Credit Fire Sales:

Captive Lending as Liquidity in Distress*

Matteo Benetton¶ Sergio Mayordomo § Daniel Paravisini ‡

April 2021

Abstract

We study the role of captive finance in the car loan market when manufacturers' liquidity demand increases. Using a new multi-country dataset on securitized car loans, we show that captive lending enables a liquidity constrained integrated manufacturer to increase the cash collected from car sales via a *credit fire sale*: reducing loan-to-value in the intensive margin and relaxing lending standards in the extensive margin increases car sale down-payments, at the cost of future losses. We exploit quasi-exogenous variation in manufacturers' liquidity cost and need following the Volkswagen emissions scandal to identify the channel. A simple calibrated model shows that a standalone manufacturer would have to decrease car prices by 10% to generate the same liquidity of a credit fire sale.

*We thank Nicola Cetorelli (discussant), Tim McQuade, Adair Morse, Yueran Ma (discussant), Emi Nakamura, Ryan Pratt (discussant) and seminar participants at Berkeley, Caixa Bank, Esade, Finest 2020, Gerzensee 2019, Insead, LSE, MFA 2021, RCFS Winter Conference 2021 and the Virtual Corporate Finance Fridays. The views expressed are those of the authors and do not necessarily reflect those of the Banco de España or the Eurosystem. All errors are our own.

¶Haas School of Business, University of California, Berkeley. Email: benetton@berkeley.edu.

§Banco de España . Email: sergio.mayordomo@bde.es.

‡London School of Economics. Email: d.paravisini@lse.ac.uk

1 Introduction

Over the last 50 years an increasing number of industrial firms have internalized financial intermediation by creating units that perform bank-like activities - so called "captive lenders" (Banner, 1958; Greenwood and Scharfstein, 2013; Bodnaruk et al., 2016). This phenomenon has been particularly pronounced for durable good industries such as real estate (Stroebel, 2016), cars (Benmelech et al., 2017), and equipment (Murfin and Pratt, 2019).[1] Given the central role durable goods played in the global financial crisis (Bernanke, 2018; Gertler and Gilchrist, 2018; Mian and Sufi, 2018), a natural question arises: does the vertical integration of manufacturing and credit provision affect how shocks to manufacturers/lenders propagate to consumer credit and durable good consumption?

In this paper we uncover a new channel through which captive lending affects the propagation of shocks from durable-good manufacturers to consumers. Captive lending enables manufacturers to convert car inventory into cash by changing jointly credit terms and standards, a behavior that we label a *credit fire sale*. Instead of fire-selling car inventory, we show that an integrated manufacturer/lender can increase the cash generated via car sales by: 1) lowering loan LTV and maturity, which brings forward cash payments by inframarginal buyers, and 2) relaxing lending standards to risky borrowers, which boosts demand and cash down-payments from marginal buyers.[2]

Credit fire sales have novel implications for how funding shocks affect manufacturers and consumers. While liquidating inventory at fire-sale prices has an observable and immediate impact on the manufacturer's balance sheet, the costs of a credit fire sale—lower interest

[1] According to Benmelech et al. (2017) before the crisis nonbank lenders financed more than half of all new cars bought in the United States. In in 2019 captive lenders account for about 28% of total car financing in the United States (See: https://www.experian.com/content/dam/marketing/na/automotive/quarterly-webinars/credit-trends/q1-2019-safm-final-v2.pdf)

[2] Anecdotal evidence during the recent Pandemic stresses the role of captive lenders for manufacturers cash management. For example, Ford Chief Operating Officer Jim Farley said Ford Credit "has been indispensable" during the pandemic, while GM's Suryadevara said GM Financial is "inherently cash generative during a downturn." (See: https://www.cnbc.com/2020/05/11/coronavirus-detroits-automakers-have-enough-cash-to-last-the-year-without-a-bailout.html).

revenue and larger default losses—are only realized in the future and difficult to evaluate by outsiders. For consumers, a credit fire sale results in a shift of car purchases, access to credit, and leverage from infra-marginal (safe) borrowers to marginal (risky) borrowers, an outcome that is difficult to rationalize if standalone lenders or manufacturers face a funding shock.

Using a new multi-country dataset on over a million securitized used auto loans in Europe, we show that integrated manufacturers/lenders engage in credit fire sales when in financial distress. The European securitized used car loan market has three distinct features that are ideal for the empirical study of credit fire sales. First, traditional stand-alone banks are active players in the market for financing used vehicles sold by integrated lenders.[3] Thus, the credit terms offered by stand-alone lenders provide a useful counterfactual in the empirical analysis. Second, in the used car market we can ignore car manufacturing costs and focus on the transformation of car inventory into cash, the core mechanism behind credit fire sales. Finally, lenders internalize the bulk of the financial costs of default, since securitized auto loans in Europe are heavily seasoned (securitization occurs only a year after the loan has been issued) and lenders retain the equity tranche. This implies that agency or information frictions in the securitization market are an unlikely source of confounding variation on loan terms.

We begin our analysis by documenting how captive lenders adjust credit terms and standards, *relative* to terms offered by standalone banks to purchase the same model/make vehicle in the same location, when their associated manufacturer experiences an increase in CDS price (our measure of manufacturer distress following Hortaçsu et al. (2013)). We find that captive lenders tighten loan terms, increasing down-payments and interest rates, and reducing loan maturity. In the extensive margin, captive lenders increase the proportion of credit issued to buyers without income verification or stable sources of income (e.g., students, self-employed, unemployed). The financial cost of the standard relaxation generates a significant and economically large increase in the probability of future repayment arrears,

[3] According to a study by Roland Berger in 2016 the captive market share is around 36% in France, Italy and Spain, and 45% in Germany.

even after controlling for changes in observable borrower characteristics. All these stylized facts are robust to alternative specifications (e.g., comparing captive and standalone within narrower market definitions) and sample sub-periods (e.g., with or without large CDS price changes). Most notably, we show that our results on loan terms tightening and credit standard relaxation are stronger for manufacturers with larger liquidity needs, as measured by a high fraction of outstanding bonds maturing in a given month and a limited credit-line draw down capacity. Overall, our results are consistent with integrated manufacturers/lenders using credit fire sales as a tool for liquidity management, and difficult to reconcile with alternative interpretations.

Having established these facts, we then provide evidence of a causal link between manufacturer liquidity needs and credit fire sales. To do so we exploit the funding shock to manufacturers resulting from the coincidence of a large fraction of maturing long-term bonds with the unexpected and temporary increase in manufacturers' CDS prices triggered by the Volkswagen emissions scandal.[4] We posit that for manufacturers excluding Volkswagen, the coincidence constitutes a purely idiosyncratic funding shock, uncorrelated to demand or any other determinant of the credit terms offered by the associated captive lender. We estimate difference-in-difference specifications comparing credit terms and standards of the captive lender relative to standalone banks, during the two months before and after the scandal. As in the initial analysis, we include car-model × geographical market × month fixed-effects. To evaluate if the Volkswagen shock had any effect on demand that may confound the interpretation, we use manufacturers that did not have a large fraction of bonds maturing (but also experienced an increase in CDS prices following the scandal) as a placebo.[5]

[4]On September 18, 2015, the U.S. Environmental Protection Agency (EPA) found that approximately 500,000 Volkswagen diesel-engine vehicles sold in the US contained a defeat device that could detect when the car was being tested, changing the performance accordingly to improve results. A number of recent papers study the Volkswagen emission scandal and its implication for example for health outcomes (Alexander and Schwandt, 2019) and collective reputation (Bachmann et al., 2019). The shock generated a vast press coverage and immediate effects, with the CDS of Volkswagen quadrupling in a few days.

[5]In our high liquidity need group we have Ford, Mercedes and Renault, while in our low liquidity need group we have Toyota, Fiat, Opel, Peugeot and BMW. We check the number of bonds issued in the two months after the Volkswagen emissions scandal and we find that the average number of issuance for the high liquidity group is five, while the average number of issuance for the low liquidity group is 1.2.

The findings from the causal analysis are qualitatively and quantitatively similar to the stylized aggregate patterns. For integrated manufacturers with high liquidity needs a 50 basis points increase in the CDS price leads to an increase in loan rates by 36 basis points, a decrease in maturity and loan amount by almost 8% and 10% respectively, and a reduction in loan-to-values by over 2 percentage points (relative to standalone lenders). Regarding lending standards, the fraction of loans with future arrears increases by 2 percentage points relative to loans issued by standalone banks, even after controlling for observable borrower characteristics. In contrast, placebo integrated manufacturers with low liquidity needs barely change credit terms or standards despite experiencing the same increase in funding costs. Combing the results on loan terms and credit standards, our estimates show that to gain one additional euro in cash today high-liquidity-need integrated manufacturers are willing to loose 70 cents in present value terms. Taken together, the results indicate that liquidity creation through credit fire sales is an important feature of the vertical integration of car manufacturers with auto lenders.

In the last part of the paper we explore the consequences of credit fire sales for car buyers and traditional fire sales. First, regarding car buyers, we show that both consequences of credit fire sales, the credit contraction for infra-marginal buyers and the credit expansion for marginal buyers, fall disproportionately on low-income consumers. Second, we evaluate quantitatively the liquidity created by credit fire sales using a simple two-period model of borrowers' demand for cars and loans with standalone and captive lenders. In the stylized model calibrated to the micro-data, we find that captive lending can lead to a relaxation of lending standards even if the integrated manufacturer is not liquidity constrained, because the profits from marginal car sales outweigh the losses from marginal defaults.

We then use the model to compute the cash generated by a credit fire sale and its "car fire sale equivalent" for a standalone manufacturer. In our baseline calibration, we find that the average credit fire sale observed in the data generates the same amount of cash as a €1,000-1,300 reduction in car sale price by a standalone manufacturer, which corresponds to approximately a 10% discount from the equilibrium car value. Through the lens of the model, we also compare the cost of credit fire sales *relative* to car fire sales. The latter is captured by the lower revenues on the cars that would have been sold absent the price decrease; the former is due to: 1) expected losses from lending to risky marginal borrowers; 2) lower interest rate revenues from inframarginal borrowers. Our calibrated model shows that to generate the same amount of cash a credit fire sale is about 60% cheaper than a traditional fire sale for the average manufacturer.

Related literature. Our findings imply that vertical integration between production and financing fundamentally alters the consumption and credit responses to financing shocks relative to the case in which the two functions are performed by separate entities. Existing literature documents how standalone lenders that face a liquidity shock tighten credit supply, especially to high-risk borrowers (Khwaja and Mian, 2008; Paravisini, 2008; Ivashina and Scharfstein, 2010; Amiti and Weinstein, 2011). This paper demonstrates that a liquidity shock to a captive lender may lead to the exact opposite: an expansion in credit to high-risk borrowers. These findings imply that the integration of manufacturing and financial intermediation can change the sign, magnitude, and timing of the real effects of liquidity shocks to lenders and manufacturers. These new insights complement existing work on the transmission of financing shocks to the real economy (Almeida et al., 2009; Paravisini et al., 2014, 2015; Costello, 2020).

Existing literature also documents how standalone manufacturers that experience a demand shock suffer immediate revenue losses and may resort to fire sales to generate liquidity (Pulvino, 1998; Benmelech and Bergman, 2008; Campbell et al., 2011). Shleifer and Vishny (2011) define a fire sale as "essentially a forced sale of an asset at a dislocated price". In our setting, a *credit* fire sale is essentially a forced sale of an asset *bundled with financing* at dislocated *contract terms*. We demonstrate that when production and financing are integrated, credit fire sales allow avoiding the immediate and certain losses due to a fire sale. The cost of credit fire sales to the manufacturer/lender, due to lower revenues from interest payments and increased risk-taking in lending, accrue in the future. These findings imply that the integration of manufacturing and financial intermediation expand the contract terms that manufacturers owning a lending unit can adjust when in distress.

Our work also contributes to the literature on captive finance, which has proposed different explanations for the existence of captive lenders: price discrimination (Brennan et al., 1988); asymmetric information (Stroebel, 2016); commitment problems and the Coase conjecture (Murfin and Pratt, 2019). In this paper we show that captive lending adds a new tool for liquidity management for manufacturers in distress.

Finally, we contribute to the literature that studies car finance (Attanasio et al., 2008; Adams et al., 2009; Argyle et al., 2017, 2018, 2019; Melzer and Schroeder, 2017). While most previous work has focused on the demand for car loans, we focus on the supply side. Thus, our paper is mostly related to Salz et al. (2020) who study with a quantitative model the effects of dealers discretion when prime borrowers have different demand-side elasticities to rate and car prices. We complement their work focusing on discretion by vertically integrated manufacturers/lenders, when borrowers are heterogeneous on the risk dimension and manufacturers experiences liquidity shocks. Hence our paper is very related to the work by Benmelech et al. (2017) who study the effect of the collapse of the asset-baked commercial paper market on auto sales, though illiquidity of nonbank lenders. We complement their work by looking at how captive lenders can instead provide liquidity in the presence of shocks to the manufacturers. In this way our paper is also closely related to Hortaçsu et al. (2013), who show that financial distress can decrease demand for the distressed firm products, thus affecting cash flows. We show how integrated car manufacturers manage cash flows in response to financial distress through its captive lending unit.

2 Data and Setting

2.1 Data

Our main dataset comprises car loans securitised by European banks and captive lenders over the period December 2013 to December 2017. These data are available through the European Data Warehouse (EDW) and are reported according to the Asset Backed Security

(ABS) template used by ECB within the framework of the 100 percent transparent policy on securitized loans. EDW collects information on all outstanding car loan securitizations from 2013. However, the information available in the first (and successive) reports of each securitization does not necessarily include all loans that were part of the pool of the securitization at origination, unless the first report is the one corresponding to the origination date. For instance, non-performing loans and loans maturing before the first reporting date could have been excluded. To avoid any bias due to this issue, we restrict our initial sample to those securitizations for which we observe the whole pool of securitized car loans over the entire life of the securitization (i.e., up to December 2017). Thus, we use information on all data reports (usually on a quarterly basis) corresponding to securitizations originated between December 2013 and December 2017.[6]

We focus on loans originated between December 2013 and December 2017 for buying used cars. For our analysis the advantage of focusing on used cars is twofold. First, the coverage of new cars is poor for diversified lenders. Only 6% of the loans for the purchase of new cars are granted by diversified lenders in our data, whereas this fraction is 41% for the used cars.[7] Second, in the used car market we can ignore car manufacturing costs and focus on the transformation of car inventory into cash, the core mechanism behind credit fire sales.

For the main analyses, we apply the following filters. First, we restrict our sample to amortizing car loans, which means that we discard leasing, balloon loans and any other type of non-standard car loans. Second, we consider just customers with the legal form of individuals such that we do not consider public and limited companies, partnerships, government entities and any other type of customers. Third, we restrict our sample to all loans for which we have information on the interest rate, the maturity, the amount granted

[6]We screen all the reports available for each securitization given that new loans are added to the pool over time whereas some others disappear. Moreover, if any information is updated for any of the loans coming from a previous report, we use the new information to replace missing observations.

