Credit Fire Sales:

Captive Lending as Liquidity in Distress*

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Abstract

We study the role of captive finance in the car loan market when manufacturers' liquidity demand increases. Captive lending enables manufacturers to create liquidity, at the cost of future losses, by decreasing loan amounts to all borrowers and relaxing lending standards to high-risk borrowers: a *credit fire sale*. We show evidence of credit fire sales using a new multi-country dataset on securitized car loans. Captive lenders expand lending to high-risk borrowers—relative to traditional non-integrated lenders— when the parent manufacturing company's liquidity cost (CDS price) and need (large fraction of outstanding bonds expiring) are high. Through the lens of a simple model, we show that manufacturers would have to decrease car prices by about 4-5% to generate the same liquidity of a credit fire sale. Credit fire sales have new implications for the transmission of shocks to durable consumption and household leverage.

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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 credit terms and standards, a behavior that we label a *credit fire sale*.

An integrated manufacturer/lender can create liquidity when marginal value of cash is high by: 1) lowering loan LTV and maturity, which brings forward cash payments by inframarginal buyers, and 2) by relaxing lending standards to risky borrowers, which boosts demand and cash down-payments from marginal buyers. For manufacturers, credit fire sales have a distinct advantage over a regular inventory fire sale: its costs—lower interest revenue and larger default losses—are realized in the future and difficult to evaluate by outside investors. For consumers, a credit fire sale results in a shift of car purchases and access to credit from infra-marginal (safe) buyers to marginal (risky) buyers. Thus, a liquidity shock to an integrated manufacturer/lender can lead to an increase in leverage and default by risky households, an outcome that is difficult to rationalize with standalone manufacturers and lenders.

[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)

Using a new multi-country dataset on securitized car loans in Europe, we show that integrated manufacturers/lenders engage in credit fire sales when in financial distress. Our choice of empirical setting is motivated by the coexistence of captive lenders with traditional standalone banks in the market for used car loans.[2] We begin our analysis by documenting how captive lenders adjust credit terms and standards, *relative* to standalone banks, when their associated manufacturer is in distress. We use data for over a million securitized used auto loans to track credit terms (e.g., LTV, maturity, rate) and standards (ex ante and ex post measures of borrower risk) to purchase the same car-model (e.g., Peugeot 206), in the same geographical market (e.g., Madrid), and in the same month. We follow Hortaçsu et al. (2013) and use car manufacturer CDS price as a measure of manufacturer distress.

The initial analysis provides stylized evidence consistent with credit fire sales. Captive lenders reduce loan LTV (increase down-payments) and maturity, and increase rates relative to standalone banks when the captive's associated manufacturer is in distress. A 100 bps increase in the manufacturer's CDS price can be associated to changes in credit terms that increase by €200 (1.5% of average car sale price) the cash paid up front by infra-marginal buyers. When manufacturers are in distress, captive lenders also increase the proportion of credit issued to buyers without income verification or stable sources of income (e.g., students, self-employed, unemployed). The economic magnitude of the relaxation in credit standards is large. A 100 bps increase in the manufacturer's CDS price is associated with a 7.4 percentage point increase in the fraction of borrowers without verified or stable income, relative to standalone banks. The cost of the lax lending standards is also large: the same 100 bps CDS price increase is associated with a 2.5 percentage point increase in the probability of future repayment arrears relative to standalone banks. This result is controlling for observable borrower characteristics, confirming that the risk implications of the lax standards cannot be easily evaluated by outside investors.

Additional findings suggest that the observed patterns are easiest to reconcile with a credit fire sale interpretation. The findings are robust to a series of alternate specifications,

[2] 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.

for example, when comparing captive and standalone lending within narrower market definitions (e.g., car price bins, buyer income bins), which suggests that lending terms and standards are not changing due to variation in the demand for cars or in price discrimination practices by the manufacturers. The patterns are also robust across sample sub-periods with and without large swings in manufacturer CDS prices (e.g, including/excluding the events surrounding Volkswagen emissions scandal), which indicates that the results are not driven by risk-shifting by manufacturers that are close to bankruptcy. Finally, the patterns are stronger for manufacturers with larger liquidity needs (measured by the fraction of outstanding bonds maturing in a given month) and by manufacturers with limited alternate sources of liquidity (measured by the drawn fraction of pre-committed credit lines), predictions that are uniquely consistent with credit fire sales being used as a tool for liquidity management.

In the second part of the paper, 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 variation the short-lived effect that the Volkswagen emissions scandal had on *other* manufacturers' funding costs.[3] For cross sectional variation in liquidity needs, we use manufacturers' fraction of bonds maturing during the month following the scandal (September 2015). The identifying assumption, that the timing of the Volkswagen event relative to the maturity bond structure of *other* manufacturers is uncorrelated with demand shocks, seems reasonably weak. The interaction provides us with a group of three *treated* manufacturers with high-liquidity needs (Ford, Mercedes and Renault), and a group of five *placebo* manufacturers with low liquidity needs (Toyota, Fiat,

[3]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.

Opel, Peugeot and BMW). 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. We estimate difference-in-difference specifications comparing credit terms and standards of the captive lender of each group of manufacturers 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.

Manufacturers with high liquidity needs increase loan rates by 36 basis points, decrease maturity almost 8%, and reduce 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 manufacturers with low liquidity needs barely change credit terms or standards despite experiencing the same increase in funding costs. 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 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 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. Under different assumptions on the fraction of safe borrowers, we find that the average credit fire sale observed in the data generates the same amount of cash as a €300-700 reduction in car sale price by a standalone manufacturer, which corresponds to a 2-5% discount from the equilibrium car value.

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. 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; Shleifer and Vishny, 2011; Hortaçsu et al., 2013). 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 increased risk-taking in lending, accrue in the future. 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).

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 managements for manufacturers in distress.

We also contribute to the literature that studies car finance (Attanasio et al., 2008; 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 the work by Benmelech et al. (2017) who study the effect of the collapse of the assetbaked 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 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.[4]

We focus on loans originated between December 2013 and December 2017, which, given the previous requirement, means that we are considering the vast majority of loans securi-

[4]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.

tized during this period. In addition, we restrict our sample to all loans for which we have information on the interest rate, the maturity, the amount granted 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). For the main analysis, we apply the following filters. First, we restrict our sample to amortising 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, our sample is winsorized at 0.1 and 99.9 percent levels for the car value of each specific model and the following loan characteristics: interest rate, maturity, and size. Fourth, 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.[5] Fifth, we discard motorbikes, caravans, trucks and those car models that appear less than 100 times. Sixth, we exclude from our sample brands of manufacturer without a captive lender in the group.[6] Seventh, we restrict our sample to loans with a LTV above 10% at origination. Finally, for the large part of our analysis we focus on used cars because 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 whereas this fraction is 41% for the used cars).

Our final sample consists of about 1.2 million car loans granted by banks (Banco Santander, Bank Deutsches Kraftfahrzeuggewerbe, Bank 11, BNP Paribas, Socram Banque) and captive lenders (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.[7] These loans are part of the pool of 37 securitizations

[5]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.

