.

3. Empirical Specification

Our core specification to measure the effect of financial distress on used cars' values is the following:

$$p_{ijklt} = \beta CDS_{it} + X_{ijklt}\Gamma + a_{ijkT} + \varepsilon_{ijklt},$$

where i indexes manufacturer; j indexes car model, trim, and model year (we will refer to any unique combination of i and j as a "car type"); k indexes auction location (which in most specifications will be one of eight regions in the U.S.), l indexes the specific auction at which the car is sold, t indexes day, and T indexes week. Our dependent variable is the transaction price of the car at auction p_{ijklt}, though we will also estimate specifications below that use a normalized price that divides the transaction price by the average sales price of the car type throughout the entire sample. CDS_{it} is the manufacturer credit default swap spread in period t, and β is the coefficient of interest—the estimate of the effect of manufacturer

[6] This yields a CDS series for the vast majority of brands in our data, including Acura, Audi, BMW, Buick, Cadillac, Chevrolet, Chrysler, Daewoo, Dodge, Ford, Geo, GMC, Honda, Hummer, Hyundai, Infiniti, Isuzu, Jaguar, Jeep, Land Rover, Lexus, Lincoln, Mazda, Mercedes Benz, Mercury, Mini, Mitsubishi, Nissan, Oldsmobile, Plymouth, Pontiac, Porsche, Saab, Saturn, Scion, Suzuki, Toyota and Volkswagen.

[7] We use each car's odometer reading to place it into one of twenty non-overlapping mileage bins. The bins divide the sample into equal-sized parts and as such their breakpoints reflect the empirical mileage distribution. We use these bins in some of the specifications below.

CDS on the price of used cars. The vector X_{ijklt} contains other controls describing the car and auction characteristics. a_{ijkT} is a car type-region-week fixed effect.

The car-type-region-week fixed effects control for a great number of potentially confounding influences on car prices that might be spuriously correlated with CDS spreads or reflect reverse causation. This includes fundamental heterogeneity across car types, region-specific demand and supply shocks for particular vehicles or types of vehicles, and aggregate movements over time. Hence the specification estimates the relationship between car prices and CDS changes only from changes in the auction prices of a given (detailed) type of car within a given region and week.

Intuitively, the regression compares within region-week price differences in cars of manufacturers undergoing financial distress (reflected as an increase in their CDS_{it}) with contemporaneous price changes of cars sold in the same region that are made by more financially stable firms. (Of course, stability per se is not necessary for identification of β; all that is required is differential changes in spreads across manufacturers.) The regression estimate of β simply correlates the differential changes in models' auction prices with the differential changes in the respective manufacturers' CDS spreads, controlling for any fixed or variable effects on prices as captured in a_{ijkT} or X_{ijklt}.

Our choice to limit our identifying CDS price variation to within-week movements may in some ways be overly restrictive, especially if the effects of changes in financial distress take some time to diffuse into wholesale markets. However, restricting ourselves to high-frequency variation in CDS spreads and prices increases the likelihood that we capture the causal effect we seek to measure. It eliminates the possibility that lower-frequency shifts in consumers' views toward a particular manufacturer that both reduce the manufacturer's used car prices and raise its likelihood of bankruptcy are driving our results.

We conduct several additional tests for distress-driven price effects, which involve a series of specifications that interact the CDS effect with measures that plausibly reflect the extent to which an owner could expect future flows of bundled services. They have the following canonical form:

$$p_{ijklt} = \beta CDS_{it} + \gamma Z_{ijklt} + \delta\left(Z_{ijklt} * CDS_{it}\right) + X_{ijklt}\Gamma + a_{ijkT} + \varepsilon_{ijklt} ,$$

where Z_{ijklt} is a car-specific measure of the expected future flows of services. If increased financial distress decreases the expected availability of these services, financial distress should have a larger effect on cars with greater remaining service lives. If service life is positively correlated with Z_{ijklt}, this would imply $\delta < 0$.

The most direct test of this hypothesis focuses on the provision of warranties (we have gathered data on the coverage period of the cars' original factory warranties). We use two Z_{ijklt} measures to focus on the provision of warranty services. One is an indicator for cars under warranty. This is equal to one if a car meets both its warranty's mileage and age requirements at the time of the auction (e.g., it has under 36,000 miles and is less than 3 years old) and zero otherwise. Specifications estimated using this indicator reflect the average difference in CDS effects on prices for cars that are in and out of warranty. Another warranty variable measures the fraction of the original warranty remains on the car. While the effect of CDS on warranties should always be negative, discounting, as we discuss in Section 4.3.2, may imply that this effect is not monotonic. Nevertheless, it is useful to examine a basic linear specification as a function of share of warranty remaining. This is computed as the minimum of two ratios: the difference between the warranty mileage limit and the car's current mileage, divided by the mileage limit; and the difference between the warranty age limit and the car's current age, divided by the age limit. Each of the ratios is defined to be zero if the car's current mileage (age) is greater than the warranty limit. In this specification, the effect of financial distress on prices changes linearly as a car gets closer to the expiration of its warranty.

We include two additional measures of Z_{ijklt}. We include measures of cars' odometer readings that allow us to flexibly capture the differential effect of financial distress across cars of various mileage levels. Another measure of Z_{ijklt} that we use is the set of indicators for the auction house's condition rating for cars that were described in Table 2. Low values for the rating indicate cars in poorer conditions, and as such those with shorter expected service lives than other cars of the same make, model, trim level, and model year.

Because our CDS measures do not vary across cars made by the same manufacturer and may also be serially correlated, we cluster all standard errors reported below by manufacturer-month. This allows an arbitrary error correlation structure across cars made by the same manufacturer as well as intertemporally within months.

4. Results

A first glance at the data suggests that there may in fact be a link between increases in a manufacturer's financial distress and the value of its used cars. The two panels of Figure 1 compare relative bankruptcy risks and wholesale prices of two manufacturers that experienced considerable financial distress during our sample: Ford and GM. The top panel shows two time series for Ford Motors, both constructed from our data. The solid line shows Ford's CDS spread, which we use to measure its financial distress. The dashed line is the price residual of all Ford used cars sold at auction in our sample.[8] As is apparent in the figure, during 2008 in particular, as Ford's financial condition worsened, the values of its used cars dropped as well. There is also some indication that as Ford's relative financial condition was improving in late 2006, its vehicles were also rising in relative value. The bottom panel repeats the exercise but replaces Ford with GM, another manufacturer with obvious financial difficulties toward the end of the sample. Again, we see the clear negative correlation in relative prices and financial strength in 2008, but the patterns are less clear prior to that year.

These results are only expository—indeed, our core specifications below don't even use the aggregate, lower-frequency movements shown in the figure to identify the links between distress and used car values—but they serve to motivate the possibility that such links exist.

4.1. Baseline Specification

[8] We obtain cars' price residuals from a regression that controls for a number of factors that are expectedly invariant to financial conditions. We filter this series through a 12-week moving average in order to reduce statistical noise. In order to remove common movements in price and CDS spreads across manufacturers over the sample, the plotted series are actually the difference between Ford and Honda's respective values. We chose Honda for no special reason other than it was a reasonably financially stable company throughout the sample.

The patterns seen in Figure 1 suggest that there are negative correlations between manufacturers' CDS spreads and the values of their used cars. However, to try to eliminate as many confounding factors as possible, we will focus below on our more saturated specification that looks at differences within car type-region-week cells.

The results from the first specification of this type are shown in Table 7, Column (1). Not surprisingly, given the extent of our included controls, our model does very well explaining the substantial variation in car prices in our sample. The adjusted R^2 is 0.986. The coefficient on manufacturer CDS is -0.068, with a standard error of 0.021. The coefficient implies that a 1000 basis point increase in CDS spread leads to a drop in a car's value of $68. That is roughly a 0.5 percent drop in value off the average $13,062 price of a used car in our sample.

Note that besides the fixed effects, the specification controls for a number of other possibly confounding factors in the data. We include a set of dummies for mileage bins to flexibly capture the effect of mileage on prices. Not surprisingly, average prices decline in mileage. In fact, prices monotonically decrease as one moves from low to high mileage bins. We include dummies for the auction format the car was sold under (this does vary within a day at specific auction locations) and the number of times the car was wheeled through the auction lane, which could be a function of demand or supply factors affecting car price.

One potential worry with our estimation strategy is that car owners adjust the supply of cars in these auctions when they are affected by the same shocks as the manufacturer. For instance, perhaps rental car companies that have close ties with a particular manufacturer suffer financial shocks that are correlated with those of the manufacturer and are forced to respond by liquidating inventory. This would induce a negative correlation between CDS spreads and prices arising not simply from the manufacturer's financial distress but from supply effects as well. We control for such supply effects using two different measures. The first supply control is the number of cars of the same model, trim, and model year being sold on that day in the particular auction location. The second measures how many cars of same model, trim, and model year had been sold up to this point in the sample at the same location.

The specification in Table 7, Column (1) uses the car's auction price as a dependent variable, which restricts the effect of CDS movements to have the same absolute size across all cars. However, it is possible that the absolute effect could be related to the price level of the car rather than independent of it. To account for this possibility, we also run the same specification using as the dependent variable the car's auction price normalized by the average price of its car type (make, model, trim, and model year) throughout the entire sample. In this case, the coefficient on CDS can be interpreted as the size of the effect of financial distress in proportion to the average price level of a car's type.

The results from this specification are shown in Table 7, Column (3). Here, the coefficient on manufacturer CDS is -5.15×10^{-6} (s.e. = 1.52×10^{-6}). This implies that for each 1000 basis point increase in CDS spreads, a car's price falls by roughly 0.5 percent. This is essentially the same as the implied percentage change in price from the previous specification using dollar-valued prices. Thus our basic estimated effects are consistent across price measurements.

4.2. Interactions with Expected Service Lives

Perhaps the most important remaining concern with our baseline specifications is that our week fixed effects strategy might not necessarily account for high-frequency shifts in demand that are also reflected in CDS prices. An additional prediction of the financial distress/bundled services link is that the effect of financial distress should vary across cars with different remaining service lives. For example, cars within warranties have more coverage remaining. They also have longer expected service lives even outside of warranty, so the value of bundled services that their manufacturer provides is also greater.

4.2.1 Interactions with Warranty Status

We obtain perhaps the most convincing results by focusing on the role of warranties in two specifications. In one, we define an indicator variable denoting if a car is still under original factory warranty. To be defined as such, it must meet both the mileage and age requirements of the warranty. We then test whether the price effects of CDS increases are in fact larger in magnitude (i.e., more negative) for cars under warranty than those out of warranty. In the second warranty check, we compute the fraction of the warranty remaining for a car. (The minimum fraction between the mileage and age limits is used; cars out of warranty receive a value of zero.) We interact this variable with CDS to see if cars with different degrees of remaining warranties see different price effects.