[7]Our identification strategy requires that for a brand-model in a market at a certain time we always observe at least a loan issued by a captive and a loan issued by a diversified lender. This requirement is even stronger in the several sample splits that we implement to understand the joint role of manufacturers' liquidity cost and need.

at origination, the value of the car, and the car model. We also discard loans without information on borrower characteristics such as income, employment status, and region in which his/her domicile is located (i.e., NUTS codes). Fourth, our sample is winsorized at 0.1 and 99.9% levels for the car value of each specific model and the following loan characteristics: interest rate, maturity, and size. Fifth, we exclude duplicated loans given that although each loan and borrower has a unique identifier in each securitization, they could appear in more than one securitization of the same lender.[8] Sixth, we discard motorbikes, caravans, trucks; car models that appear less than 100 times and loans with a LTV below 10% at origination. Finally, we exclude from our sample brands of manufacturers without a captive lender in the group.[9]

Our final sample consists of about 1.2 million car loans granted by standalone banks (Banco Santander, Bank Deutsches Kraftfahrzeuggewerbe, Bank 11, BNP Paribas, Socram Banque) and captive lenders from nine large parent manufacturers (BMW, Fiat Chrysler, Ford, Mercedes, Opel/GM, Peugeot, Renault, Toyota and Volkswagen) over the period December 2013 to December 2017 to individuals domiciled in France, Germany, Italy and Spain.[10] These loans are part of the pool of 37 securitizations and are granted for the purchase of 25 different brands and 272 different models made by the nine manufacturers mentioned above. All the loans that form of our final sample are fixed-rate loans with a monthly payment frequency. In terms of coverage of our sample, we find that the total amount of loans granted in Spain over the period 2013Q2 - 2017Q4 with maturities between

[8]We consider that a loan is duplicated when there is more than one loan granted by the same lender at the same date for the same interest rate, amount, down-payment, and maturity; to individuals that buy the same car model at the same price and who are domiciled in the same region, with the same employment status, and the same income.

[9]These brands could belong to manufacturers with captive lenders not operating in Europe (e.g, Japanese brands) or not issuing Asset-backed securities (ABS) for financing.

[10]Note that within each group there are different subsidiaries and branches that operate in different countries: Banco Santander (Santander Consumer EFC, Santander Consumer Bank AG, Santander Consumer Bank S.p.A.), Bank Deutsches Kraftfahrzeuggewerbe GmbH, Bank11 fur Privatkunden und Handel GmbH, BNP Paribas Personal Finance, Socram Banque, BMW Bank, Fiat Chrysler (FCA Bank Deutschland GmbH, FCA Bank S.p.A., FCA Capital Espana, FGA Capital S.p.A.), Ford (FCE Bank German Branch), Mercedes-Benz Bank, Opel/GM (GMAC Bank GmbH, Opel Bank GmbH), PSA (Banque PSA Finance, Banque PSA Finance Espana, BPF Italy, PSA Bank Deutschland GmbH, Credipar), Renault (RCI Banque, RCI Banque S.A. Niederlassung Deutschland), Toyota (TKG), Volkwagen (Volkswagen Bank GmbH, Volkswagen Bank Branch Italy, Volkswagen Finance S.A.).

1 and 5 years for the purchase of both old and new cars represent around 20% of all consumer credit with similar maturities for the purchase of durable and non-durable goods. Of course, this coverage would be higher if one considers just durable goods but this information is not available.

Our analysis combines the previously described dataset and four additional ones. The information on the lender's balance sheet is obtained from SNL (at branch or subsidiary level) and include proxies for size (logarithm of total assets), risk (equity over total assets) and profitability (ROA). CDS prices for the underlying lenders' debt securities are obtained from Reuters. We use Dealogic to conduct the analysis based on the financing needs of manufacturers. More specifically, we use information on all individual debt securities issued by the parent firm or its subsidiaries (issuance and maturity dates and amount issued) to define the liquidity needs of manufacturers. Finally, we rely on the Banco de España's Central Credit Register (CCR) to define an alternative proxy for liquidity needs. The CCR contains information on all bank credits given to non-financial institutions above 6,000 euro. The outstanding amount of credit of each firm in each bank is available on a monthly basis and it is reported in terms of the amount drawn and undrawn, in the case of credit lines. Based on the outstanding amount undrawn, we define car manufacturer liquidity needs, we assume that the manufacturer faces liquidity needs in a given month if there is a drop in the balance of credit lines. Importantly, the use of credit lines is considered at a consolidated level given that we aggregate the credit lines of the parent firm and all the subsidiaries that are domiciled in Spain.

Table 1 shows the main variables used in the analysis. Panel A shows the main contract characteristics. The average car loan in the sample has an interest rates of 6.2%, a maturity of 51 months and a loan-to-value of 73%. There is lots of variation in all contract dimensions with rates ranging from 3 to 10%, maturities from 14 to 84 months and loan-to-value from about 20 to more than 110%. The average car value is about €13 thousand and car values go from about €4 to €25 thousand.

Panel B and C of Table 1 show borrowers characteristics and performances, respectively.

The average annual gross income is about €36 thousands and it goes from about €7 thousands to more than €60 thousands. About 81% of borrowers are paid employee, 6% are self-employed, 1% student or unemployed and 11% pensioners. Income is verified in about 62% of loans. Finally, about 5% of loans are in arrears.

Panel D shows the average seasoning at the securitization level. The average seasoning is approximately 15 months. Hence there is a lag greater than a year between the date the loan is originated and the date the loan is added to the security pool. Additionally, while we do not observe in the data what fraction of the securitization is retained by the issuer, we used the International Securities Identification Number (ISIN) to manually check the securitization prospectus. For all securitization in our sample for which we found an available prospectus the issuing lender retained a material net economic interest which is never less than 5% in accordance with regulatory requirements.[11]

Panel E and F of Table 1 show manufacturers' and lenders' variables, respectively. The average CDS in the sample is 1.2%, but there is a lot of variation with CDS as high as 3%. The average value of maturing bonds as a fraction of the total outstanding value is about 4%. There are manufacturers-month pairs with no maturing bonds, and months in which a manufacturer has more than 14 bonds maturing. In 37% of the months, manufacturers use credit lines. Finally, we report lenders controls that we use in our regressions. Lenders average return on assets is about one, while the ratio of equity over total assets is around 11%. The average lenders' total assets are around 16 millions, ranging from one to more than one hundred millions.

2.2 Captive Lenders VS Standalone Banks

In this section we describe some preliminary facts about car loans issued by captive lenders and traditional standalone banks. We emphasize differences in loan terms and lending

[11]For example the prospectus of one of the securitization in our sample reads: "The Seller will retain for the life of the Transaction a material net economic interest of not less than 5 per cent in accordance with Article 405 of Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (the "CRR")."

Table 1: Summary statistics

	Mean	Median	SD	P5	P95	N
Panel A: Loan terms and car value						
Interest (%)	6.18	6.00	2.21	3.00	10.00	1,155,450
Maturity (Months)	50.95	49.00	18.79	14.00	84.00	1,155,450
Size (euro)	9,216	8,269	5,640	2,125	19,599	1,155,450
Car value (euro)	13,192	12,387	6,281	4,707	24,440	1,155,450
LTV (%)	72.79	80.00	30.37	17.65	112.36	1,155,450
Panel B: Ex - ante risk measures						
Income (euro)	35,855	24,000	7,192,142	7,200	63,000	1,113,559
Paid-employed (0/1)	0.81	1	0.39	0	1	1,155,450
Self-employed (0/1)	0.06	0	0.24	0	1	1,155,450
Unemployed (0/1)	0.01	0	0.12	0	0	1,155,450
Student (0/1)	0.01	0	0.08	0	0	1,155,450
Pensioner (0/1)	0.11	0	0.31	0	1	1,155,450
Verified (0/1)	0.62	1	0.49	0	1	1,155,450
Panel C: Ex - post risk measures						
In arrears (0/1)	0.05	0.00	0.21	0.00	0.00	1,155,450
Panel D: Security						
Avg seasoning (Months)	15	15	5	1	22	37
Panel E: Manufacturers						
CDS (%)	1.252	1.034	0.915	0.279	3.020	441
Maturing bonds month t (%)	3.968	2.128	6.362	0.000	14.286	441
Credit lines utilization (%)	0.370	0.000	0.483	0.000	1.000	441
Panel F: Lenders						
ROA (%)	0.919	0.910	0.692	0.000	1.970	763
Equity / TA (%)	11.070	10.550	8.789	6.750	13.730	763
Log(TA)	16.597	16.902	1.273	14.487	18.414	763

Note: Summary statistics for the main variables used in the analysis. Panel A shows the main contract characteristics. The interest rate is in percentage points; maturity is in months; the size of the loan and the car value is in euros; the loan-to-value is in percentage points. Panel B shows borrowers characteristics. Income is in euros; paid-employed, self-employed, unemployed, student, pensioner are dummies for the status of the borrower; verified is a dummy equal to one if the income in the application has been verified by the lender. Panel C shows the ex-post performances. Arrears is a dummy equal to one if the loan is late payment. Panel D reports the average seasoning in months at the securitization level. Panel E reports the characteristics for the manufacturers. CDS is the credit default swap of the manufacturer the first day of each month t; maturing bonds is the face value of maturing bonds in each period t as a percentage of total outstanding bonds value; credit lines utilization is a variable equal to one if the car manufacturer uses credit lines in a given month and zero otherwise. Panel F reports the characteristics for the lenders. ROA is return on assets; TA is total assets. The tables reports the mean, the standard deviation, the median, and 5th and 95th percentile in the full sample. N is the number of observations.

standards by captive relative to standalone lenders due to borrower selection and collateral. The goal of the discussion is to set the stage for our empirical strategy.

Table 2 shows the main variables used in the analysis for captive lenders and traditional banks. The first fact to notice is that in our sample loans granted by captive lenders have on average a significantly higher interest rate than loans by traditional banks. The average rate for captive lenders is 6.8%, while the average rate for traditional banks is about 5.2%. Captive lenders also offer on average shorter maturities and lower loan-to-values that traditional bank. The average loan by a captive has a 48 months maturity and approximately a 65% loan-to-value; while the average loan by a bank has a 7 months longer maturity and a 20 percentage points higher loan-to-value. The large difference in the latter comes from captive lenders both financing relatively more expensive cars (€13.7 vs 12.4 thousands) and lending smaller amounts (€8.5 vs 10.2 thousands).

One of the concerns with Table 2 is that the differences in contract terms may be driven by observable or unobservables differences in borrowers or collateral characteristics. In Panel B of Table 2 we look at borrowers characteristics at origination. Borrowers from captives and banks have similar income level. Captive lenders are more likely to lend to unemployed borrowers and pensioners, while diversified lenders are more likely to lend to self-employed borrowers. The most striking difference is that all banks verify income at origination, while this is the case only for 35% of the loans issued by captive lenders.[12] Finally, borrowers from captive are about 1 percentage point more likely to be in default than borrowers from banks, 5% relative to 4% respectively.

Another important factor that can affect pricing and other loan terms is the quality of the collateral, which matters for the resale value in case of default. In our setting, we exploit the fact that both captive lenders and standalone banks finance the same brand-model in the same market and time. As an example, Figure 1 shows the share of loans made by two captive and two traditional lenders for approximately 25 different brands. Captive lenders

[12]One reason for this difference may be that it is easier for banks to verify the information on other assets or liabilities of the households. Suppose for example that the household is already a customer of the bank though a mortgage loan. Moreover, due to data protection, captive lenders cannot verify the income status of some borrowers.

Table 2: Summary Statistics by Lender Type

	Captive lenders			Diversified banks			Difference
	Mean	SD	N	Mean	SD	N	
Panel A: Loan terms and car value							
Interest (%)	6.81	2.17	681,633	5.26	1.94	473,817	1.55***
Maturity (Months)	47.98	17.38	681,633	55.22	19.89	473,817	-7.24***
Size (euro)	8,508	5,304	681,633	10,235	5,945	473,817	-1,727***
Car value (euro)	13,711	6,094	681,633	12,445	6,469	473,817	1,265***
LTV (%)	64.22	30.41	681,633	85.13	25.71	473,817	-20.90***
Panel B: Ex - ante risk measures							
Income (euro)	36,352	9,479,542	640,971	35,180	69,096	472,588	1,172
Paid-employed (0/1)	0.82	0.38	681,633	0.80	0.40	473,817	0.03***
Self-employed (0/1)	0.04	0.19	681,633	0.10	0.30	473,817	-0.06***
Unemployed (0/1)	0.02	0.14	681,633	0.00	0.05	473,817	0.02***
Student (0/1)	0.01	0.09	681,633	0.01	0.07	473,817	0.00***
Pensioner (0/1)	0.11	0.31	681,633	0.10	0.30	473,817	0.01***
Verified (0/1)	0.35	0.48	681,633	1.00	0.02	473,817	-0.6***
Panel C: Ex - post risk measures							
In arrears (0/1)	0.05	0.22	681,633	0.04	0.20	473,817	0.01***

Note: Summary statistics for the main variables used in the analysis. Panel A shows the main contract characteristics. The interest rate is in percentage points; maturity is in months; the size of the loan and the car value is in euros; the loan-to-value is in percentage points. Panel B shows borrowers characteristics. Income is in euros; paid-employed, self-employed, unemployed, student, pensioner are dummies for the status of the borrower; verified is a dummy equal to one if the income in the application has been verified by the lender. Panel C shows the ex-post performances. Arrears is a dummy equal to one if the loan is late payment. The tables reports the mean and the standard deviation for captive and diversified lenders in the full sample. N is the number of observations. The last column reports the difference in means between the means for captive and diversified lenders. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

fully specialize in their brands: approximately 45% of PSA loans are for Citroen and 55% for Peugeot; more than 60% of Volskwagen finance loans goes to Volskwagen and Seat, which is also part of the group. Diversified lenders spread their loans across different brands. Bank A has no share greater than 30% in any brand, while lender B is even more diversified with no single brands accounting for more than 15% of the loans.