[6]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.

[7]Note that within each group there are different subsidiaries and branches that operate in different coun-

and are granted for the purchase of 25 different brands and 272 different models made by the manufacturers which are the parent firms of the previously enumerated captive lenders. 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 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

tries: 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.).

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 and E 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 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 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: 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 E: 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 loan amount is in euros; the loan-to-value is in percentage points. Panel B shows borrowers characteristics. Income is in 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 characteristics for the manufacturers. CDS is the credit default swap of the manufacturer; 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 E 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.

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

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 loan amount is in euros; the loan-to-value is in percentage points. Panel B shows borrowers characteristics. Income is in 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. *** denotes statistical significance at the 1% level.

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.[8] 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 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. BNP loans are more tilted toward French brands, such as Renault, Peugeot, Citroen, but none of them has a share greater than 30%. Santander loans are 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.[9] Most notably, we estimate the following empirical model:

[8] 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.

[9] 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 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.

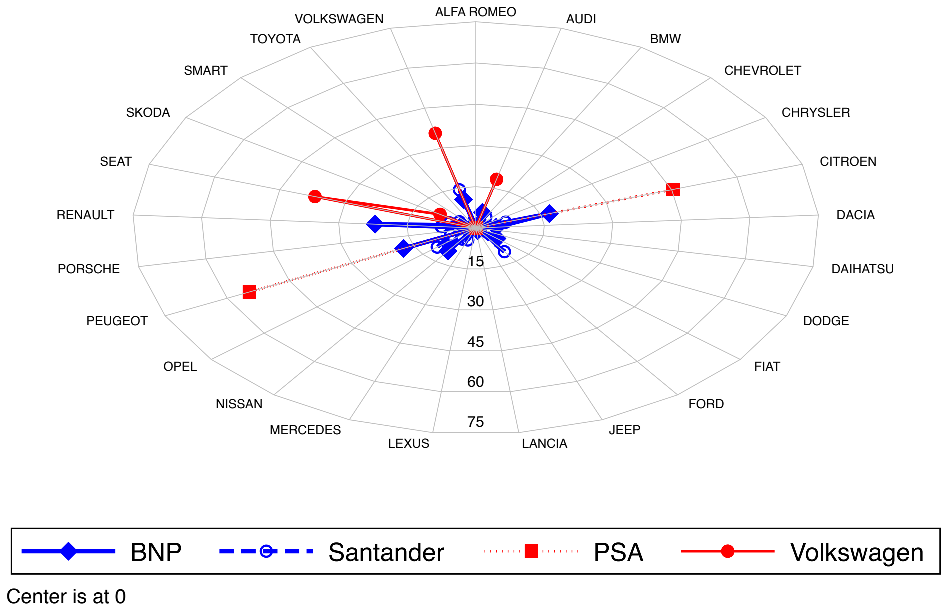

Figure 1: SPECIALIZATION BY BRANDS

Note: The figure shows the share of loans made by two captive and two diversified lenders for approximately 25 different brands. The captive lenders are PSA finance and Volskwagen Finance. The diversified lenders are Santander and BNP Paribas. 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).

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

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.

Table 3 shows the results.[10] The positive difference in rates between captive and banks

[10]Table A1 in Appendix ?? we show the result for new cars. We focus our main analysis on old cars because on new car our data have only a relatively small number of originations by diversified lenders. 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

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-squared	0.731	0.326	0.460	0.572	0.445
Adj. R-squared	0.659	0.147	0.317	0.459	0.297
Observations	906,085	906,085	906,085	906,085	906,085

Note: The Table shows the results from equation (1) on the sample of old cars. 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.

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.

Finally, in Appendix **??** we provide additional evidence on differences in loan terms by captive and banks exploiting an event study that change the status of a captive lender. In 2015 Santander (a standalone bank) acquired a large stake in PSA (a captive lender).[11] We

and need.

[11]The agreement between Santander and PSA affects 11 euro area countries including the four we use in our analysis (France: February 2015; Spain: October, 2015; Italy: January, 2016; Ger-

estimate a difference in difference specification using car loans originated by PSA, the treated captive lender, and by RCI, another French captive lenders as control:

$$y_{ilbmt} = \alpha RCI_l \times Post_{mt} + \theta X_{ilt} + \gamma_b + \gamma_{mt} + \epsilon_{ilbmt}, \tag{2}$$

where RCI_l is a dummy equal to one for RCI and $Post_{mt}$ is a dummy equal to one after the acquisition; γ_b are brand-model fixed effects; γ_{mt} are market-time fixed effects; and all other variables are as in equation (1).[12]

The coefficient of interest is α which captures the difference in loan terms of a loan issued in the same market at the same time to similar borrowers by a captive lender relative to another captive lenders which is now partially controlled by a standalone bank. Table A2 in Appendix **??** reports the results. We find that after the acquisition by Santander PSA decreases rates and increases maturity and loan-to-value, thus behaving more like a standalone bank relative to RCI, which fully maintain its captive lender status.

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.

many: July, 2016). See Santander annual reports in 2015 and 2016 for more details about the operations (https://www.santanderconsumer.com/wp-content/uploads/2018/05/Annual-Report-2015.pdf and https://www.santanderconsumer.com/wp-content/uploads/2018/06/Annual-Report-2016.pdf).

[12] Notice that in this specification we cannot have interacted brand-model, market and time fixed effects, because we are only using variation within captive lenders which are specialized in different brands. Additionally we allow the $Post_{mt}$ variable to vary before and after the acquisition differentially across the four countries using the dates reported in footnote 11.

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). 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 and fire sales (adjustment in the initial price of the car).[13]

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.[14] Furthermore, the captive lending unit can adjust the approval rate for potential buyers seeking financing for the purchase of the car.[15]

Our baseline empirical model is given by:

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

where y_{ilbmt} is outcome of interest y (e.g., interest rate, maturity, lending standards) for

[13] 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.

[14] 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.

[15] In Section **??** we sketch a simple model to explore this important dimension.

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; $Captive_l$ 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 (3) car-model $\times$ geographical market $\times$ month fixed-effects to capture for several factors that can affect loan terms and lending standards. Additionally, equation (3) 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 identify of the car loan provider (captive VS standalone) for identification.[16]

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

[16]Note that the use of lender fixed effects captures not only time-invariant differences between captive and standaloe lenders, but also time-invariant differences across captive lenders of different manufacturers (and across different standalone lenders). Also, the car-model $\times$ geographical market $\times$ month fixed-effects absorb the direct effect of manufacturers CDS on loan terms and lending standards.

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-squared	0.780	0.334	0.470	0.586	0.464
Adj. R-squared	0.721	0.157	0.329	0.476	0.321
Observations	906,085	906,085	906,085	906,085	906,085

Note: The Table shows the results from equation (3) on the sample of old cars. 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.

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.[17]

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

[17]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.

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-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 (3) 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.[18] 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.

