THE REAL EFFECTS OF LIQUIDITY DURING THE FINANCIAL CRISIS: EVIDENCE FROM AUTOMOBILES*

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Illiquidity in short-term credit markets during the financial crisis might have severely curtailed the supply of nonbank consumer credit. Using a new data set linking every car sold in the United States to the credit supplier involved in each transaction, we find that the collapse of the asset-backed commercial paper market reduced the financing capacity of such nonbank lenders as captive leasing companies in the automobile industry. As a result, car sales in counties that traditionally depended on nonbank lenders declined sharply. Although other lenders increased their supply of credit, the net aggregate effect of illiquidity on car sales is large and negative. We conclude that the decline in auto sales during the financial crisis was caused in part by a credit supply shock driven by the illiquidity of the most important providers of consumer finance in the auto loan market. These results also imply that interventions aimed at arresting illiquidity in short-term credit markets might have helped contain the real effects of the crisis. *JEL Codes:* G01, G23, L62.

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I. Introduction

Financial crises can have large adverse effects on real economic activity. Illiquidity in one corner of the financial system and large realized balance sheet losses in the financial sector can lessen the aggregate credit supply and spur economic decline.[1] Consistent with these theoretical predictions, there is growing evidence from the 2007–2009 financial crisis that the balance sheet losses incurred by traditional financial institutions—banks and credit unions—might have led to a fundamental postcrisis disruption in credit intermediation, contributing to the recession and the subsequent slow economic recovery (Chodorow-Reich 2014; Ramcharan, van den Heuvel, and Verani forthcoming).[2]

However, nonbank financial institutions—such as finance and leasing companies—are historically important sources of credit, especially for purchases of such consumer durable goods as automobiles and appliances (Ludvigson 1998). Before the crisis, for example, nonbank lenders financed more than half of all new cars bought in the United States (Online Appendix Table A.1). Unlike most traditional banks, nonbank financial institutions have connections to the shadow banking system, relying for funding primarily on short-term markets, such as the asset-backed commercial paper (ABCP) market.

We investigate how runs in the ABCP market and the loss of financing capacity at nonbank institutions, such as the captive leasing arms of car manufacturers, might have curtailed the supply of auto credit, led to the collapse in car sales, and exacerbated the financial difficulties of companies such as General Motors (GM) and Chrysler that were already verging on bankruptcy. Between 2007 and 2008, short-term funding markets in the United States dried up as money market funds (MMFs) and other traditional buyers of short-term debt fled these markets (Covitz, Liang, and Suarez 2013). Although the initial decline in 2007 was driven mainly by ABCP backed by mortgage-backed securities, the decline following the Lehman Brothers bankruptcy affected all ABCP issuers.

By early 2009, growing illiquidity in the ABCP market—a key source of short-term credit in the United States—made it difficult

1. See, for example, Diamond and Rajan (2005, 2011), Shleifer and Vishny (2010).

2. The crisis may have also disrupted intermediation even at such nontraditional lenders as Internet banks (Ramcharan and Crowe 2013).

for many nonbank intermediaries to roll over debt or secure new funding (Campbell et al. 2011). This illiquidity coincided with the collapse of several large nonbank lenders, chief among them the General Motors Acceptance Corporation (GMAC), the financing arm of GM and one of the world's largest providers of auto financing. At the same time, automobile sales fell dramatically in 2008 and 2009, and GM and Chrysler eventually filed for Chapter 11 bankruptcy protection.

To uncover the economic consequences of these disruptions in short-term funding markets, we use a proprietary micro-level data set from Polk automotive data from HIS Global (Polk) of all new car sales in the United States. Our data set matches every new car sale to its financing source (e.g., auto loan or lease) and identifies the financial institution involved in the sale. The data, reported quarterly starting in 2002, also identify each vehicle's make and model along with county of registration. This micro-level detailed information and its spatial nature enable us to develop an empirical identification strategy to identify how the loss of financing capacity in the shadow banking system might have affected U.S. car sales.

Our identification strategy hinges on the notion that by the end of 2008, liquidity runs in the ABCP market and dislocations in other short-term funding markets might have curtailed the financing capacity of nonbank institutions, notably the captive financing arms of automakers. We show cross-sectionally that in counties where buyers are historically more dependent on nonbank lenders for auto credit, sales of cars fell even more sharply in 2009. In particular, a 1 standard deviation increase in nonbank dependence is associated with a 1 percentage point or 0.08 standard deviation decline in the growth in new car transactions over the 2008–2009 period. This point estimate implies that even with the unprecedented interventions aimed at unfreezing short-term funding markets in 2008 and 2009, as well as the bailout of U.S. automakers and their financing arms, the liquidity shock to nonbank financing capacity might explain about 31% of the drop in car sales in 2009 relative to 2008.

Nonbank lenders tend to serve lower-credit-quality borrowers—the very people identified as most affected by the Great Recession. There is compelling evidence that these borrowers suffered significantly from the collapse in house prices, reducing their demand for automobiles and other durable goods (Mian and Sufi 2014a). These borrowers are also more likely to have faced a reduction in their credit card limits. Rather than reflecting the effects of diminished captive financing caused by illiquidity in short-term funding markets, the results reported here could reflect a more general contraction in credit to riskier borrowers.

To address this challenge to causal inference, we show that our county-level results are robust to the inclusion of the most common proxies for household demand—house prices, household leverage, and household net worth—as well as to measures of unemployment (Mian and Sufi 2014a). We also find evidence of substitution: sales financed by noncaptive lenders—those financial institutions more dependent on traditional deposits for funding—actually rose during this period in counties where borrowers had a higher dependency on nonbank credit. The evidence on substitution from nonbank to bank financing suggests that our results are unlikely to be driven by latent demand factors; rather, they reflect a credit supply shock.

The rich data, especially the make-segment information, allow us to address other concerns about county-level omitted variables. Within the same make, manufacturers use different models to appeal to diverse consumers at varying price points. GM, for example, markets Chevrolets to nonluxury buyers, whereas it promotes Cadillacs to wealthier consumers. The effects of the Great Recession on likely buyers of Chevrolets were probably very different than on potential buyers of Cadillacs, even for those living in the same county. We can thus use county-segment fixed effects to nonparametrically control for differences in demand within a county across different model segments. Our results remain unchanged.

Whereas the Polk data set is rich in its coverage of information regarding automobiles, it contains no information on borrower characteristics. We supplement the data from Polk with a large micro-level panel data set from Equifax of about three million individuals. The Equifax data include the dynamic risk score of each borrower, along with age, automotive credit, mortgage, and other credit usage measures. For automotive debt, the data set also identifies whether credit was obtained from a nonbank or bank lender. Although Equifax does not provide as rich a set of information about the car purchase as does Polk, it has a wealth of borrower characteristics that directly address concerns about borrower credit quality, credit access, and latent demand among users of nonbank credit relative to other sources of automotive credit. Combining information from Polk and Equifax enables us to alleviate concerns pertaining to omitted variables at both the borrower and the car level.

Using the Equifax data and controlling for borrower's risk score, homeownership status, and other observables, we find significant evidence that for borrowers living in counties more traditionally dependent on nonbank financing, the probability of obtaining nonbank credit fell sharply over the 2008–2009 period, falling to zero in late 2009. Falsification tests reveal no similar pattern for either mortgage or revolving lines of credit. Furthermore, we find that access to nonbank automotive credit declined sharply toward the end of 2008 and again in the second half of 2009, even among borrowers with high credit scores.

Taken together, these results imply that funding disruptions in short-term credit markets during the financial crisis significantly diminished car sales. This evidence of a credit supply shock adds to our understanding of financial crises more broadly and complements those papers that emphasize alternative mechanisms, such as the role of debt, deleveraging, and regulation, that might shape post–credit boom economies (see Mian and Sufi 2010, 2014a; Mian, Rao, and Sufi 2013; Rajan and Ramcharan 2015, forthcoming). We argue that a credit supply channel during the crisis was especially important in the new car auto market because more than 80% of new cars in the United States are financed through leases and auto loans from nonbank and bank lenders; under 20% are bought in all-cash transactions. Our evidence also tentatively suggests that the Treasury and Federal Reserve programs aimed at stopping illiquidity in credit markets might have helped contain the real effects of the crisis (Goolsbee and Krueger 2015).

This article adds to the broader literature on the effects of financial markets and bank lending on real economic outcomes.[3] But whereas previous studies of the financial crisis document the importance of short-term funding for banks' liquidity and lending, less is known about the consequences of the collapse of short-term funding markets. Also less well understood is the importance of leasing companies and nonbank institutions in the provision of credit in auto markets and how these institutions might be

3. See Khwaja and Mian (2008); Brunnermeier (2009); Gorton (2010); Ivanshina and Scharfstein (2010); Acharya, Schnabl, and Suarez (2011); Cornett et al. (2011); Gorton and Metrick (2012); Acharya and Mora (2013); and Becker and Ivashina (2014).

connected to nontraditional sources of financing. We fill this void by documenting that the collapse of short-term funding reduced auto lending by financial institutions, which in turn resulted in fewer purchases of cars and reduced economic activity. We also provide evidence that, because the ABCP market collapse curtailed the financing capacity of many captive financing companies, illiquidity in the short-term funding markets might have played an important role in limiting the supply of *nonbank* consumer credit during the crisis.[4]

The rest of the article is organized as follows. Section II describes the institutional background of captive leasing and institutions' reliance on ABCP funding. Section III presents the data and the main summary statistics. Section IV describes the construction of our measure of captive dependence. Section V displays the empirical results on the collapse of auto sales using the Polk data. Section VI presents our micro-level analysis using the Equifax data. Section VII concludes.

II. Automotive Nonbank Credit

Nonbank financial institutions, especially the captive financing arms of the major automobile manufacturers, have long been important suppliers of automotive credit in the United States. Online Appendix Table A.1 shows that in 2005 about half of automotive credit came from nonbank sources of credit. Among these nonbank purveyors of credit, captives accounted for around 90% of nonbank financing in 2008 (Online Appendix Table A.2). The rise of nonbank automotive financing, especially that of captives, arose because the automobile industry's unique combination of high cost, mass appeal, and independent dealership networks required a new form of financing to expand distribution and sales. A further impetus came from the reluctance of many commercial banks to use cars as collateral.

Banks were reluctant to make car loans because cars were a relatively novel and difficult-to-value durable good. For example, banks had scant information about a model's depreciation path, especially given that the introduction of new models often led to a sharp drop in the resale value of outgoing models. When banks did

4. Kacperczyk and Schnabl (2010) provide a detailed account of the collapse of the commercial paper market during the financial crisis of 2007–2009. Gao and Yun (2013) study the consequences of illiquidity in the commercial paper market for corporate borrowing.

make car loans, interest rates often approached the legal maximum. Some bankers even thought it unwise for commercial banks to provide credit for a luxury good out of concern that such credit might discourage the virtue of thrift (Phelps 1952). Last, car sales were highly seasonal, and banks' reluctance to provide automotive financing affected the ability of dealers to finance their inventories (Hyman 2011).