Hence we exploit the variation within brand-model across captive and standalone lenders to study how loan terms vary for *similar* cars.[13] Most notably, we estimate the following

[13]We use the term similar and not identical, as we do not observe some relevant cars characteristics such as engine type or year of manufacturing which can affect the resale value upon default. In a robustness exercise of the main analysis we replicate our analysis controlling for bins of car value within each brand-model, thus

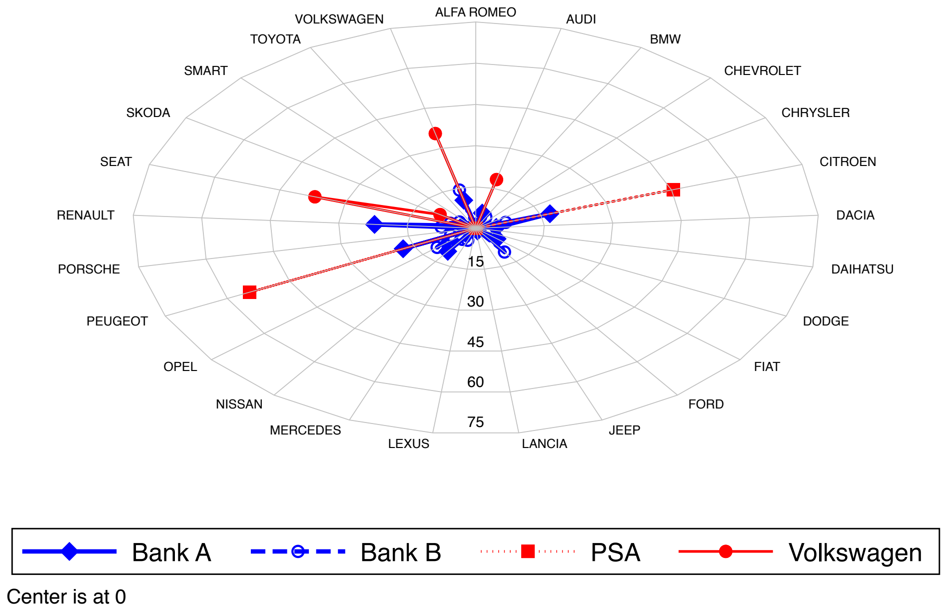


Figure 1: Specialization by brands

Note: The figure shows the share of loans made by two captive and two standalone lenders for approximately 25 different brands. The captive lenders are PSA finance and Volskwagen Finance. The standalone lenders are not reported to preserve confidentiality. The data comes from securitized loans issued by the four lenders between December 2013 and December 2017 in four European Countries (Spain, France, Germany and Italy).

empirical model:

$$y_{ilbmt} = \alpha Captive_l + \theta X_{ilt} + \gamma_{bmt} + \epsilon_{ilbmt}, \tag{1}$$

where $Captive_l$ is a dummy equal to one if the lender is a captive firm; X_{ilt} are borrower and lenders controls; γ_{bmt} are interacted brand-model, market and time fixed effects (market is defined using 2-digits NUTS code, while time is a year-month pair). The coefficient of interest is α which captures the difference in loan terms of a loan issued by a captive lender relative to a traditional bank for the same brand-model issued in the same market at the same time to similar borrowers.

capturing differences in observed value possible unobserved differences in car attributes. Additionally, even if the two cars are identical the valuation for a captive can be different from the one for a bank. For example the captive can attribute a higher value to a specific brand-model than a bank, because the former may incur less losses when reselling the car than the latter.

Table 3: Captive Lenders VS Standalone Banks

	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)
Captive Lender	1.278***	-0.082***	-9.276***	0.138***	0.052
	[0.170]	[0.027]	[1.407]	[0.033]	[0.050]
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES
Avg Dep Var	6.177	3.868	72.795	9.372	8.94
R^2	0.731	0.326	0.460	0.572	0.445
Observations	906,085	906,085	906,085	906,085	906,085

Note: The Table shows the results from equation (1). The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in loan and loan size in log. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3 shows the results. The positive difference in rates between captive and banks that we discuss in Table 2 is now lower, but still statistically significant and large in magnitude. On average a borrower taking a loan from a captive lender for an old car of a certain brand-model in a market pay about 1.3 percentage points higher rate borrowing from a captive rather than a diversified lender. Similarly the differences in maturity and loan-to-value remain statistically significant and large in magnitude, after controlling for borrowers and collateral characteristics. Most notable, loans from captive have approximately a 8% shorter duration and a 9 percentage points lower loan-to-value. The difference in loan-to-value seems to be driven by captive lenders financing more expensive cars.

To summarize, we find that captive lenders offer relatively worse financing conditions (higher rate, lower maturity, lower loan-to-value) to similar customers for the same brand-model in the same market and time. These results seem to be consistent with captive lenders having some market power over customers with high shopping costs, as captives provides a convenient one-stop shop alternative. At the same time, captive may target some segment of the population that are less likely to get credit by banks. Irrespective of the main determinants, the existence of persistent differences in loan terms for similar loan profiles between captive and banks gives captive the flexibility to adjust loan terms and lending standard to create liquidity following shocks to their parent manufactures, which is the main object of our analysis.

3 Evidence on the Credit Fire Sale Channel

This section provides stylized evidence consistent with credit fire sales. We begin by discussing our manufacturers' distress measure and framework. Then we show how captive lenders adjust loan terms and risk-taking relative to standalone lenders when the parent manufacturer experience distress. Finally, we show that captive lending liquidity creation is stronger for manufacturers with larger liquidity needs and limited alternate sources of liquidity consistent with credit fire sales being used as a tool for liquidity management.

We depart from the vast literature on the effect of credit shocks on the real economy by looking at financial distress to the producer of the product, namely the car manufactures. We follow Hortaçsu et al. (2013) and measure financial distress using the car manufacturers credit default swaps (CDS). While the parent manufacturer and the captive unit may have separate funding sources, we use the manufacturer CDS as a measure of distress for the entire vertically integrated producers (i.e., the manufacturer plus the captive finance arm). Panel (a) of Figure A2 in Appendix A shows the CDS separately for Ford and Ford Motor Credit. The two CDSs are almost identical with a correlation of about 0.98.[14]

In a situation without captive lending the only options for a standalone manufacturer experiencing a liquidity shock are: 1) drawing down available credit lines; 2) investment cuts

[14]For other car makers separate high frequency data on the CDS for both the parent manufacturer and the captive unit are not available. However, we also check the yields on comparable bonds issued by manufacturers and their captive unit and find on average a very high correlation. For example, Panel (b) of Figure A2 shows the yields on a bond issued in March 2014 by Renault and on a bond with the same maturity issued in the same month by RCI (Renault Credit International). The yields are very similar with a correlation of about 0.97.

and fire sales (adjustment in the initial price of the car).[15] With captive finance an array of possibilities arises. At origination the loan is provided by the own lending unit, so that the only cash flow from the borrower-buyer to the lenders is the down payment. However, given the borrower down payment, the price of the car at origination affects the loan amount that is repaid. The interest rate becomes now payoff relevant for the manufacturer, because the cash flows from the buyer-borrower extend beyond period the initial period.[16] Furthermore, the captive lending unit can adjust the approval rate for potential buyers seeking financing for the purchase of the car.[17]

Our baseline empirical model is given by:

$$y_{ilbmt} = \alpha Manuf.CDS_{bt} \times Captive_l + \theta X_{ilt} + \gamma_l + \gamma_{bmt} + \epsilon_{ilbmt}, \tag{2}$$

where y_{ilbmt} is outcome of interest y (e.g., interest rate, maturity, lending standards) for individual i borrowing from lender l and buying brand-model b in market m and period t; $Manuf.CDS_{bt}$ is the manufacturer credit default swap at the beginning of period t; $Captive_l$ is a dummy equal to one if the lender is a captive firm; X_{ilt} are borrower and lenders controls; γ_l are lender fixed effects; and γ_{bmt} are interacted brand-model, market and time fixed effects. The coefficient of interest is α which captures the effect of variation in manufacturer CDS on loan terms and lending standard by captive lenders *relative* to standalone banks.

Following the discussion in Section 2.2, we include in equation (2) car-model $\times$ geographical market $\times$ month fixed-effects to capture for several factors that can affect loan terms and lending standards. Additionally, equation (2) includes lenders' fixed effects, thus removing time-invariant differences in loan terms between captive and standalone lenders. Thus we only use the variation over time and across manufacturers in financial distress *interacted* with the identity of the car loan provider (captive VS standalone) for identification.[18]

[15]We exclude possible cash flows related to replacement or complementary goods. Hence, after the purchase, there is no cash flow between the manufacturer and the buyer-borrower.

[16]Figure A1 in Appendix A shows the cash flows for an hypothetical one-period car loan in two cases: (a) with only traditional standalone lenders; (b) with captive lenders.

[17]In Section 5.2.1 we sketch a simple model to explore this important dimension.

[18]Note that the use of lender fixed effects captures not only time-invariant differences between captive

3.1 Manufacturers' Distress and Captive Lenders Loan Terms

In this section we focus on the effect of financial distress on loan terms offered by captive lenders relative to traditional banks. Table 4 shows the results. The effect of financial distress on car loan rates is a priori ambiguous. On the one hand, the higher financing costs for the manufacturer (and possibly for the integrated captive lender) may lead to pass-through to higher interest rates for car loans. On the other hand, the manufactures may now use the rates as a tool to promote sales by lowering the interest rate. We find that when the car manufacturer CDS increases captive lenders increases the interest rate for car loans relative to standalone banks. Our basic specification indicates that a 100 basis point increase in a manufacturer's CDS spread increases the relative rate by captive lender by 13 basis points, or about 2% of the average loan rate.

At the same time we find that captive lenders shorten the maturity and decrease the loan-to-value relative to standard banks when the car manufacturer CDS increases. The decline in maturity is statistically significant, but small in magnitude at 0.8%. The decline in loan-to-value is approximately 0.8 percentage points, or about 1% of the average loan-to-value. The decline in the loan-to-value is driven by a statistically and economic significant decline in the loan size which drops by about 2%. Interestingly, we do not find evidence of differential changes in the price of the car between captive lenders and traditional banks when the CDS of the manufacturers increase.[19]

Another way to gauge a sense of the magnitude of the result is to compare them to the average differences between captive and banks that we have shown in Table 3 in Section 2. The 13 basis points differential increase in the rates offered by captive lenders when the car manufacturer is in financial distress corresponds to about 10% of the average difference between captive and banks. The relative magnitude are similar for maturity and loan-to-

and standalone lenders, but also time-invariant differences across captive lenders of different manufacturers (and across different standalone lenders). Also, the car-model × geographical market × month fixed-effects absorb the direct effect of manufacturers CDS on loan terms and lending standards.

[19]This result does not mean that the price of the car may increase or decrease when the the car manufacturer experience financial distress. Our null result is about differential changes between captive and bank, not overall changes for the manufacturer.

Table 4: Distress and captive lending: Loan terms

	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)
Manuf. CDS × Captive Lender	0.133***	-0.008**	-0.805**	-0.006	-0.019**
	[0.049]	[0.004]	[0.341]	[0.008]	[0.008]
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES
Avg Dep Var	6.177	3.868	72.795	9.372	8.94
R^2	0.780	0.334	0.470	0.586	0.464
Observations	906,085	906,085	906,085	906,085	906,085

Note: The Table shows the results from equation (2). The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in loan and loan size in log. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

value. Thus manufacturer financial distress increases pre-existing differences in loan terms between captive lenders and traditional banks for financing the same brand-model, in the same market at the same time.

3.2 Manufacturers' Distress and Captive Lenders Risk-Taking

Owning the financing arm gives additional flexibility to car manufacturers by allowing them to adjust loan terms when they experience financial distress. However, owning the lending unit gives manufacturers' an extra margin: lending standards. Unfortunately, we do not observe approvals and rejections, but we observe some information on borrowers demographics, an indicator if the income on the loan contract is verified and additional information on the performances of the loans over time. Thus, we proxy changes in risk-taking and lending standards by looking at changes in ex-ante borrowers' demographics, the fraction of verified loans and ex-post performances.

We estimate a model similar to equation (2) with a different set of dependent variables. Table 5 shows the results. The results for demographics variables at origination suggest an increasing risk-taking behavior by the captive unit once the parent company is in financial distress. The average income associated to a loan by a captive relative to a traditional bank for the same brand-model in the same market decreases, but the effects are imprecisely estimated.[20] When the manufacturing company experience financial distress, captive lenders increase the fraction of loans to unemployed and self-employed relative to diversified banks, potentially taking on more risk. The effects are statistically significant and large in magnitude. A 100 basis points increase in the manufacturer's CDS spread increase the relative fraction of unemployed and self-employed by captive lender by about 2 percentage points.

The third column of Table 5 looks at the fraction of loans that have their income verified. When the manufacturing company experience financial distress, captive lenders decrease the share of verified loans relative to diversified banks, potentially taking on more risk. Our basic specification indicates that a 100 basis points increase in a manufacturer's CDS spread decreases the relative share of verified income by captive lender by 5 percentage points. As we showed in Table 2 in Section 2 while traditional banks always verify borrower income, captive lenders do it in approximately for 35% of car loans. Thus, when the car manufacturers are suffering, their captive units are decreasing the share of verified income by about 15% relative to their average share of verified income.

Overall, the result on verified income and borrowers characteristics at origination suggest an increase in risk-taking by captive lenders relative to traditional banks when the car manufacturing company experience an increase in CDS. In Table 5 we also look at ex-post performances, to verify if the increase in ex-ante risk taking is indeed associated to ex-post riskier loans. When pooling all loans we do not find significant effects on future arrears. However, the loans originated by captive lenders when the parent manufacturer experience fianancial distress are significant more likely to be in arrears in the last part of the loan's life.[21] Our basic specification indicates that loans originated by captive lenders when manu-

[20] The point estimate is only marginally insignificant, with a p-value of 0.14.

[21] Agarwal et al. (2008) study a large pool of US direct car loans with a competing risks model of auto loan

Table 5: DISTRESS AND CAPTIVE LENDING: RISK-TAKING

	EX-ANTE			EX-POST: ARREARS		
	Income (log)	Other employment (dummy)	Income verified (dummy)	All (dummy)	<75% time to maturity (dummy)	>75% time to maturity (dummy)
Manuf. CDS × Captive Lender	-0.008	0.021***	-0.053***	-0.005	-0.010	0.024***
	[0.005]	[0.005]	[0.013]	[0.005]	[0.006]	[0.006]
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES
Borrower Controls	NO	NO	YES	YES	YES	YES
Avg Dep Var	10.058	.188	.615	.050	.048	.056
R^2	0.478	0.330	0.887	0.290	0.310	0.346
Observations	906,085	906,085	906,085	906,085	637,651	197,699

Note: The Table shows the results from equation (2). The dependent variables for ex-ante risk are the borrower income in log, a dummy for borrowers who are student, pensioner, unemployed or self-employed, and dummy for verified income. The dependent variable for ex-post risk is a dummy variable that is equal to one if the loan is in arrears. The first column for arrears use the full sample, while the other two columns correspond to different subsamples of loans with a remaining time to maturity of less than 75% or more than 75%, respectively. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

facturer's CDS spread increases by 100 basis points increase are about 2.5 percentage points more likely to be in arrears over the course of the loan. Given a baseline default probability of approximately 5 percentage points, our results represent an almost 50% increase in the probability of future arrears.

Our analysis thus far provides two main findings about the propagation of shock to manufacturers when production and financing are vertically integrated. First, the loan term results imply that a shock to manufacturers generates a response by captive lenders akin to a credit tightening by a traditional standalone lenders. Captive lenders increase rates, lower LTV and shorten maturities. Additionally, the larger down payment and shorter

termination through default and prepayment and find that account seasoning (time since loan origination) increases the probability of default.

maturity generate a reallocation of cash flows toward the present when liquidity is more costly, potentially avoiding the need to draw down liquidity or restore to fire sales.

Second, the risk-taking results imply that a shock to manufacturers generates a response by captive lenders that is the opposite of a credit tightening by a traditional standalone lenders. Captive lenders relax lending standard to promote sales and, combined with larger down payments and shorter maturities, increase liquidity in the short term, at the cost of uncertain higher losses in the longer term. Both the loan terms adjustments and the risk-taking are consistent with the integrated manufacturer maximizing current liquidity. In Section 3.3 we explore further the mechanism.