Column (3) 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

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

Table 5: Distress and captive lending: Risk-taking

	Ex-ante			Ex-post: arrears	
	Income (log)	Other employment (dummy)	Income verified (dummy)	<75% time to maturity (dummy)	>75% time to maturity (dummy)
Manuf. CDS × Captive Lender	-0.008	0.021***	-0.053***	-0.010	0.024***
	[0.005]	[0.005]	[0.013]	[0.006]	[0.006]
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	NO	NO	YES	YES	YES
Avg Dep Var	10.058	.188	.615	.048	.056
R-squared	0.478	0.330	0.887	0.310	0.346
Adj. R-squared	0.339	0.152	0.856	0.100	0.113
Observations	906,085	906,085	906,085	637,651	197,699

Note: The Table shows the results from equation (3) on the sample of old cars. 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. Each column corresponds to different subsamples of loans with a remaining time to maturity of less than 75% of maturity at origination 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.

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. We look at arrears for different fraction of time to maturity. We find that loans originated by captive lenders when the car manufactures CDS are higher are more likely to experience future arrears. Up to loan to maturities of 75% the effects are not significant, but the effect become significant in the last part of the loan time to maturity.[19] Our basic specification indicates that loans originated by captive when manufacturer'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 a 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 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.

[19] Agarwal et al. (2008) study a large pool of US direct car loans with a competing risks model of auto loan termination through default and prepayment and find that account seasoning (time since loan origination) increases the probability of default.

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.

To understand the importance of liquidity creation when manufacturers experience financial distress we construct two measures of liquidity needs for car manufacturers. The idea is that 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 (3), separating the full sample into two subgroups based on the manufacturers' liquidity needs.

First, we compute this measure for each manufacturers 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 need, 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 (3) 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 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 only the CDS is high but liquidity needs are low

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-squared	0.768	0.364	0.472	0.600	0.464	0.442	0.319	0.836	0.420
Adj. R-squared	0.704	0.189	0.326	0.490	0.316	0.288	0.131	0.790	0.184
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-squared	0.785	0.324	0.461	0.580	0.462	0.486	0.334	0.904	0.337
Adj. R-squared	0.729	0.147	0.321	0.470	0.321	0.351	0.160	0.878	0.106
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 (3) on the sample of old cars. 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, two dummy variables denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and an indicator of whether loan has been ever in arrears. 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.

the increase in arrears is less than 2 percentage points.

Table A3 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 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, relative to the case with low liquidity needs. The significance and point estimates with respect to the share of income verification are similar in the case of high and low liquidity needs.

To summarize, our additional 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

In Appendix A we report the results of additional analyses and robustness checks. 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 (3) controlling within each brand-model for quartiles of the car value. Table A5 shows the estimates. All our results are similar in both significance and magnitude.

Second, we look at the number of loans originated. One concern is that by raising rates and increasing the down payment requirement the manufacturer in distress may loose volumes. For each market-time we count the number of loans included in the securitizations originated by each lender for each brand-model. We then regress the logarithm of this variable on the manufacturing CDS interacted with a dummy for captive lenders. Table A4 shows the estimates. 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 the quantification exercise of Section 5.2.

Third, another possible effect of changing loan terms and extending loans to riskier borrowers is their impact on the financing cost for the captive lender itself. If the information on the pool of borrowers is priced in by investors the securitization may become more or less costly depending on the net effect of changing in loans terms relative to changes in the quality of borrowers. First, it is worth mentioning that the average age of the loan is about 15 months when it is securitized.[20] Given such a long lag, lenders may not internalize the impact on the cost of the securitization of loans originated today.[21] However, even if the price of the securitization is not available, we explore this possibility by looking at the coupon payment of the different tranches of the securitizations in our sample. Table A6 shows the estimates.[22] As expected securitization with longer maturity are more expensive. We also find that securitization with a larger principal are less expensive, but the effect is small in magnitude. We do not find differences for tranches issued by captive lenders or differential effect of financial distress on tranches issued by captive lenders. We also include in the specification the average characteristics of the borrowers and loan terms of the car loans included but the coefficients (unreported) turn out not to be significant.

[20]A seasoning of about 15 months is in line with securitization of car loans in US and Canada (see for example: https://www.spratings.com/documents/20184/0/Securitized+Term+Auto+Receivables+Trust+2019-1.pdf/3e39fe54-adf1-68d2-d008-1536d611d72a).

[21]We also run a regression of the lag in months from origination to securitization and find that when manufacturer CDS are high, loans originated by their captive unit tend to be securitized later.

[22]The total number of securitization is 37 and there are on average about 2 tranches for each securitization.

Fourth, while our identification strategy relies on differential changes between captive and traditional lenders, we study in our setting the response of standalone lenders to distress, measured by their CDSs. We estimate the following empirical model:

$$y_{ilbmt} = \alpha LenderCDS_{lt} + \theta X_{ilt} + \gamma_l + \gamma_{bmt} + \epsilon_{ilbmt}, \tag{4}$$

where $LenderCDS_{lt}$ is the CDS for standalone lender l; and all other variables are as in equation (3). Table A7 shows the results. When CDS of standalone lenders are higher, we find that lenders increase rates, but the results are not significant and small in magnitude. Perhaps surprisingly we find that lenders increase maturity, while the increase in the loan-to-value is not significant. In terms of risk taking, standalone lenders originate car loans to lower income borrower, but they decrease loan originations to ex-ante riskier categories, such as unemployed and self-employed borrowers. Overall, borrowers obtaining a car loan from a standalone lender in distress are ex-post significantly less likely to default.

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 A2 in Appendix A2 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 quadruple 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.

We provide two complementary strategies to identify the role of captive lenders as liquidity providers when the parent manufacturer experience financial distress. Our first and 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 bonds maturing in the three months after the event (i.e. September to November 2015). 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.[23]

Thus we estimate a difference-in-difference empirical model separately for the high liquidity needs (treated) and low liquidity needs (control) manufacturers:[24]

$$y_{ilbmt} = \alpha Post_t \times Captive_l + \theta X_{ilt} + \gamma_l + \gamma_{bmt} + \epsilon_{ilbmt}, \tag{5}$$

[23]Also in levels the two groups experience a similar change. The average change in the CDS for those manufacturers with high liquidity needs (109 basis points) is not significantly different to that observed in the average CDS of manufacturers with low liquidity needs (102 basis points).

[24]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.