The results using the dichotomous in-warranty indicator are in Table 9, Column (1). The main effect of CDS, and therefore the average effect for cars that are *out* of warranty, has a coefficient of -0.006 (s.e. = 0.025). Thus, the specification implies a negative but insignificant effect on these cars' prices. The interaction, however, has a negative and significant coefficient. The full implied effect of CDS has a coefficient of -0.062 (s.e. = 0.020). This is roughly the size of the main effect estimated above. This is consistent with the threat of the loss of warranty coverage being an important driver of the CDS price effect.

The second warranty specification, which interacts a measure of the fraction of the factory warranty that remains on the car with the CDS spread, is in Table 9, Column (2). The estimated coefficient on the CDS main effect again represents the average effect for cars that are out of warranty and is a statistically insignificant -0.010. The coefficient on the interaction of CDS and the fraction of warranty remaining, however, is -0.129, and is significant at the 10 percent level. The fully interacted effect of CDS is -0.139 (s.e. = 0.050), which is significant at the 1 percent level. This result implies that a car with its full factory warranty remaining (i.e., its fraction is one) would see a price hit of $139 per 1000 point CDS change, and this then linearly declines until the warranty expires at an insignificant $10 per 1000 point change. This result has the intuitive property that the effect of CDS on prices increases with the length of the remaining period over which the warranty applies and during which the car will be operational.

If we linearly extrapolate our warranty estimates for a 10,000 point change in the CDS spread, that is, from no chance of bankruptcy to certain bankruptcy, we obtain an approximate valuation of a full warranty in the used car market of $1390.[9] It is useful to compare this value to the accounting accruals of

[9] This assumes no recovery on warranties in bankruptcy.

warranties in the auto industry, which are between $400 and $2015 per vehicle.[10] While these accruals reflect the approximate cost to the manufacturer, and do not take into account the margins charged on the warranties nor the consumer surplus from the insurance value of warranties, the fact that they are the same order of magnitude suggest our estimates are sensible, even when crudely extrapolated.

4.2.2. Interactions with Mileage

As discussed previously, we test for these service life effects in several ways. We next interact manufacturer CDS spreads with our set of twenty mileage quantile indicators. Table 7, Column (3) shows the results of this exercise. We also present the implied relationship between the effect of CDS and car mileage graphically in Figure 4. We can see that, with the exception of the first mileage bin (the excluded category and thus reflected in the main CDS coefficient), the estimated total effects of the interactions are significantly negative for the lowest 14 mileage bins (this corresponds to cars with no more than 50,035 miles, which, perhaps not surprisingly, is a standard warranty cutoff). The point estimates initially become more negative (i.e., larger in magnitude) as mileage increases, but after reaching an interacted effect of -0.154 in the 9th bin (cars in this bin have 28,215 miles on average, implying a $154 dollar price drop for a 1000-point rise in CDS spreads), they begin to become more positive. They continue to rise throughout the rest of the mileage bins, and actually become significantly positive by the 17th bin and remain so after.

These results are echoed when we use normalized prices instead of price levels, as seen in Table 7, Column (4). There are negative and significant coefficients of CDS on cars in the first 15 mileage bins (applying a test for the base effect plus interaction coefficients, the 2nd and 3rd bins are only significant at the 10 percent level). After the 14th mileage bin, the CDS effect begins to become more positive. Also in line with the results above, the maximum estimated effect is a one percent price drop per 1000 point CDS increase; the estimated $154 effect from the levels specification is about 1.2 percent of the average price

[10] http://www.warrantyweek.com/archive/ww20090723.html

in the sample. Further, as above, cars in the highest mileage bin see significant price gains when their manufacturer's CDS rise.

While it is reassuring that the CDS coefficient is negative only for cars that have below 50,000 miles, one may expect the prices of cars with lower mileage, and thus higher warranty-coverage to drop more in response to an increase in the manufacturer's CDS than cars with higher mileage. However, we find that the effect of CDS is less for cars in the smallest mileage bins than for cars with higher mileage.

One possible reason for this observed non-monotonicity is simple discounting. With discounting, while the effect of CDS on cars in warranty is negative, this effect need not be monotone over the in-warranty range. We can think about the value of a car as a discounted utility flow the consumer obtains from the car. Suppose that if the consumer were to need a warranty, she will need it only after 20,000 miles, which in expectation will be two years in the future. The price of a two-year-old car therefore varies with the expected value of the warranty. The value of a brand new car, on the other hand, is the value of the utility flow of the car for the first two years plus the value of the two-year-old car discounted by two years. This discounting applies to the utility flow from the used car as well as to the effect of warranties, which—in the case of a brand new car—will be consumed only two years from now. Thus, compared to a two-year-old car, the effect of CDS on car value for a brand new car may be less. It is possible the applicable discount rate is quite high in this case; car manufacturer bankruptcy is likely to be highly correlated with aggregate risk. As stated above, however, even with discounting, the effect of CDS should be negative for cars under warranty. We discuss how the selection of mileage bins affects the non-monotonicity in the Appendix.

4.2.3. Interactions with Physical Condition

We also interact CDS with a measure of the car's physical quality. As mentioned above, the auction house grades cars' conditions on a six-point scale, ranging from 0 (useful for salvage only) to 5 (no or minor defects). This specification tests whether financial distress has a different effect across cars of varying quality by interacting our CDS spread measures with both the car's condition score and its mileage band. The results are presented in Table 9, Column (3). The main CDS effect, which corresponds to cars in condition category 0 (salvage only) is actually positive and significant. This is consistent with these cars, as a store of available replacement parts, actually becoming more valuable when the manufacturer faces financial distress. However, the size of the coefficient, 0.463, implies what is probably an implausibly large point estimate of a $463 price gain when CDS spreads rise by 1000 basis points. Such cars represent less than 0.3 percent of the sample, however. Category 1 (poor condition) cars also have a positive total effect of CDS, but this has a more modest (and realistic) coefficient of 0.121. The interactions between categories and CDS continue to fall monotonically as the car's condition improves, as would be expected if better condition cars have longer expected service lives. When CDS rises, those in the best 3 condition categories (3, 4, and 5) experience significantly negative price effects on the order of $56 to $78 price drops per 1000 point CDS increase.

4.2.4. Discussion of Expected Service Life Interactions

The results from each of these alternative specifications are consistent with the notion that the negative effect of a manufacturer's financial distress is larger for cars with longer expected remaining service lives, and therefore greater expected future flows of bundled services. There seems to be a special role for warranty coverage in explaining these effects.

We have also conducted several robustness checks that we do not report in the paper. The interaction results above are robust to excluding the data after September 15, 2008 (the Lehman Brothers bankruptcy), including car type-auction location-week dummies instead of the car type-region-week dummies, and estimating the specifications separately for SUV and non-SUV vehicles.

These results also help address the alternative hypothesis that time-varying perceptions of a manufacturer's car quality drive both the manufacturer's CDS spreads and car prices simultaneously. For this alternative story to be true, these innovations in quality perceptions would have to disproportionally affect lower mileage cars—in particular, cars that are under their warranty thresholds—and cars that are in better physical condition. In other words, people's perceptions of the quality of, say, a 2003 Ford Focus with 20,000 miles would have to change very frequently and be highly correlated with Ford's financial condition, while at the same time, there would be virtually no quality updating for a 2003 Ford Focus with 90,000 miles.

4.3. Robustness Checks

While it is difficult to imagine an omitted factor that would generate the results above, in particular those regarding expected remaining service life (interactions with mileage, warranty status, and quality), we present further tests to probe the robustness of our results. We present additional robustness tests in the Appendix.

4.3.1 A "Placebo" Test

To see if, despite all of our controls, our results reflect a spurious correlation between a manufacturer's CDS spread and its used car prices, we conduct a "placebo"-type test. That is, we run our basic specification after having randomly reassigned manufacturers' CDS series among one another. In particular, Ford and GM, which experienced CDS growth in 2008 far beyond that of other companies, are assigned the CDS series of Mitsubishi and Toyota. Of course, two more stable manufacturers, Hyundai and Mitsubishi, had, respectively, Ford and GM's CDS values reassigned to them. This placebo specification therefore compares the auction prices of a manufacturer's cars to the CDS prices of another manufacturer. Since reassignment should expectedly destroy any causal link, the coefficient on CDS in this specification should be informative.

The results of this exercise (using the same set of controls as in Table 7, Column (1)) are shown in Table 9, Column (1). The coefficient on CDS is now positive and insignificant. Hence it appears that the CDS-price correlations we observed above were tied to within-manufacturer relationships of product values and financial distress.

4.3.2 Dealers' Financial Distress

Our next robustness check investigates whether *dealers'* (i.e., auto retailers') financial distress, not the preferences of final demanders for bundled services, actually drives the relationship between used car prices and manufacturers' CDS spreads. Namely, if dealers become more concerned about their own business prospects when the manufacturer with whom they are affiliated experiences financial distress, this may reduce their demand for used autos. Moreover, since dealers disproportionately purchase used cars of the same makes that their affiliated manufacturer produces, this could lead to a decline in the prices of that manufacturer's used cars. While one might imagine this is another way a manufacturer's financial decisions can have external effects, it is not the consumer-driven bundled-services channel that is of interest to us here.

To see whether this dealer based-mechanism is driving our results, we take advantage of the fact that our data contains the full name of the winner of every auction. These are nearly always car dealerships, as perusal of the names makes clear. Since dealerships that are affiliated with manufacturers (i.e., those that sell new cars, not just used ones) almost invariantly have the name of the make(s) that they sell new in their name, we can tell when, say, a Ford (or Mercury, Lincoln, or Mazda—all makes that Ford owns partially or outright) dealer buys a used car. If the dealer-based mechanism just described is driving our results, we should expect that Ford-affiliated dealers are less likely to buy Ford cars when Ford's CDS rises. We test whether or not this is true for dealers affiliated with the two companies that experienced, by some distance, the greatest amount of financial distress during our sample: Ford and GM.[11]

We do so by estimating a similar specification to our benchmark regression above, with a few exceptions. First, most obviously, the dependent variable is now an indicator equal to one if a Ford dealer (or a GM dealer, in the GM regression) buys the car. Second, we restrict the sample to only cars with a Ford (GM) make. We keep the saturated fixed effect structure from before. Therefore we are testing whether Ford-affiliated (GM-affiliated) dealers are less likely to buy a used car with a Ford (GM) make

[11] Chrysler was of course having serious troubles during much of our sample. However, they were sold to the private equity firm Cerberus in early 2007, well before the financial crisis began and CDS spreads began to rise. There were no Cerberus CDSs in the market, so we have no way to correlate the manufacturer of Chrysler's financial condition with the prices of its used cars. Thus we dropped all Chrysler cars from our sample from 2007 on.

when Ford's (GM's) CDSs are high, controlling for the average probability across all sales of a particular car type in a region-week. If the dealer-based mechanism is important, we should find a negative and significant coefficient on CDS in this linear probability model.