3.3 Captive Lenders Liquidity Creation

We have shown so far how captive lenders differentially adjust loan terms and lending standards when the parent manufacturing company is in financial distress. The results are consistent with captive lenders adjusting lending standards to push demand for the car manufacturer good, by lending to riskier borrowers. At the same time the evidence is consistent with captive lenders adjusting loan terms to increase the car manufacturer current liquidity, with or without increasing demand. As an example, we find that when the CDS are high captive requires larger down payments. All else equal, larger down payment requirements increase the liquidity today for the manufacturers, but without increasing demand along the extensive margin, all else equal. A larger down payment requirement may even reduce overall demand if more constraint borrowers cannot afford it and delay buying the good or move to a competitor. Is this therefore the combination of the loan term adjustment and lending standard that allow the manufacturers through the captive unit to extract liquidity from inframarginal buyers, without loosing (or even increasing) marginal buyers.[22]

[22] In an unreported regression we look how the total number of car financed for each brand-model in each region respond to changes in the manufacturers CDS for captive relative to standalone lenders. We do not find significant differential effects on originations from captive lenders when the manufacturer experiences financial distress. One possible explanation is our risk-taking channel. By extending loans to ex-ante riskier borrowers the captive unit can offer worse financing terms without sacrificing volumes. We explore this trade-off further in both Sections 4 and 5.2.

To understand the importance of liquidity creation when manufacturers experience financial distress we construct two measures of liquidity needs for car manufacturers. If the differential behavior of captive lenders relative to standalone lenders when the manufacturing company is in financial distress is driven by a liquidity creation motive, we expect our results to be stronger when the manufacturer needs liquidity relative to when the manufacturer has enough liquidity. Our first measure is based on the fraction of expiring bonds; while our second measure is based on credit lines utilization. In practice, we estimate our baseline empirical model given by equation (2), separating the full sample into two subgroups based on the manufacturers' liquidity needs.

First, we compute this measure for each manufacturer in each quarter as the face value of manufacturer b expiring bonds over its total amount of outstanding bonds. We define that a car manufacturer has high liquidity needs, if it lies in the top quartile of the distribution of the ratio of the face value of maturing bonds in a given quarter over the total amount of bonds outstanding in that quarter. Second, based on the outstanding amount undrawn, we assume that a car manufacturer faces liquidity needs in a given month if there is a drop in the balance of credit lines. We expect the coefficient α in equation (2) in the high liquidity need sample to capture the effect of captive lenders as liquidity providers in distress.

Table 6 shows the results using the liquidity measure based on expiring bonds. Panel A reports the results obtained for the periods in which the car manufacturer has a high relative need of liquidity, while Panel B contains the results for the period in which the car manufacturer has relatively low liquidity needs. We find that our findings that the differential adjustment of loan terms by captive lenders when the manufacturer's CDS is high are more likely to be significant and stronger in magnitude when the average value of maturing bond as a fraction of the total outstanding is high. Following a 100-basis-points increase in the parent manufacturer's CDS, captive lenders increase rate by about 30 basis points when they have high liquidity needs, while the increase is about 12 basis point when the manufacturer's liquidity needs are low. Both maturity and loan-to-value decrease by a significant and large amount when the manufacturers needs liquidity, while the effects are not significant and small in magnitude when liquidity needs are low. The relative decrease in loan size is strongly significant and about 4% when liquidity needs are high, relative to a baseline decline of about 2% in the full sample (see Table 4), and a marginally significant decline of less than 2% when liquidity needs are low.

In Table 6 we also look at how captive lending standards adjust during financial distress for different manufacturers' liquidity needs. When the manufacturer is in distress and has high liquidity need, captive lenders extend loans to borrowers with relative lower income than standalone lenders. The effect is large in magnitude, as borrowers' income decline by about 4%. Furthermore, the income is less likely to be verified. When the car manufactures CDS and liquidity needs are high, captive lenders reduce the relative share of verified income by 11 percentage points, while the decrease is about 4 percentage points when the manufacturers liquidity needs are low. Finally, when the car manufactures CDS increases by 100 basis points and liquidity needs are high, we find that loans originated by captive lenders have a 5 percentage points higher probability of future arrears, while when the CDS increases but liquidity needs are low the increase in arrears is less than 2 percentage points.

Table A1 in Appendix A shows the results using the liquidity measure based on credit lines. Similarly to Table 6, Panel A reports the results obtained for the periods in which the car manufacturer has a high relative need of liquidity, while Panel B contains the results for the period in which the car manufacturer has relatively low liquidity needs. The results using credit lines as a measure of liquidity needs echo the results we just discussed using the fraction of expiring bonds. With respect to loan terms, we find that captive lenders increase interest rate and decrease maturity, loan-to-value and loan amount relative to standalone lenders, when the manufacturers experience financial distress and liquidity needs are high, while we do not find any significant changes in loan terms when liquidity needs are low. With respect to lending standards, we find that the interaction of liquidity needs measured by credit lines and financial distress is associated to significant lower income and higher arrears, while the effects are not not significant and small in magnitude when the manufacturers' liquidity needs are low. The significance and point estimates with respect to the share of income

Table 6: Liquidity Channel: Maturing bonds

	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Panel A: High manuf. liquidity need									
Manuf. CDS × Captive Lender	0.285***	-0.029***	-2.327***	-0.010	-0.039***	-0.042***	0.020*	-0.117***	0.052***
	[0.066]	[0.009]	[0.748]	[0.015]	[0.014]	[0.009]	[0.012]	[0.031]	[0.013]
Avg Dep Var	6.18	3.867	68.292	9.422	8.895	9.983	.185	.564	.042
R^2	0.768	0.364	0.472	0.600	0.464	0.442	0.319	0.836	0.420
Observations	220,563	220,563	220,563	220,563	220,563	220,563	220,563	220,563	22,728
Panel B: Low manuf. liquidity need									
Manuf. CDS × Captive Lender	0.118***	-0.005	-0.538	-0.007	-0.018**	0.005	0.021***	-0.040***	0.015****
	[0.040]	[0.004]	[0.329]	[0.007]	[0.007]	[0.005]	[0.006]	[0.008]	[0.005]
Avg Dep Var	6.124	3.868	74.631	9.349	8.954	10.083	.181	.636	.058
R^2	0.785	0.324	0.461	0.580	0.462	0.486	0.334	0.904	0.337
Observations	682,679	682,679	682,679	682,679	682,679	682,679	682,679	682,679	174,971
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	YES	YES

Note: The Table shows the results from equation (2). Panel A reports the case when the face value of expiring bonds over the face value of outstanding bonds is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis; Panel B reports the case when the same fraction is below the 75 percentile. The dependent variables are the interest rate in percentage points, maturity in logs, loan-to-value in percentage points, car value in logs, loan size in logs, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

verification are similar in the case of high and low liquidity needs.

To summarize, our results show that the differential behavior of captive lenders relative to standalone lenders when the parent manufacturers experience distress is driven by liquidity needs. Both the loan terms adjustments and the relaxation of lending standards are stronger when the integrated manufacturer liquidity needs are higher.

3.4 Additional Results and Robustness

We provide additional evidence on the risk-taking channel of credit fire sales looking at borrowers' credit score. For one captive lender and one standalone lender we obtained additional information on the internal credit score for borrowers. Different lenders adopt different scoring systems (unobservable) which yield different ranks (observable) for borrowers' risk. In our context, the standalone lender classifies borrowers on a scale from 0 (highest risk) to 9 (lowest risk); while the captive lender classifies borrower on a scale from 1 (lowest risk) to 3 (highest risk). For comparability we create a dummy variable equal to one for borrowers with a low credit score.[23]. We estimate our baseline model from equation (2) using as dependent variable the share of borrowers with low credit score and a slightly different set of fixed effects given the more limited sample based on only two lenders.

Table 7 shows the result. The first two columns measure liquidity needs looking at the fraction of expiring bonds. We find that when the car manufactures CDS increases by 100 basis points and liquidity needs are high, captive lenders increase their share of low credit score borrowers by about 2 percentage points. Given an average share of low credit score borrower of 15%, our estimates implies an increase by about 13%. The differential response by captive relative to standalone to increase in manufacturers CDS is statistically insignificant and small in magnitude when manufactures' liquidity needs are low. The last two columns of Table 7 show similar results when we use credit lines draw down as a measure of manufacturers' liquidity needs.

Finally, in Appendix A we report the results of additional analyses and robustness checks.

[23]Low credit score is defined as 1 to 7 for the captive lenders and 2 to 3 for the standalone lenders.

Table 7: ADDITIONAL EVIDENCE WITH BORROWERS CREDIT SCORES

	LOW CREDIT SCORES BORROWERS (%)			
	MATURING BONDS		CREDIT LINES USE	
	High	Low	High	Low
Manuf. CDS × Captive Lender	0.021**	0.003	0.010**	-0.008
	[0.010]	[0.002]	[0.004]	[0.014]
BrandModel-YearMonth FE	YES	YES	YES	YES
Region-YearMonth FE	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES
Avg Dep Var	.153	.149	.146	.154
R^2	0.179	0.234	0.228	0.247
Observations	44,650	106,714	83,786	66,819

Note: The Table shows the results from equation (2) using a captive lenders and a standalone lender for which we obtained data on internal credit score for borrowers. The dependent variable is the fraction of low credit score borrowers. Maturing bonds is the face value of expiring bonds over the face value of outstanding bonds High is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis. Credit lines use is high when there is a drop in the balance. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model and year-month fixed effect are interacted fixed effects for the brand-model and the month and year in which it was sold. Region and year-month fixed effect are interacted fixed effects for the region where the car was sold and the month and year in which it was sold . Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

First, while we control for car type with brand-model fixed effects, there can be unobservable characteristics that vary systematically between captive and traditional lenders and are correlated with both financing terms and manufacturers distress. To lower the concern about omitted characteristics we re-estimate our model (2) controlling within each brand-model for quartiles of the car value. We also estimate our baseline model controlling within each brand-model for quartiles of the borrower income to capture in a more granular way omitted variable that are correlated with income. Tables A2 and A3 show the estimates controlling for quartile of car value and quartile of borrower income, respectively. Table A4 reports an additional robustness test which excludes the month of the Volkswagen Emission Scandal (September 2015) and the two months after. Our main results are robust to additional granular controls and the exclusion of extreme changes in manufacturers CDS.

4 Evidence from the Volkswagen Emission Scandal

Using variation in the full sample in manufacturers' financial distress and liquidity needs and a rich set of fixed effects, we have provided evidence that captive lenders adjust loan terms and relax credit standards to increase the cash paid upfront. In this section we establish a causal link between manufacturer financial distress and the documented credit fire sale behavior. The goal is to isolate changes in captive lending terms and standards due to manufacturer funding needs, and distinguish them from those driven by demand shocks, changes in price discrimination or the value of collateral.

We exploit as a source of time-series quasi-experimental variation the short-lived effect of the Volkswagen emissions scandal on car manufacturers' funding costs. On September 18, 2015, the U.S. Environmental Protection Agency (EPA) found that approximately 500,000 Volkswagen diesel-engine vehicles sold in the US contained a defeat device that could detect when the car was being tested, changing the performance accordingly to improve results. Figure A3 in Appendix A3 shows the CDS for Volkswagen and other car manufactures. We show both the level of CDS and a version normalized to 100 in September 2015. Before the scandal the different brands have a similar trend in CDS, with minor deviations and with Volkswagen having a lower average CDS than other manufacturers. After the onset of the scandal we observe a huge increase in the CDS of Volkswagen, which quadruples in the month of September and remain more than twice higher than before the event for several months. Other car manufacturers also experienced large increases in their CDS although to a lower extent relative to Volkswagen.

Our main identification strategy combines time-series variation in the CDS of manufacturers *other* than Volkswagen with cross-sectional variation in liquidity needs. Most notably, we divide the brands in our sample into high and low liquidity needs based on the fraction of

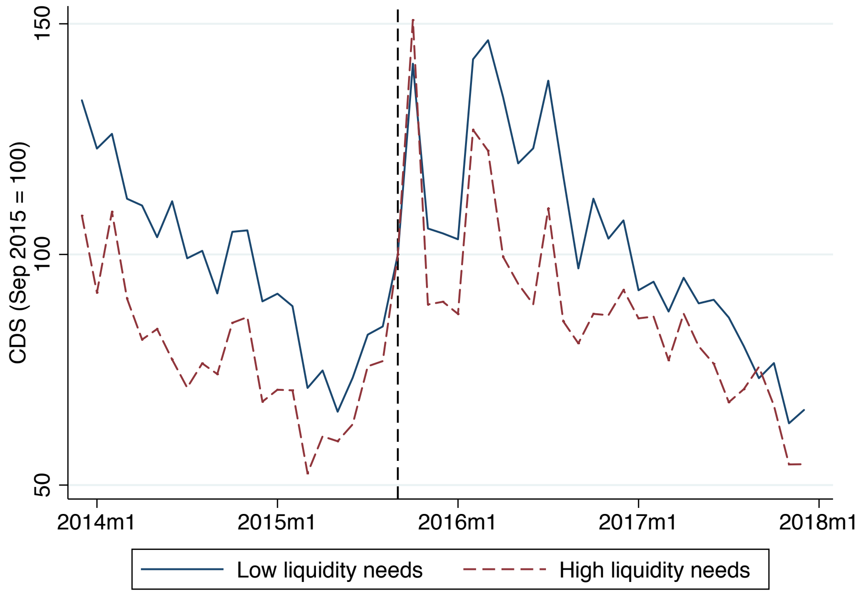


Figure 2: Volkswagen Emissions Scandal: CDS high and low liquidity manufacturers

Note: The figure shows the CDS for two groups of observations depending on the liquidity needs faced by captive lenders in each month. The High liquidity needs dotted line corresponds to the cases when the face value of expiring bonds over the face value of outstanding bonds is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis. The Low liquidity needs line corresponds to the cases when the same fraction is below the 75 percentile. The figures plots the monthly averages of daily CDS from December 2013 to December 2017. The CDS values are normalized to 100 in September 2015.

bonds maturing in September 2015 and the two months after the event. This is our ex-ante measure of cross-sectional exposure to the shock. Figure 2 shows that manufacturers with high and low liquidity needs face a very similar pattern in terms of changes in CDS as a result of the scandal. The average CDS price of both groups increased by 50% on the date of the Volkswagen scandal, and returned to the pre-scandal level after a few months.[24]

Thus we estimate a difference-in-difference empirical model separately for the high liquidity needs (treated) and low liquidity needs (control) manufacturers:[25]

[24] Also in levels the two groups experience a similar change around 50 basis point.