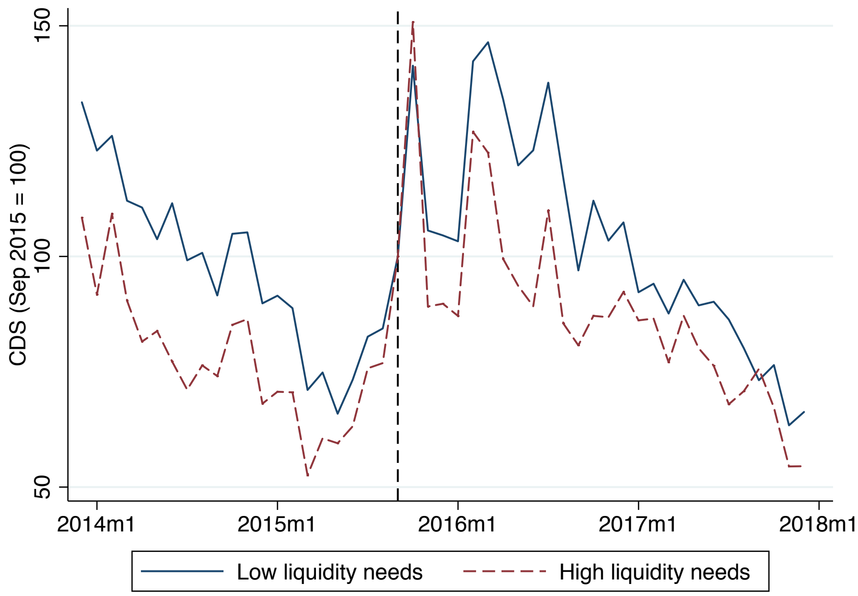

Figure 2: Volkswagen Emissions Scandal: CDS high and low liquidity manufacturers

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 value are normalized to 100 in September 2015.

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 7 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. High-liquidity-need manufacturers increase loan rates relative to standalone lenders by more than 35 basis points, decrease maturity by almost 8%, loan-to-values by more than 2 percentage points and 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 an 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.

Our additional test also exploits time-series variation in CDS coming from the Volkswagen emissions scandal. However, the cross-section variation is now coming from the "captiveness" of captive lenders. Most notably, we exploit the fact that in February 2015 Santander (a standalone bank) acquired a large stake in PSA in France (a captive lender). As we have discussed in Section 2, after the takeover by Santander, PSA behave relatively more like a standalone bank than RCI, which is the other main captive lender in France. Controlling for time invariant difference between the two captive lenders, we now test if they also react differently to similar changes in CDS. Figure A3 in Appendix A shows that indeed the two car manufacturers experience very similar changes in CDS after the emissions scandal.

We estimate the following difference-in-difference specification:

$$y_{ilbmt} = \alpha Post_t \times RCI_l + \theta X_{ilt} + \gamma_b + \gamma_{mt} + \epsilon_{ilbmt}, \tag{6}$$

where RCI_l is a dummy equal to one for RCI and $Post_t$ is a dummy equal to one after the Volkswagen emissions scandal; γ_b are brand-model fixed effects; γ_{mt} are market-time fixed

Table 7: Credit fire sales during the VW emission scandal

	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									
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-squared	0.799	0.302	0.413	0.551	0.377	0.473	0.255	1.000	0.296
Adj. R-squared	0.754	0.144	0.280	0.450	0.237	0.354	0.087	1	0.049
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-squared	0.726	0.334	0.494	0.582	0.462	0.461	0.275	0.761	0.400
Adj. R-squared	0.651	0.151	0.356	0.467	0.314	0.313	0.076	0.696	0.086
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 (5) on the sample of old cars using a sample period of two months before and two months after the month of the Volkswagen Emission Scandal. 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, two dummy variables denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and an indicator of whether loan has been ever in arrears. 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.

effects; and all other variables are as in equation (5).[25] The coefficient of interest is α which captures the differential changes on loan terms and lending standards by RCI relative to PSA after the outbreak of the scandal.

Table A8 in Appendix A shows the coefficients for RCI (the relative more captive lender) in the aftermath of the Volkswagen emissions scandal. We find that RCI increases rates by significantly more than PSA despite the two manufacturers experiences similar changes in CDS. The economic magnitude is also large. RCA increases rates by 24 basis points more than PSA after the Volkswagen emissions scandal. We do not find significant differences in relative maturity adjustment, but we find that RCA lower the loan-to-value by about 2 percentage points, which is driven by a decline by approximately 5% of the loan balance. In terms of risk-taking we find that RCI decreases the share of originations with verified income after the Volkswagen emissions scandal relative to PSA.

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 borrowing

[25]Notice that in this specification we cannot have interacted brand-model, market and time fixed effects, because we are only using variation within captive lenders which are specialized in different brands.

measured by loan-to-value and loan amount, and in their ex-post arrears. Table 8 shows the results using maturing bonds as a measure of liquidity needs, while Table A9 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 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. 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 8 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.

Table 8: Effects of Loan Fire Sales on Car Buyers

	Loan Size (log)		LTV (%)		Arrears (dummy)	
	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***	-0.015	0.109***
	[0.014]	[0.028]	[0.659]	[0.835]	[0.026]	[0.039]
Avg Dep Var	8.975	8.822	68.850	68.129	.033	.051
R-squared	0.537	0.462	0.525	0.505	0.468	0.479
Adj. R-squared	0.356	0.266	0.340	0.325	0.171	0.224
Observations	96,022	96,411	96,022	96,411	7,629	10,593
Panel B: Low manuf. liquidity need						
Manuf. CDS × Captive Lender	-0.011	-0.021**	-0.532	-0.642	0.015*	0.012
	[0.010]	[0.010]	[0.445]	[0.466]	[0.008]	[0.011]
Avg Dep Var	9.040	8.850	73.599	74.870	.041	.076
R-squared	0.529	0.449	0.503	0.506	0.376	0.373
Adj. R-squared	0.354	0.262	0.318	0.337	0.086	0.110
Observations	308,251	296,295	308,251	296,295	72,679	73,915
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	YES	YES	YES	YES	YES	YES

Note: The Table shows the results from equation (3) on the sample of old cars. 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 month. The dependent variables are loan size in log, loan-to-value in percentage points and an indicator of whether the loan has been ever in arrears. 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.

5.2 Implications for Traditional Fire Sales

5.2.1 A Simple Model 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 manufacturer, 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 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:

$$\Pi_j(p_1, ..., p_N) = (p_j - \kappa)D_j(p_1, ..., p_N) - K, \tag{7}$$

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:

$$Pr(b_{ij} \geq max_{k \neq j} b_{ik}) = \int \prod_{k \neq j} \left[F(p_k - pj + v) \right] f(v) dv. \quad (8)$$

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 $\bar{i}$.[26]

Lenders observe a signal about borrowers' type that is draw 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:

$$\pi_b(s_b) = P(L|s)(i - r) + (1 - P(L|s))(d - r) - c, \quad (9)$$

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

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

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 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 (9):

$$i(s) = \frac{(r+c) - (1 - P(L|s))d}{P(L|s)}. \tag{10}$$

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 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 (9) to zero at the maximum interest rate $\bar{i}$:

$$P(L|\bar{s}_b) = \frac{c + r - d}{\bar{i} - d}. \tag{11}$$

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:

$$\overbrace{(p - \kappa)}^{\text{Profits from sales}} \quad + l \overbrace{\left[P(L|s)(\bar{i} - r) + (1 - P(L|s))(d - r) - c\right]}^{\text{Per dollar financing profits: } \pi_j(s_j)}. \tag{12}$$