The results of this estimation are in Table 9, Columns (2) and (3). The coefficient in the GM equation is positive and significant: GM dealers are, if anything, more likely to buy GM-make used cars when GM's CDS rises. Any such effect is small, however. The coefficient implies that a 1000-point increase in CDS raises the probability that a GM dealer wins an auction for a GM car by 1.55 percentage points. In the entire sample, 31.6 percent of GM car auctions are won by a GM-affiliated dealer (most of the rest are won by used car specialists, though it is not uncommon for new car dealers to purchase across makes when buying used). Thus even a large CDS change doesn't move the probability of purchase far from the baseline. The coefficient in the Ford equation is negative, which is more consistent with a dealer-based mechanism being at work. However, the estimate is marginally statistically significant and is again small in magnitude. A 1000-point increase in Ford's CDS reduces the probability that a Ford-affiliated dealer wins an auction for a Ford-make used car by 1.79 percentage points. On average 38.1 percent of Ford cars are bought by Ford dealers. Thus the likelihood of purchase drops only about 4 percent. It is difficult to know the implied price effect of this reduction without knowing more about the supply of other bidders and their valuations, but this does not seem to be a clear driver of our results above, particularly in light of the GM results.

4.3.3 "Fire Sale" Pricing of New Cars

Our next robustness check addresses the possibility that the relationship between CDS and used car prices is driven by "fire sale" pricing of new cars by car manufacturers. If manufacturers drop prices precipitously as CDS increases, this could spill over into prices of used cars as well. Since our identification comes from within-week price variation, this effect is unlikely, since the pricing of new cars would have to be responsive to high frequency variation of CDS. We nevertheless test for this possibility by including the average retail new car price in the region on the day of the sale as a control. The retail price in our new car sales data is computed to reflect the rebates and incentives consumers obtain as well as taking into account the trade in value of the used car. The results are presented in Table 10.

The coefficient on new car price is negative, but economically and statistically insignificant. The insignificant coefficient points to the fact that there is very little variation in new car prices within a given week, since manufacturers rarely change list prices or promotions (our data is based on transaction prices, not list prices, though it appears that transaction prices reflect the same feature). Moreover, some of the demand variation that drives new car price changes, such as financial distress, is already captured in CDS prices. The coefficient on new prices only captures variation in new car prices that is orthogonal to CDS. In any case, the results from our basic specification and our warranty specifications remain quantitatively similar to the benchmark results above when we control for new car prices. The standard errors on the CDS effects are higher, though, probably because of the decreased sample size resulting from matching the used car transaction sample with new car prices.

5. Discussion

The results above indicate that auto owners do see a drop in the value of their vehicles when those vehicles' manufacturers are in financial distress. In this section, we do some simple calculations to gauge what our estimates imply about the indirect costs of financial distress and the choice of capital structure for car manufacturers.

To approximate the drop in demand for new cars from our used car estimates above, we conservatively assume that the valuation hit taken by new cars is the same as the estimated drop in the valuation of an (almost-new) used car under full warranty. (This essentially assumes away any "drive off the lot" depreciation that might reduce the size of the effect on used cars.) The estimated drop in valuation for a used car with a full factory warranty remaining is in Table 9, Column (2): every 1000 basis point increase in the manufacturer's CDS spread leads to a $139 loss in value. For simplicity, and because it is a reasonable approximation to reality, we assume that manufacturers' short-run supply curves are inelastic, so this $139 drop in value is reflected completely in reduced sales prices rather than fewer sales, which would dampen the effect.

Thus we estimate a car manufacturer can expect a reduction in price per car of $139 per 1000 point increase in its CDS spread. However, a manufacturer's expected warranty costs also decline as it falls deeper into financial distress, as it becomes less likely it will need to actually honor warranties. Warranty costs are not directly observed in the data, but industry trade press estimates suggest that dealers charge up to 50 percent markup on extended warranties (which does not include the markup of the actual warranty provider).[12] Additionally, GM reported warranty claims of around 3 percent of sales over 2003 to 2008.[13] Given our estimate above that consumers value the warranty on a new car at about $1400, and supposing an average wholesale (i.e., to-dealer) price of $25,000 per car, this also implies a warranty margin of just under 50 percent. Hence, we approximate a manufacturer loses an average of about $70 of margin per car for every 1000 point increase in its CDS spread.

5.1 Ex Post Cost of Financial Distress: GM at the End of 2008

At the end of 2008 GM was in substantial financial distress. Its CDS spread had increased to 8000, exceeding Ford's spread by 3000 points. We take an extremely conservative approach and assume that only the *difference* between GM and Ford is caused by GM's financial decisions, that is, we let Ford's CDS proxy for common factors.[14] Between 2006 and 2009, the largest accounting margin that GM earned on its vehicles was 7 percent.[15] Since estimates of margins in the car industry differ widely, we'll also consider potential margins of 2 and 15 percent.[16] Again, suppose an average new car price of $25,000. At

[12] http://www.edmunds.com/auto-warranty/how-to-get-the-best-price-on-an-extended-car-warranty.html

[13] http://www.warrantyweek.com/archive/ww20081113.html

[14] Given that Ford's credit rating in 2008 was fluctuating between B and CCC+, this is a very conservative assumption.

[15] We calculate the accounting margin as (automotive sales/automotive cost of sales) – 1, where the figures are taken from Motors Liquidation Co. 10-K; March 5, 2009.

[16] 15 percent is at the lower end of markups estimated by a number of empirical studies of the auto industry using discrete choice demand models. For example, Berry, Levinsohn, and Pakes (1995) find, using 1990 data, an average markup of 23.9 percent, and Goldberg (1995) reports an average markup of 38 percent. Using micromoments, Petrin

a 2 percent gross margin rate, a manufacturer's per car margin is $500; at 7 percent, it is $1750; and at 15 percent, it is $3750. A 1000 point increase in CDS spread therefore wipes out 14 percent of the per car margin if the margin rate is at our lowest assumed value, 4 percent of the per car margin at the rate observed in GM's data, and about 1.9 percent at the highest margin rate we consider. Therefore even the most conservative estimates suggest that the financial distress tied to GM's 3000 point CDS spread increase resulted in it losing 5.6 percent of its gross margin. At the 7 percent accounting margin rate reported by GM, the estimated loss is 12 percent of gross margin.

Alternatively, we can approximate the present value of cash flows lost to the vehicles division of GM North America because of financial distress, and compare it to our estimate of the enterprise value of the division. GM sold 4.65 million vehicles in North America in 2006. Every 1000 point CDS increase therefore translates in a lost margin of $325.5 million (= 4.65 million x $70) per year. At a cost of capital of 10 percent, this implies a loss of $3.26 billion in value. To approximate the enterprise value of the vehicles division of GM North America in 2006, we would ideally add the market value of debt and equity of the division, and subtract its cash holdings. However, we can only obtain the equity valuation and book value of debt for GM as a whole, and the book value of debt at this point in time was a poor proxy for its market value. So we instead first assume that GM's book value of assets, which was $186.3 billion at the time, was the market value of the firm. (Given that the firm was headed toward bankruptcy, this likely overestimates its value.) We then assume that the vehicle divisions are valued in proportion to their share of cars in GM's overall world production. This will again inflate the value of auto divisions, since it ignores the value of other parts of GM. In 2006 GM sold approximately half of its cars in North America.[17]

This procedure gives an approximate value for GM's North America auto division at $93.2 billion. Combining this with the $3.26 billion estimated loss in valuation for every 1000 point CDS increase from

(2002) estimates markups between 15 and 16.7 percent, and the Berry, Levinsohn, and Pakes (2004) study with "second-choices" data reports a mean price elasticity of -3.94, implying a markup of 25.4 percent.

[17] GM sold 4.65 million vehicles in North America and 9.18 million vehicles worldwide in 2008. (Motors Liquidation Co. 10-K, March 05 2009.)

above implies that a 3000 point increase would have cost GM North America 10 percent (= 9.78/93.2) of its value. Interestingly, these magnitudes are not far off from those obtained by Andrade and Kaplan (1998) in their work on highly leveraged transactions, and they are also similar in size to the estimates of direct legal costs of Chapter 11 by Bris, Welch and Zhu (2006). Our assumptions in these calculations are conservative and probably underestimate the ex post indirect cost of financial distress.

5.2 Ex Ante Cost of Financial Distress

At the end of 2008, GM was already in considerable financial distress. To understand how much indirect financial distress cost is borne by a healthy car manufacturer, we compute what the expected cost of financial distress would be for car manufacturers with different credit ratings. We first compute the expected CDS of firms with different credit ratings. We use estimates of risk neutral 5-year default probabilities from Almeida and Philippon (2007) and the recovery rate of 0.413 they use to obtain these estimates. The expected CDS spreads are presented in Table 11, Panel A.

Our calculation above provides the cost of financial distress for a given change in CDS—3.5 percent of firm value for a 1000 basis point increase in CDS. Our estimates imply that the expected cost of financial distress for a car manufacturer with a credit rating of AAA is 0.1 percent of its value. The expected CDS for an AAA rated manufacturer is 32 basis points, so 32*0.035/1000 = 0.1 percent. This expected cost of financial distress increases to 2.3 percent at the lowest investment grade rating of BBB, but starts growing quickly for lower ratings: a car manufacturer with a B rating suffers a financial distress cost of 7 percent of its value.

It is interesting to compare these estimates to those from the literature. Almeida and Philippon (2007) estimate the expected financial distress cost from bond data. Even though our estimates are obtained using a different approach they are of very similar magnitudes (see Table 11, Panel A, column 5). Our calculations capture the demand driven component of indirect cost of financial distress. Any additional cost of financial distress such as the direct cost of bankruptcy should be added to our calculations to compute the full ex ante cost of financial distress.

5.3 Marginal Cost of Debt and Implications for Capital Structure

Indirect costs have been used to rationalize the reluctance of firms to use debt financing despite large tax benefits of debt. Here, we use our estimates and a simple static trade-off model to see if the estimated cost of financial distress is large enough to rationalize the leverage choices of General Motors and Ford over 1998-2007. A back of the envelope calculation like this should always be interpreted with caution, however, since it ignores strategic considerations among firms and dynamic considerations in capital structure choice.

In a simple static trade-off model, firms' choose capital structure by equalizing the marginal tax benefits of debt with the marginal costs of financial distress. We first compute the marginal cost of leverage: how a marginal increase in leverage changes the expected indirect cost of financial distress for car manufacturers. We decompose the marginal cost of leverage into two effects: the expected increase in CDS resulting from a marginal increase in leverage, $\frac{dCDS}{dD}$, and the expected cost of financial distress, $E(CFD)$, for a given increase in CDS, $\frac{dE(CFD)}{dCDS}$. The marginal cost of leverage can then be expressed as $MC = \frac{dE(CFD)}{dCDS}\frac{dCDS}{dD}$. Above, we computed an estimate of the first quantity: a 1000 point increase in CDS results in a 3.5 percent decrease in firm value, or $\frac{dE(CFD)}{dCDS} = \frac{3.5\%}{1000bp}$.