The organizational form of captives was a response to these frictions. Captives such as GMAC, founded in 1919, were vertically integrated into the manufacturer and better able to overcome informational frictions surrounding the value of car collateral.[5] For example, they knew the model release schedule well ahead of arm's-length lenders. Vertically integrated captives were also less encumbered by moral objections to consumer spending on cars. On the dealer side of the transaction, captives often allowed the dealer to intermediate captive credit and earn additional markups. Captives became important sources of credit or floorplan financing for the dealer—a form of credit collateralized by the dealer's auto inventory.[6] Captives thus relaxed financial constraints at both the dealership and consumer sides of the sales transaction.[7]

The modern auto credit market is large because most new cars in the United States are bought on credit through either car loans or leasing. At its peak in 2006, auto credit was $785 billion, accounting for 32% of consumer debt, and assets at GMAC, then the largest of the captive financiers, totaled around $26 billion. Captive lessors are often seen as providing credit to riskier borrowers (Barron, Chong, and Staten 2008; Einav,

5. Import brands such as Toyota tend to rely more heavily on nonbank captives that are not vertically integrated. For example, existing nonbank lenders, such as World Omni Financial, created a dedicated subsidiary, Southeast Toyota Finance, in 1981, to help Toyota establish a foothold in the North American market in key geographic regions. Toyota Motor Credit was established only in 1982 and focuses on markets outside the Southeast (Kaisha 1988).

6. These points are echoed by William C. Durant in announcing the formation of GMAC in a letter dated March 15, 1919: "The magnitude of the business has presented new problems in financing which the present banking facilities seem not to be elastic enough to overcome. . . . This fact leads us to the conclusion that the General Motors Corporation should lend its help to solve these problems. Hence the creation of General Motors Acceptance Corporation; and the function of that Company will be to supplement the local sources of accommodation to such extent as may be necessary to permit the fullest development of our dealers' business" (Sloan 1964, p. 303).

7. Murfin and Pratt (2015) expand on these ideas within a theoretical model and provide evidence based on equipment leasing.

Jenkins, and Levin 2013).[8] In 2006, the median FICO score for car buyers obtaining nonbank credit was 640, as opposed to 715 for buyers using bank credit.

Before the financial crisis, securitization gave nonbank suppliers of automotive credit new ways to tap into cheap funding (Calder 1999; Hyman 2011).[9] In particular, ABCP became nonbank lenders' main source of funding, enabling them to turn relatively illiquid auto term loans into liquid assets that could be used to obtain funding for new loans. In this form of securitization, pooled auto loans are placed in a special-purpose vehicle (SPV) that is bankruptcy remote from the originating captive lessor. The SPV then issues short-term secured commercial paper (ABCP) to finance loans and market the commercial paper—generally with a duration of no more than three months (see Acharya, Schnabl, and Suarez 2011 for a detailed discussion of ABCP structures).

MMFs and other institutional investors seeking to invest in liquid and high-yield short-term assets are the main buyers of commercial paper. In mid-2007, just before the turbulence in credit markets, MMFs held about 40% of outstanding commercial paper in the United States. The bankruptcy of Lehman Brothers on September 15, 2008, and the "breaking of the buck" at Reserve Primary Fund the next day triggered heavy outflows from MMFs, leading the Treasury to announce an unprecedented guarantee program for virtually all MMF shares. The Federal Reserve followed suit by announcing a program to finance purchases of ABCP—which were highly illiquid at the time—from MMFs. Despite these interventions, flows into MMFs remained highly

8. Charles, Hurst, and Stephens (2010) document that minorities, particularly African Americans, are more likely to receive auto loans from financing companies and to pay, on average, higher interest rates on those loans. One plausible explanation for this pattern is that minorities have, on average, lower credit scores and therefore are more likely to receive financing from captives. For a detailed analysis of subprime auto-lending contracts, see Adams, Einav, and Levin (2009); and Einav, Jenkins, and Levin (2012).

9. Online Appendix Table A.3, based on nonpublic data collected by the Federal Reserve, demonstrates the importance of commercial paper as a source of funding for selected major automobile captives active in the United States. Given the nature of the data, we cannot disclose the identities of the captive lessors in the table and instead label them Captive 1 through Captive 4. As Online Appendix Table A.3 shows, commercial paper was a major source of funding for three out of the four captive lessors. Although commercial paper accounted for just 10.2% of one lessor's liabilities (Captive 3), the other three relied much more heavily on this form of short-term funding, with the share of commercial paper in their liabilities ranging from 45.9% (Captive 2) to 75.1% (Captive 4).

erratic, and MMFs significantly retrenched their commercial paper holdings. In the three weeks following Lehman's bankruptcy, prime MMFs reduced their holdings of commercial paper by $202 billion, a steep decline of 29%.

The reduction in commercial paper held by MMFs led to a sharp rise in borrowing costs for issuers of commercial paper. ABCP issuances also fell sharply amid the turmoil in short-term credit markets, and the sharp outflows of assets from MMFs in the third quarter of 2008 precipitated a run on many of these auto-related securitization pools. Online Appendix Figure A.1 displays the outstanding amount of ABCP issued by SPVs associated with the captive leasing arms of the big three U.S. automakers: GMAC, Chrysler Financial (CF), and Ford Motor Credit (FMC). Although the ABCP market began to weaken in 2007, automakers' issuance of ABCP began to collapse in the third quarter of 2008. Together, the big three captive lessors had about $40 billion worth of ABCP outstanding in 2006 before they largely collapsed by the end of 2009.[10]

Before turning to the data and statistical tests, we provide narrative-based evidence on how the decline in nonbank financing capacity might have affected automobile sales. Although nonbank lenders such as captives are key providers of consumer credit, they are also an important source of credit for auto dealerships. The floorplan financing provided by nonbank lenders enables dealerships to purchase their car inventory. Although it is not easy to obtain dealership-level data on floorplan loans, we have read the financial reports of the largest publicly traded automotive dealerships in the United States to understand the challenges that dealerships faced during the Great Recession.

In these reports, these dealerships frequently list a lack of financing for both consumers and dealerships as a first-order reason for the decline in auto sales. Collectively, these reports point to the possibility that the illiquidity of nonbank lenders might

10. Ford's financing arm, FMC, survived the crisis in part because of its continued access to the Federal Reserve's Commercial Paper Funding Facility (CPFF), which bought ABCP to alleviate liquidity pressures in the funding markets after the Lehman Brothers collapse. The Federal Reserve announced the CPFF to provide a liquidity backstop for U.S. commercial paper issuers with high short-term credit ratings on October 14, 2008. Before losing access in January 2009, GMAC heavily relied on CPFF, selling a total of $13.5 billion in ABCP to the facility. In contrast to GMAC and CF, FMC was able to maintain its short-term credit rating and never lost access to CPFF, from which it had raised almost $16 billion by summer 2009 and then began to raise funds from private investors.

have led to a decline in auto sales through a credit supply channel that affected not only consumers but also car dealerships. We collect and reproduce discussions from the Form 10-Ks of the largest publicly traded dealership companies in the United States that pertain to the role of nonbank credit and the automotive industry in general and during the financial crisis and report on them in the Online Appendix.

III. Data and Summary Statistics

For our county-level analysis, we use a proprietary data set from R. L. Polk & Company that records all new car sales in the United States. Beginning in 2002, for each new car purchased in the United States, the data set identifies the vehicle make and model, such as Ford (make) Focus (model) or Toyota (make) Camry (model), and whether the car was purchased by a private consumer (retail purchase), a firm (commercial purchase), or the government. The data set also details the county, year, and quarter of vehicle registration. Because we are interested in identifying the effect of a credit supply shock on household consumption, we focus exclusively on retail purchases. Moreover, for each retail credit transaction starting in the first quarter of 2008, Polk lists the name of the financial institution and type of financial services provider: bank, credit union, or nonbanks such as the automaker's captive financing arm.

Using the Polk data, we replicate the well-known observation that durable goods purchases—particularly automobiles—declined sharply during and after the financial crisis. Online Appendix Figure A.2 plots the number of automobiles sold annually from 2002 to 2013. Car sales plummeted from a peak of 17 million units in 2006 to 11 million units in 2009 before rebounding slightly in 2010 and 2011. In 2012, auto sales had recovered to around 14 million units sold, and by 2013 sales approached precrisis levels. The decline in automobiles sales during the crisis was driven largely by retail auto sales (see Online Appendix Figure A.3).

Summary statistics of annual county-level retail auto sales are reported in the Online Appendix (Table A.4). County-level mean sales dropped from 3,866 units in 2007 to 3,168 and 2,563, respectively, in 2008 and 2009, reflecting the dramatic decline in auto sales during the crisis. This pattern of dramatic decline is not driven by outlier counties and can also be observed by inspecting such sample order statistics as the median and the first and third quartiles. Figure I displays the spatial variation in the collapse of

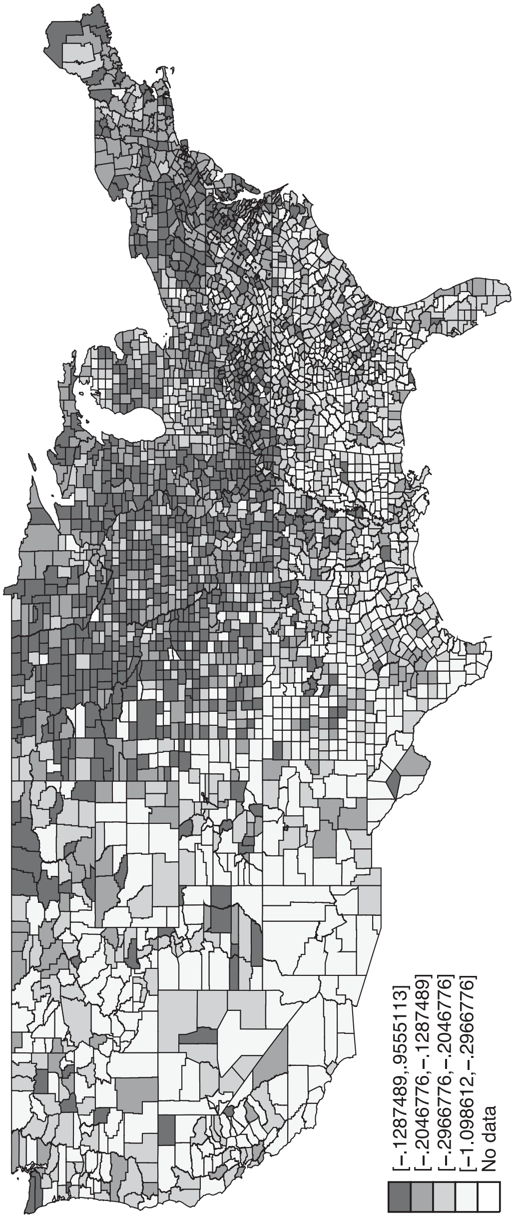

FIGURE I

County-Level Change in Retail Car Sales, 2008–2009

Retail car sales are the sum of retail leases and retail purchases in Polk.

retail car sales, defined as the percentage change in retail automobile sales from 2008 to 2009 within a county. Counties in New England and parts of the upper West experienced a smaller drop in retail auto sales relative to the majority of counties in the South and West.

IV. Measuring Nonbank Dependence

To analyze the role of nonbank financing in the collapse of car sales, we construct a measure of a county's dependence on nonbank financing. We define our measure of nonbank dependence as the ratio of the number of retail auto sales financed by nonbanks to the number of all retail financed transactions in the county in the first quarter of 2008. An alternative definition of this measure is to divide the number of retail auto sales financed by nonbanks by all retail transactions in the county, regardless of whether they are financed. We focus on the former measure because it alleviates the concern that nonbank dependence proxies for more general credit usage and demand in a county. To wit, when dependence is defined as a share of total retail sales, it might be high in counties that use more financing, which might be correlated with demand shocks. By using nonbank-financed transactions as a share of all retail financed transactions in the county, we purge the pure financing effect and focus instead on the intensive margin of the composition of financing.