Setting equation (12) equal to zero at the maximum interest rate $\bar{i}$, gives the optimal cutoff signal for the captive lender:

$$P(L|\bar{s}_j) = \frac{c + r - d - \frac{p-\kappa}{l}}{\bar{i} - d} \tag{13}$$

Note that $P(L|\bar{s}_j) < P(L|\bar{s}_b)$, where the latter is given by equation (11). 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:

$$(1-\alpha)\overbrace{\left[\gamma(1-G_L(\bar{s}_b))+(1-\gamma)(1-G_H(\bar{s}_b))\right]}^{A(\bar{s}_b):\text{ Approval rate standalone lender}}+\alpha\overbrace{\left[\gamma(1-G_L(\bar{s}_j))+(1-\gamma)(1-G_H(\bar{s}_j))\right]}^{A(\bar{s}_b):\text{ Approval rate captive lender}}, \tag{14}$$

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:

$$\Pi(s_j)=\overbrace{\frac{M}{N}\left[(1-\alpha)A(\bar{s}_b)+\alpha A(\bar{s}_j)\right](p-\kappa)}^{\text{Total profits from sale}}+\alpha\overbrace{\frac{M}{N}(A(\bar{s}_j)-A(\bar{s}_b))(l\pi_j(\bar{s}_j))}^{\text{Losses from financing risky consumers}}-K=0. \tag{15}$$

The equilibrium number of lender N is obtained by setting total profit given by equation (15) equal to zero:

$$N=\frac{\left[(1-\alpha)A(\bar{s}_b)+\alpha A(\bar{s}_j)\right]M(p-\kappa)}{K}+\frac{\alpha M(A(\bar{s}_j)-A(\bar{s}_b))(l\pi_j(\bar{s}_j))}{K}. \tag{16}$$

Finally, under the Bertrand-Nash assumption that each manufacturer chooses price to maximize its expected profits, the FOC from equation (15) is:

$$p=\kappa+\frac{1}{N(N-1)\int\left[F(v)\right]^{N-2}f(v)^2dv}+\frac{\frac{\alpha(A(\bar{s}_j)-A(\bar{s}_b))}{\alpha A(\bar{s}_j)+(1-\alpha)A(\bar{s}_b)}\pi_j(\bar{s}_j)}{N(N-1)\int\left[F(v)\right]^{N-2}f(v)^2dv}, \tag{17}$$

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 VS Traditional 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 A10 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, the number of manufacturers and the average loan rate. We over-predict arrears, which are in the model higher on average than in the data. However, our model generates 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 accepted 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.[27]

Table 9 shows the results for several variables of interest.[28] Notice that the number of manufacturers and the price of the car exhibit only small variation across different scenarios,

[27]The optimal cutoff signal for the captive lender is obtained by setting the joint profits given by equation (12) equal to $\tau < 0$. In the calibration we set $\tau = -25$.

[28]Table A11 in Appendix B shows the same variables for a calibration with a higher fraction of safe borrowers (90% rather than 80%).

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 8.5% of them end up in arrears.

First, we compare the baseline scenario to the case without captive lenders. Captive lenders have and approval rate of about 93%, or about 22 percentage points higher than standalone lenders. The key intuition is that the captive lenders internalize the profit from the sell of the car by the parent manufacturing company. As a result of the higher approval rate, captive lenders experience higher average default rates at about 15%. The average loss for the defaulting high risky loans is however small given the low loan-to-value. The higher approval rate lead to almost 4.5 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 3.2 (Goldberg, 1995; Goldberg and Verboven, 2001). 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:

Table 9: Substitution of credit fire sales with car fire sales

	No captive lenders	Baseline	High liquidity need	High liquidity need + losses
Panel A: Car market				
Car price (euros)	13,179	13,161	13,161	13,161
Number of manufacturers	5.6	6.2	6.2	6.2
Panel B: Loan Market				
Approved Buyers	25,075	29,441	29,476	29,643
Traditional Banks				
Fraction approved (%)	71.6	71.6	71.6	71.6
Number approved	25,075	10,532	10,532	10,532
Fraction default (%)	8.58	8.58	8.58	8.58
Captive lenders				
Fraction approved (%)		93,2	93.3	94.1
Number approved		18,909	18,944	19,111
Fraction default (%)		15.84	15.93	16.36
Average loss on high-risk loan (euros)		95	92	95
Panel C: Credit fire sales				
Δ approval rate captive - traditional		21.50	21.68	22.50
Extensive margin		4,365	4,400	4,567
Liquidity creation (M euros)		3.24	4.07	4.20
Marginal borrowers (M euros)		3.24	3.45	3.59
Inframarginal borrowers (M euros)		0.00	0.62	0.62
Car fire sale equivalent (euros)		-533	-669	-688
Car fire sale equivalent (% car price)		4.05	5.08	5.23

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 A10. 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 A10, 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. Finally, 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.

$$\overbrace{\Delta p \times \frac{M}{N}\left[(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)(1-\theta)\right]}^{\Delta p \times q\text{: Losses from inframarginal buyers}} \overbrace{-\epsilon \times \Delta p \times \frac{M}{N}\left[(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)(1-\theta)\right]}^{\Delta q \times p\text{: Gains from marginal buyers}}, \tag{18}$$

where the second term is obtained by inverting the formula for the demand elasticity; $\frac{M}{N}(1-\alpha)A(\bar{s}_b)$ is the demand financed by standalone lenders; 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 needed to generate the same amount of liquidity that is obtained through a loan fire sale can be calculated by setting (18) equal to the amount of liquidity and solving for Δp, as follows:

$$\Delta p = \frac{\text{Liquidity from credit fire sale}}{(1-\epsilon) \times \frac{M}{N}\left[(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)(1-\theta)\right]}. \tag{19}$$

Table 9 shows that the price of the car would have to decrease by about €500 to generate the same liquidity that captive lenders generate only via lending to marginally riskier borrower. This decline in price is equivalent to approximately 4% of the equilibrium car value.

The third column of Table 9 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 €95 to €92. 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 €620 thousands from borrowers financed by the captive unit, that would have been also approved by standalone lenders. 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 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 €660, or about 5% of its value.

Finally, the last column of Table 9 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 additional 200 risky borrowers. As a result the default rate is slightly higher, but the average losses are the same as in the baseline at €95. 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 about €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 €700, or about 5.2% of its 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 discuss how our mechanism has new implications for the transmission of shocks to durable consumption and household leverage, and how it compares to traditional fire sales.