To compute the change in CDS that results from a change in leverage, we decompose it into the change in ratings caused by a marginal change in leverage and the marginal change in CDS from a given change in ratings: $\frac{dCDS}{dD} = \frac{dCDS}{d\,ratings}\frac{d\,ratings}{dD}$. We compute the change in CDS that results from a marginal change in ratings as the average change in CDS from adjacent ratings, using the estimates from Table 11, Panel B, Column 3.[18] Intuitively, we average the left and right derivative of CDS with respect to ratings

[18] For example, for a AA rated company, $\frac{dCDS}{d\,ratings} = \frac{(CDS(A)-CDS(AA))+(CDS(AA)-CDS(AAA))}{2}$.

for a given rating.[19] Next we obtain the estimate of the rating change that results from a marginal increase in leverage, $\frac{d\,ratings}{dD}$, from Molina (2005). He estimates the relationship between ratings and leverage, taking into account the endogenous choice of leverage. We use his baseline model coefficient of 13.78.

We combine these estimates to compute the marginal cost of leverage, $MC = \frac{dE(CFD)}{dCDS}\frac{dCDS}{d\,ratings}\frac{d\,ratings}{dD}$, and present the results in Table 11, Panel B, column 3. The marginal cost of indirect financial distress increases monotonically in leverage. It starts at 2 percent for a hypothetical AAA-rated car manufacturer and reaches 39 percent for a B-rated company. There is a particularly large increase in the marginal cost as the rating slides from investment grade to junk: the marginal cost is 20 percent for a BBB rating and increases to 33 percent for a car manufacturer with BB-rated debt.

Finally, we apply these estimates to examine the capital structure choices of GM and Ford. We compare the marginal cost of financial distress to the marginal benefit of tax savings from leverage—the effective tax rate. We obtained the effective tax rates from John Graham (see Graham (2000)). Since the effective tax rates for GM are provided through 2007, we start our exercise in 1998 to obtain a decade of data for GM.

GM and Ford experienced substantial variation in their capital structure and effective tax rates from 1998 onward. The credit ratings of both companies decline quite steadily through most of the period: in 1998 GM and Ford had credit ratings of A, but both had declined to B by 2007. Ford's credit rating recovers somewhat after 2009. The ratings decrease implies a large increase in marginal cost of debt, from 14 percent for Ford in 1998 to 39 percent in 2006. At the same time there is substantial variation in the effective tax rates faced by these companies.

The static trade-off theory has a difficult time rationalizing financial choices of GM and Ford year by year. For example, GM is significantly under levered in the beginning of the sample: its effective tax rates

[19] For the lowest rating, B, which we examine, we cannot interpolate the derivative, so we simply use the left derivative, the change in CDS from B+ to B.

are over 33 percent throughout 1998-2000, but its calculated marginal cost of financial distress is 14 percent of firm value over the same period. Towards the end of the sample, the situation is reversed: GM's marginal costs of financing exceed its marginal tax rates by over 20 percentage points, suggesting that the firm was over levered. GM's capital structure departs substantially from the model-implied optimum for 8 out of 10 years; only in 2001 and 2002 is the marginal cost of debt within 5 percentage points of the marginal benefit. Ford exhibits a similar time gradient, but spends more of the 2000s with a debt burden that is too high relative to what the model computes as optimal. Further, Ford's wedge between marginal cost and benefits fluctuates over time. From 2005 to 2010, the wedge increases from -19 to -37 percent, then decreases to -4 percent, increases again to -38 percent, and decreases to -9 percent.

Next, instead of examining choices year by year, we average the marginal costs and benefits over the decade from 1998 to 2007. The averages convey a somewhat different story. GM's capital structure is optimal from the perspective of a simple trade-off model: the marginal costs are on average 24 percent and almost identical to its marginal benefits of 23 percent. Ford, on the other hand, is more consistently over-levered during this period, with the marginal cost exceeding marginal benefits by 5 percentage points. Given these estimates, Ford would have to change its capital structure enough to increase its bond rating by approximately two notches to achieve its optimal capital structure, assuming that the effective benefits were to remain unchanged. Interestingly, returning Ford to investment grade status has been one of the main goals of the current Ford CEO Alan Mulally.[20]

The GM and Ford results suggest that car manufacturers do not choose the optimal capital structure as suggested by the static trade-off model at every point in time. On the other hand, over longer periods of time, the marginal indirect costs of debt computed using our estimates appear to roughly match debt's tax benefit, especially in the case of GM. One potential explanation for the short-run deviations is that adjustment costs prevent companies' from instantaneously adjusting their leverage (see, for example, Strebulaev, 2007), which results in divergence from the optimal capital structure over time. Ford's

[20] http://corporate.ford.com/news-center/press-releases-detail/fs-video-ford-investment-grade-status

apparent over-leveraging may be a particularly stark case in point: while Ford's CEO also believed the firm was over-levered, it took the firm until 2012 to achieve the stated goal of investment grade ratings.

Our computation using average marginal costs and benefits is closest to the literature using static trade-off models to evaluate the magnitude of the benefits of financial distress, such as Graham (2000), Molina (2005), and Almeida and Philippon (2007). These studies examine capital structure choices over a large sample of firms, averaging over a large sample of firms, rather than over time for a given firm as we do. The implications for the optimality of leverage choice of GM and Ford during the decade of 1998-2007 are closest to Almeida and Philippon (2007), who use bond yields and estimates of financial distress from Andrade and Kaplan (1998) to show that a simple trade-off model can rationalize the on average low leverage choices of companies issuing bonds. Korterweg (2010) computes optimal leverage for individual firms on a year to year basis. He finds very similar results for GM: too little leverage for GM until 2004 and too much leverage for 2005 and 2006.[21] He also finds that Ford is significantly over-leveraged during this period, even in 1998 to 2000, when our estimates suggest too little leverage.[22] Since Korterweg (2010) estimates the total distress cost, rather than demand driven indirect cost of financial distress, these other costs could explain the differences in our results.

6. Conclusions

We have documented a mechanism through which firms' financial structure decisions create indirect costs of financial distress. Durable goods producers provide their customers a stream of complementary services (warranties, spare parts, maintenance, upgrades, etc.) after the initial purchase of the core product. Bankruptcy threatens this provision, so in taking on debt a durable goods producer reduces consumers' willingness to pay for its product. As a result, shifts in financial health change the value of the manufacturer's products to their current owners.

[21] Korterweg's sample ends in 2006.
[22] Our results differ

We find evidence that this mechanism is at work in the auto market. Using wholesale auction price data for millions of used cars sold in the U.S. during 2006-8, we show that an increase in an auto manufacturer's financial distress (as measured by an increase in its CDS spread) results in a contemporaneous drop in the prices of its cars at auction, controlling for a host of other influences on price. The estimated effects are statistically and economically significant. A one-point increase in CDS spread results in a 6.8 cent drop in prices. This implies that a 1000 basis point movement in CDS spreads causes a price reduction of $68, about 0.5 percent of the average sales price in the sample.

Furthermore, cars with longer expected service lives (under manufacturer warranty, lower mileage, or better condition cars) see larger price declines than those with shorter remaining lives. This is consistent with manufacturers' provision of bundled services being an important component of the value of a durable good. There seems to be in particular an important role of warranties in this regard. Additionally, there is some evidence that parts availability might also move prices. High-mileage and low-quality cars actually see price increases when their manufacturer experiences financial distress, and these vehicles might actually be net suppliers of parts rather than net demanders.

We show that these results are robust across a number of specifications with various measurement strategies. They also do not appear to reflect the reduced demand from dealers affiliated with manufacturers experiencing financial distress or a decrease in new car prices driven by manufacturer "fire sales," but rather from the consumers' potential loss of a flow of bundled services.

Calculations done using our estimates indicate that this drop in car demand from financial distress generates a substantial indirect cost of financial distress for car manufacturers. Bundling amenities with the core product is a common feature of durable goods markets. Understanding which amenities have to be bundled and how susceptible their provisions is to financial distress should allow much better insight into the costs and benefits of financial choices for an important segment of firms.

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Appendix: Additional Robustness

Parametric non-monotonicity

Beyond economic reasons, it also appears that the non-monotonicity is somewhat dependent on how we select the mileage bins. For example, if we instead use flexible polynomials in mileage to account for the nonlinear effect CDS-mileage response (Table A1), the non-monotonicity only becomes evident in specifications including 5th or higher polynomial terms (as shown in Figure 5). Based on this, we investigated the source of the non-monotonicity further. It turns out that the small estimated CDS effect in the lowest mileage bin (up to 4,818 miles) is driven by cars with fewer than 1000 miles. It is possible that used cars with fewer than 1000 miles might exhibit a very different selection pattern into the wholesale market than those with more typical mileage levels. One possible story is that these cars are considered essentially perfect substitutes for new cars, and because new car prices do not respond to CDS movements, the prices of these very low mileage cars do not vary with CDS that much either.

New car prices in the future

It is also possible that the CDS reflects the fact that the manufacturer will lower prices in the future, and thus we should be controlling for *expectations* of new car prices rather than the current new car prices in our regressions. If consumers have rational expectations, however, we can use realized "future" new car prices as unbiased proxies for consumer expectations. In Table A2, we run a number of additional specifications which control for future new car prices. We include future new car prices at 7-, 30-, and 60-day lead windows to account for stickiness in new car prices. We also experimented with a host of specifications including lags in case the price formation process was autoregressive and found no differences. Our results are largely unchanged compared to Table 10, where we only controlled for the contemporaneous new car prices. In particular, our warranty interaction specifications (the second and third specification in each panel) still show that the CDS changes have the largest effect for cars under warranty, which is what theory suggests.

Other Possible Sources of High-Frequency Demand Fluctuations

Our final robustness check is to explicitly control for changes in consumer perceptions of car quality or reliability that are changing with high frequency. To perform this check, we collected two sources of data on information flows that may affect consumer demand for a particular manufacturer's cars. In particular, we obtained daily data from the US National Highway Traffic Safety Administration (NHTSA) regarding recall filings by auto manufacturers. Tables 14, and A1-A3 use the NHTSA data in various specifications to control for contemporaneous (Table A3), lagged (Table A4), and future (Table A5) recall notices in our main econometric specifications. Moreover, Table A6 introduces NHTSA recall registrations into our main specifications using a 3-day moving average.

Second, we collect data from the Associated Press on daily news mentions of manufacturers in the press and, alternatively, in the headline of the article. We also separately measure if the manufacturer was mentioned in an article that also mentioned recalls or bankruptcy and distress. We present these results in Table A7. All of these specifications uphold our main results, with very minor changes to the size and significance of our estimated coefficients. These specifications therefore reassure us further that our results are not driven by unobserved high frequency shifts in demand due to changing perceptions of quality/reliability of the cars.