The timing of our baseline measure of nonbank dependence can also affect inference. The first quarter of 2008 is the earliest available date that Polk records lender information. But if dealers and consumers began substituting away from nonbank financing to other lenders during this period, the baseline measure might already reflect the effects of this substitution, rather than a county's historic dependence on nonbank credit. Also, because the baseline dependence measure is based on first quarter 2008 data, seasonality in the provision of credit across lenders could lead to inaccurate estimates of a county's nonbank dependence.

These measurement concerns are valid. But they are likely to be mitigated by the relationship-based nature of nonbank auto credit, most of which consists of captive credit. Captive relationships are especially strong at the wholesale or dealership level and can render the cross-county variation in nonbank dependence persistent, at least before the full onset of the financial crisis. Figure II plots the county-level variation in nonbank

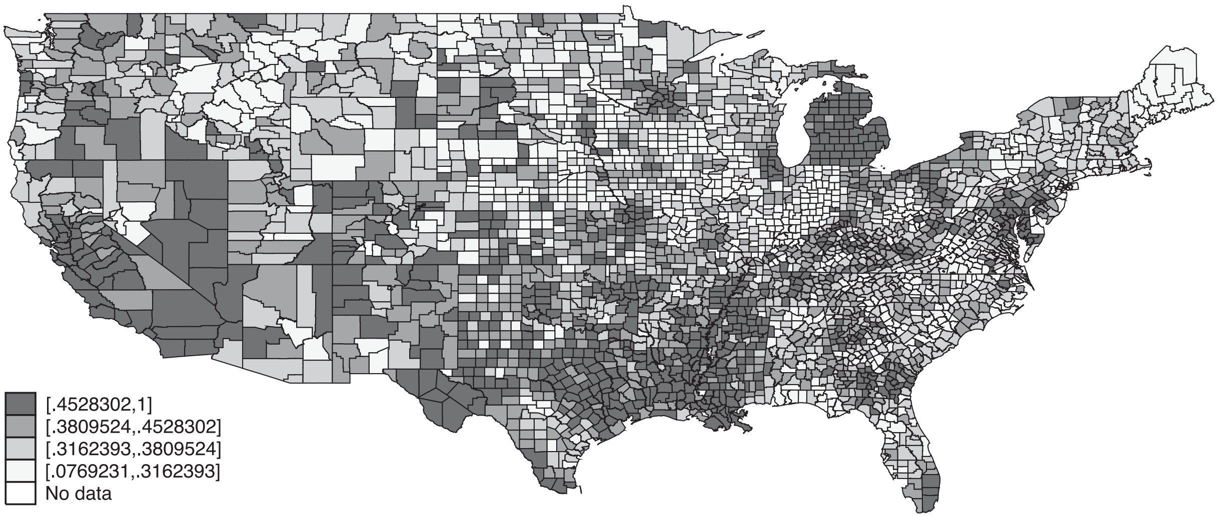

FIGURE II

County-Level Share of Retail Cars Financed by Nonbanks in 2008 Q1

Retail car sales are the sum of retail leases and retail purchases in Polk. The share is defined relative to all retail transactions in the county, regardless of the source of financing.

dependence, measured in the first quarter of 2008. Not surprisingly, Michigan—the headquarters of the three major domestic manufacturers and their respective captive financing arms—has the largest share of nonbank-financed transactions in the United States. In areas where other auto manufacturers have a long-standing presence and dealers have close relationships with captives, such as Alabama and Tennessee, captives also appear to dominate credit transactions.

To address these measurement concerns, we use data from Equifax to supplement our Polk-based baseline county-level nonbank dependence measure. Equifax, one of the three major credit bureaus in the United States, collects data on individuals' liabilities, including their car purchases; in the version of the data set available to us, it identifies whether the source of automotive credit is a nonbank financier along with the borrower's zip code. These data are available quarterly and extend back to 2006, which enables us to construct measures of nonbank dependence at least two years before the onset of the financial crisis.[11] We draw a 10% random sample from Equifax, which yields a panel of about three million households. As Figure III demonstrates, the quarterly growth in car sales derived from both Polk and Equifax are very similar.

We aggregate the Equifax data at the county level and create two measures of nonbank dependence. These measures are: (i) the ratio of nonbank financed transactions to all financed transactions in the county in the first quarter of 2008, which corresponds to the time period in the baseline Polk measure, and (ii) the ratio of nonbank financed transactions to all finance transactions in 2006. Table I reports the summary statistics for the two Equifax-based measures of nonbank dependence (columns (1) and (2)); the Polk derived ratio of nonbank to all new transactions (column (3)); and the baseline ratio of nonbank to all financed transactions, also from Polk (column (4)), along with key control variables.

The basic summary statistics suggest that nonbanks account for about 40% of all auto purchases (column (3)) and for about 52% of all financed purchases (column (4)). The dependence measures derived from Equifax and Polk are very similar to each other, although the average incidence of nonbank credit appears to be a little smaller in 2006 compared with that observed in the first quarter of 2008. The cross-sectional variation in all four variables

11. Equifax does not list the name of the credit supplier.

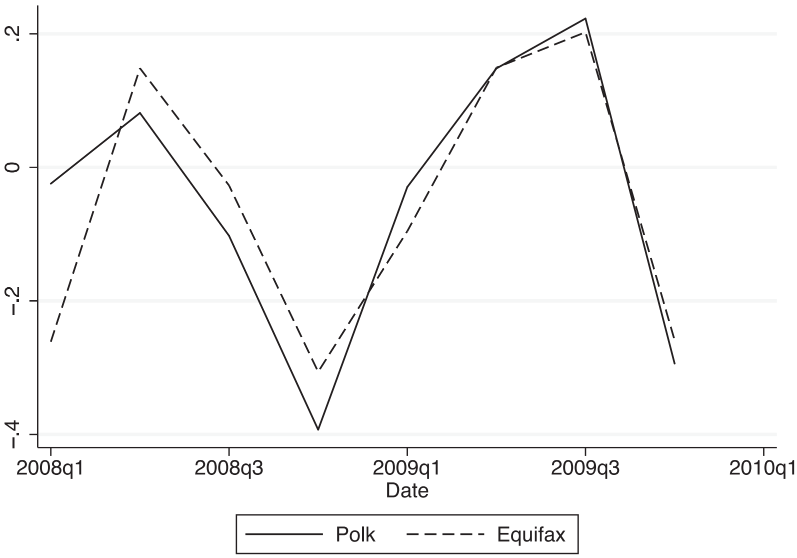

FIGURE III

Quarterly Growth in New Car Sales—Comparing Polk and Equifax

The figure plots the quarter on quarter growth in car sales, as reported by Polk and Equifax.

is very similar. Online Appendix Table A.5 reports the coefficient from regressing separately the Equifax 2008 first quarter measure of dependence separately on the other three alternative dependence variables, controlling for state fixed effects. The point estimates in these regressions range from 0.762 to 0.821 and are all statistically significant at the 1% level. In robustness tests we present later, we show that our baseline estimates are relatively unchanged across the alternative measures of captive dependence.

IV.A. The Determinants of Nonbank Dependence

To understand the determinants of a county's dependence on nonbank financing, we estimate cross-county regressions of nonbank dependence on a number of county-level demographic variables and report the results in Table II. The first 12 columns of Table II show the coefficient from univariate regressions of nonbank dependence on each of these variables. Counties more dependent on nonbank credit are generally more populous, have higher median income, and have greater income inequality (measured

TABLE I

SUMMARY STATISTICS

	Captive dependence											
	Equifax 2008 Q1	Equifax 2006	Polk 2008 Q1	Polk 2008 Q1 financed	County area, log	Population, log	Median income, log	African American population, log	White population, log	Gini coefficient	Employment in automobile sector, share	Median credit score, 2008 Q1 (Trans Union)
Mean	0.49	0.45	0.39	0.52	6.47	10.25	0.66	6.78	10.06	0.43	0.42	675.74
Median	0.5	0.45	0.38	0.52	6.42	10.15	10.65	6.95	9.99	0.43	0	679
25th percentile	0.38	0.35	0.32	0.44	6.06	9.32	10.5	4.9	9.12	0.41	0	634
75th percentile	0.6	0.56	0.45	0.6	6.82	11.09	10.79	8.73	10.94	0.45	0.04	717
Min	0.1	0	0.08	0.14	0.69	4.39	9.86	0	4.17	0.21	0	507.5
Max	0.88	1	1	1	9.91	16.1	11.65	14.11	15.42	0.64	18.66	811
Standard deviation	0.15	0.18	0.1	0.12	0.87	1.45	0.25	2.61	1.44	0.04	1.44	54.66

Notes. This table presents the summary statistics for county characteristics used in the empirical analysis. In column (1), nonbank dependence is the ratio of nonbank-financed transactions to all financed transactions in a county as of 2008 Q1 and reported in Equifax. Column (2) defines nonbank dependence similarly, but taken over all of 2006. Column (3) defines nonbank dependence as the ratio of nonbank-financed transactions to all sales in the county, including self-financed transactions, as of 2008 Q1 and reported in Polk. Column (4) defines nonbank dependence as the ratio of nonbank-financed transactions to all financed transactions in a county as of 2008 Q1 and reported in Polk. Population, county area, median household income, Gini coefficient, poverty rate, African American population, and white population are taken from the American Community Survey. Employees in automobile sector and total employment are taken from the Quarterly Census of Employment and Wages (QCEW).

TABLE II

THE DETERMINANTS OF NONBANK DEPENDENCE

	Dependent variable: nonbank financed to all financed transactions (Polk)														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
County area, log	−0.00419													−0.00391	0.00354
	(0.00364)													(0.00614)	(0.00471)
Population, log		0.0104***												0.0443*	0.0146
		(0.00289)												(0.0244)	(0.0231)
Median income, log			0.0396**											0.0425**	0.0684***
			(0.0153)											(0.0173)	(0.0158)
African American population, log				0.00795***										0.00185	0.000138
				(0.00173)										(0.00248)	(0.00227)
White population, log					0.00843***									−0.0418*	−0.00936
					(0.00288)									(0.0226)	(0.0216)
Gini coefficient						0.325***								0.300***	0.101
						(0.0853)								(0.0788)	(0.0625)
Employment in automobile sector, share							−0.0461							−0.105	−0.211*
							(0.160)							(0.145)	(0.114)

TABLE II

(CONTINUED)

	Dependent variable: nonbank financed to all financed transactions (Polk)														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Median credit score, 2008 Q1 (Trans Union)								–0.000137 (9.60e–05)						–4.06e–05 (0.000103)	–0.000692*** (9.18e–05)
Unemployment rate, 2008									0.000758 (0.00136)					–0.000244 (0.00110)	0.00128 (0.000891)
Unemployment rate, 2006										–0.00150 (0.00336)					
Unemployment rate, 2007											–0.000543 (0.00299)				
Poverty rate, 2008												0.000616 (0.000710)			
Change in house prices, 2005–2006													–0.0913 (0.0897)		
Observations	3,092	3,092	3,092	2,860	3,092	3,092	3,087	3,092	2,534	2,534	2,534	3,092	1,239	2,301	2,301
R^2	0.309	0.320	0.313	0.371	0.316	0.316	0.308	0.310	0.299	0.299	0.299	0.309	0.425	0.372	0.399

Notes. This table reports the regression results of regressing county-level nonbank dependence (Polk), 2008 Q1, on demographic and economic variables observed around the same period. Employment in the automobile sector is number of employees in the automobile sector divided by total employment. The socioeconomic variables are taken from the American Community Survey. County-level unemployment rates come from the Bureau of Labor Statistics. Employees in automobile sector are taken from the QCEW. The dependent variable in column (15) is nonbank-financed to all transactions (Polk). ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

by the county's Gini coefficient). There is no evidence that economic conditions before the crisis, as proxied for by the unemployment rate in either 2006 or 2007, are correlated with dependence. Nonbank dependence is also not significantly related to the housing cycle, as measured by the change in house prices during the boom (2005–2006).