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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: Captive Lenders VS Standalone Banks: New Cars

	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)
Captive Lender	1.962***	-0.246***	-11.360***	-0.070***	-0.277***
	[0.122]	[0.024]	[2.819]	[0.023]	[0.044]
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	7.106	3.884	68.337	9.69	9.21
R-squared	0.818	0.335	0.481	0.760	0.450
Adj. R-squared	0.789	0.229	0.399	0.722	0.362
Observations	1,257,034	1,257,034	1,257,034	1,257,034	1,257,034

Note: The Table shows the results from equation (1) on the sample of new cars. 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 A2: SANTANDER ACQUISITION OF PSA

	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)
Post × RCI	0.998***	-0.020**	-4.318***	0.016*	-0.111***
	[0.080]	[0.009]	[0.506]	[0.009]	[0.007]
BrandModel FE	YES	YES	YES	YES	YES
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	7.46	3.808	54.534	9.470	8.668
R-squared	0.467	0.208	0.233	0.496	0.224
Adj. R-squared	0.449	0.181	0.208	0.479	0.199
Observations	33,528	33,528	33,528	33,528	33,528

Note: The Table shows the results from equation (2) on the sample of old cars using a sample period of two months before and two months after the acquisition of the PSA subsidiary or branch in each specific country by Banco Santander. 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. Post is a dummy equal to one after the acquisition of the PSA subsidiary or branch operating in each specific country by Santander. RCI is a dummy for Renault group. 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 A3: Liquidity Channel: Credit lines usage

	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	0.215***	-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-squared	0.785	0.340	0.479	0.606	0.486	0.475	0.338	0.853	0.344
Adj. R-squared	0.726	0.159	0.336	0.498	0.345	0.331	0.156	0.813	0.115
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-squared	0.771	0.330	0.461	0.571	0.447	0.478	0.325	0.910	0.346
Adj. R-squared	0.711	0.156	0.321	0.460	0.304	0.342	0.150	0.887	0.110
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 (3) on the sample of old cars. 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, two dummy variables denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and an indicator of whether loan has been ever in arrears. 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 A4: Quantity results

	All cars	Old cars	Old cars by income		Old cars by segment			
			Low	High	A	B	C	D
Manuf. CDS × Captive Lender	-0.001	-0.006	-0.010	0.004	-0.018	0.016	-0.014	0.008
	[0.049]	[0.004]	[0.341]	[0.008]	[0.012]	[0.023]	[0.012]	[0.009]
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
Adj. R-squared	0.341	0.291	0.316	0.249	0.348	0.351	0.226	0.275
Observations	2,267,009	2,267,009	2,267,009	2,267,009	526,927	309,281	777,995	652,806

Note: The dependent variable is the logarithm of the number of cars financed in each market-time for each brand-model. 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 and in column (1) also the type of car (old vs new), 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: 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
Car value bins	YES	YES	YES	YES	YES	YES	YES	YES	YES
Avg Dep Var	6.177	3.868	72.795	9.372	8.94	10.058	.188	.618	.056
R-squared	0.814	0.448	0.564	0.886	0.601	0.545	0.415	0.904	0.416
Adj. R-squared	0.731	0.201	0.369	0.836	0.424	0.343	0.155	0.861	0.101
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 (3) on the sample of old cars. 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, 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 A6: Securitization cost

	All tranches					Equity tranche				
Log(Bond tranche maturity)	0.014***	0.015***	0.012***	0.015***	0.012*	0.016***	0.017**	0.016*	0.024**	0.017
	[0.002]	[0.003]	[0.004]	[0.004]	[0.007]	[0.004]	[0.007]	[0.009]	[0.011]	[0.017]
Log(Bond tranche principal)	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.004**	-0.003*	-0.003	-0.003	-0.004
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]
Captive Lender		0.000	0.008	0.010	-0.010		0.002	0.012	0.014	-0.002
		[0.003]	[0.007]	[0.008]	[0.022]		[0.005]	[0.014]	[0.015]	[0.053]
Lender CDS			0.876*	0.753	-1.169			0.953	0.570	-1.075
			[0.507]	[0.536]	[1.738]			[0.985]	[1.074]	[4.115]
Lender CDS x Captive Lender			-0.697	-0.600	1.306			-0.912	-0.421	1.107
			[0.529]	[0.563]	[1.852]			[1.028]	[1.131]	[4.468]
Average Security Controls	NO	NO	NO	YES	YES	NO	NO	NO	YES	YES
YearMonth FE	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Avg Dep Var	.01	.01	.01	.01	.01	.015	.015	.015	.015	.015
R-squared	0.297	0.297	0.333	0.365	0.549	0.188	0.191	0.208	0.276	0.647
Adj. R-squared	0.280	0.272	0.291	0.290	0.401	0.140	0.117	0.0764	0.0254	0.118
Observations	87	87	86	86	86	37	37	36	36	36

Note: The dependent variable is the coupon rate of the securitization tranche. Bond tranche maturity and principal are the maturity and principal on the tranche of the security. Captive is a dummy equal to one if the lender originating the loan is a captive lender. Lender CDS is the CDS of the lender. Average loan controls refer to the average of the following characteristics of the pool of loans that form the securitization: LTV, interest rate and employment status. YearMonth FE denote the use of time (i.e. year-month) fixed effects. In the first set of columns we consider all the tranches of each securitization, whereas in the second set of columns we only consider the equity tranche. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A7: Standalone Lender

	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Lender CDS	0.042	0.048***	1.024	0.024**	0.038*	-0.064***	-0.091***	0.000	-0.095***
	[0.070]	[0.009]	[0.789]	[0.012]	[0.020]	[0.015]	[0.014]	[0.000]	[0.021]
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
Avg Dep Var	5.261	3.958	85.125	9.294	9.074	10.295	.203	1	.062
R-squared	0.645	0.111	0.133	0.438	0.280	0.356	0.175	0.042	0.280
Adj. R-squared	0.633	0.0805	0.104	0.419	0.256	0.334	0.147	0.009	0.191
Observations	321,281	321,281	321,281	321,281	321,281	321,281	321,281	321,281	45,544

Note: The Table shows the results from equation (4) on the sample of old cars financed by standalone lenders. 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, two dummy variables denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and an indicator of whether loan has been ever in arrears. Lender CDS is the CDS of the lender financing the car. 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 A8: Liquidity Channel during the VW emission scandal: PSA-Santander VS RCA