Table 1
Most Common Car Characteristics

The table presents the most common car characteristics by different variables in our sample. The % of Obs refers to the % share of the category among observations for which information was available.

Brands				Models			
Rank	**Car Make**	**# of Obs.**	**% of Obs.**	**Rank**	**Car Make**	**# of Obs.**	**% of Obs.**
1	FORD	1,387,982	22.43	1	TAURUS	227,158	3.67
2	CHEVROLET	982,143	15.87	2	EXPLORER 4WD V6	123,892	2.00
3	NISSAN	351,425	5.68	3	IMPALA	118,306	1.91
4	TOYOTA	313,965	5.07	4	ALTIMA	112,353	1.82
5	PONTIAC	285,381	4.61	5	GRAND PRIX	108,419	1.75
6	JEEP	255,400	4.13	6	FOCUS	99,004	1.60
7	DODGE	216,632	3.50	7	F150 PICKUP 4WD V8	97,916	1.58
8	HONDA	199,190	3.22	8	MALIBU V6	66,717	1.08
9	B M W	170,190	2.75	9	F150 PICKUP 2WD V8	65,494	1.06
10	HYUNDAI	162,162	2.62	10	MUSTANG V6	64,639	1.04

Model Year				Category			
Rank	**Year**	**# of Obs.**	**% of Obs.**	**Rank**	**Category**	**# of Obs.**	**% of Obs.**
1	2006	1,278,944	20.67	1	SUV	1,839,362	29.73
2	2005	1,225,995	19.81	2	MIDSIZE CAR	1,486,014	24.02
3	2004	833,631	13.47	3	LUXURY CAR	759,971	12.28
4	2007	815,163	13.17	4	COMPACT CAR	706,807	11.43
5	2003	660,975	10.68	5	PICKUP	593,749	9.60
6	2002	385,805	6.23	6	VAN	464,510	7.51
7	2008	250,785	4.05	7	SPORTS CAR	184,297	2.98
8	2001	247,052	3.99	8	FULLSIZE CAR	124,620	2.01
9	2000	183,006	2.96	9	EXCLUDED	27,080	0.44
10	1999	124,512	2.01				

Car Condition			
Rank	**Condition**	**# of Obs.**	**% of Obs.**
1	3	3,622,619	58.54
2	4	1,310,341	21.17
3	2	918,274	14.84
4	1	174,978	2.83
5	5	141,234	2.28
6	0	21,313	0.34

Table 2
Car Condition Levels

The table provides information on how the different car condition codes are constructed.

Grade	0	1	2	3	4	5
Paint & Body	Good for parts only	Sustained major collision damage, but may be drivable	Dents, scratches and body panels require replacement	Conventional body and paint work needed	Minor conventional body and paint work	No or minor defects
		May be cost prohibitive to extensively recondition this vehicle by industry standards	Parts broken and missing	Requires parts	Small dents that have not broken the paint	
	Missing or disconnected mechanical parts		Multiple prior repairs performed at substandard levels	Sustained cosmetic/light collision damage and repaired to industry standards	High-quality conventional repairs of cosmetic/light collision damage	
	Operable, but near the end of its useful life	Repaired or unrepaired collision damage	Windshield may be damaged	Minor pitting of glass		
Interior	Mechanical and body parts may be inoperable, disconnected, damaged or missing	Operability of accessories is doubtful	Signs of excess wear	Signs of normal wear and usage	Minimal wear and minor missing or broken parts	Shows no signs of wear
			Burns, cuts, tears and non-removable stains	Requires repair or replacement of parts	No odors	
Frame/Unibody			Repaired or unrepaired frame structure or frame damage	No repairs or alterations	No repairs or alterations	No repairs or alterations
Mechanical			Mechanical damage that prohibits operation properly	Mechanically sound	Sound and operable	Mechanically sound
			Engine and or transmission in poor condition	Requires maintenance or minor repair of accessories	Fluids may require service	Accessories are operable
			Operability of accessories is questionable	Fluid levels low or require replacement		Fluid levels full and clean
Tires			Worn or mismatched	Average or better	Identical	Identical
				Match by size and style	Good or better condition	Near new condition

Table 3
Auction Characteristics

Summary statistics of auction characteristics in our sample. The table contains information on the most common auction locations, whether auctions were closed to non-franchised dealers, the way purchases were transacted, and the source of the used vehicles.

Auction Open/Closed			Transaction Type			Vehicle Source		
Closed?	**# of Obs.**	**% of Obs.**	**Type**	**# of Obs.**	**% of Obs.**	**Source**	**# of Obs.**	**% of Obs.**
N	4,723,193	76.32	Lane	5,110,836	82.58	Fleet/Lease	4,140,882	66.91
Y	1,465,566	23.68	Upstream	953,435	15.41	Factory	1,741,028	28.13
			Online	124,488	2.01	Dealer	306,849	4.96

Top 10 Auction Locations			
Rank	**Auction Location**	**# of Obs.**	**% of Obs.**
1	Pennsylvania	474,288	7.66
2	Orlando	269,173	4.35
3	Riverside	225,562	3.64
4	Nashville	207,583	3.35
5	Dallas	203,371	3.29
6	Southern California	179,224	2.90
7	Chicago	165,734	2.68
8	New Jersey	157,914	2.55
9	Georgia	155,448	2.51
10	Milwaukee	154,819	2.50

Table 4
Summary Statistics of Select Variables

Variable	Min	Max	Mean	Median	Sd
Run #	1	3,960	185.15	121	227.64
# of Wheel-ins	0	80	0.30	0	0.92
Miles	1	999,991	44,270.38	31,743	36,875.77
Price	0	341,000	13,062.27	12,300	7,560.18
Manuf. CDS	2.5	8,039.70	643.13	520	856.14
# of Same Trim Cars That Day	0	443	8.98	2	19.42
# of Same Trim Cars so Far	0	443	3.39	0	9.44

Table 5
Car Prices and Manufacturer CDS by Car Condition

Condition	Avg. Price	Avg. Manuf. CDS
0	3,743.25	834.06
1	6,753.09	894.28
2	8,681.25	635.18
3	13,111.68	640.04
4	16,340.73	640.99
5	19,085.67	453.94

Table 6
Car Prices and Manufacturer CDS by Mileage Bands

Mileage Band	Avg. Mileage	Avg. Price	Avg. Manuf. CDS
1	4,818.98	19,823.08	614.32
2	10,244.34	17,936.70	649.72
3	13,244.71	17,111.88	625.50
4	15,880.88	16,573.01	609.78
5	18,459.50	16,143.92	603.33
6	20,856.87	15,730.07	616.69
7	23,214.74	15,149.07	627.93
8	25,765.59	14,497.46	638.18
9	28,215.15	13,917.72	701.23
10	30,416.64	13,901.36	691.40
11	33,417.61	14,193.16	644.36
12	37,167.25	14,303.58	591.99
13	41,836.43	13,882.19	570.29
14	47,083.13	13,417.75	553.98
15	53,753.09	11,985.07	578.45
16	62,320.51	10,172.16	616.94
17	73,232.08	8,152.84	678.44
18	87,090.39	6,365.74	719.17
19	106,344.00	4,744.05	747.39
20	152,056.50	3,242.93	783.55

Table 7
Effect of Auto Manufacturers' CDS Spread on Used Car Prices, Baseline Specification

The dependent variable is the (raw or normalized) transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. Manuf. CDS x Band 2-Band 20 denotes the interactions of Manuf. CDS with a set of dummy variables indicating to which of the 20 mileage bands a car belongs. Auction Closed is a dummy for whether the auction was closed to non-franchised dealers. # of Same Trim Cars That Day is the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. # of Same Trim Cars so Far is the number of cars of the same model, trim and model year being sold on the same day in the particular auction location before the auction. # of Wheel-ins is the number of times the car was wheeled through the auction lane. Run # is the location of the car in a particular run. Columns (1) and (3) also include car condition controls. All regressions include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers x month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)	(4)
Dependent Var:	Price	Price	Normalized price	Normalized price
Manuf. CDS	-0.0679***	-0.00514	-5.15e-06***	-3.58e-06
	(0.0214)	(0.0340)	(1.52e-06)	(2.69e-06)
Manuf. CDS X Band 2		-0.0419*		-5.60e-07
		(0.0233)		(1.18e-06)
Manuf. CDS X Band 3		-0.0608**		-1.11e-06
		(0.0250)		(1.19e-06)
Manuf. CDS X Band 4		-0.0854***		-2.50e-06*
		(0.0296)		(1.42e-06)
Manuf. CDS X Band 5		-0.105***		-3.24e-06**
		(0.0322)		(1.45e-06)
Manuf. CDS X Band 6		-0.119***		-3.70e-06**
		(0.0350)		(1.66e-06)
Manuf. CDS X Band 7		-0.128***		-4.27e-06***
		(0.0338)		(1.47e-06)
Manuf. CDS X Band 8		-0.143***		-5.30e-06***
		(0.0382)		(1.79e-06)
Manuf. CDS X Band 9		-0.149***		-5.71e-06***
		(0.0360)		(1.78e-06)
Manuf. CDS X Band 10		-0.147***		-5.94e-06***
		(0.0381)		(1.71e-06)
Manuf. CDS X Band 11		-0.120***		-4.89e-06***
		(0.0333)		(1.66e-06)
Manuf. CDS X Band 12		-0.132***		-6.45e-06***
		(0.0296)		(1.84e-06)
Manuf. CDS X Band 13		-0.108***		-6.73e-06***
		(0.0324)		(2.57e-06)
Manuf. CDS X Band 14		-0.0811**		-7.11e-06**
		(0.0350)		(3.02e-06)
Manuf. CDS X Band 15		-0.00877		-5.63e-06
		(0.0427)		(4.43e-06)
Manuf. CDS X Band 16		0.0429		-3.39e-06
		(0.0420)		(6.00e-06)
Manuf. CDS X Band 17		0.107**		3.41e-06
		(0.0450)		(6.92e-06)
Manuf. CDS X Band 18		0.151***		1.33e-05*
		(0.0466)		(7.93e-06)
Manuf. CDS X Band 19		0.158***		2.09e-05**
		(0.0482)		(9.94e-06)
Manuf. CDS X Band 20		0.173***		3.43e-05***
		(0.0469)		(1.28e-05)
Band 2	-219.4***	-193.7***	-0.00632***	-0.00602***
	(15.68)	(21.75)	(0.000871)	(0.00120)
Band 3	-418.3***	-380.2***	-0.0182***	-0.0175***
	(18.33)	(23.39)	(0.000975)	(0.00129)
Band 4	-581.1***	-527.7***	-0.0284***	-0.0268***
	(21.55)	(26.79)	(0.00112)	(0.00151)
Band 5	-741.9***	-676.2***	-0.0390***	-0.0369***
	(22.95)	(28.08)	(0.00117)	(0.00157)
Band 6	-998.4***	-924.5***	-0.0565***	-0.0542***
	(26.06)	(31.73)	(0.00138)	(0.00187)