[25] In our exercise we exclude on purpose loans for buying Volskwagen cars and other brands of the group (Audi, Porsche, Seat, and Skoda), given the largely different change in CDS, and to minimize direct demand effects. In our high liquidity need group we have Ford, Mercedes and Renault, while in our low liquidity need group we have Toyota, Fiat, Opel, Peugeot and BMW. We check the number of bonds issued in the two months after the Volkswagen emissions scandal and we find that the average number of issuance for the high liquidity group is five, while the average number of issuance for the low liquidity group is 1.2.

$$y_{ilbmt} = \alpha Post_t \times Captive_l + \theta X_{ilt} + \gamma_l + \gamma_{bmt} + \epsilon_{ilbmt}, \tag{3}$$

where y_{ilbmt} is outcome of interest y (e.g., interest rate, maturity, lending standards) for individual i borrowing from lender l and buying brand-model b in market m and period t; $Post_t$ is a dummy equal to one after the Volkswagen emissions scandal; $Captive_l$ is a dummy equal to one if the lender is a captive firm; X_{ilt} are borrower and lenders controls; γ_l are lender fixed effects; and γ_{bmt} are interacted brand-model, market and time fixed effects. The coefficient of interest is α which captures the differential changes on loan terms and credit standards by captive lenders relative to standalone banks after the outbreak of the scandal. Our key estimates of interest are the αs for the manufacturers which are mostly exposed to the increase in CDS, due to a high fraction of expiring bonds.

Table 8 shows the result. Consistent with credit fire sales being used as a tool for liquidity management (and with our results for the full sample), we find that the action is driven by captive lenders of manufacturers which face distress and have higher liquidity needs. For manufacturers with high liquidity needs a 50 basis points increase in the CDS price leads to an increase in loan rates relative to standalone lenders by more than 35 basis points, a decrease in maturity by almost 8%, in loan-to-values by more than 2 percentage points and in loan amounts by almost 10%. Low-liquidity-need manufacturers, despite experiencing a similar increase in CDS, barely change loan terms relative to standalone lenders. We only find a significant result for maturity, which is in magnitude less than half the effect for treated manufactures.

With respect to risk-taking, we find that manufacturers which experience a 50 basis points increase in CDS with high liquidity needs originate loans to lower income borrower, who ex-post are 2 percentage points more likely to default relative to loans originated by standalone lenders. In contrast, placebo manufactures with low liquidity needs barely change credit terms or standards despite experiencing the same increase in CDS. If anything, placebo manufacturers increase significantly the share of borrowers with verified income relative to standalone lenders.

Table 8: Credit fire sales during the VW emission scandal

	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Panel A: High manuf. liquidity need									
Post × Captive Lender	0.366***	-0.078***	-2.188***	-0.045	-0.099***	-0.027**	-0.004	0.000	0.019**
	[0.068]	[0.016]	[0.732]	[0.029]	[0.029]	[0.012]	[0.014]	[0.000]	[0.009]
Avg Dep Var	5.719	3.79	70.804	9.380	8.899	10.029	.122	.484	.020
R^2	0.799	0.302	0.413	0.551	0.377	0.473	0.255	1.000	0.296
Observations	35,215	35,215	35,215	35,215	35,215	35,215	35,215	35,215	9,665
Panel B: Low manuf. liquidity need									
Post × Captive Lender	0.092	-0.036**	-0.641	-0.013	-0.031	-0.003	0.015	0.040***	-0.009
	[0.081]	[0.016]	[0.624]	[0.016]	[0.020]	[0.015]	[0.010]	[0.013]	[0.017]
Avg Dep Var	5.879	3.9	76.329	9.27	8.893	10.078	.199	.637	.060
R^2	0.726	0.334	0.494	0.582	0.462	0.461	0.275	0.761	0.400
Observations	37,830	37,830	37,830	37,830	37,830	37,830	37,830	37,830	5,135
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	YES	YES

Note: The Table shows the results from equation (3) using a sample period of two months before and two months after the month of the Volkswagen Emission Scandal (September 2015). Panel A reports the case when the face value of expiring bonds over the face value of outstanding bonds is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis; Panel B reports the case when the same fraction is below the 75 percentile. The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in log, loan size in log, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Post is a dummy equal to one after the Volkswagen Emission Scandal. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

We combine the results on loan terms and credit standards in Table 8 to compute a measure of the cost to generate an extra euro of cash today in terms of the net-present-value of future revenues from expected interest payments. Using the summary statistics in Table Table 1 and the statistically significant estimates for high- and low-liquidity need manufacturers from Table 8 we compute the additional cash, the new monthly payment and the expected net-present-value.[26] High-liquidity-need manufacturers obtain approximately €850 in cash as a result of the larger down payment, while low-liquidity-need manufacturers experience no significant changes in down payment. Despite the significantly higher interest rate, the monthly payment for high-liquidity-need manufacturers decreases and the present value of expected revenues declines by about €1000 relative to the baseline; low-liquidity-need manufacturers experience a lower decline in the present value of expected revenues at about €450. Putting together these numbers, our estimates show that to gain one additional euro in cash today high-liquidity-need manufacturers loose 70 cents in present value terms.

Finally, Table 9 provides additional evidence on the risk-taking channel of credit fire sales following the Volkswagen emission scandal. In the first four columns we compute the total number of cars financed and the share to low income borrowers in each market and month, for each brand-model by captive and standalone lenders. We find that after the Volkswagen emissions scandal captive lenders neither increase nor decrease the number of cars financed relative to standalone lenders. This result holds for both captives whose parent manufacturer has high and low liquidity needs. While the total number of cars does not change between captive and standalone, we find that captive lenders with high liquidity needs increase their share of low income borrowers relative to standalone lenders. The higher overall lending to low income borrower is only marginally significant and large in magnitude for manufacturers with high liquidity needs, consistent with the results in Table 8.

The last column of Table 9 look at the fraction of borrowers with a low credit scores. In this case we cannot distinguish between manufacturers with high and low liquidity needs, as we only have data on borrower credit scores for one captive lender (which in our case is in

[26]Notice that for high-liquidity manufacturers (the treated group) focusing on the significant coefficients is basically allowing all financial contract terms to change and keeping the car value unchanged.

the group with high liquidity need). We can however study if when the parent manufacturer experience financial distress as a result of the Volkswagen emissions scandal, the captive unit increases risk taking relative to a standalone lender financing similar cars. We find that the captive lender with high liquidity need increases the share of loans to low credit score borrowers relative to the standalone lender by almost 3 percentage points. The effect are significant and also larger in magnitude that the effect we documented in Section 3.3 using the full sample. Given an average share of low credit score borrowers of 15%, our estimates implies an increase by almost 20%.

Overall, the findings from the causal analysis are qualitatively and quantitatively similar to the stylized aggregate patterns. Taken together, the results indicate that liquidity creation through credit fire sales is an important feature of the vertical integration of car manufacturers with auto lenders. In the next Section we explore the implications of credit fire sales for car buyers and traditional fire sales.

5 Implications of Credit Fire Sales

5.1 Implications for Car Buyers

What are the implication of credit fire sales for car buyers? In this section we explore the consequences of credit fire sales, via credit contraction for infra-marginal buyers and credit expansion for marginal buyers, on different consumers. Most notably, we divide borrowers in our sample into high and low income, if they are above or below the median in the region and month when they purchase the car. We then look at the change in their borrowings measured by loan-to-value and loan amount, and in their ex-post arrears. Table 10 shows the results using maturing bonds as a measure of liquidity needs, while Table A5 in the Appendix replicate the same exercise using credit lines.

First, we find that both high and low income car buyers borrowing from a captive lender experience a significant decline in loan amount and loan-to-value when manufacturers experience financial distress, and liquidity needs are high. This is consistent with a lower loan

Table 9: Additional evidence on risk taking

	Number of Cars (log)		Low income borrowers (%)		Low credit score borrowers (%)
	Manuf. liquidity need:		Manuf. liquidity need:		
	Low	High	Low	High	
Post × Captive Lender	0.039	0.007	-0.006	0.035*	0.028**
	[0.033]	[0.039]	[0.018]	[0.016]	[0.011]
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	NO
Lender FE	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES
BrandModel-YearMonth FE	NO	NO	NO	NO	YES
Region-YearMonth FE	NO	NO	NO	NO	YES
Borrower Controls	NO	NO	NO	NO	YES
Avg Dep Var	.987	1.063	.495	.453	.158
R^2	0.677	0.705	0.600	0.620	0.209
Observations	10,586	8,562	10,586	8,562	10,781

Note: The Table shows the results from equation (3) using a sample period of two months before and two months after the month of the Volkswagen Emission Scandal (September 2015). The dependent variables are the logarithm of the total number of car financed, the share of low income borrowers (defined as income below the median in the region and month when they purchase the car) and the share of low credit score borrowers. The last column only refers to the one captive lender and one standalone lender for which we have credit score information. High manufacturer liquidity need is the case when the face value of expiring bonds over the face value of outstanding bonds is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis; low manufacturer liquidity need is the case when the same fraction is below the 75 percentile. Post is a dummy equal to one after the Volkswagen Emission Scandal. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

amount generating more cash upfront for the manufacturer from any car buyer. Interestingly, we find stronger effect in magnitude for buyers with lower income. The decline in loan size is about 2.5% for high income borrowers, while the decrease is around 6.5% for low income borrowers. Similarly, the decline in loan-to-value is less than 1.5 percentage points for high income borrowers, and almost 5 percentage points for low income borrowers. For both low and high income borrowers the decline in loan-to-value is driven by a lower loan amount, while car values do not change differently between captive and standalone lenders as in our baseline estimates. The effects on loan amount and loan-to-value are smaller in magnitude and not significant in most cases when the manufacturer liquidity needs are low, consistent with our previous results.

Second, we look at arrears by income level. Table 10 shows that the increase in arrears for loans originated by captive lenders when their parent manufacturers experience financial distress is coming only from low income borrowers. Most notably, while the default of high income borrowers is not affected, car loans originated to low income borrowers by distressed captive lenders with high liquidity needs are about 10 percentage points more likely to experience arrears relative to car loans originated by standalone lenders. The results are less significant and smaller in magnitude, when the liquidity needs of manufacturers are low.

Overall, the credit fire sale channel that we document has disproportionately larger effect on low-income, high-risk borrowers. We find that when the parent manufacturing company's liquidity costs and needs are high, captive lenders expand lending to low-income high-risk borrowers, who ex-post are more likely to end up in arrears. To extract more upfront cash and limit future losses from these marginally riskier buyers, captive lenders decrease the amount they lend to them relative to high-income, low-risk inframarginal buyers.

5.2 Implications for Car Fire Sales

5.2.1 A Simple Model of the Car Market with Standalone and Captive Lenders

We have shown that captive lenders decrease loan amounts and relax lending standards relative to standalone lenders to generate liquidity for the parent manufacturers, when the latter experience financial distress and liquidity needs are high. Additionally, we do not find differential effects on car values financed by captive lenders relative to standalone lenders. Thus, credit fire sales generate liquidity for the manufacturing company, without the need to lower prices to increase demand.

To gauge the importance of the new channel we document and compare it to more traditional asset fire sales, in this section we develop a simple model of borrowers' demand for car loans with standalone and captive lenders. We then calibrate the model using our

Table 10: Effects of Loan Fire Sales on Car Buyers

	Loan Size (log)		LTV (%)		Car value (log)		Arrears (dummy)	
	High income	Low income	High income	Low income	High income	Low income	High income	Low income
Panel A: High manuf. liquidity need								
Manuf. CDS × Captive Lender	-0.026*	-0.066**	-1.429**	-4.929***	-0.012	0.005	-0.015	0.109***
	[0.014]	[0.028]	[0.659]	[0.835]	[0.014]	[0.020]	[0.026]	[0.039]
Avg Dep Var	8.975	8.822	68.850	68.129	9.483	9.359	.033	.051
R^2	0.537	0.462	0.525	0.505	0.605	0.643	0.468	0.479
Observations	96,023	96,408	96,023	96,408	96,023	96,408	7,629	10,593
Panel B: Low manuf. liquidity need								
Manuf. CDS × Captive Lender	-0.011	-0.021**	-0.532	-0.642	-0.003	-0.005	0.015*	0.012
	[0.010]	[0.010]	[0.445]	[0.466]	[0.009]	[0.009]	[0.008]	[0.011]
Avg Dep Var	9.040	8.850	73.599	74.870	9.451	9.244	.041	.076
R^2	0.529	0.449	0.503	0.506	0.596	0.604	0.376	0.373
Observations	308,254	296,290	308,254	296,290	308,254	296,290	72,679	73,915
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	YES	YES	YES

Note: The Table shows the results from equation (2). Panel A reports the case when the face value of expiring bonds over the face value of outstanding bonds is above the 75 percentile of the distribution of this ratio for car manufacturers on a quarterly basis; Panel B reports the case when the same fraction is below the 75 percentile. High income are borrowers with an income above the median in their regions and year. The dependent variables are loan size in logs, loan-to-value in percentage points, car value in logs and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

micro-data and perform a counterfactual analysis to quantify the effect of credit fire sales on manufacturers' liquidity.

Car market. We model the car loan market following Perloff and Salop (1985). There are N differentiated cars producers indexed by j. We assume each manufacturer produces only one brand-model for simplicity. Manufacturers produce cars at common marginal cost k and incur a fixed cost K, and they set a price p_j for the car they sell. Manufacturer's j profits from selling the car are then given by:

$$\Pi_j(p_1, ..., p_N) = (p_j - \kappa)D_j(p_1, ..., p_N) - K, \tag{4}$$

where $D_j(p_1, ..., p_N)$ is the expected demand for manufacturer j.

Demand comes from M potential buyers indexed by i. We assume consumer i valuation for car j is given by v_{ij}, which is drawn from a distribution $F(v)$ with density $f(v)$. Consumer net surplus from purchasing car j is given by $b_{ij} = v_{ij} - p_j$. Consumer i will buy car j over car k if $b_{ij} > b_{ik}$ or $v_{ij} - p_j + p_k > v_{ik}$, which has a probability given by $F(v_{ij} - p_j + p_k)$. We assume valuations are independent and identically distributed across consumers. Thus, the fraction of consumer buying product j is given by:

$$Pr(b_{ij} \geq max_{k \neq j} b_{ik}) = \int \prod_{k \neq j} \left[F(p_k - pj + v)\right] f(v) dv. \tag{5}$$

Loan market. We assume that consumers need a loan to buy the car along the lines of Barron et al. (2008). A fraction γ of consumers is low risk (L), while a fraction $1 - \gamma$ is high risk (H). We assume that low risk consumers will always repay, while high risk will always default.

We make two simplifying assumptions on the supply side of car loans to avoid additional complications that are not central to the main channel we document in the empirical analysis. First, loans are provided in competitive markets by standalone banks and captive lenders. Second, a given fraction α of buyers goes to captive lenders and a fraction $1 - \alpha$ seeks a loan from standalone banks. In other words, credit markets are segmented.

We assume that all lenders borrow at rate r and incur a processing cost c per dollar loan. Lenders set an interest rate $i \leq \bar{i}$ based on the signal s from the consumer, which is below the maximum interest rate allowed in the car loan market $\bar{i}$.[27]

Lenders observe a signal about borrowers' type that is drawn from a normal distribution $G_L \sim N(\mu_L, \sigma)$ for low risk consumers, and $G_H \sim N(\mu_H, \sigma)$ for high risk consumers. We assume that $\mu_L > \mu_H$, i.e. low risky consumers generate higher signals on average. The per dollar profits from lending to consumer i an amount $l = \theta p$, where θ is the loan-to-value, are given by:

$$\pi_b(s_b) = P(L|s)(i - r) + (1 - P(L|s))(d - r) - c, \tag{6}$$

where $P(L|s)$ is the probability that the consumer is low risk given the signal and d is what the lender gets from the collection of the salvage value of the collateral.