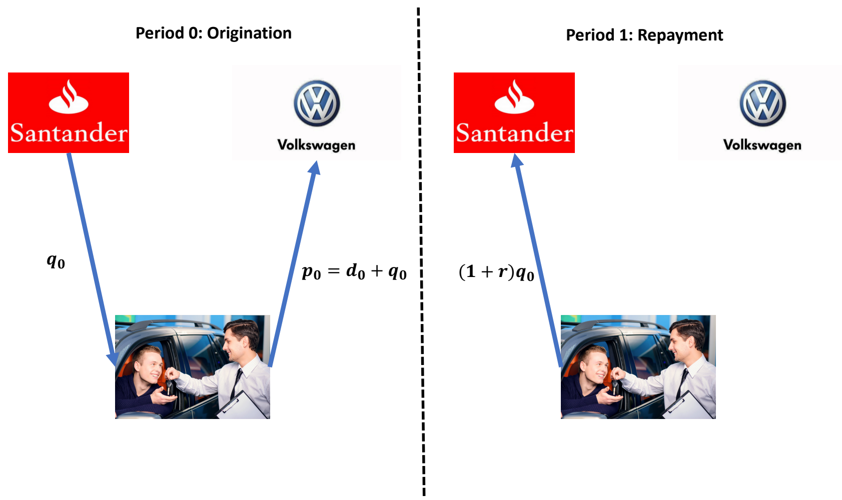
	Loan Terms					Lending standards			
	Rate (%)	Maturity (log)	LTV (%)	Car value (log)	Loan Size (log)	Income (log)	Other employment (dummy)	Income verified (dummy)	Arrears (dummy)
Post × RCI	0.239***	-0.017	-1.965**	-0.002	-0.052***	0.002	-0.015	-0.058***	0.003
	[0.076]	[0.012]	[0.941]	[0.005]	[0.018]	[0.013]	[0.010]	[0.004]	[0.013]
BrandModel FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
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
Avg Dep Var	7.291	3.764	52.423	9.495	8.625	9.759	.142	.177	.018
R-squared	0.361	0.197	0.179	0.472	0.189	0.125	0.145	0.412	0.081
Adj. R-squared	0.349	0.182	0.164	0.463	0.174	0.109	0.130	0.401	0.0325
Observations	25,675	25,675	25,675	25,675	25,675	25,675	25,675	25,675	8,768

Note: The Table shows the results from equation (6) on the sample of old cars sold in France and using a sample period of two months before and two months after the month of the Volkswagen Emission Scandal. We focus on France because the takeover of PSA by Banco Santander in other countries occurred after the Volkswagen emissions scandal. 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, two dummy variables denoting the employment situation (student, pensioner, unemployed or self-employed), a dummy variable denoting if the income is verified and an indicator of whether loan has been ever in arrears. Post is a dummy equal to one after the Volkswagen Emission Scandal. RCI is a dummy for Renault group. 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.

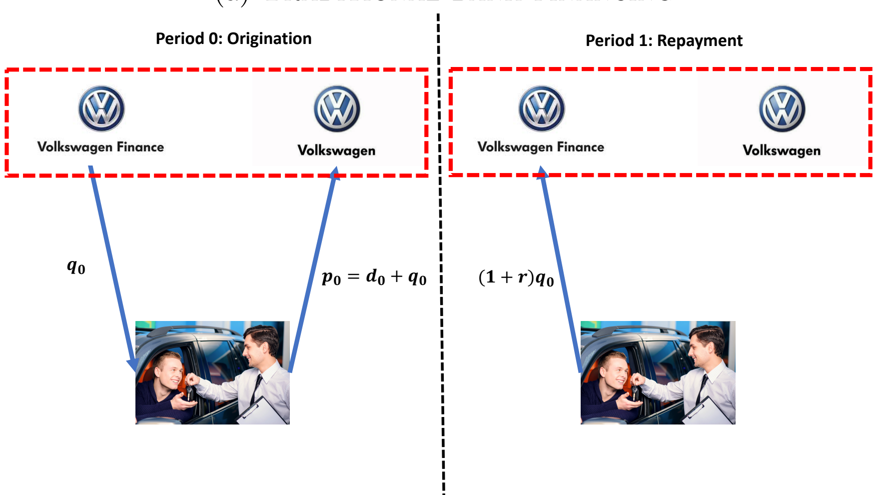
Table A9: Effects of Loan Fire Sales on Borrowers (Robustness)

	Loan Size (log)		LTV (%)		Arrears (dummy)	
	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***	0.004	0.047***
	[0.015]	[0.012]	[0.609]	[0.553]	[0.016]	[0.018]
Avg Dep Var	9.003	8.852	70.063	71.629	.044	.081
R-squared	0.552	0.485	0.529	0.514	0.372	0.379
Adj. R-squared	0.380	0.300	0.348	0.340	0.084	0.120
Observations	169,909	161,546	169,909	161,546	35,855	37,651
Panel B: Low manuf. liquidity need						
Manuf. CDS × Captive Lender	0.015	-0.019	-0.145	-0.980	0.018**	0.006
	[0.012]	[0.014]	[0.565]	[0.661]	[0.009]	[0.017]
Avg Dep Var	9.043	8.837	74.387	74.309	.037	.065
R-squared	0.519	0.431	0.501	0.507	0.395	0.384
Adj. R-squared	0.340	0.238	0.315	0.340	0.100	0.116
Observations	235,718	232,022	235,718	232,022	44,453	46,857
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	YES	YES	YES	YES	YES	YES

Note: The Table shows the results from equation (3) on the sample of old cars. 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 month. The dependent variables are loan size in log, loan-to-value in percentage points and an indicator of whether the loan has been ever in arrears. 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.



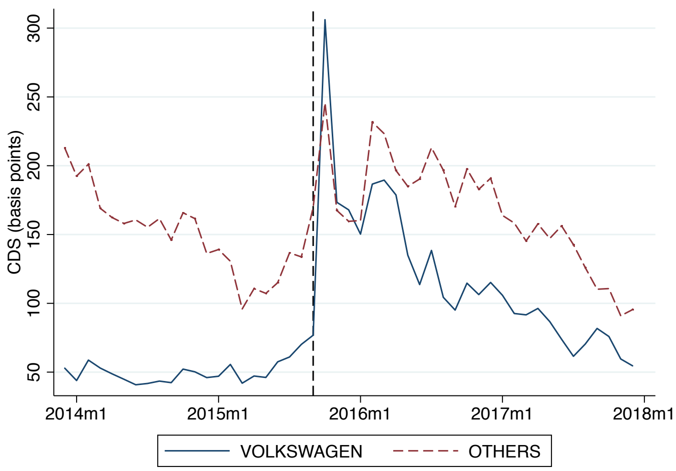
(a) Traditional bank financing



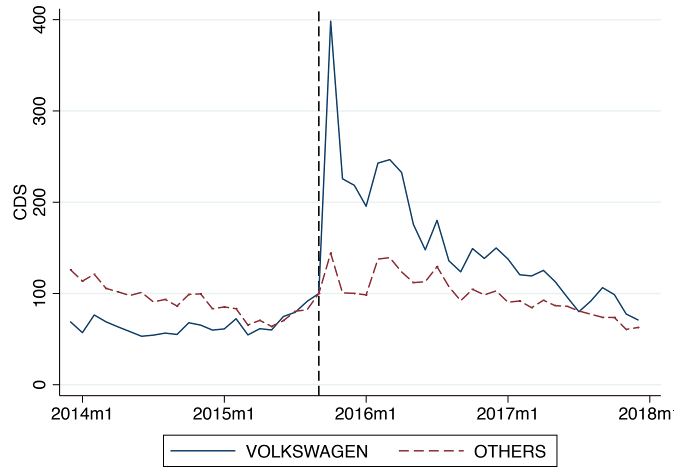
(b) Captive financing

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 LEVEL



(b) CDS NORMALIZED

Figure A2: 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 value are in basis points in panel (a) and normalized to 100 in September 2015 in panel (b).