Table 7
Continued

Band 7	-1,116***	-1,037***	-0.0648***	-0.0622***
	(27.17)	(32.69)	(0.00143)	(0.00190)
Band 8	-1,268***	-1,178***	-0.0758***	-0.0725***
	(29.42)	(35.67)	(0.00162)	(0.00214)
Band 9	-1,412***	-1,318***	-0.0863***	-0.0827***
	(33.40)	(39.10)	(0.00205)	(0.00257)
Band 10	-1,601***	-1,507***	-0.1000***	-0.0961***
	(31.19)	(37.97)	(0.00195)	(0.00242)
Band 11	-1,767***	-1,692***	-0.111***	-0.108***
	(29.85)	(37.40)	(0.00186)	(0.00233)
Band 12	-2,018***	-1,938***	-0.128***	-0.124***
	(32.46)	(40.44)	(0.00206)	(0.00261)
Band 13	-2,454***	-2,387***	-0.157***	-0.153***
	(35.62)	(45.40)	(0.00236)	(0.00300)
Band 14	-2,802***	-2,748***	-0.181***	-0.177***
	(39.96)	(51.86)	(0.00277)	(0.00347)
Band 15	-3,491***	-3,476***	-0.231***	-0.227***
	(44.64)	(58.85)	(0.00343)	(0.00421)
Band 16	-4,050***	-4,066***	-0.282***	-0.280***
	(44.36)	(58.16)	(0.00454)	(0.00543)
Band 17	-4,657***	-4,721***	-0.353***	-0.355***
	(44.50)	(57.39)	(0.00642)	(0.00733)
Band 18	-5,262***	-5,363***	-0.448***	-0.457***
	(44.48)	(57.16)	(0.00926)	(0.0100)
Band 19	-5,818***	-5,927***	-0.566***	-0.582***
	(44.35)	(57.70)	(0.0130)	(0.0136)
Band 20	-6,431***	-6,551***	-0.735***	-0.761***
	(45.82)	(58.71)	(0.0173)	(0.0174)
Auction Closed	269.2***	275.5***	0.0245***	0.0246***
	(24.17)	(24.17)	(0.00190)	(0.00189)
Condition 1	3,065***	3,065***	0.360***	0.360***
	(96.01)	(95.98)	(0.0153)	(0.0154)
Condition 2	4,000***	4,004***	0.461***	0.461***
	(132.4)	(131.7)	(0.0213)	(0.0212)
Condition 3	4,847***	4,851***	0.547***	0.547***
	(137.1)	(136.4)	(0.0229)	(0.0229)
Condition 4	5,091***	5,095***	0.562***	0.562***
	(134.7)	(134.1)	(0.0228)	(0.0227)
Condition 5	5,333***	5,335***	0.570***	0.571***
	(136.2)	(135.7)	(0.0226)	(0.0226)
# of Same Trim Cars That Day	1.964***	1.894***	6.17e-05**	5.92e-05**
	(0.367)	(0.363)	(2.47e-05)	(2.44e-05)
# of Same Trim Cars So Far	-5.601***	-5.552***	-0.000268***	-0.000266***
	(0.635)	(0.631)	(3.89e-05)	(3.89e-05)
Run #	-0.273***	-0.272***	-3.48e-05***	-3.48e-05***
	(0.0164)	(0.0164)	(1.58e-06)	(1.58e-06)
# of Wheel-ins	-120.3***	-119.7***	-0.00930***	-0.00927***
	(4.090)	(4.129)	(0.000401)	(0.000407)
Constant	10,768***	10,720***	0.668***	0.667***
	(142.5)	(135.3)	(0.0200)	(0.0203)
Observations	6,188,759	6,188,759	6,188,725	6,188,725
R-squared	0.986	0.986	0.899	0.899

Table 8
Effect of Auto Manufacturers' CDS Spread on Used Car Prices, The Warranty Channel

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. We also use the car condition indicators (0-6) defined in Table 2. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)
Dependent var.:	Price	Price	Price
Manuf. CDS	-0.00580	-0.0101	0.463***
	(0.0246)	(0.0322)	(0.0522)
Car in warranty?	1,890***		
	(32.67)		
Car in warranty? × Manuf. CDS	-0.0565**		
	(0.0233)		
Fraction of remaining warranty		4,145***	
		(89.42)	
Fraction of remaining warranty × Manuf. CDS		-0.129*	
		(0.0716)	
Condition 1 × Manuf. CDS			-0.342***
			(0.0358)
Condition 2 × Manuf. CDS			-0.415***
			(0.0437)
Condition 3 × Manuf. CDS			-0.518***
			(0.0510)
Condition 4 × Manuf. CDS			-0.527***
			(0.0542)
Condition 5 × Manuf. CDS			-0.540***
			(0.0690)
Constant	7,414***	7,283***	8,152***
	(124.9)	(132.5)	(99.80)
Observations	6,188,759	6,188,759	6,188,759
R-squared	0.982	0.982	0.979

Table 9
Robustness Check: Placebo and Dealer Financial Distress

The dependent variable in the column (1) is the transacted price of the used cars in the sample. "Placebo" Manuf. CDS refers not to the actual manufacturer CDS, but to the CDS of an unrelated manufacturer. In columns (2) and (3), the dependent variable is an indicator for whether the buyer is a GM or a Ford dealer, respectively. These regressions use the CDS of the car's manufacturer. Other controls not reported in the table are the same as in Table 7 and include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)
Dependent var.:	Price	GM dealer buys	Ford dealer buys
"Placebo" Manuf. CDS	0.047		
	(0.0758)		
Manuf. CDS		1.55e-05***	-1.69e-05*
		(4.89e-06)	(1.03e-05)
Constant	15447***	0.299***	0.397***
	(33.10)	(0.00551)	(0.00982)
Observations	6,177,673	1,744,349	1,782,919
R-squared	0.984	0.523	0.513

Table 10
Robustness Check: Controlling for New Car Prices

Columns (2) and (3) of this table replicate Columns (1) and (2) of Table 8, but controlling for the new car price on the day of the auction (note that sample size is much smaller as we could not find new car transaction data for many auction days). Column (1) estimates the main effect of manufacturer CDS. As in Table 8, the dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)
Dependent var.:	Price	Price	Price
Manuf. CDS	-0.0775	0.0843	0.0677
	(0.0599)	(0.0647)	(0.0572)
Car in warranty?		2038***	
		(50.28)	
Car in warranty? × Manuf. CDS		-0.135***	
		(0.0326)	
Fraction of remaining warranty			4721***
			(134.6)
Fraction of remaining warranty × Manuf. CDS			-0.333**
			(0.152)
New car price	-0.0019	-0.0023	-0.0018
	(0.0032)	(0.0033)	(0.0033)
Constant	17,102***	13,337***	13,333***
	(88.47)	(83.34)	(78.52)
Observations	1,007,990	1,007,990	1,007,990
R-squared	0.980	0.975	0.977

Table 11
Cost of Financial Distress and Implications for Capital Structure

Panel A computes the Ex ante cost of financial distress for car manufacturers with different credit ratings. Risk neutral probability of default is the 5-year risk neutral probability of default from Almeida and Philippon (2007), Table 3. CDS is the expected CDS in basis points. Value loss is the expected share of value lost, in percent. The last column presents estimates of value loss from Almeida and Philippon (2007), Table 4, benchmark model. Panel B computes the marginal cost. dCDS/d ratings is computed as the difference in the rating. Marginal Cost is the marginal cost of financial distress in percent of firm value. Panel C compares the marginal tax benefit of debt to the marginal cost for General Motors and Ford. Credit Ratings are from Compustat. Effective tax rates are the effective tax rates after interest deductions provided by John Graham (see Graham 2000). For ratings below B, I assign the marginal cost at B. I interpolate for ratings that are not in the table above linearly.

Panel A: Ex ante cost of financial distress

Credit Rating	Risk neutral probability of default	CDS (bp)	Value loss (%)	Value loss (Almeida and Philippon (2007))
AAA	0.54%	32	0.11%	0.32%
AA	1.65%	97	0.34%	1.84%
A	7.07%	415	1.45%	3.83%
BBB	11.39%	669	2.34%	4.53%
BB	21.07%	1,237	4.33%	6.81%
B	34.90%	2,049	7.17%	9.54%

Panel B: Marginal cost

Credit Rating	dCDS / dRating	Marginal Cost
AAA	48	2%
AA	192	9%
A	286	14%
BBB	411	20%
BB	690	33%
B	812	39%

Table 11
Continued

Panel C: Marginal Tax Benefits versus Marginal Cost

General Motors

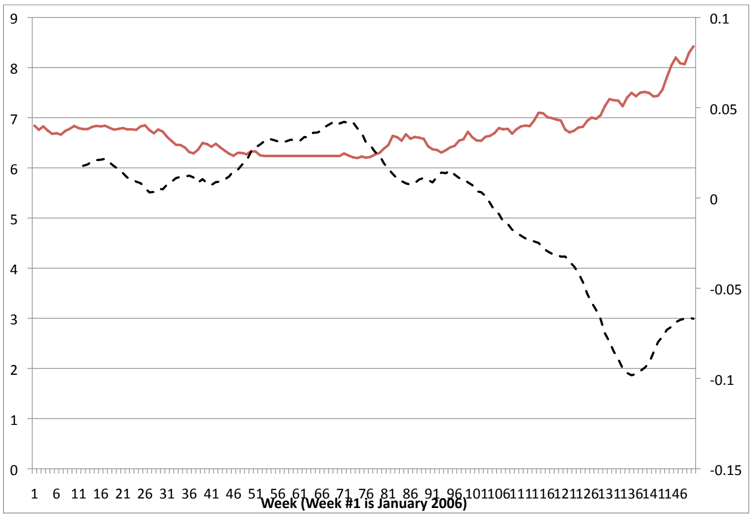
Year	Credit Rating	Marginal Benefit (effective tax rate)	Marginal Cost	Marginal Benefit - Marginal Cost
1985	AA+	46%	7%	39%
1986	AA	44%	9%	34%
1987	AA-	37%	11%	27%
1988	AA-	34%	11%	23%
1989	AA-	34%	11%	23%
1990	AA-	16%	11%	5%
1991	A	0%	14%	-14%
1992	A-	0%	12%	-12%
1993	BBB+	28%	18%	10%
1994	BBB+	33%	18%	15%
1995	A-	35%	12%	23%
1996	A-	35%	12%	23%
1997	A-	35%	12%	23%
1998	A	33%	14%	19%
1999	A	35%	14%	21%
2000	A	34%	14%	20%
2001	BBB+	20%	18%	3%
2002	BBB	18%	20%	-2%
2003	BBB	30%	20%	10%
2004	BBB-	33%	24%	9%
2005	B	19%	39%	-20%
2006	B	5%	39%	-34%
2007	B	4%	39%	-36%
Avg. 1998-2007	N/A	23%	24%	-1%