Column (14) reports results from a multivariate regression that includes these variables jointly. There is some evidence that nonbank dependence is smaller in counties with more white residents, and the positive coefficients on both the median income and population variables remain significant.

Column (15) uses the extensive margin measure of nonbank dependence as the dependent variable: the number of nonbank-financed transactions divided by the number of transactions in a county. The results confirm the concern that this extensive margin measure of dependence is potentially more affected by differential credit usage across income groups within a county; the coefficient on the median FICO score in the county is now negative and statistically significant. Borrowers with lower FICO scores were disproportionately affected by the crisis, however, and inference based on this measure of dependence might be more prone to concerns about omitted demand-side factors.[12]

Although the concern about the correlation between borrower credit quality and nonbank dependence is valid, it is important to put this concern in context. By the first quarter of 2007 only 15% of GMAC's U.S.-serviced consumer asset portfolio was considered nonprime; GMAC was the biggest nonbank automotive lender at that point.[13] That is, the largest nonbank automotive lenders did not concentrate on subprime borrowers, but the vast majority of car buyers who relied on nonbank credit were safer borrowers who had lower sensitivity to the housing cycle.

V. Nonbank Credit and the Collapse of Auto Sales: The Aggregate Evidence

Here we present county-level evidence of the relation between nonbank credit and car sales during the crisis.

12. We are grateful to an anonymous referee for suggesting this test and the intensive measure of dependence.

13. See GMAC LLC, 8-K, April 26, 2007, File No. 001-03754. The document is available at the SEC's EDGAR company filings website.

V.A. Sales Financed by Nonbank Creditors

We analyze the effect of nonbank credit dependence on the change in automotive sales financed by nonbank creditors between 2008 and 2009. We use the following baseline regression specification:

$$\log(cars)_{2009i} - \log(cars)_{2008i} = \alpha_0 + \alpha_1 \times dependence_i + X_i\beta + S_i + e_i, \quad (1)$$

where the dependent variable is the difference in the log number of cars financed by nonbank creditors in county i between 2008 and 2009. Our main explanatory variable is the county's dependence on nonbank financing. The baseline county-level specifications use Polk data and define dependence as the ratio of retail sales financed by nonbanks to all financed transactions in the county, observed in 2008 Q1—the earliest date for which the Polk data identifies the credit provider in the transactions.[14]

Table III presents the results from estimating different variants of the model with standard errors (in parentheses) clustered at the state level. We also weight these county-level regressions by the population in the county circa 2009.[15] All specifications include state fixed effects (the vector $\boldsymbol{S}$) to absorb time-invariant state heterogeneity. Most of our specifications also control for county-level economic and demographic variables that are included in the vector $\boldsymbol{X_i}$.[16] Our main coefficient of interest is α_1, which measures the effect of nonbank credit dependence on car sales during the crisis.

14. Theoretically, nonbank lenders may decide to cut funding to consumers with no regard to the level of nonbank dependence in the county. However, in practice they would like to maintain presence in low-dependence counties as well, which results in larger disproportionate reduction in credit in high-dependence counties. Moreover, in the context of captive lessors, dealers (more so than consumers) were almost completely dependent on captives for floorplan or wholesale credit. For example, GMAC accounted for about 85% of this wholesale credit and for 40% of direct consumer credit. Given the nearly absolute dependence of the dealer network on GMAC credit and to protect this dealer network and ensure the long-term viability of GM, GMAC actually shifted credit away from consumers toward its dealer network during the crisis, resulting in a disproportionate reduction in credit in high-dependence counties.

15. Although our results hold if we use regular OLS regressions, we weight our regressions by population to account for county size (see, e.g., Autor and Dorn 2013; Mian and Sufi 2014a).

16. Table I reports summary statistics for the explanatory variables used in these regressions.

TABLE III

NONBANK DEPENDENCE AND NONBANK SALES

Variables	(1) Economic and demographic controls, without state fixed effects	(2) Economic and demographic controls, with state fixed effects	(3) Unemployment and leverage	(4) House prices	(5) Household net worth
Captive dependence, 2008 Q1 (Polk), financed transactions	-0.369^{**}	-0.319^{***}	-0.342^{***}	-0.348^{***}	-0.316^{***}
	(0.141)	(0.0620)	(0.0679)	(0.0811)	(0.0771)
County area, log	-0.0656^{**}	-0.0227^{**}	-0.0243^{**}	-0.0270^{*}	-0.0271^{*}
	(0.0289)	(0.0112)	(0.0119)	(0.0140)	(0.0141)
Population, log	0.109	0.108^{***}	0.107^{***}	0.110^{***}	0.102^{***}
	(0.0706)	(0.0336)	(0.0345)	(0.0373)	(0.0361)
Median income, log	–0.0445	0.0284	0.0255	0.0389	0.0533
	(0.0773)	(0.0344)	(0.0347)	(0.0434)	(0.0428)
African American population, log	–0.00390	0.00769^{*}	0.00792^{*}	0.00586	0.00610
	(0.0104)	(0.00403)	(0.00439)	(0.00518)	(0.00492)
White population, log	–0.0662	-0.110^{***}	-0.110^{***}	-0.106^{***}	-0.0973^{***}
	(0.0606)	(0.0286)	(0.0301)	(0.0315)	(0.0310)
Gini coefficient	0.519	0.365^{**}	0.407^{**}	0.354^{*}	0.272
	(0.348)	(0.174)	(0.165)	(0.183)	(0.201)
Employment in automobile, share	–1.136	–0.274	–0.303	–0.323	–0.396
	(0.837)	(0.261)	(0.254)	(0.335)	(0.353)
Median credit score, 2008 Q1 (Trans Union)	0.00103^{**}	0.000881^{***}	0.000851^{***}	0.000809^{***}	0.000842^{***}
	(0.000450)	(0.000174)	(0.000184)	(0.000236)	(0.000238)
House price change				0.0812	
				(0.125)	

TABLE III

(CONTINUED)

Variables	(1) Economic and demographic controls, without state fixed effects	(2) Economic and demographic controls, with state fixed effects	(3) Unemployment and leverage	(4) House prices	(5) Household net worth
Unemployment rate			0.00492	0.00363	
			(0.00438)	(0.00420)	
Household leverage, 2006			0.0227	0.0363	
			(0.0231)	(0.0286)	
Change in household net worth, 2006–2009					–0.0437
					(0.0912)
Observations	2,825	2,825	2,056	958	932
R^2	0.236	0.761	0.785	0.840	0.842

Notes. This table reports the regression results of estimating equation (1). The dependent variable is the log change in the number of cars financed by nonbanks in 2009 relative to 2008 as reported in Polk. Nonbank dependence is the ratio of nonbank-financed to all financed transactions, (Polk) 2008:Q1. Percentage African American is the African American population divided by population. Employment in automobile sector is number of employees in the automobile sector divided by total employment. Population, county area, median household income, Gini coefficient, poverty rate, African American population, and white population are taken from the American Community Survey. County-level unemployment rates are taken from the BLS. Employees in automobile sector and total employment are taken from the QCEW. Household leverage is the debt-to-income ratio (Federal Reserve Bank of New York). House price change is the change in the house price index (CoreLogic). Household net worth is from Mian and Sufi (2014a). All variables are defined in Appendix A. All regressions are weighted by the county population and include state fixed effects, except for column (1). Standard errors are clustered at the state level. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Table III, column (1) presents the results of regression (1) using demographic and economic county-level controls as proxies for local demand, but excludes state fixed-effects. As column (1) illustrates, the nonbank dependence coefficient is economically and statistically significant. A 1 standard deviation increase in nonbank dependence is associated with a 3.5 percentage point or 0.17 standard deviation decline in the growth in nonbank financed transactions over this period. Alternatively, moving from a county at the 25th to the 75th percentile in nonbank credit dependence is associated with a 5 percentage point drop in the growth in nonbank financed transactions. The nonbank dependence coefficient is only slightly smaller when adding state fixed effects (column (2)), but in what follows all specifications use state-level fixed effects to absorb potentially relevant regulatory, geographic, and other time-invariant state-level factors.

We control for log median income because the demand for cars might be higher in counties with higher household income. Similarly, we control for the number of African American and white residents, given the evidence that race might affect access to automotive credit (Barron, Chong, and Staten 2008; Einav, Jenkins, and Levin 2013). We also add income inequality, as measured by the Gini coefficient, as a control variable in our regressions. The majority of those who relied on nonbank credit were safer borrowers with lower sensitivity to the housing cycle. But because nonbanks might be more likely to serve lower-credit-quality borrowers, who in turn might have been more exposed to the Great Recession, we control for the median credit score in the county using data from Transunion. Credit scores in a county might endogenously respond to any credit supply disruptions, and as with the nonbank dependence variable, our baseline specification uses the median credit score observed in 2008 Q1. In the robustness section we show that these results are unchanged when using alternative measures of borrower credit quality.

A county's employment structure could also drive unobserved demand shocks. In counties with strong employment links to the automotive sector, the demand for cars might endogenously vary with the health of that sector. At the same time, these counties might have higher levels of nonbank dependence because of these automotive linkages. Figure II shows, for example, that counties in Michigan—the headquarters of the "big three"—and counties in states where auto manufacturers have a long-standing presence (such as Alabama, Indiana, Kentucky, and Tennessee) also have the largest share of nonbank-financed transactions in the

United States.[17] We thus add the fraction of employment in the automotive sector as a control variable to the regression in columns (1) and (2).

Among these demographic and economic variables, we find that the number of African American residents in the county is positively correlated with the number of car sales financed by nonbank lenders. Also, as one might expect, the credit quality of borrowers within a county is positively correlated with the growth in nonbank-financed transactions. In the Online Appendix we combine the 2005–2009 ACS with county-level data from the 2000 census to compute the changes in median income, poverty rate, overall population, and African American population within counties over time. In supplementary analysis presented in Online Appendix Table A.6, column (1), we show that using the changes instead of the level of these sociodemographic control variables does not change the point estimate on the nonbank dependence variable.

We next incorporate household balance sheet control variables into our analysis. There is a burgeoning literature on the effect of home prices, household leverage, and net worth on local demand and employment (see Mian and Sufi 2011, 2014a; and the broader discussion in Mian and Sufi 2014b). Some of this literature has also directly connected car purchases to household-level changes in debt service (DiMaggio, Kermani, and Ramcharan 2014). To the extent that our measure of nonbank dependence is correlated with the household balance sheet–driven demand channel, estimates of the dependence coefficient might be biased.