Equilibrium. In Appendix B we solve the equilibrium of the model under different assumptions on the loan market. Most notably, we discuss the case when buyers do not require financing (i.e., only cash buyers); and the case when only standalone banks operate in the car loan market. In the main text we focus on the general case with both standalone and captive lenders, which is the baseline model that we calibrate with our data. First, we discuss lending standards of standalone banks and captive lenders. Then we solve for the equilibrium car price and number of manufacturers.

The equilibrium interest rate is obtained by setting to zero the per-dollar profits for standalone banks given by equation (6):

$$i(s) = \frac{(r + c) - (1 - P(L|s))d}{P(L|s)}. \tag{7}$$

Note that if there are only low risk borrowers ($P(L|s) = 1$) we obtain the standard equation of price equal to marginal costs ($i = r + c$). Consumers with a better signal pay

[27] Usury limit are common in automobile lending, see for example Melzer and Schroeder (2017).

lower interest rates (i.e. $\frac{\partial i(s)}{\partial s} < 0$). The equilibrium signal threshold for standalone banks $\bar{s}_b$, below which they would not lend, is obtained by setting the per-dollar profits given by equation (6) to zero at the maximum interest rate $\bar{i}$:

$$P(L|\bar{s}_b) = \frac{c + r - d}{\bar{i} - d}. \tag{8}$$

The equilibrium signal threshold for captive lenders is obtained by looking at the joint profit from the car and loan sale, which are given by:

$$\overbrace{(p - \kappa)}^{\text{Profits from sales}} \quad + l \overbrace{\left[P(L|s)(\bar{i} - r) + (1 - P(L|s))(d - r) - c\right]}^{\text{Per dollar financing profits: } \pi_j(s_j)}. \tag{9}$$

Setting equation (9) equal to zero at the maximum interest rate $\bar{i}$, gives the optimal cutoff signal for the captive lender:

$$P(L|\bar{s}_j) = \frac{c + r - d - \frac{p-\kappa}{l}}{\bar{i} - d} \tag{10}$$

Note that $P(L|\bar{s}_j) < P(L|\bar{s}_b)$, where the latter is given by equation (8). Thus the captive lender has a lower signal threshold than the standalone lender $\bar{s}_j < \bar{s}_b$.

The total fraction of buyers approved in the loan market is then given by:

$$(1 - \alpha) \overbrace{\left[\gamma(1 - G_L(\bar{s}_b)) + (1 - \gamma)(1 - G_H(\bar{s}_b))\right]}^{A(\bar{s}_b)\text{: Approval rate standalone lender}} + \alpha \overbrace{\left[\gamma(1 - G_L(\bar{s}_j)) + (1 - \gamma)(1 - G_H(\bar{s}_j))\right]}^{A(\bar{s}_b)\text{: Approval rate captive lender}}, \tag{11}$$

and the effective market size is $((1 - \alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j))M$, which is strictly lower than M unless both standalone and captive lenders approve all buyers.

In the car market, we focus on a symmetric equilibrium where all manufacturers set the same price, i.e. $p_j = p \; \forall j = 1, ..., N$ (Perloff and Salop, 1985). Thus, each manufacturer receive a fraction $\frac{1}{N}$ of approved buyers. The total profits of manufacturer j are then given by:

$$\Pi(s_j) = \overbrace{\frac{M}{N}\left[(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)\right](p-\kappa)}^{\text{Total profits from sale}} + \overbrace{\alpha\frac{M}{N}(A(\bar{s}_j) - A(\bar{s}_b))(l\pi_j(\bar{s}_j))}^{\text{Losses from financing risky consumers}} - K = 0. \quad (12)$$

The equilibrium number of lender N is obtained by setting total profit given by equation (12) equal to zero:

$$N = \frac{\left[(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)\right]M(p-\kappa)}{K} + \frac{\alpha M(A(\bar{s}_j) - A(\bar{s}_b))(l\pi_j(\bar{s}_j))}{K}. \quad (13)$$

Finally, under the Bertrand-Nash assumption that each manufacturer chooses price to maximize its expected profits, the FOC from equation (12) is:

$$p = \kappa + \frac{1}{N(N-1)\int \left[F(v)\right]^{N-2} f(v)^2 dv} + \frac{\frac{\alpha(A(\bar{s}_j)-A(\bar{s}_b))}{\alpha A(\bar{s}_j)+(1-\alpha)A(\bar{s}_b)}\pi_j(\bar{s}_j)}{N(N-1)\int \left[F(v)\right]^{N-2} f(v)^2 dv}, \quad (14)$$

where the three terms on the right side represent the marginal costs of producing a car, the mark-up due to product differentiation, and the expected losses on the riskier buyers that captive lenders approve, respectively.

5.2.2 Credit Fire Sales VS Car Fire Sales

Our model is very stylized and leaves out several real world complexities. However, it allows us to highlight the key mechanism of the credit fire sales channel that we identify empirically. Most notably, through the lens of the model we quantify the effect of credit fire sales on manufacturers' liquidity, decompose the role of marginal and inframarginal borrowers, and compare our channel to a traditional car fire sale.

We calibrate the model leveraging the richness of our micro data. Table A6 in Appendix B shows the main parameters that we observe in the data or calibrate, as well as the endogenous outcomes of the model that we also observe in the data and use as target moments for our calibration. Our simple model can match quite closely the average price of the car and the number of manufacturers. We over-predict arrears, which are in the model higher on average than in the data. This result is driven by the simplifying assumption that all risky borrowers default, while in the data only a fraction of ex-ante risky borrowers end up in arrears.[28] Additionally, our simple model is able to generate a positive differential in arrears between captive and standalone lenders which is the main object of interest from our empirical specifications.

We then simulate the calibrated model in the baseline and three alternative scenarios. First, we calculate the equilibrium in the car loan market without captive lenders simply by setting the fraction of borrowers going to captive lenders α equal to zero. Second, we consider a counterfactual in which manufacturers have high liquidity needs. We proxy this case by lowering the loan-to-value θ for car loans originated by captive lenders by 2 percentage points, which is in line with our empirical estimates from Table 6. Third, we allow captive lenders to accept higher expected future losses on their car loans in order to increase current liquidity. We implement this scenario by allowing captive lenders to target a certain profit level $\tau < 0$ when deciding their optimal acceptance threshold.[29]

Table 11 shows the results for several variables of interest. Notice that the number of manufacturers and the price of the car exhibit only small variation across different scenarios, consistent with our empirical results that the action is taking place on the loan market. Standalone banks' behavior is the same across scenarios, as the only difference is the exogenous fraction of borrowers that finance their cars purchases from them $(1 - \alpha)$. Standalone banks approve about 70% of borrowers, and approximately 5.7% of them end up in arrears.

First, we compare the baseline scenario to the case without captive lenders. Captive lenders have an approval rate of about 92%, or about 20 percentage points higher than standalone lenders. The key intuition is that captive lenders internalize the profit from the sell of the car by the parent manufacturing company. As a result of the higher approval

[28] Adding a probability of default conditional on the borrower type (safe or risky) will complicate the model without providing additional insights. If in reality safe borrowers almost never default and risky borrowers may also end up not defaulting our estimates of the liquidity generated by credit fire sales represent a likely lower bound, as captive lenders have an even higher incentive to lend to risky borrowers who may not default than to risky borrower who always default.

[29] The optimal cutoff signal for the captive lender is obtained by setting the joint profits given by equation (9) equal to $\tau < 0$. In the calibration we set $\tau = -25$.

rate, captive lenders experience higher average default rates at about 10%. The average loss for the defaulting high risky loans is however small given the low loan-to-value. The higher approval rate leads to almost 4.2 thousands more originations. Lending to marginally riskier buyers generates approximately €3.2 million in extra liquidity each month for the average manufacturer. Given the average price of the car and the average loan-to-value by captive, the extra liquidity is computed as the down payment in euros by the buyers approved by captive lenders, who would not have been approved by standalone lenders.

Finally, we calculate the car fire sale that would generate the same amount of liquidity for the manufacturer as the credit fire sale. A decline in car price would increase liquidity for the manufacturers via additional sales, but also decrease the liquidity because of the lower price paid by buyers who would have bought at the original (higher) price. To obtain the change in sales as a result of a percentage change in prices we borrow from previous works in the IO literature, which find a demand elasticity around 4 (Goldberg, 1995; Goldberg and Verboven, 2001; Salz et al., 2020). Differently from the traditional case of cash buyers, the change in cash is the full price of the car when financed by a standalone lender, while it is only given by the down payment when financed by the captive lender.

The well-known trade-off though the lens of our model is captured by the following expression:

$$\overbrace{\Delta p \times \frac{M}{N}\alpha A(\bar{s}_j)(1-\theta)}^{\Delta p\times q:\text{ Losses from inframarginal buyers}} \quad \overbrace{-\epsilon \times \Delta p \times \frac{M}{N}\alpha A(\bar{s}_j)(1-\theta)}^{\Delta q\times p:\text{ Gains from marginal buyers}}, \tag{15}$$

where the second term is obtained by inverting the formula for the demand elasticity; and $\frac{M}{N}\alpha A(\bar{s}_j)(1-\theta)$ is the demand financed by captive lenders, which generate cash only through the fraction of the price that is paid upfront $(1-\theta)$.

Thus, the change in car price for cars financed by captive lenders needed to generate the same amount of liquidity that is obtained through a loan fire sale can be calculated by setting (15) equal to the amount of liquidity and solving for Δp, as follows:

$$\Delta p = \frac{\text{Liquidity from credit fire sale}}{(1-\epsilon) \times \frac{M}{N} \alpha A(\bar{s}_j)(1-\theta)}. \tag{16}$$

Table 11 shows that the price of the car would have to decrease by about €990 to generate the same liquidity that captive lenders generate only via lending to marginally riskier borrower. This decline in price is equivalent to approximately 7.5% of the equilibrium car value.

The last row of Table 11 we report a measure of the cost of a credit fire sale *relative* to a car fire sale. The cost of lowering the price of the car is captured by lower revenues on the cars that would have been sold absent the price decrease. The cost of a credit fire sales comes from: 1) expected losses from lending to risky marginal borrowers; 2) lower interest rate revenues from inframarginal borrowers.[30] Using this simple measure, our calibration shows that to generate the same amount of cash a credit fire sale is about 60% cheaper than a traditional fire sale for the average manufacturer.

The third column of Table 11 shows the case in which manufacturers have high liquidity needs. Relative to the baseline, the captive lenders approved a slightly higher number of buyers. The intuition is that the lower loan-to-value decrease the losses on the risky borrowers, who end up defaulting. Indeed we find that the average loss on high-risk loans decrease from €100 to €97. Lowering the loan-to-value generates an additional margin to create liquidity, which is now also operating via inframarginal borrowers. A 2 percentage points lower loan-to-value increase monthly cash by about €630 thousands from inframarginal borrowers financed by the captive unit. The extensive margin is also higher than in the baseline case, relative to the case with no captive lenders. The reason for the increase in twofold. First, captive lenders are approving more borrowers than in the baseline, even if only slightly so. Second, each marginal borrower is borrowing less due to the lower loan-to-value, thus generating more liquidity upfront. Overall, lending to marginally risky buyers and asking for a larger down payment generate more than €4 millions in extra liquidity each month for the

[30] To compute the missed interest revenues in our simple one-period model we take a maturity of 4 years and an interest rate of 7% for loans originated by captive lenders consistent with our summary statistics in Table 2.

average manufacturer. To generate the same cash of a credit fire sale, the manufacturers would have to decrease the price of the car by about €1250, or about 9.5% of its equilibrium value.

Finally, the last column of Table 11 combines the case with high liquidity needs, as captured by a lower loan-to-value, with the same expected losses like in the baseline scenario. In this counterfactual, the approval rate of captive lenders increase by about 1 percentage point relative to the baseline scenario, which translates into the approval of more than 200 additional risky borrowers relative to the case with only high liquidity need, but no losses. As a result the default rate is slightly higher, but the average losses are the same as in the baseline at €100. The credit fire sale channel generates about €4.2 million in extra cash. Notice that the cash from the inframarginal borrowers is the same as in the case of high liquidity needs, given the same loan-to-value. However, the higher approval rates generate extra €150 thousand via inframarginal risky borrowers. In this last case, to generate the same cash of a credit fire sale, the manufacturers would have to decrease the price of the car by almost €1300, or about 10% of its equilibrium value.

6 Conclusions

In this paper we study the role of captive finance in the car loan market when the parent manufacturing company's liquidity cost (CDS price) and need (large fraction of outstanding bonds expiring) are high. Using a new multi-country dataset on securitized car loans, we show that captive lending enables distressed manufacturers to create liquidity, at the cost of future losses, by lowering loan amounts to all borrowers and relaxing lending standards to high-risk borrowers relative to standalone lenders. We label this mechanism a *credit fire sale.*

We quantify the mechanism by exploiting a funding shock to manufacturers resulting from the coincidence of a large fraction of maturing long-term bonds with the unexpected and temporary increase in manufacturers' CDS prices triggered by the Volkswagen emissions scandal. Taken together, the results indicate that liquidity creation through credit fire sales is an important feature of the vertical integration of car manufacturers with auto lenders.

Our mechanism has novel implications for the transmission of shocks to durable consumption and household leverage. Most notably, our findings imply that the integration of manufacturing and financial intermediation can change the sign, magnitude, and timing of the real effects of liquidity shocks to lenders and manufacturers. Finally, while our paper focuses on the auto market, our novel extended definition of fire sales may apply to many other settings where assets sales and financing are bundled together.