Ford

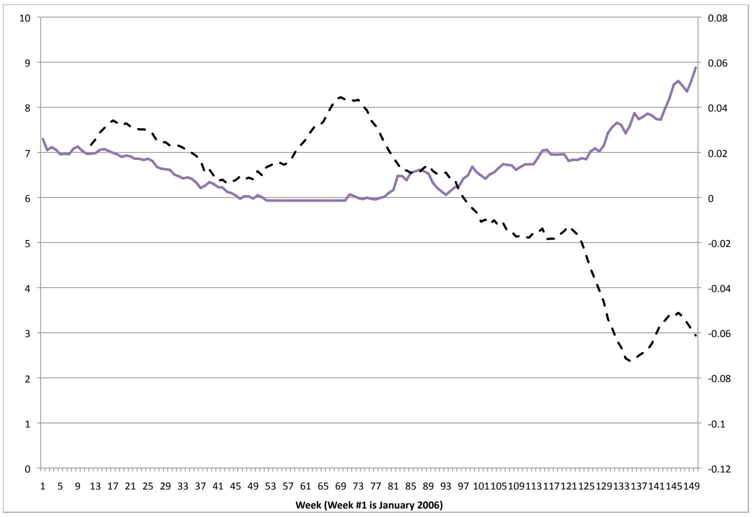
Year	Credit Rating	Marginal Benefit (effective tax rate)	Marginal Cost	Marginal Benefit - Marginal Cost
1985	A	46%	14%	32%
1986	AA-	46%	11%	35%
1987	AA-	39%	11%	28%
1988	AA	34%	14%	20%
1989	AA	34%	14%	20%
1990	AA-	32%	11%	21%
1991	A	17%	14%	3%
1992	A	0%	14%	-14%
1993	A	35%	14%	21%
1994	A	35%	14%	21%
1995	A+	35%	7%	28%
1996	A+	35%	7%	28%
1997	A	35%	14%	21%
1998	A	35%	14%	21%
1999	A+	35%	7%	28%
2000	A	25%	14%	11%
2001	BBB+	7%	18%	-11%
2002	BBB	22%	20%	2%
2003	BBB-	5%	24%	-19%
2004	BBB-	2%	24%	-23%
2005	BB+	10%	29%	-19%
2006	B	2%	39%	-37%
2007	B	35%	39%	-4%
2008	CCC+	1%	39%	-38%
2009	B-	31%	39%	-9%
2010	B+	33%	37%	-4%
Avg. 1998-2007	N/A	18%	23%	-5%

Figure 1

The panels compare the relative average used car prices and CDS series for Ford (top) and GM (bottom). Each series shows the difference between the appropriate Ford (GM) series and the corresponding series for Honda. The price series are constructed by taking the residual from a regression of cars' auction prices on detailed car type fixed effects, sets of dummies for mileage quantiles, auction location fixed effects, and week-of-year fixed effects. These residuals are averaged by week for every manufacturer and the difference between Ford's (GM's) and Honda's price series is shown, after using a 12-week moving average to smooth the figure. The CDS series are computed by taking the car-weighted average CDS value for each manufacturer and subtracting Honda's series from Ford's (GM's). The log of this difference is shown in the figure to make visualization easier.



(a) Ford



(b) GM

Figure 2
Auto Manufacturer CDS Spreads

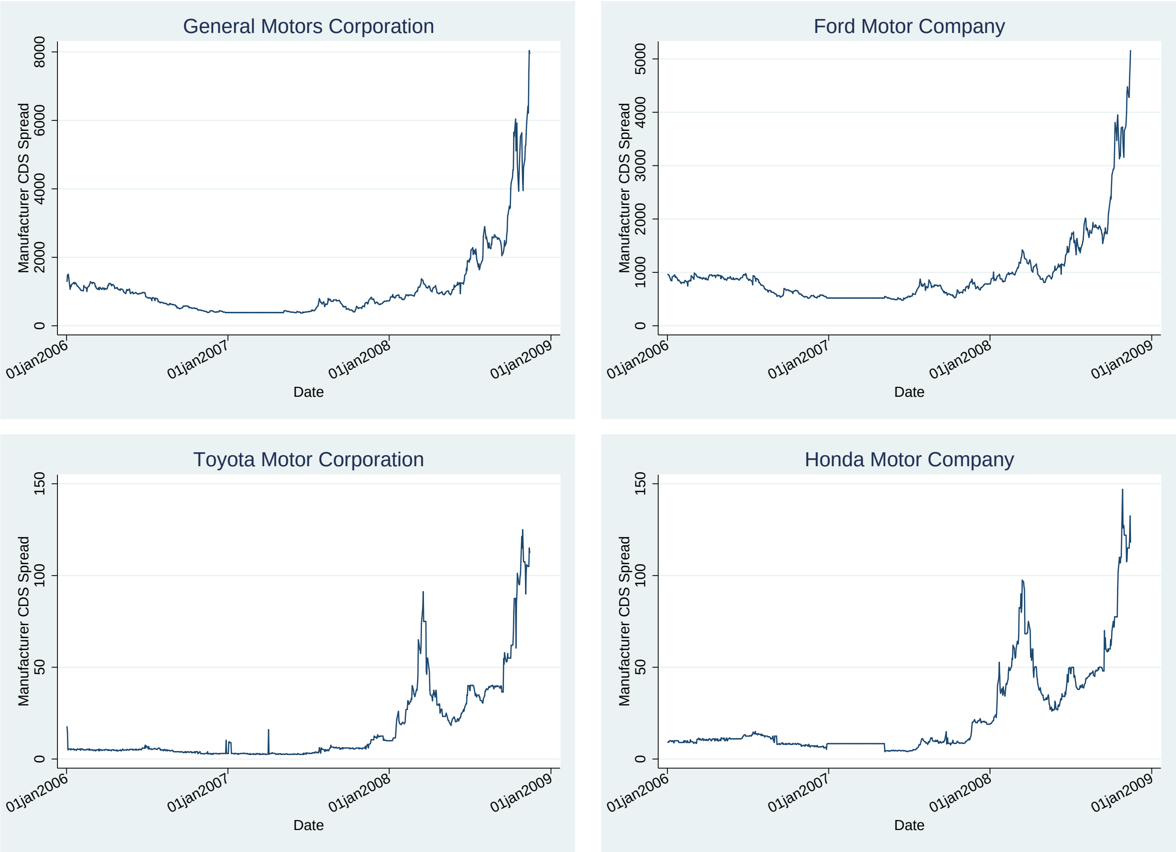


Figure 3
Plot of Mileage Interaction Coefficients from Column (3) of Table 7

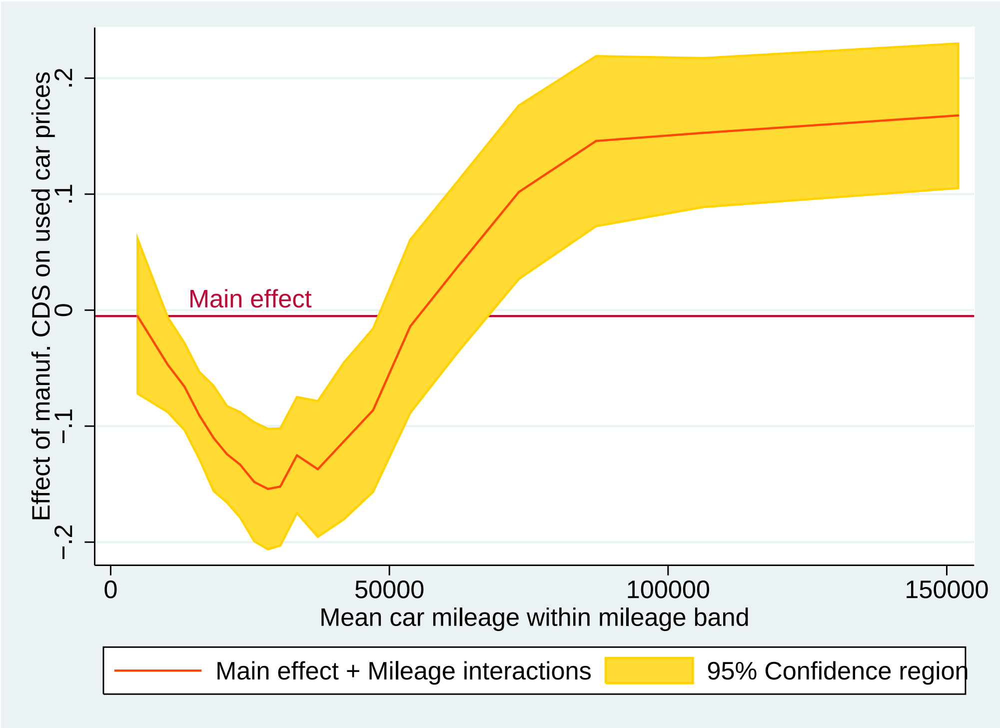


Table A1
Effect of Auto Manufacturers' CDS Spread on Used Car Prices: Parametric Mileage

	(1)	(2)	(3)	(4)	(5)
Dependent var.:	Price	Price	Price	Price	Price
Manuf. CDS	-0.206***	-0.162***	-0.0997***	-0.0352	0.0487
	(0.0368)	(0.0319)	(0.0305)	(0.0284)	(0.0321)
Mileage $\times$ Manuf. CDS	0.0383***	0.0211*	-0.0197	-0.0725***	-0.154***
	(0.0123)	(0.0109)	(0.0140)	(0.0195)	(0.0314)
Mileage$^2 \times$ Manuf. CDS	-0.000389	0.000881	0.00689***	0.0175***	0.0388***
	(0.000664)	(0.000628)	(0.00155)	(0.00337)	(0.00738)
Mileage$^3 \times$ Manuf. CDS		-2.85e-05***	-0.000283***	-0.000977***	-0.00300***
		(1.09e-05)	(6.28e-05)	(0.000197)	(0.000623)
Mileage$^4 \times$ Manuf. CDS			2.58e-06***	1.78e-05***	9.47e-05***
			(6.35e-07)	(3.83e-06)	(2.14e-05)
Mileage$^5 \times$ Manuf. CDS				-1.01e-07***	-1.25e-06***
				(2.37e-08)	(2.99e-07)
Mileage$^6 \times$ Manuf. CDS					5.79e-09***
					(1.45e-09)
Constant	11327***	11535***	11506***	11350***	11119***
	(143.5)	(143.6)	(145.1)	(146.2)	(145.0)
Observations	6188759	6188759	6188759	6188759	6188759
R-squared	0.986	0.986	0.986	0.986	0.986