Table III, column (3) adds the 2009 county-level unemployment rate as well the median debt-to-income ratio for households in a county in 2006 to the control variables used in columns (1) and (2).[18] These data are available for a smaller subsample of counties, reducing the sample size from 2,825 in column (1) to 2,056 counties in column (2). Yet the negative impact of nonbank dependence remains robust, with statistical significance at the 1% level and a point estimate that is very close to the one obtained in column (1). Since unemployment and leverage might be highly correlated, in Online Appendix Table A.6, columns (2) and (3), we

17. Appendix A provides a detailed description of the construction of the variables and their sources.

18. We thank Amir Sufi for providing debt to income ratio data.

include these variables in separate regressions; the results are unchanged.

House price dynamics was a chief catalyst behind the collapse in household demand. To address further concerns about latent demand, column (3) directly controls for the average change in home prices in a county from 2008 to 2009. Including this variable further reduces the sample size, but as Table III, column (4) demonstrates, our main finding is little changed. The house price change point estimate is positive, though imprecisely estimated, and suggests that a 1 standard deviation increase in house prices is associated with a 0.05 standard deviation increase in the growth in nonbank-financed transactions. In Online Appendix Table A.6, column (4), we also include an interaction term between household leverage and house price changes in the county, and our basic results remain unchanged.

Last, in column (4) we add the change in household net worth between 2006 and 2009 as a control variable. Mian, Rao, and Sufi (2013) show that the deterioration in household balance sheets, as measured by county-level changes in household net worth, might have had a significant negative impact on local demand. Including this variable attenuates the sample size considerably, but our main results again remain unchanged. In summary, we have included a panoply of variables associated in the literature with the household demand channel, and consistent with a credit supply shock, Table III shows that nonbank-financed auto sales fell in those areas where borrowers were more heavily dependent on nonbank automotive credit.

V.B. Nonbank Dependence, Substitution, and Total Auto Sales

Here we examine the impact of nonbank dependence on sales financed by traditional deposit-taking institutions, as well as on total auto sales. If nonbank dependence proxies for latent demand, then a demand-side shock should induce a negative correlation between nonbank dependence and the growth in car sales, regardless of the lender's source of funds. In contrast, a decline in the supply of nonbank credit could prompt banks and credit unions to increase their financing of automobiles in areas most affected by the loss of nonbank credit. When using the growth in bank-financed transactions as the dependent variable, this substitution would in turn lead to a positive coefficient on the nonbank dependence variable. Such a change in the sign of the coefficient would be hard to reconcile with a "latent demand" interpretation of nonbank dependence.

Panel b of Online Appendix Table A.1 provides aggregate evidence consistent with substitution from nonbank credit to deposit-taking institutions during the crisis. The auto loan market share of finance companies—the bulk of which is captive finance—was 51.3% in 2005 and declined to just 41.3% and 36.7%, respectively, in 2009 and 2010. In contrast, the combined auto loan market share of credit unions and commercial banks rose from 44.9% in 2005 to 56.2% and 61.1%, respectively, in 2009 and 2010.

We test the substitution hypothesis directly in Table IV. We use the same empirical specification as in column (1), but we redefine the dependent variable as the change in the number of cars financed by banks and credit unions within a county between 2008 and 2009. Similar to the analysis presented in Table III, standard errors (in parentheses) are clustered at the state level, and the regressions are weighted using county population. We use the same set of explanatory variables from column (2) of Table III in the columns of Table IV.[19] As Table IV, column (1) illustrates, the nonbank dependence point estimate is now positive and statistically significant. A 1 standard deviation increase in captive dependence is associated with a 2.6 percentage point or 0.15 standard deviation increase in bank-financed transactions in the county. In Online Appendix Table A.7 we repeat the analysis in Table IV, column (1) for each of the specifications in Table III and find positive and statistically significant point estimates of nonbank dependence in every specification. The evidence of partial substitution from nonbank providers of credit to traditional deposit-taking institutions lends additional credence to the credit supply shock.

Next we analyze the aggregate consequences of the contraction in nonbank credit supply. To do so, we redefine the dependent variable as the log change in the number of all car sales in a county between 2008 and 2009, regardless of whether they were financed or what the source of financing was. As Table IV, column (2) demonstrates, the dependence coefficient is negative and statistically significant. A 1 standard deviation increase in nonbank dependence is associated with a 1 percentage point or 0.08 standard deviation decline in the growth in new car transactions over this period.

19. For brevity, we do not report the coefficients on the socioeconomic and demographic controls in Table IV.

TABLE IV

NONBANK DEPENDENCE AND AGGREGATE EFFECTS

	Bank-financed transactions	All transactions					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Nonbank dependence: Polk, 2006	Nonbank dependence: Polk, 2006	Nonbank dependence: Equifax, 2006	Nonbank dependence: Equifax, 2008	Polk: Extensive margin	Equifax credit score	Change: 2009–2007
Nonbank dependence, 2008 Q1 (Polk), financed transactions	0.257*** (0.0831)	−0.0926* (0.0490)				−0.0940* (0.0503)	−0.121* (0.0660)
Nonbank dependence, Equifax, 2006, financed transactions			−0.117*** (0.0251)				
Nonbank dependence, Equifax, 2008, Q1, financed transactions				−0.0972*** (0.0220)			
Nonbank dependence, 2008 Q1 (Polk), extensive margin					−0.126** (0.0567)		

TABLE IV

(CONTINUED)

	Bank-financed transactions	All transactions					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Nonbank dependence: Polk, 2006	Nonbank dependence: Polk, 2006	Nonbank dependence: Equifax, 2006	Nonbank dependence: Equifax, 2008	Polk: Extensive margin	Equifax credit score	Change: 2009–2007
Median credit score, 2008 Q1 (Equifax, nonbanks)						5.12e−05	
						(5.22e−05)	
Observations	2,825	2,825	2,827	2,287	2,825	2,494	2,825
R^2	0.700	0.703	0.707	0.723	0.705	0.712	0.797

Notes. This table reports regression results of estimating equation (1). The dependent variable in column (1) is the log change in the number of cars financed by banks and credit unions in 2009 relative to 2008. The dependent variable in columns (2)–(6) is the log change in the total number cars sold in a county in 2009 relative to 2008, regardless of the source of financing. Column (7) uses the log change in total number cars sold in a county in 2009 relative to 2007, regardless of the source of financing, as the dependent variable. Column (3) defines nonbank dependence as the ratio of nonbank transactions to all financed transactions, based on data from Equifax in 2006. Column (4) defines nonbank dependence as the ratio of nonbank transactions to all financed transactions, based on data from Equifax in 2008 Q1. Column (5) defines nonbank dependence as the ratio of nonbank transactions to all transactions, based on data from Equifax in 2006. Column (6) adds the Equifax measure of median credit score in the county of buyers using nonbank sources of automotive credit, observed in 2008 Q1, to the set of control variables. All columns include the same set of controls as in Table III, column (2). All variables are defined in Appendix A. All regressions are weighted by the county population and include state fixed effects. Standard errors are clustered at the state level. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

The implied economic impact of nonbank dependence on sales appears sizable. For each county we multiply its dependence on nonbank financing by the dependence coefficient from column (2). This product yields each county's predicted growth in total car sales, as determined by the county's degree of nonbank dependence. Multiplying this predicted growth rate by the level of sales in 2008 within the county gives the predicted change in car sales. Summing up across all counties suggests that the distress among nonbanks might account for a drop of about 478,776 cars in 2009 relative to 2008 sales; in our sample, 8.1 million cars were sold in 2008 and 6.5 million in 2009. This implies that the liquidity shock to nonbank financing capacity can potentially explain 31% of the drop in car sales in 2009 relative to 2008.

V.C. Measurement of Nonbank Dependence and Robustness Tests

We now check that our results are robust to alternative definitions of the timing of the nonbank dependence measure. Our baseline Polk measure is calculated using 2008 Q1 data, which might already reflect some credit substitution from nonbank to depository institutions and hence might not fully represent dependence on nonbank entities within the county. We address this concern in Table IV, column (3). We use the same specification as in column (2) but use the Equifax-derived nonbank dependence measure, calculated using 2006 data, instead of the baseline Polk measure. This measure precedes the crisis, is computed over a full year, and likely measures nonbank dependence more precisely.

The point estimate in column (3) is negative and significant and is larger than the baseline estimate in column (2) (−0.117 compared to −0.0926). A 1 standard deviation increase in this measure of nonbank dependence is associated with a 1.9 percentage point or 0.16 standard deviation decline in the growth in total car sales. Computing nonbank dependence based on Equifax data observed in 2008 Q1 (column (4)) yields a point estimate that is similar to that of column (2). In column (5) we use the extensive margin measure of nonbank dependence from Polk—nonbank-financed transactions to all transactions—observed in 2008 Q1 and find similar results. The results presented in Table IV demonstrate that the economic impact of the loss of nonbank financing capacity appears significant and robust across various measures of nonbank dependence from different sources.

Our baseline results are robust to the inclusion of the median Transunion-based FICO score in the county, but to assuage lingering measurement concerns, we turn again to Equifax micro-level data. Using these data, we calculate the median credit score for those borrowers who obtained nonbank automotive credit in the county in 2008 Q1, which allows us to measure more accurately the credit quality of nonbank customers. As column (6) shows, the point estimate on the baseline measure of dependence is little changed, and the Equifax-derived measure of borrower credit quality adds little information beyond the more general Transunion credit quality variable.

We investigate the sensitivity of these results to the timing of the collapse in auto sales. Because the Polk data set does not identify the source of credit before 2008 Q1, we have defined the collapse in car sales as the change in sales between 2008 and 2009. Given that the trough in annual sales occurred in 2009, this approach provides a reasonable approximation for the decline in auto sales (see Online Appendix Figure A.2). Nevertheless, disruptions in the ABCP market started in late 2007, and car sales began falling in 2008. As a robustness exercise, we use the log difference in car sales in 2009 relative to 2007 as the dependent variable in Table IV, column (7). As the final column of the table demonstrates, the nonbank dependence coefficient is similar to the one reported in column (2). A 1 standard deviation increase in nonbank dependence is associated with a 1.3 percentage point or 0.08 standard deviation decline in the growth in car sales, measured between 2007 and 2009.

The panel structure of the data can also illuminate the timing of the collapse in car sales. To this end, we regress the quarterly growth in new car sales within a county from 2006 Q1 through 2009 Q4. We include the baseline county-level controls along with our nonbank dependence measure. We interact the nonbank coefficient with quarter dummies to permit the impact of nonbank dependence to vary by quarter over the sample period. These coefficients, along with the 95% confidence bands—in dashed lines—are plotted in Figure IV.