Table 11: Credit fire sales VS car fire sales

	No captive lenders	Baseline	High liquidity need	High liquidity need + losses
Panel A: Car market				
Car price (euros)	13,180	13,166	13,166	13,166
Number of manufacturers	6	6	6	6
Panel B: Loan Market				
Approved Buyers	24,817	29,012	29,052	29,236
Traditional Banks				
Fraction approved (%)	71	71	71	71
Number approved	24,817	10,423	10,423	10,423
Fraction default (%)	5.7	5.7	5.7	5.7
Captive lenders				
Fraction approved (%)		92	92	93
Number approved		18,589	18,629	18,813
Fraction default (%)		10.6	10.7	11.0
Average loss on high-risk loan (euros)		100	97	100
Panel C: Credit fire sales				
Δ approval rate captive - traditional		21	21	22
Extensive margin		4195	4235	4419
Liquidity creation (M euros)		3.21	4.06	4.21
Marginal borrowers (M euros)		3.21	3.43	3.58
Inframarginal borrowers (M euros)		0.00	0.63	0.63
Car fire sale equivalent (euros)		-990	-1249	-1282
Car fire sale equivalent (% car price)		-7.5	-9.5	-9.7
Cost of credit fire sale relative to car fire sale		0.37	0.36	0.37

Note: The Tables shows the several variables in three different scenarios. The Baseline scenario represent the full model described in Section 5 and calibrated using the parameters from Table A6. The "No captive lenders" assume that in the model all borrowers go to standalone lenders (i.e. $\alpha = 0$). The details are discussed in Appendix B. The "High manufacturers liquidity need" scenario represents the full model described in Section 5 and calibrated using the parameters from Table A6, but setting the loan-to-value by captive lenders to 0.63, rather than the baseline value of 0.65. Panel A shows the equilibrium car price in euros and number of manufacturers. Panel B shows the variables in the loan market. The total number of approved borrowers, and the fraction approved, number approved and fraction in default for standalone and captive lenders, respectively. Panel B also shows the average loss in euros for captive lenders on risky loans, that standalone lenders would not have approved. Panel C shows several variables related to the loan fire sale channel. The difference in approval rate between standalone and captive lenders and the extensive margin which is the extra number of borrowers approved by the captive lenders. The cash generated by the captive lenders through relaxing lending standard to marginal borrowers and changing loan-to-values to inframarginal borrowers. The fire sale equivalent of loan sale represent the decrease in car price that would generate the same cash flow as the loan fire sale expressed in euros and as a percentage of the car price. Finally, the cost of credit fire sale relative to car fire sale is the cost in terms of foregone revenues for creating the same amount of cash either by lowering the price of the car or by a credit fire sale.

References

Adams, W., L. Einav, and J. Levin (2009): "Liquidity constraints and imperfect information in subprime lending," *American Economic Review*, 99, 49–84.

Agarwal, S., B. W. Ambrose, and S. Chomsisengphet (2008): "Determinants of automobile loan default and prepayment," *Economic Perspectives*, 32, 17–29.

Alexander, D. and H. Schwandt (2019): "The Impact of Car Pollution on Infant and Child Health: Evidence from Emissions Cheating," .

Almeida, H., M. Campello, B. Laranjeira, and S. Weisbenner (2009): "Corporate debt maturity and the real effects of the 2007 credit crisis," Tech. rep., National Bureau of Economic Research.

Amiti, M. and D. E. Weinstein (2011): "Exports and financial shocks," *The Quarterly Journal of Economics*, 126, 1841–1877.

Argyle, B., T. Nadauld, and C. Palmer (2017): "Real effects of search frictions in consumer credit markets," .

Argyle, B., T. D. Nadauld, and C. Palmer (2019): "Monthly payment targeting and the demand for maturity," Tech. rep., National Bureau of Economic Research.

Argyle, B., T. D. Nadauld, C. Palmer, and R. D. Pratt (2018): "The capitalization of consumer financing into durable goods prices," Tech. rep., National Bureau of Economic Research.

Attanasio, O. P., P. Koujianou Goldberg, and E. Kyriazidou (2008): "Credit constraints in the market for consumer durables: Evidence from micro data on car loans," *International Economic Review*, 49, 401–436.

Bachmann, R., G. Ehrlich, Y. Fan, and D. Ruzic (2019): "Firms and collective reputation: a Study of the Volkswagen Emissions Scandal," Tech. rep., National Bureau of Economic Research.

Banner, P. H. (1958): "Competition, credit policies, and the captive finance company," *The Quarterly Journal of Economics*, 72, 241–258.

Barron, J. M., B.-U. CHONG, and M. E. Staten (2008): "Emergence of captive finance companies and risk segmentation in loan markets: theory and evidence," *Journal of Money, Credit and Banking*, 40, 173–192.

Benmelech, E. and N. K. Bergman (2008): "Liquidation values and the credibility of financial contract renegotiation: Evidence from US airlines," *The Quarterly Journal of Economics*, 123, 1635–1677.

Benmelech, E., R. R. Meisenzahl, and R. Ramcharan (2017): "The real effects of liquidity during the financial crisis: Evidence from automobiles," *The Quarterly Journal of Economics*, 132, 317–365.

Bernanke, B. (2018): "The real effects of the financial crisis," *Brookings Papers on Economic Activity*, 20.

Bodnaruk, A., W. O'Brien, and A. Simonov (2016): "Captive finance and firm's competitiveness," *Journal of Corporate Finance*, 37, 210–228.

Brennan, M. J., V. Maksimovics, and J. Zechner (1988): "Vendor financing," *The journal of finance*, 43, 1127–1141.

Campbell, J. Y., S. Giglio, and P. Pathak (2011): "Forced sales and house prices," *American Economic Review*, 101, 2108–31.

Costello, A. M. (2020): "Credit market disruptions and liquidity spillover effects in the supply chain," *Journal of Political Economy*, 128, 3434–3468.

GERTLER, M. AND S. GILCHRIST (2018): "What happened: Financial factors in the great recession," *Journal of Economic Perspectives*, 32, 3–30.

GOLDBERG, P. K. (1995): "Product differentiation and oligopoly in international markets: The case of the US automobile industry," *Econometrica: Journal of the Econometric Society*, 891–951.

GOLDBERG, P. K. AND F. VERBOVEN (2001): "The evolution of price dispersion in the European car market," *The Review of Economic Studies*, 68, 811–848.

GREENWOOD, R. AND D. SCHARFSTEIN (2013): "The growth of finance," *Journal of Economic Perspectives*, 27, 3–28.

HORTAÇSU, A., G. MATVOS, C. SYVERSON, AND S. VENKATARAMAN (2013): "Indirect costs of financial distress in durable goods industries: The case of auto manufacturers," *The Review of Financial Studies*, 26, 1248–1290.

IVASHINA, V. AND D. SCHARFSTEIN (2010): "Bank lending during the financial crisis of 2008," *Journal of Financial economics*, 97, 319–338.

KHWAJA, A. I. AND A. MIAN (2008): "Tracing the impact of bank liquidity shocks: Evidence from an emerging market," *American Economic Review*, 98, 1413–42.

MELZER, B. AND A. SCHROEDER (2017): "Loan contracting in the presence of usury limits: Evidence from automobile lending," *Consumer Financial Protection Bureau Office of Research Working Paper*.

MIAN, A. AND A. SUFI (2018): "Finance and business cycles: the credit-driven household demand channel," *Journal of Economic Perspectives*, 32, 31–58.

MURFIN, J. AND R. PRATT (2019): "Who Finances Durable Goods and Why It Matters: Captive Finance and the Coase Conjecture," *The Journal of Finance*, 74, 755–793.

Paravisini, D. (2008): "Local bank financial constraints and firm access to external finance," *The Journal of Finance*, 63, 2161–2193.

Paravisini, D., V. Rappoport, and P. Schnabl (2015): "Specialization in bank lending: Evidence from exporting firms," Tech. rep., National Bureau of Economic Research.

Paravisini, D., V. Rappoport, P. Schnabl, and D. Wolfenzon (2014): "Dissecting the effect of credit supply on trade: Evidence from matched credit-export data," *The Review of Economic Studies*, 82, 333–359.

Perloff, J. M. and S. C. Salop (1985): "Equilibrium with product differentiation," *The Review of Economic Studies*, 52, 107–120.

Pulvino, T. C. (1998): "Do asset fire sales exist? An empirical investigation of commercial aircraft transactions," *The Journal of Finance*, 53, 939–978.

Salz, T., A. Grunewald, D. C. Low, and J. A. Lanning (2020): "Auto Dealer Loan Intermediation: Consumer Behavior and Competitive Effects," Tech. rep., National Bureau of Economic Research.

Shleifer, A. and R. Vishny (2011): "Fire sales in finance and macroeconomics," *Journal of Economic Perspectives*, 25, 29–48.

Stroebel, J. (2016): "Asymmetric information about collateral values," *The Journal of Finance*, 71, 1071–1112.

Appendix

The appendix is structured as follows. Section A provides supplementary figures and tables with additional results and robustness checks. Section B provides additional derivation and results for the model of Section 5.2 in the main text.

A Additional tables and figures

Table A1: Liquidity Channel: Credit lines usage

	Loan Terms					Lending standards			
	Rate	Maturity	LTV	Car value	Loan Size	Income	Other employment	Income verified	Arrears
	(%)	(log)	(%)	(log)	(log)	(log)	(dummy)	(dummy)	(dummy)
Panel A: High manuf. liquidity need									
Manuf. CDS × Captive Lender	0.215***	-0.022***	-1.087**	-0.011	-0.031***	-0.013*	0.003	-0.056***	0.026***
	[0.043]	[0.005]	[0.438]	[0.008]	[0.010]	[0.007]	[0.007]	[0.015]	[0.010]
Avg Dep Var	6.456	3.873	70.773	9.399	8.935	10.027	.187	.632	.062
R^2	0.785	0.340	0.479	0.606	0.486	0.475	0.338	0.853	0.344
Observations	378,210	378,210	378,210	378,210	378,210	378,210	378,210	378,210	87,814
Panel B: Low manuf. liquidity need									
Manuf. CDS × Captive Lender	0.055	0.009*	-0.485	-0.001	-0.006	-0.002	0.042***	-0.054***	0.012*
	[0.062]	[0.005]	[0.390]	[0.010]	[0.009]	[0.008]	[0.007]	[0.011]	[0.006]
Avg Dep Var	5.963	3.865	74.349	9.351	8.944	10.081	.183	.604	.051
R^2	0.771	0.330	0.461	0.571	0.447	0.478	0.325	0.910	0.346
Observations	527,875	527,875	527,875	527,875	527,875	527,875	527,875	527,875	109,885
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	YES	YES

Note: The Table shows the results from equation (2). Panel A reports the case when car manufacturers experience a drop in the balance of credit lines; while Panel B reports the cases when we do not observe such a drop. The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in log, loan size in log, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A2: Main result controlling for bins of car value

	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Manuf. CDS × Captive Lender	0.127**	-0.008*	-0.893**	-0.009	-0.022***	-0.012**	0.018***	-0.057***	0.028***
	[0.058]	[0.005]	[0.407]	[0.007]	[0.007]	[0.006]	[0.006]	[0.014]	[0.007]
BrandModel-Region-YearMonth-CarValueBin FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	YES	YES
Avg Dep Var	6.177	3.868	72.795	9.372	8.94	10.058	.188	.618	.056
R^2	0.814	0.448	0.564	0.886	0.601	0.545	0.415	0.904	0.416
Observations	685,268	685,268	685,268	685,268	685,268	685,268	685,268	685,268	134,660

Note: The Table shows the results from equation (2). The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in log, loan size in log, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region, year-month and car-value-bin fixed effect are interacted fixed effects for the brand-model, the region where the car was sold, the month and year in which it was sold, and quartiles of car value. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A3: Main result controlling for bins of income

	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Manuf. CDS × Captive Lender	0.139***	-0.007	-0.694*	-0.002	-0.012	0.002	0.030***	-0.057***	0.030**
	[0.051]	[0.005]	[0.410]	[0.009]	[0.009]	[0.003]	[0.006]	[0.013]	[0.012]
BrandModel-Region-YearMonth-IncomeBin FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	NO	YES
Avg Dep Var	6.177	3.868	72.795	9.372	8.94	10.058	.188	.618	.049
R^2	0.813	0.436	0.549	0.651	0.542	0.895	0.441	0.910	0.434
Observations	663,803	663,803	663,803	663,803	663,803	663,803	663,803	663,803	105,389

Note: The Table shows the results from equation (2). The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in log, loan size in log, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region, year-month and income-bin fixed effect are interacted fixed effects for the brand-model, the region where the car was sold, the month and year in which it was sold, and quartiles of borrower income. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A4: Main result excluding Volkswagen Emission Scandal Months

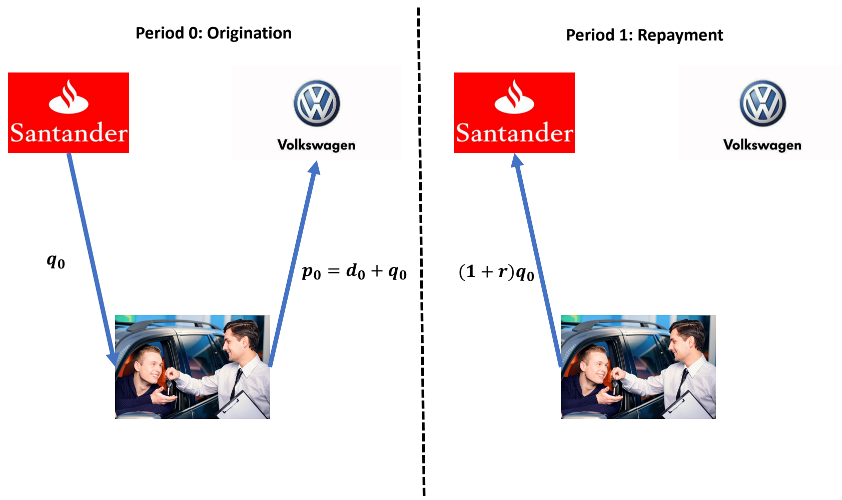
	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Manuf. CDS × Captive Lender	0.132*	-0.009*	-1.050**	-0.009	-0.020**	-0.008	0.030***	-0.070***	0.025***
	[0.072]	[0.005]	[0.462]	[0.011]	[0.010]	[0.007]	[0.006]	[0.017]	[0.007]
BrandModel-Region-YearMonth	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	NO	NO	YES	YES
Avg Dep Var	6.197	3.868	72.661	9.372	8.939	10.058	.19	.614	.057
R^2	0.780	0.335	0.470	0.588	0.466	0.479	0.334	0.887	0.345
Observations	841,616	841,616	841,616	841,616	841,616	841,616	841,616	841,616	185,620

Note: The Table shows the results from equation (2) excluding the month of the Volkswagen Emission Scandal (September 2015) and the two months after. The dependent variables are the interest rate in percentage points, maturity in log, loan-to-value in percentage points, car value in log, loan size in log, income in logs, a dummy variable denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

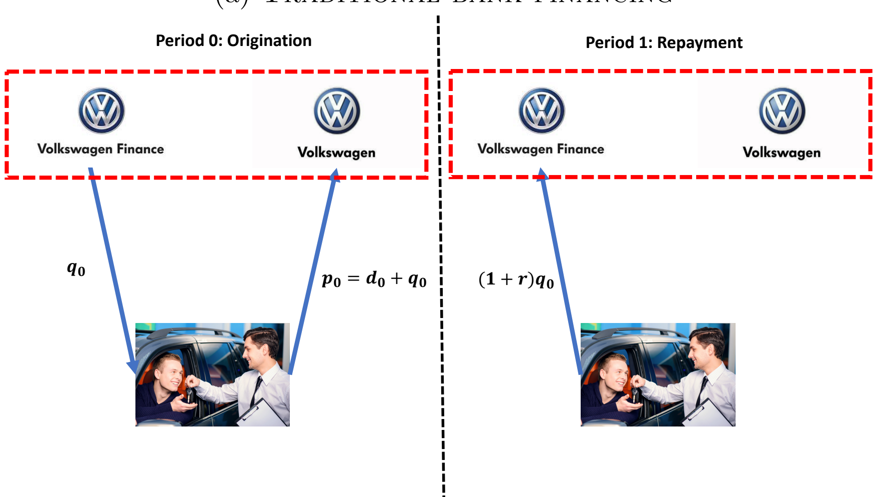
Table A5: Effects of Loan Fire Sales on Borrowers (Robustness)