Table A2
Robustness Check: Controlling for Future New Car Prices

This table presents regressions that respectively control for the new car price 7, 30, and 60 days after the day of the auction; the coefficients for these controls are labeled "Future new car price" (note that sample size is much smaller as we could not find new car transaction data for many auction days). For each time horizon, the first two columns replicate Columns (1) and (2) of Table 8, but including the additional future new car price covariate. For each time horizon, the first column estimates the main effect of manufacturer CDS. As in Table 8, the dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent var.:	Price	Price	Price	Price	Price	Price	Price	Price	Price
Future new car price at:	7 days after transaction			30 days after transaction			60 days after transaction		
Manuf. CDS	-0.0888	0.0760	0.0616	-0.0812	0.0825	0.0690	-0.0521	0.117	0.122
	(0.0553)	(0.0626)	(0.0562)	(0.0615)	(0.0680)	(0.0652)	(0.0665)	(0.0761)	(0.0879)
Car in warranty?		2050***			2036***			2014***	
		(50.65)			(50.39)			(52.54)	
Cary in warrant?× Manuf. CDS		-0.140***			-0.134***			-0.153***	
		(0.0325)			(0.0323)			(0.0398)	
Fraction of remaining warranty			4745***			4716***			4688***
			(135.0)			(134.6)			(150.5)
Fraction of remaining warranty×Manuf. CDS			-0.361**			-0.348**			-0.443**
			(0.153)			(0.151)			(0.223)
Future new car price	-0.00145	-0.00139	-0.00184	0.00483	0.00537	0.00582*	-0.00342	-0.00349	-0.00513
	(0.00306)	(0.00329)	(0.00311)	(0.00317)	(0.00339)	(0.00315)	(0.00370)	(0.00425)	(0.00375)
Constant	17120***	13350***	13368***	16949***	13190***	13189***	17006***	13327***	13360***
	(78.61)	(76.97)	(76.25)	(82.08)	(83.65)	(75.00)	(95.08)	(94.30)	(88.09)
Observations	1010621	1010621	1010621	1000337	1000337	1000337	935613	935613	935613
R-squared	0.980	0.975	0.977	0.980	0.975	0.976	0.979	0.974	0.976

Table A3
Robustness Check: Controlling for Recalls

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. Recalls is the number of recalls of cars made by each manufacturer on the transaction day. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)
Dependent var.:	Price	Price	Price
Manuf. CDS	-0.0736***	-0.00880	-0.0149
	(0.0210)	(0.0269)	(0.0323)
Car in warranty?		1954***	
		(32.49)	
Car in warrany? × Manuf. CDS		-0.0563**	
		(0.0252)	
Recalls	4.28e-05	7.91e-05	5.23e-05
	(4.66e-05)	(6.65e-05)	(7.79e-05)
Fraction of remaining warranty			4236***
			(92.76)
Fraction of remaining warranty × Manuf. CDS			-0.132*
			(0.0767)
Constant	15501***	11868***	11969***
	(35.88)	(23.88)	(28.81)
Observations	6188759	6188759	6188759
R-squared	0.984	0.980	0.980

Table A4
Robustness Check: Controlling for Lagged Recalls

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. Lagged recalls is the number of recalls of cars made by each manufacturer 1, 7, 30, and 60 days before the transaction day, respectively. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Depedent var.:	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price
	1 day before transaction			7 days before transaction			30 days before transaction			60 days before transaction		
Manuf. CDS	-0.0738***	-0.00930	-0.0152	-0.0740***	-0.00976	-0.0156	-0.0742***	-0.0111	-0.0174	-0.0908***	-0.0202	-0.0264
	(0.0212)	(0.0269)	(0.0324)	-0.0212	-0.0269	-0.0323	-0.0212	-0.0268	-0.0315	-0.0324	-0.0308	-0.0347
Car in warranty?		1954***			1953***			1951***			1947***	
		(32.49)			-32.52			-33.01			-33.7	
Car in warranty? × Manuf. CDS		-0.0563**			-0.0555**			-0.0543**			-0.0521**	
		(0.0252)			-0.0253			-0.0255			-0.0258	
Lagged Recalls	8.64e-05*	5.98e-05	7.00e-05	-4.92E-05	-9.69E-06	-1.02E-05	-5.15E-05	-3.39E-05	-4.59E-05	-5.27E-05	-2.41E-05	-2.36E-05
	(4.56e-05)	(6.93e-05)	(5.48e-05)	-0.00011	-8.06E-05	-8.76E-05	-9.84E-05	-0.0001	-9.98E-05	-4.47E-05	-3.47E-05	-3.72E-05
Fraction of remaining warranty			4236***			4236***			4248***			4260***
			(92.76)			-92.88			-94.09			-96.23
Fraction of remaining warranty × Manuf. CDS			-0.132*			-0.129*			-0.126*			-0.122*
			(0.0767)			-0.0755			-0.0733			-0.0709
Constant	15501***	11868***	11969***	15503***	11870***	11970***	15527***	11886***	11981***	15559***	11905***	11994***
	(35.95)	(23.88)	(28.79)	-36	-23.89	-28.84	-36.35	-24.1	-29.03	-39.56	-26.44	-31.02
Observations	6188759	6188759	6188759	6153996	6153996	6153996	5998937	5998937	5998937	5768892	5768892	5768892
R-squared	0.984	0.980	0.980	0.984	0.98	0.98	0.984	0.98	0.98	0.984	0.98	0.98

Table A5
Robustness Check: Controlling for Future Recalls

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. Future recalls is the number of recalls of cars made by each manufacturer on 1, 7, 30, and 60 days after the transaction day, respectively. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent var.:	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price	Price
	1 day after transaction			7 days after transaction			30 days after transaction			60 days after transaction		
Manuf. CDS	-0.0736***	-0.00947	-0.0154	-0.0738***	-0.00921	-0.0152	-0.0739***	-0.00933	-0.0152	-0.0819**	-0.00825	-0.00833
	(0.0210)	(0.0269)	(0.0324)	(0.0212)	(0.0269)	(0.0324)	(0.0212)	(0.0269)	(0.0324)	(0.0336)	(0.0394)	(0.0490)
Car in warranty?		1954***			1954***			1954***			1957***	
		(32.49)			(32.49)			(32.49)			(34.75)	
Car in warranty? × Manuf. CDS		-0.0563**			-0.0563**			-0.0563**			-0.0618*	
		(0.0252)			(0.0252)			(0.0252)			(0.0317)	
Future Recalls	2.14e-05	-1.67e-05	-1.87e-05	4.53e-05	7.06e-05	2.60e-05	-1.44e-05	-1.37e-05	-1.93e-06	5.83e-05	5.07e-05	2.20e-05
	(2.56e-05)	(3.35e-05)	(2.70e-05)	(7.66e-05)	(6.19e-05)	(6.78e-05)	(2.53e-05)	(2.76e-05)	(3.04e-05)	(4.39e-05)	(3.54e-05)	(3.99e-05)
Fraction of remaining warranty			4236***			4236***			4236***			4258***
			(92.76)			(92.76)			(92.76)			(104.3)
Fraction of remaining warranty × Manuf. CDS			-0.132*			-0.132*			-0.132*			-0.184
			(0.0767)			(0.0767)			(0.0767)			(0.120)
Constant	15501***	11869***	11970***	15501***	11868***	11969***	15501***	11869***	11970***	15518***	11884***	11984***
	(35.89)	(23.85)	(28.79)	(36.02)	(23.88)	(28.82)	(35.93)	(23.88)	(28.80)	(39.42)	(28.74)	(34.81)
Observations	6188759	6188759	6188759	6188759	6188759	6188759	6188759	6188759	6188759	6103801	6103801	6103801
R-squared	0.984	0.980	0.980	0.984	0.980	0.980	0.984	0.980	0.980	0.984	0.980	0.980

Table A6
Robustness Check: Controlling for 3 Day Moving Average Recalls

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. Recalls 3DMA is a three day moving average around the transaction day of the number of recalls of cars made by each manufacturer. "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)
Dependent var.:	Price	Price	Price
Manuf. CDS	-0.0729***	-0.00877	-0.0148
	(0.0208)	(0.0270)	(0.0325)
Car in warranty?		1954***	
		(32.49)	
Car in warranty? × Manuf. CDS		-0.0563**	
		(0.0252)	
Recalls 3DMA	0.000173*	0.000102	8.45e-05
	(9.98e-05)	(0.000114)	(0.000104)
Fraction of warranty remaining			4236***
			(92.76)
Fraction of remaining warranty × Manuf. CDS			-0.132*
			(0.0767)
Constant	15500***	11868***	11969***
	(35.90)	(23.92)	(28.87)
Observations	6188759	6188759	6188759
R-squared	0.984	0.980	0.980

Table A7
Robustness Check: Controlling for Manufacturer News Mention

The dependent variable is the transacted price of the used cars in the sample. Manuf. CDS refers to the credit-default swap (CDS) spread (in basis points) of the manufacturers of the used cars. News mentions is a variable with meanings specific to each regression set. Bankrupt distress ((1), (2), (3)) counts articles that mention the automaker and either "bankrupt" (or "bankruptcy") and "distress". Recall ((4), (5), (6)) counts articles that mention the automaker and "recall". "Car in warranty?" is an indicator variable denoting if a car is still under original factory warranty. This is also interacted with the manufacturer CDS. "Fraction of remaining warranty" is calculated as the minimum fraction between the mileage and age limits; cars out of warranty receive a value of zero. Other controls not reported in the table include dummies for the auction format the car was sold under, the number of times the car was wheeled through the auction lane, and the number of cars of the same model, trim and model year being sold on the same day in the particular auction location. All regressions also include car type-region-week fixed effects. All regressions also include car type-region-week fixed effects. Reported standard errors are clustered on car manufacturers×month, and are reported in parentheses. (*** denotes significance at the 1% level, ** at the 5% level, and * at the 10% level.)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent var.:	Price	Price	Price	Price	Price	Price
	Bankrupt distress			Recalls		
Manuf. CDS	-0.0788***	-0.0105	-0.0151	-0.0740***	-0.00688	-0.0125
	(0.0203)	(0.0270)	(0.0336)	(0.0211)	(0.0271)	(0.0330)
Car in warranty?		1959***			1959***	
		(33.36)			(33.37)	
Car in warranty? × Manuf. CDS		-0.0599**			-0.0599**	
		(0.0254)			(0.0254)	
News Mentions	-3.217*	-2.583	-2.039	0.850	2.374	3.842
	(1.866)	(2.256)	(2.650)	(4.429)	(4.616)	(5.107)
Fraction of remaining warranty			4254***			4254***
			(96.50)			(96.49)
Fraction of remaining warranty × Manuf. CDS			-0.143*			-0.143*
			(0.0801)			(0.0801)
Constant	15678***	12016***	12138***	15673***	12011***	12134***
	(37.67)	(24.36)	(29.67)	(37.67)	(24.30)	(29.24)
Observations	5926446	5926446	5926446	5926446	5926446	5926446
R-squared	0.984	0.980	0.980	0.984	0.980	0.980

Figure A1
Predicted CDS Effect on Price