As the figure shows, in 2006, when nonbank lenders were in general not financially constrained, car sales growth was positive in those counties where borrowers were more dependent on nonbank credit. The coefficient turns negative in the final quarter of 2007 as the ABCP market became stressed and again in the quarters around the collapse of Lehman Brothers. Consistent with the notion that the shutdown of the ABCP conduits of the major automotive captive financing arms in early 2009 might have greatly

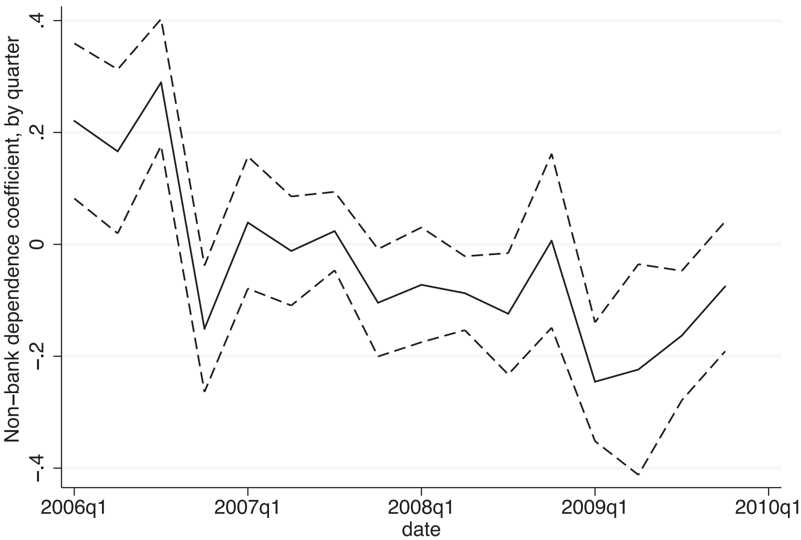

FIGURE IV

Captive Dependence and Car Sales, 2006 Q1–2009 Q4

The figure plots the coefficient (solid line) along with the 95% confidence band (dashed line) from regressing the quarterly growth in aggregate car sales (at the county level) on captive dependence (Polk), and the baseline controls from Table III, column (2), along with year-quarter fixed effects. The captive dependence coefficient is allowed to vary by quarter over the sample period.

increased financing constraints among nonbank lenders, the coefficient on nonbank dependence becomes even more negative in early 2009.

Changes in MMF flows—mutual funds that invest in short-term securities—over time can also shed light on the timing of the collapse in car sales (Online Appendix Figure A.4). Because MMFs were the principal source of funding for many securitization conduits, we would expect that when net flows into MMFs are plentiful, these funds are likely to increase their demand for nonbank automotive ABCP. Moreover, among MMFs, holdings of ABCP were highest among those that catered to institutional investors and specialized in non-Treasury securities (Kacperczyk and Schnabl 2013). In Online Appendix Table A.8, we show that car sales are more sensitive to aggregate fluctuations in short-term financing conditions—primarily flows into non-Treasury institutional MMFs—in those counties more dependent on nonbank credit.

In additional robustness tests, we repeat the main specification in Table IV, column (2) for each of the four broad geographic census regions and report results in Online Appendix Table A.9. Apart from the Northeast, where the small number of observations renders the estimates unreliable, the point estimate on nonbank dependence is negative across the regions, though imprecisely estimated when the sample size shrinks. Online Appendix Tables A.10A, A.10B, and A.10C consider a battery of additional robustness tests. Online Appendix Table A.10A replicates the robustness exercises from Table III using total car purchases as the dependent variable; the economic significance of the nonbank dependence coefficient is stable, but the coefficient becomes more imprecise when the sample size declines and the regressions are weighted by population. Online Appendix Table A.10B conducts the same exercise, but without the population weights; the nonbank dependence point estimate is negative and significant. Finally, Online Appendix Table A.10C repeats this exercise using the potentially more accurate nonbank dependence measure from Equifax (in 2006). Using the 2006 Equifax-based measure, we find that the point estimates are negative and robust across the various specifications even with the smaller sample sizes and when weighted by population.

V.D. Make Heterogeneity and County Fixed Effects

We analyze the heterogeneity of the effect of nonbank dependence on auto sales across the three largest auto manufacturers.[20] In the first nine columns of Table V, we restrict our analysis to one automaker in each regression and estimate specifications similar to regression (1) with the same set of control variables as in Table III, column (2). *Nonbank dependence* is defined as a county's dependence on nonbank credit for each of the automakers based on sales financed in 2008 Q1. Likewise, each of the dependent variables is calculated using the corresponding auto sales of GM, Ford, or Toyota. The table reports results for the three largest automakers in the United States: GM, columns (1)–(3); Ford, columns (4)–(6); and Toyota, columns (7)–(9).

The dependent variable in Table V, column (1) is the change in total GM sales within a county from 2008 to 2009. As the

20. There is evidence that concerns about the long-term solvency of the automobile manufacturer could independently shape the demand for its cars (see Hortaçsu et al. 2013).

TABLE V

WITHIN-MAKE EFFECTS OF CAPTIVE FINANCING ON AUTO SALES

Variables	(1) All GM sales	(2) GMAC-financed GM Sales	(3) Substitution: non-GMAC-financed GM sales	(4) All Ford sales	(5) FMC-financed Ford sales	(6) Substitution: non-FMC-financed Ford sales	(7) All Toyota sales	(8) TMC-financed Toyota sales	(9) Substitution: non-TMC-financed Toyota sales	(10) County, make-segment fixed effects
Nonbank dependence	−0.0419*	−0.425***	0.0814***	−0.0371**	−0.146***	0.299***	−0.0202*	−0.233***	0.192***	−0.0262*
	(0.0228)	(0.0537)	(0.0288)	(0.0182)	(0.0266)	(0.0295)	(0.0117)	(0.0613)	(0.0264)	(0.0145)
Observations	2,857	2,854	2,857	2,857	2,856	2,856	2,855	2,837	2,851	32,872
R^2	0.377	0.407	0.509	0.389	0.369	0.583	0.289	0.328	0.271	0.718

Notes. The dependent variable in column (1) is the log change in all GM sales in 2009 relative to 2008. Column (2) is the log change in GMAC-financed GM sales. Column (3) is the log change in all non-GMAC-financed GM sales. Columns (4)–(9) follow a similar pattern for Ford and Toyota sales. Captive dependence is defined as the 2008 Q1 market shares of GMAC, FMC, and TMC, respectively, in a particular county. In all cases, the share of the make in total county sales is included as a regressor along with the demographic controls in Table III, column (2). All changes are defined as the percentage change in 2009 over 2008. Column (10) stacks the data by make: GM, Ford, Toyota, and Honda; county and model segment. Column (10) includes county and brand fixed effects, along with county-segment fixed effects. All regressions are weighted by the county population and include state fixed effects. Standard errors are clustered at the state level. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

table shows, the point estimate on dependence is negative and significant, suggesting that the decline in GM sales was larger in those areas more dependent on GMAC: a 1 standard deviation increase in dependence is associated with a 0.14 standard deviation drop in the change in GM-branded cars sales. Column (2) shows that although GM cars financed by GMAC fell in those areas more dependent on GMAC, bank- and credit union–financed GM sales rose sharply in those areas in which nonbank providers like GMAC were more dominant (column (3)).

The remaining columns of Table V repeat the basic specifications for Ford and Toyota. The pattern is similar across the three largest automakers. It suggests that despite the variation in experiences across these firms, dependence on captive financing played a significant role in explaining a portion of the collapse in car sales.

Last, the richness of our data and particularly the availability of make- and model-level data allow us to once more gauge the extent of biased estimates due to latent county-level unobservables that might explain the demand for cars within a county and its dependence on captive financing. We build on the fact that the automobile market is highly segmented and thus that shocks to the demand for cars within a county could vary substantially across models, even for those sold by the same firm.

For example, some manufacturers, such as GM, offer a large number of makes and models aimed at buyers with different income levels: Chevrolet, a major make within GM, generally sells nonluxury models that are marketed toward lower- and middle-income buyers, whereas Buick and Cadillac, also GM makes, sell more luxurious models aimed at higher-income buyers.[21] As a result, the collapse in house prices and the rise in household leverage among lower-income borrowers could precipitate a drop in the demand for Chevrolet models within a county, whereas demand for Buicks and Cadillacs within the same county could be less affected because house price dynamics might have had a smaller impact on the net worth of these higher-income buyers.

Using the detailed model and make data from Polk, along with information on model types from Ward's Automotive (one of the

21. Even within some makes such as Chevrolet, some models, like the Corvette, are aimed at richer buyers. Bricker, Ramcharan, and Krimmel (2014) and the references therein discuss cars, status, and the marketing of cars in the United States.

standard purveyors of intelligence on the automotive industry), we augment our analysis to employ within-make within-county within-segment heterogeneity. Ward's identifies the market segment in which each car model competes, and we use this information to construct a county-make-segment panel: the number of cars that each make sold within each county in each market segment. The market segmentation in the industry can be highly detailed, and Ward's lists 30 segments. This level of granularity can lead to a large number of missing observations in our data set, as specialized models, such as the Chevrolet Corvette, tend to have a small number of sales in a limited geographic area. We thus collapse the 30 segments in Ward's into eight broad market segments that correspond to the Insurance Institute for Highway Safety's classification: small cars, mid-sized cars, large cars, luxury cars, small utility vehicles, mid-sized utility vehicles, large utility vehicles, and luxury utility vehicles.[22]

With information on county, make, and segment, we can include make fixed effects, county fixed effects, and county-segment fixed effects. Make fixed effects allow us to absorb any shocks to make-level sales that affects all counties and segments, such as the potential insolvency of a make, while county fixed effects absorb county-specific time-invariant factors that affect sales of all cars equally within the county. For example, a county's exposure to the Cash for Clunkers program, as determined by the preexisting fraction of "clunkers" in the county's automobile stock, could be correlated with sales in 2009 and with nonbank dependence (Mian and Sufi 2012). Similarly, a county's industrial structure, such as the degree of employment in nontraded goods, or its indirect connections to the automobile sector not measured by Bureau of Labor Statistics employment shares, could also drive demand and correlate with the nonbank credit, leading to biased estimates. County-segment fixed effects, however, absorb invariant factors that affect sales of a particular segment that vary across segments, even within the same county.

As Table V, column (10) demonstrates, our basic results remain the same when controlling for make and county-segment fixed effects. A 1 standard deviation increase in captive dependence measured is associated with about a 1.2 percentage point drop in sales in 2009. In summary, the combined evidence in

22. Appendix B provides more details on how the Ward's data are merged with Polk.

Table V renders it unlikely that our results are driven by omitted county or automaker factors. More important, column (10) shows that our results hold when we compare cars sold within county and auto segment, and thus it is unlikely that our captive dependence measure captures latent demand for cars.

VI. Micro-Level Evidence from Equifax

VI.A. *Controlling for Individual Equifax Risk Scores*

Our county-level analysis provides evidence that illiquidity among nonbank lenders had a significant adverse effect on car sales. Although these results are robust to the inclusion of various measures of household demand and the housing cycle, there remains a concern that county-level variation in nonbank dependence might reflect compositional differences in borrower credit quality and latent demand between nonbank and bank borrowers. Because of these differences, borrowers from captive leasing companies and other sources of nonbank credit might be more likely to face a contraction in their credit limits imposed by other lenders, such as credit card companies. Rather than reflecting the effects of diminished nonbank financing induced by illiquidity in short-term funding markets, these results might be an artifact of a more general contraction in credit to risky borrowers.

To address these concerns, we turn to individual-level data from Equifax. Equifax records information about a person's liabilities—automotive debt, mortgages, student loans, credit card debt, and credit card borrowing limits—along with the person's age, Equifax dynamic risk score, and zip code of residence. In the case of automotive debt, the data set also identifies whether credit was obtained from a nonbank lender or a depository institution. We use a 10% random sample from Equifax that we observe quarterly from 2006 Q1 through 2009 Q4—a panel of about three million individuals.