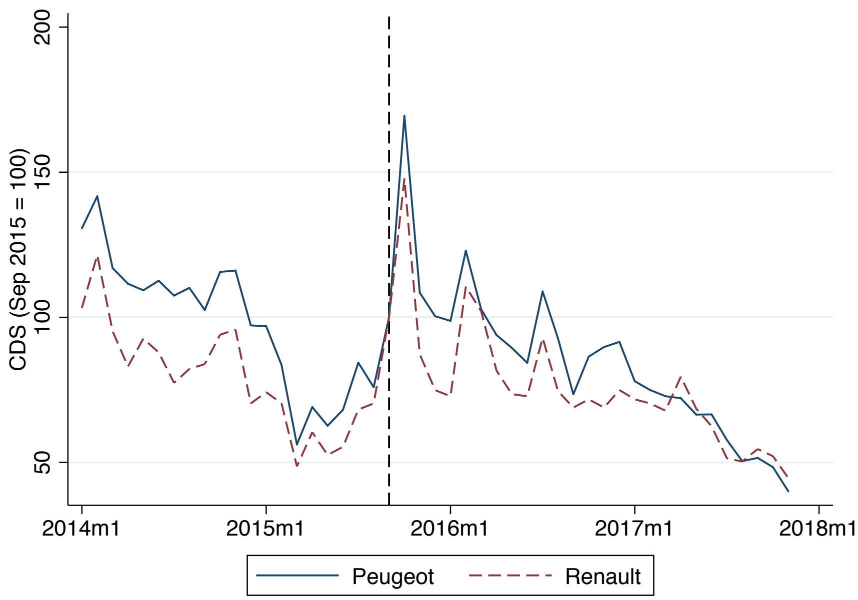


Figure A3: Volkswagen Emissions Scandal: CDS Peogeot and Renault

Note: The figure shows the CDS for two French car manufactures (Peugeot and Renault). The figures plots the monthly averages of daily CDS from December 2013 to December 2017. The CDS value are normalized to 100 in September 2015.

B Additional derivations for the model

In this Appendix we discuss the solutions of the model presented in Section **??** 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 (8), we can compute demand for manufacturer j as follow:

$$D_j(p_1, ..., p_N) = M \int \left[F(p - p_j + v)\right]^{N-1} f(v)dv. \tag{20}$$

Under the Bertrand-Nash assumption that each supplier chooses price to maximize its expected profits, then the FOC from (7) is:

$$p_j = \kappa - \frac{D_j(p_1, ..., p_N)}{\frac{\partial D_j(p_1,...,p_N)}{\partial p_j}}. \tag{21}$$

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 (21) with (20) and using the symmetric equilibrium assumption, we get the optimal price:

$$p = \kappa + \frac{M \int \left[F(v)\right]^{N-1} f(v)dv}{(N-1)M \int \left[F(v)\right]^{N-2} f(v)^2 dv} = \kappa + \frac{1}{N(N-1) \int \left[F(v)\right]^{N-2} f(v)^2 dv}, \tag{22}$$

and the number of manufacturers is given by the zero profits conditions (7):

$$\frac{M}{N}(p - \kappa) - K = 0 \;\rightarrow\; N^* = \frac{M(p-k)}{K}. \tag{23}$$

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 (11). The approval rate by standalone banks is then given by:

$$A(\bar{s}_b) = \gamma(1 - G_L(\bar{s}_b)) + (1 - \gamma)(1 - G_H(\bar{s}_b)). \tag{24}$$

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:

$$A(\bar{s}_b)\frac{M}{N}(p - \kappa) - K = 0 \;\rightarrow\; N = \frac{A(\bar{s}_b)M(p - k)}{K}. \tag{25}$$

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 (22) with the new number of manufacturers from equation (25).

Calibration and robustness. Table A10 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.[29]

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

[29] 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.

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. Additionally, we perform two calibration varying the fraction of safe borrowers.

Table A10: Calibration

	Variables	Data	Model	
			Low risk = 90%	Low risk = 80%
Panel A: Parameters observed in the data				
Proportion of borrowers going to captive	α	0.58	0.58	0.58
Maximum loan rate	$\bar{i}$	0.13	0.13	0.13
Loan-to-value (captive)	θ	0.65	0.65	0.65
Panel B: Parameters calibrated				
Marginal cost of producing car	κ		13,000	13,000
Fixed cost of producing car	K		800,000	800,000
Potential Buyers	M		35,000	35,000
Support for uniform density function of car valuation	$f(v)$		15,000-16,000	15,000-16,000
Proportion of low risk borrowers	γ		0.90	0.80
Mean of signal for low and high risk borrowers	μ_L, μ_H		-1,1	-1,1
Variance of signal	σ^2		2	2
Cost of funds	r		0.06	0.06
Net collection rate upon default (standalone-captive)	d		0.01-0.02	0.01-0.02
Cost of processing loan (standalone-captive)	c		0.04-0.02	0.04-0.02
Panel C: Comparison data - model				
Car value	p	13,000	13,154	13,161
Number of car manufacturers	N	9	7	6
Loan rate	i	0.06	0.08	0.08
Arrears rate standalone	$\delta(s_b)$	0.04	0.06	0.09
Arrears rate captive	$\delta(s_j)$	0.05	0.09	0.16
Approved buyers (monthly)	$(1-\alpha)A(\bar{s}_b) + \alpha A(\bar{s}_j)$	30,000	33,070	29,441

Note: Panel A shows the parameter of the model that we observe directly in our micro-data. α is the fraction of buyers going to captive lenders; $\bar{i}$ if the maximum interest rate in the data; θ is average loan-to-value by captive lenders. 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.

Table A11: Substitution of credit fire sales with car fire sales: Extra

	No captive lenders	Baseline	High liquidity need	High liquidity need + losses
Panel A: Car market				
Car price (euros)	13,160	13,154	13,154	13,154
Number of manufacturers	6	7	7	7
Panel B: Loan Market				
Approved Buyers	31,177	33,070	33,080	33,173
Traditional Banks				
Fraction approved (%)	89.0	89.0	89.0	89.0
Number approved	31,177	13,094	13,094	13,094
Fraction default (%)	5.9	5.9	5.9	5.9
Captive lenders				
Fraction approved (%)		98.4	98.5	99.0
Number approved		19,976	19,986	20,079
Fraction default (%)		8.9	8.9	9.2
Average loss on high-risk loan (euros)		70	66	55
Average loss on high-risk loan (euros)		54	52	54
Panel C: Credit fire sales				
Δ approval rate captive - traditional		9.32	9.37	9.84
Extensive margin		1894	1904	1998
Liquidity creation (M euros)		1.34	2.15	2.22
Marginal borrowers (M euros)		1.34	1.42	1.49
Inframarginal borrowers (M euros)		0.00	0.73	0.73
Car fire sale equivalent (euros)		-197	-317	-327
Car fire sale equivalent (% car price)		1.50	2.41	2.49

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 A10. The "No captive lenders" assume that in the model all borrowers go to standalone lenders (i.e. $\alpha = 1$). 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 A10, 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. Finally, 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.