	Loan Size (log)		LTV (%)		Car value (log)		Arrears (dummy)	
	High income	Low income	High income	Low income	High income	Low income	High income	Low income
Panel A: High manuf. liquidity need								
Manuf. CDS × Captive Lender	-0.033**	-0.030**	-0.996	-1.562***	-0.013	-0.005	0.004	0.047***
	[0.015]	[0.012]	[0.609]	[0.553]	[0.008]	[0.013]	[0.016]	[0.018]
Avg Dep Var	9.003	8.852	70.063	71.629	9.477	9.304	.044	.081
R^2	0.552	0.485	0.529	0.514	0.615	0.645	0.372	0.379
Observations	169,911	161,540	169,911	161,540	169,911	161,540	35,855	37,651
Panel B: Low manuf. liquidity need								
Manuf. CDS × Captive Lender	0.015	-0.019	-0.145	-0.980	0.007	0.001	0.018**	0.006
	[0.012]	[0.014]	[0.565]	[0.661]	[0.012]	[0.012]	[0.009]	[0.017]
Avg Dep Var	9.043	8.837	74.387	74.309	9.477	9.304	.037	.065
R^2	0.519	0.431	0.501	0.507	0.587	0.597	0.395	0.384
Observations	235,720	232,020	235,720	232,020	235,720	232,020	44,453	46,857
BrandModel-Region-YearMonth FE	YES	YES	YES	YES	YES	YES	YES	YES
Lender FE	YES	YES	YES	YES	YES	YES	YES	YES
Lender-time Controls	YES	YES	YES	YES	YES	YES	YES	YES
Borrower Controls	YES	YES	YES	YES	YES	YES	YES	YES

Note: The Table shows the results from equation (2). Panel A reports the case when car manufacturers experience a drop in the balance of credit lines; while Panel B reports the cases when we do not observe such a drop. High income are borrowers with an income above the median in their regions and year. The dependent variables are loan size in log, loan-to-value in percentage points, car value in log and a dummy variable that is equal to one if the loan is in arrears when the remaining time to maturity is more than 75%. Manuf. CDS is the CDS of the manufacturer of the car. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Brand-model, region and year-month fixed effect are interacted fixed effects for the brand-model, the region where the car was sold and the month and year in which it was sold. Region is defined as NUTS2. Lender-time controls are ROA, Equity as a fraction of total assets and the logarithm of total assets. Borrowers controls are income, employment status dummy and and dummy for verified income. Standard errors are double clustered at brand-model and region-lender levels. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.



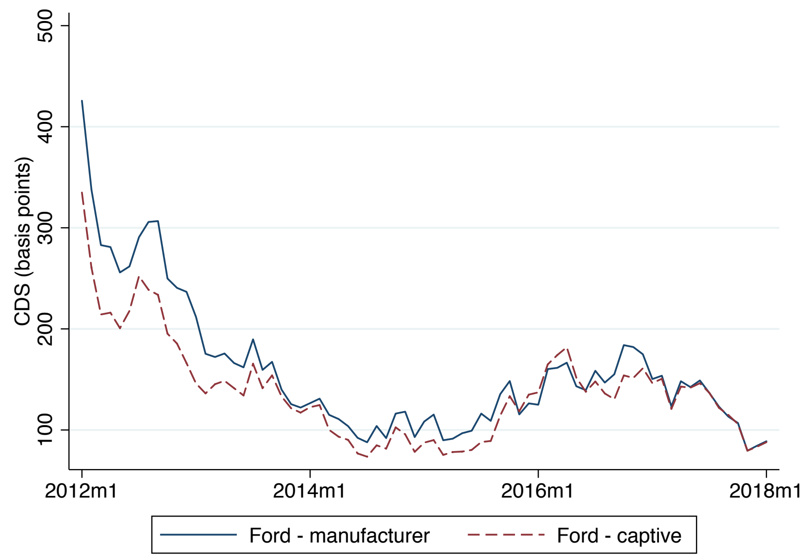
(a) Traditional bank financing



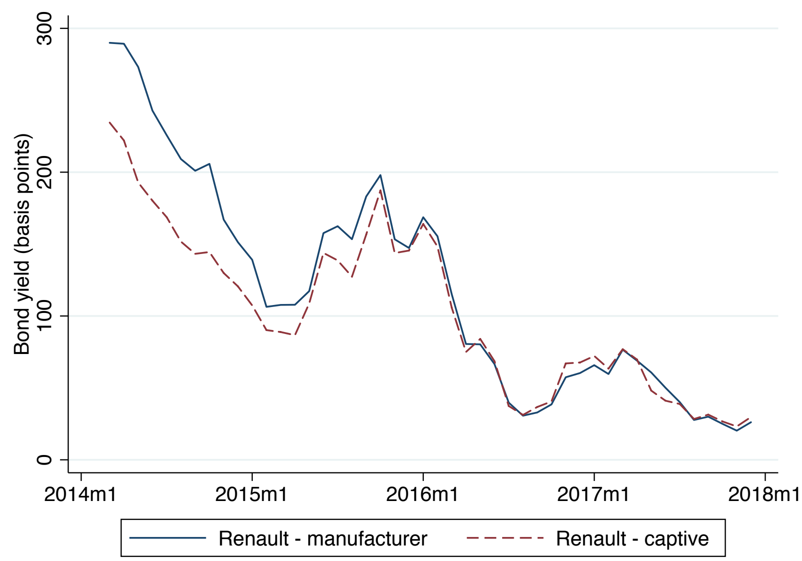
(b) Captive financing

Figure A1: Cash flows with traditional bank and captive lenders

Note: The figure show the key flow and contract term for a car purchase with financing at origination and repayment (assuming a one period contract). q_0 is the original loan amount, p_0 is the car value, d_0 is the down payment and r is the interest rate. Panel (a) shows the case with traditional bank financing, while panel (b) shows the case with captive financing. The red dotted line that circles the car maker and the captive lender indicates that they are part of the same group.



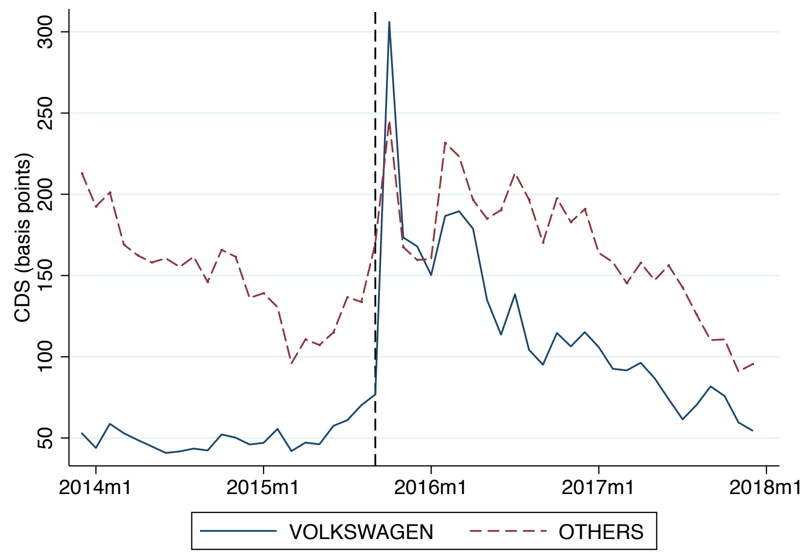
(a) CDS Ford



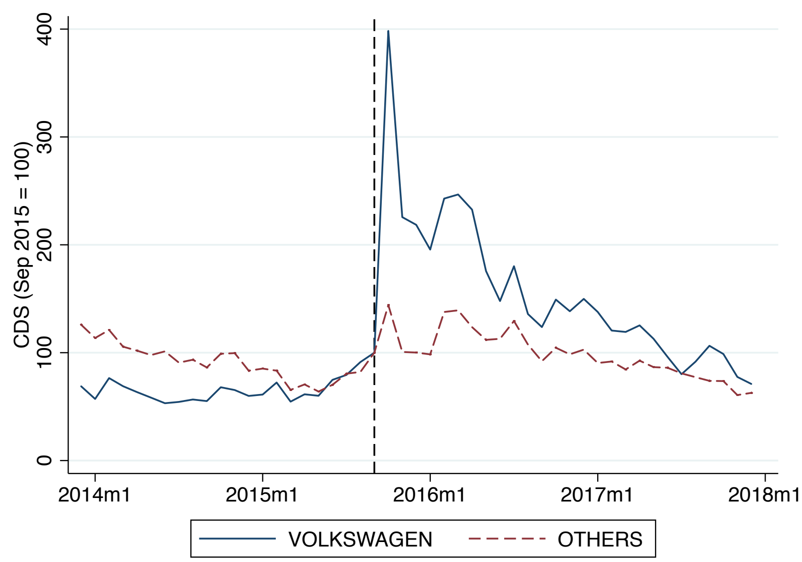
(b) Bond yields Renault

Figure A2: Financing of manufacturer and captive unit

Note: Panel (a) shows the CDS in basis points for Ford and Ford Motor Credit from December 2013 to December 2017. Panel (b) shows the yields on a bond issued in March 2014 by Renault and on a bond with the same maturity issued in the same month by RCI (Renault Credit International).



(a) CDS level



(b) CDS normalized

Figure A3: Volkswagen Emissions Scandal: CDS car manufacturers

Note: The figure shows the CDS for Volkswagen and an average of all other manufacturers. The figures plots the monthly averages of daily CDS from December 2013 to December 2017. The CDS values are in basis points in panel (a) and normalized to 100 in September 2015 in panel (b).

B Additional derivations for the model

In this Appendix we discuss the solutions of the model presented in Section 5.2.1 in two simpler cases. First, focusing only in the car market under the assumption that all buyers can purchase the car. Second, looking at both the car market and the loan market, when only standalone lenders offers financing.

Car market only (i.e., all cash buyers). The endogenous variables in the car market are the number of manufacturers N and the price of the cars p_j. Given a market size M and using (5), we can compute demand for manufacturer j as follow:

$$D_j(p_1, ..., p_N) = M \int \left[F(p - p_j + v)\right]^{N-1} f(v)dv. \tag{17}$$

Under the Bertrand-Nash assumption that each supplier chooses price to maximize its expected profits, then the FOC from (4) is:

$$p_j = \kappa - \frac{D_j(p_1, ..., p_N)}{\frac{\partial D_j(p_1,...,p_N)}{\partial p_j}}. \tag{18}$$

We focus on a symmetric equilibrium where all manufacturers set the same price, i.e. $p_j = p \; \forall j = 1, ..., N$ (Perloff and Salop, 1985). Thus, each manufacturer receive a fraction $\frac{1}{N}$ of approved buyers. Combining (18) with (17) and using the symmetric equilibrium assumption, we get the optimal price:

$$p = \kappa + \frac{M \int \left[F(v)\right]^{N-1} f(v)dv}{(N-1)M \int \left[F(v)\right]^{N-2} f(v)^2 dv} = \kappa + \frac{1}{N(N-1) \int \left[F(v)\right]^{N-2} f(v)^2 dv}, \tag{19}$$

and the number of manufacturers is given by the zero profits conditions (4):

$$\frac{M}{N}(p - \kappa) - K = 0 \;\; \rightarrow \;\; N^* = \frac{M(p - k)}{K}. \tag{20}$$

Loan market with only standalone banks. We now assume that in order to buy a car consumers need financing which is provided by standalone banks. The endogenous variables are now the number of manufacturers N and the price of the cars p_j as above, and also s_b, which is the optimally chosen lending signal threshold for standalone banks. The latter is obtained by setting lenders' profit to zero at the highest interest rate in the market as shown in (8). The approval rate by standalone banks is then given by:

$$A(\bar{s}_b) = \gamma(1 - G_L(\bar{s}_b)) + (1 - \gamma)(1 - G_H(\bar{s}_b)). \tag{21}$$

Note that an increase in the signal threshold reduce the approval rate. Because now consumers who are denied a loan cannot buy the good, the effective market size becomes: $A(\bar{s}_b)M$. The latter is strictly lower than M unless standalone lenders approve all potential buyers. The new equilibrium number of manufacturers N is then given by:

$$A(\bar{s}_b)\frac{M}{N}(p - \kappa) - K = 0 \;\rightarrow\; N = \frac{A(\bar{s}_b)M(p - k)}{K}. \tag{22}$$

Unless traditional banks approve all consumers we have a lower number of manufacturers than in the case in which all buyer can purchase a car irrespective of financing. And the new equilibrium price p is given by (19) with the new number of manufacturers from equation (22).

Calibration. Table A6 shows the main parameters that we observe in the data or calibrate, as well as the endogenous outcomes of the model that we also observe in the data and use as target moments for our calibration. Panel A shows the parameter of the model that we observe directly in our micro-data, namely the fraction α of borrowers going to captive lenders, the maximum rate $\bar{i}$, and the average loan-to-value by captive lenders θ.[31] We also observe in the data for a captive and a standalone lender the fraction of borrowers with a low credit score which we use to fix the proportion of low risk borrowers. Finally we

[31] Given the assumption that loans are provided in competitive markets by standalone banks and captive lenders we only need the loan-to-value by captive lenders. The latter is used to compute the losses on the risky loans approved by captive lenders, that would not be approved by standalone lenders.

proxy the cost of funds using the average car manufacturer CDS and the sovereign yield in our sample period.

Panel B shows the parameters that we have calibrated using the targeted endogenous outcomes of the model that we observe in the data and are reported in Panel C. To allow more flexibility in calibrating the model to the data we allow processing cost c and collection rates upon default d to vary between standalone and diversified lenders.

Table A6: Calibration

	Variables	Data	Model
Panel A: Parameters from the data			
Proportion of borrowers going to captive	α	0.58	0.58
Maximum loan rate	$\bar{i}$	0.13	0.13
Loan-to-value (captive)	θ	0.65	0.65
Proportion of low risk borrowers	γ	0.85	0.85
Cost of funds	r	0.02	0.02
Panel B: Parameters calibrated			
Marginal cost of producing car	κ		13,000
Fixed cost of producing car	K		800,000
Potential Buyers (monthly)	M		35,000
Support for uniform density function of car valuation	$f(v)$		15,000-16,000
Net collection rate upon default (standalone-captive)	d		0.01-0.02
Cost of processing loan (standalone-captive)	c		0.09-0.08
Panel C: Comparison data - model			
Car value	p	13,000	13,166
Number of car manufacturers	N	9	6
Arrears rate standalone	$\delta(s_b)$	0.04	0.06
Arrears rate captive	$\delta(s_j)$	0.05	0.10
Approved buyers (monthly)	$(1-\alpha)A(\bar{s}_b)+\alpha A(\bar{s}_j)$	30,000	29,012

Note: Panel A shows the parameter of the model that we observe directly in our micro-data. Panel B shows the parameters that we have calibrated. Panel C shows endogenous outcomes of the model that we also observe in the data and use as target to calibrate the parameters of the model.