These micro-level individual data enable us to study how exposure to nonbank financing—the degree of nonbank dependence in the county—might have affected an individual's likelihood of obtaining nonbank automotive credit, controlling directly for the borrower's risk score, as well as other measures of borrower credit quality. We present summary statistics for the Equifax sample on credit card balances, credit card limits, risk score, year of birth, and homeownership rate in Table VI for counties below and above

TABLE VI

NONBANK DEPENDENCE AND INDIVIDUAL-LEVEL CHARACTERISTICS, EQUIFAX

	Credit card balance	Credit card limits	Equifax risk score	Year of birth	Homeownership rate
Panel A: Counties below the median in “captive dependence”					
Mean	5,232	3,992.3	687.3	1957.4	0.18
Median	4,301	3,774.3	690.4	1957.7	0.18
Std. dev.	5,282	1,707.2	27.2	3.0	0.07
Panel B: Counties above the median in “captive dependence”					
Mean	5,594	3,439.5	674.2	1958.4	0.17
Median	4,684	3,201.1	676.0	1958.6	0.17
Std. dev.	4,772	1,980.1	29.4	3.0	0.07

Notes. This table reports summary statistics from the Equifax data set in 2007 at the county level. Panel a restricts the sample to individuals living in counties with a below median “captive dependence” share, defined as the ratio of captive financed transactions to all retail transactions, as recorded in Polk 2008 Q1. Panel b restricts the sample to those counties at or above the median level of captive dependence. Credit card balances are computed for the sample of individuals with a positive balance.

the nonbank-dependence median. The Equifax-based summary statistics in Table VI are consistent with the notion that counties more dependent on automotive nonbank finance generally have populations that register higher credit card balances and lower credit limits, with concomitantly lower credit scores. The populations in the more nonbank-dependent counties are also marginally younger and are less likely to own a home or at least have mortgage-related debt.

These potentially important differences in borrower composition among users of nonbank credit render the household-level tests even more important. By including the individual’s risk score, age, and homeownership status, plus credit card balances and revolving credit limits, we can directly control for key measures of borrower credit quality. That is, unlike the more aggregate county-level evidence, these individual-level controls restrict the potential for biased estimates that might arise from latent demand and unobserved differences in the composition of borrowers between nonbank lenders and other sources of automotive credit. The panel structure of these tests, which allow us to hold constant these borrower-level observables and study how the variation in nonbank financing capacity over the crisis period might have affected individual-level credit access, can offer powerful evidence of the credit supply channel.

In Table VII, column (1) we use a linear probability model to estimate the probability that an individual obtains nonbank

TABLE VII
NONBANK DEPENDENCE AND CAR BUYING, INDIVIDUAL-LEVEL EVIDENCE

Variables	(1) Nonbanks 2008–2009	(2) Nonbanks 2007–2009	(3) All sales 2008–2009	(4) Mortgage credit 2008–2009	(5) Credit limit 2008–2009
Equifax risk score, log	−0.0159***	−0.0188***	−0.0107***	0.383***	5.161***
	(0.000873)	(0.000954)	(0.000743)	(0.0147)	(0.240)
Credit card balance, log	−0.000329***	−0.000358***	−0.000838***	0.00524***	0.923***
	(4.21e−05)	(3.66e−05)	(7.72e−05)	(0.00124)	(0.00328)
Credit card limit, log	0.000308***	0.000335***	0.000872***	0.0277***	
	(1.68e−05)	(1.69e−05)	(3.81e−05)	(0.000713)	
Age	0.149***	0.165***	0.438***	3.854***	−46.41***
	(0.0121)	(0.0127)	(0.0174)	(0.382)	(1.660)
Homeowner indicator	0.00702***	0.00778***	0.0162***		2.119***
	(0.000288)	(0.000318)	(0.000649)		(0.0545)
Nonbank dependence (Polk)	0.00818***	0.00787***	−0.00803*	−0.0112	−1.535***
	(0.00190)	(0.00244)	(0.00415)	(0.0284)	(0.191)
Nonbank dependence (Polk) * 2007 Q2		3.41e−05			
		(0.000759)			
Nonbank dependence (Polk) * 2007 Q3		0.00133			
		(0.00260)			
Nonbank dependence (Polk) * 2007 Q4		−0.00138			
		(0.00221)			
Nonbank dependence (Polk) * 2008 Q1		−0.000629			
		(0.00104)			

TABLE VII

(CONTINUED)

Variables	(1) Nonbanks 2008–2009	(2) Nonbanks 2007–2009	(3) All sales 2008–2009	(4) Mortgage credit 2008–2009	(5) Credit limit 2008–2009
Nonbank dependence (Polk) * 2008 Q2	–0.00161**	–0.00224**	–0.00556***	–0.00108	–0.0757***
	(0.000653)	(0.00103)	(0.00170)	(0.00230)	(0.0175)
Nonbank dependence (Polk) * 2008 Q3	–0.000939	–0.00158	–0.00371***	–0.00281	–0.00740
	(0.000685)	(0.00117)	(0.00125)	(0.00245)	(0.0417)
Nonbank dependence (Polk) * 2008 Q4	–0.00217**	–0.00282*	–0.00212	–0.000755	0.0619
	(0.000983)	(0.00157)	(0.00188)	(0.00270)	(0.0630)
Nonbank dependence (Polk) * 2009 Q1	–0.000795	–0.00148	0.00162	0.00173	0.223***
	(0.00127)	(0.00174)	(0.00192)	(0.00531)	(0.0789)
Nonbank dependence (Polk) * 2009 Q2	–0.00147	–0.00216	–0.00251	0.000728	0.243***
	(0.00127)	(0.00165)	(0.00224)	(0.00575)	(0.0843)
Nonbank dependence (Polk) * 2009 Q3	–0.00664***	–0.00733***	–0.00998***	–0.000442	0.229**
	(0.00180)	(0.00234)	(0.00320)	(0.00500)	(0.0902)
Nonbank dependence (Polk) * 2009 Q4	–0.00250	–0.00318	–0.00251	–0.00175	0.226***
	(0.00161)	(0.00216)	(0.00266)	(0.00624)	(0.0820)
Observations	23,665,802	35,561,957	23,665,802	23,665,802	23,665,802
R^2	0.003	0.003	0.006	0.110	0.200

Notes. The dependent variable in columns (1) and (2) equals 1 if an individual financed a car purchase in the quarter through a nonbank lender and 0 otherwise. The dependent variable in column (3) equals 1 if an individual financed a car in the quarter, regardless of the credit source and 0 otherwise. The dependent variable in column (4) equals 1 if the individual obtained a mortgage in the quarter and 0 otherwise. The dependent variable in column (4) is the log of the individual's credit limit. In all columns, the data are quarterly and, for columns (1) and (3)–(5), are observed from 2008 Q1–2009 Q4; column (2) includes data from 2007 Q1–2009 Q4.

automotive credit in a given quarter in 2008–2009. Building on the earlier panel-level results (Figure IV), which show that captive financing capacity changed substantially over this period, we allow the coefficient on nonbank dependence at the county level to vary by quarter. In addition to the household-level controls, we include state and year-by-quarter fixed effects, and we cluster standard errors at the state level.

The evidence in column (1) suggests that with individual risk score, age, credit card balance, and mortgage status held constant, individuals are more likely to obtain nonbank automotive credit when they live in a county with a greater dependence on nonbank credit. Strikingly, however, the impact of nonbank dependence on the probability of obtaining captive credit changes considerably over the sample period. The coefficient drops by about 28% from the first quarter of 2008 to the final quarter of that year. It rebounds slightly in the beginning of 2009 but drops sharply toward the end of the year, by a factor of almost eight relative to its peak in the first quarter of 2008, and becomes insignificant in the third quarter of 2009.

To understand better the timing of the shock at the individual level, we extend the sample back to 2007. These results are reported in Table VII, column (2). Although turbulence in the housing market and deleveraging already began in 2007, we find no evidence of a decline in the nonbank coefficient during this period (Mayer, Pence, and Sherlund 2009). Similar to the county-level results (Figure IV), the nonbank dependence coefficient becomes significantly negative for the first time in the second quarter of 2008. Also consistent with Figure IV, this point estimate remains negative throughout the remaining quarters. This suggests that our findings are unlikely to be driven by omitted variables pertaining to the local housing market and its effects on consumer credit. In Online Appendix Table A.11A, column (1) we confirm this result by restricting the sample to 2007. These results are also little changed if we model the persistence in car-buying behavior with a lagged dependent variable or if we control for borrower observables using lagged values—observed either one quarter before or at the beginning of year.

Table VII, column (3) focuses on aggregate car sales over 2008–2009. The dependent variable is the probability that an individual obtains automotive credit, regardless of the source of financing—excluding cash purchases, since Equifax has no information on these. As with column (1), for individuals living in a more nonbank-dependent county, the likelihood of obtaining automotive credit fell sharply at the end of 2009. In particular, the nonbank-dependence coefficient declines by about 33% in the third quarter of 2009 compared to its peak in the first quarter of 2008. This decline is less than the eightfold drop observed in column (1), as other sources of automotive financing might have substituted for the loss of nonbank financing.

We now consider a number of robustness tests. Table VI suggests that counties more dependent on nonbank finance might differ from those more dependent on bank credit. To check whether nonbank dependence might more generally proxy for credit conditions within a county, Table VII, column (4) uses the probability that the individual buys a home in the quarter as the dependent variable. If the nonbank-dependence variable reflects local credit conditions, such as the supply of mortgage financing, then the nonbank-dependence coefficients should also evince a similar pattern to that observed in columns (1) and (2). The estimates in column (4) show no such pattern. Instead, the nonbank dependence coefficient is insignificant. That said, the demand for houses might have begun declining before the first quarter of 2008, and in Online Appendix Table A.11A, column (2) we repeat the analysis for 2007–2009. The nonbank dependence coefficient remains insignificant.

To check further whether nonbank dependence might proxy for other types of binding credit constraints at the individual level, Table VII, column (5) uses the log of the individual's credit card limit as the dependent variable.[23] If anything, the nonbank-dependence point estimate becomes less negative and even positive over time as the economy exited the recession in the second half of 2009. As an alternative measure, we let the credit limit equal 1 for those households with positive limits and 0 otherwise. We also consider the credit utilization rate— the ratio of credit balances to limits—among those individuals with positive credit limits. In both cases, there is no evidence that nonbank dependence might proxy for other types of binding credit constraints as demonstrated in Online Appendix Table A.11A, columns (3) and (4).

Last, we aggregate the individual-level data up to the county to check further whether nonbank dependence might be associated with broader credit outcomes. That is, we examine whether the change in mortgage balances between 2008 and 2009

23. We transform the credit card limit to log(1 + credit card limit).

within a county, or the log level of mortgage balances in 2009, is correlated with the county's nonbank dependence. Similarly, we aggregate up credit card balances and examine whether the change in the total credit card balance between 2008 and 2009 at the county level is correlated with nonbank dependence. In all cases the nonbank dependence coefficient is not significant. These results are presented in Online Appendix Table A.11B.

VI.B. Captive Dependence and Local Auto Sales Stratified by Equifax Risk Score

Reputational motives as well as declining collateral values can prompt financial institutions to tighten credit policies after an adverse shock.[24] Therefore, to gauge further the robustness of our results and understand better the underlying channels through which the financing shock might have led to the drop in car sales, we examine how the impact of exposure to nonbank financing on the likelihood of obtaining nonbank automotive credit might have varied by borrower credit quality. To this end, we estimate the baseline specification in Table VII, column (1) separately for borrowers with different risk scores and report the results in Table VIII. We stratify the Equifax data by risk score quartiles: column (1) uses the subsample of borrowers in the lowest quartile—those with a risk score below 603; column (2) uses borrowers from the second quartile, between 603 and 706; column (3) focuses on the third quartile, 706–784; and column (4) contains those borrowers with scores above 784.

Across all borrower risk score categories, the point estimates imply that access to nonbank automotive credit declined sharply toward the end of 2008 and again in the second half of 2009. For example, even among those borrowers in the top quartile, the nonbank dependence coefficient, although positive in the first quarter of 2008, declines by about 43% in the third quarter of 2009 relative to its value in the first quarter of 2008. But consistent with the idea that credit policy might have become especially conservative after a shock, the decline in nonbank credit access appears to be most severe for those borrowers with risk scores in the bottom quartile. From column (1) the overall impact of dependence in the third quarter of 2009 is negative, suggesting that these

24. See Bernanke and Gertler (1989), Rajan (1994), and the loan-level evidence from the financial crisis in Ramcharan, van den Heuvel, and Verani (2016) and Ramcharan and Crowe (2013).

TABLE VIII

CAPTIVE DEPENDENCE AND CAR BUYING STRATIFED BY EQUIFAX RISK SCORE

Variables	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Captive dependence (Polk)	0.00290	0.0129***	0.00980***	0.00739***
	(0.00378)	(0.00223)	(0.00144)	(0.00210)
Captive dependence (Polk) * 2008 Q2	−0.00214	−0.00184	5.59e−06	−0.00244
	(0.00272)	(0.00166)	(0.00128)	(0.00194)
Captive dependence (Polk) * 2008 Q3	−0.00252	−0.000426	−0.000534	0.000776
	(0.00232)	(0.00146)	(0.00113)	(0.000887)
Captive dependence (Polk) * 2008 Q4	−0.00175	−0.000221	−0.00261**	−0.00254**
	(0.00251)	(0.00159)	(0.00127)	(0.00118)
Captive dependence (Polk) * 2009 Q1	0.000400	−0.000336	−0.000574	−0.000840
	(0.00270)	(0.00173)	(0.00138)	(0.00113)
Captive dependence (Polk) * 2009 Q2	0.000407	−0.000803	−0.000461	−0.00287*
	(0.00332)	(0.00184)	(0.00105)	(0.00154)
Captive dependence (Polk) * 2009 Q3	−0.00557**	−0.00847***	−0.00576***	−0.00342*
	(0.00269)	(0.00273)	(0.00199)	(0.00178)
Captive dependence (Polk) * 2009 Q4	−0.00208	−0.00308	−0.000748	−0.00140
	(0.00328)	(0.00188)	(0.00174)	(0.00146)
Observations	5,870,586	5,934,242	5,896,749	5,858,620
R^2	0.002	0.003	0.003	0.003

Notes. The dependent variable equals 1 if an individual financed a car purchase in the quarter through a nonbank and 0 otherwise. All columns include the same controls as in Table VII; observed from 2008 Q1–2009 Q4, and standard errors are clustered at the state level. Column (1) includes individuals with a risk score below 603; column (2) uses scores between 603 and 706 (second quartile); column (3) uses 706–784 (third quartile); and column (4) focuses on individuals with scores above 784.

borrowers were less likely to obtain captive credit in those areas more dependent on nonbank financing.

VII. CONCLUSION

There is growing consensus that the financial crisis of 2008–2009 shared many elements of a bank run, but one concentrated in the non-deposit-taking sectors of the financial system that primarily relied on short-term funding. Less well understood, however, are the economic consequences of the runs in these funding markets. Focusing on the U.S. automobile sector, we show that the illiquidity in short-term funding markets during the crisis might have played an important role in limiting the supply of nonbank automotive credit, such as automotive captive lenders, during the financial crisis. In particular, our estimates suggest that this contraction in the supply of nonbank automotive credit, largely due to the illiquidity in the ABCP market, might explain about one-third of the collapse in car sales during this period, possibly further worsening the financial situation of the major U.S. automakers.

This evidence is related to the broader literature on how funding disruptions and other balance sheet shocks to traditional financial institutions might affect credit availability to the real economy. Our results also suggest that although shocks to the balance sheet of households might account for a substantial part of the decline in economic activity after the crisis, illiquidity in short-term funding markets and balance shocks to both bank and nonbank institutions might also explain some of this decline, despite myriad policy interventions. We leave it to future research to measure more precisely the efficacy of these interventions.

Appendix

A: Variable Description and Construction

For reference, the following is a list of variables used in the article, their sources, and a brief description of how each variable is constructed.

African American population: Number of African Americans in a county. (Source: American Community Survey)

Assets: Total bank assets. (Source: FR Y9-C, FFIEC 031)

Captive dependence: Share of county-level retail car sales financed by captive financing companies. (Source: Polk)

Captive financed sales: County-level retail car sales financed by captive financing companies. (Source: Polk)

County area: Size of a county in square miles. (Source: American Community Survey)

Employment in automobile manufacturing: Divides the number of employees in the automobile sector by total employment. (Source: Quarterly Census of Employment and Wages)

Gini coefficient: Measures income inequality in a county. (Source: American Community Survey)

House price change: Annual change in the local house price index. (Source: CoreLogic)

Household leverage: County-level household debt-to-income ratio. (Source: Federal Reserve of New York)

Median household income (Source: American Community Survey)

Median credit score, 2008 Q1 (Trans Union): The median FICO score in the county in 2008 Q1 from Trans Union, drawn from the entire population in the county.

Median credit score, 2008 Q1 (Equifax): The median Equifax risk score in the county in 2008 Q1 among buyers using captives for automotive credit.

Money market fund flows: Quarterly net flows to (from) money market funds. (Source: Flow of Funds, Federal Reserve Board)

Noncaptive financed sales: County-level retail car sales not financed by captive financing companies. (Source: Polk)

Percent African American: African American population divided by total population. (Source: American Community Survey)

Population: Number of people in a county. (Source: American Community Survey)

Population density: Population divided by area. (Source: American Community Survey)

Poverty rate: Number of people living below the poverty line divided by population. (Source: U.S. Census)

Retail car sales: The sum of retail purchases and retail leases. (Source: Polk)

Unemployment rate: County-level labor force divided by the number of unemployed. (Source: Bureau of Labor Statistics)

White population: Number of Caucasians in a county. (Source: American Community Survey)

B: Auto Segment Construction

The eight auto segments used in make-county regression (Table V) include the following models:

Small cars (Ward's categories: lower small and upper small): BMW 128, BMW 135, Chevrolet Aveo, Chevrolet Cobalt, Dodge Caliber, Ford Focus, Honda Civic, Honda Fit, Hyundai Accent, Hyundai Elantra, Kia Forte, Kia Rio, Kia Soul, Kia Spectra, Mazda 3, Mini Cooper, Mitsubishi Lancer, Nissan Cube, Nissan Sentra, Nissan Versa, Pontiac G3, Pontiac Vibe, Saab 93, Saturn Astra, Subaru Impreza, Saturn Ion, Suzuki Aerio, Suzuki Forenza, Suzuki Reno, Suzuki SX4, Toyota Corolla, Toyota Yaris, Volkswagen GLI, Volkswagen Golf, Volkswagen Jetta, Volkswagen Rabbit, Volkswagen R32, Volvo V50.

Mid-sized cars (Ward's categories: lower middle and upper middle): Buick Lacrosse, Chevrolet Impala, Chevrolet Malibu, Chrysler Sebring, Dodge Avenger, Ford Fusion, Honda Accord, Honda FCX, Honda Insight, Hyundai Azera, Hyundai Sonata, Kia Optima, Mazda 6, Mercury Mila, Mercury Montego, Mercury Sable, Mitsubishi Galant, Nissan Altima, Pontiac G6, Pontiac G8, Pontiac Grand Prix, Saturn Aura, Subaru Legacy, Suzuki Kizashi, Toyota Camry, Volkswagen CC, Volkswagen Passat, Volvo V70.

Large cars (Ward's category: large): Buick Lucerne, Chrysler 300, Dodge Charger, Dodge Magnum, Ford Crown Victoria, Ford Five Hundred, Ford Taurus, Kia Amanti, Mercury Grand Marquis, Mercury Monterey.

Luxury cars (Ward's categories: small luxury, middle luxury, and large luxury): Acura RL, Acura TL, Acura TSX, Audi A3, Audi A4, Audi A6, Audi S4, Bentley Continental, BMW 328, BWM 335, BW 525, BMW 528, BMW 530, BMW 535, BMW 550, BMW M3, BMW M5, Cadillac CTS, Cadillac DTS, Cadillac STS, Chevrolet Monte Carlo, Hyundai Genesis, Infiniti G35, Infiniti G37, Infiniti M35, Infiniti M45, Jaguar S-Type, Jaguar X-Type, Lexus ES, Lexus GS, Lexus HS250H, Lexus IS, Lincoln MKS, Lincoln MKZ, Lincoln Town Car, Mercedes-Benz C-Class, Mercedes-Benz CLK-Class, Mercedes-Benz E-Class, Nissan Maxima, Toyota Avalon, Volvo S40, Volvo S60, Volvo S80.

Small utility vehicles (Ward's categories: small cross/utility and small sport/utility): Chevrolet HHR, Chrysler PT Cruiser, Dodge Nitro, Honda Element, Hyundai Tucson, Jeep Compass, Jeep Liberty, Jeep Patriot, Jeep Wrangler, Kia Sportage, Land Rover LR2, Mercury Mariner, Saab 95, Suzuki Grand Vitara.

Mid-sized utility vehicles (Ward's categories: middle cross/utility and middle sport/utility): Chevrolet Equinox, Chevrolet Trailblazer, Dodge Journey, Ford Edge, Ford Escape, Ford Explorer, GMC Envoy, GMC Terrain, Honda CR-V, Honda

Crosstour, Honda Pilot, Hyundai Santa Fe, Hyundai Veracruz, Isuzu Ascender, Jeep Commander, Jeep Grand Cherokee, Kia Borrego, Kia Rondo, Kia Sorento, Land Rover LR3, Mazda CX-7, Mazda 5, Mazda Tribute, Mitsubishi Endeavor, Mitsubishi Outlander, Nissan Murano, Nissan Pathfinder, Nissan Rogue, Nissan Xterra, Pontiac Torrent, Saturn Vue, Subaru B9 Tribeca, Subaru Forester, Subaru Outback, Suzuki XL7, Toyota 4 Runner, Toyota FJ Cruiser, Toyota Highlander, Toyota RAV4, Toyota Venza, Volkswagen Tiguan.

Large utility vehicles (Ward's categories: large cross/utility and large sport/utility): Buick Enclave, Chevrolet Suburban, Chevrolet Tahoe, Chevrolet Traverse, Chrysler Aspen, Dodge Durango, Ford Expedition, Ford Flex, Ford Freestyle, Ford Taurus X, GMC Acadia, GMC Envoy XL, GMC Yukon, Mazda CX-9, Mitsubishi Montero, Nissan Armada, Saturn Outlook, Toyota Sequoia.

Luxury utility vehicles (Ward's categories: small luxury cross/utility, middle luxury cross/utility, large luxury cross/utility, luxury middle sport/utility, and luxury large sport/utility): Acura MDX, Acura RDX, Acura ZDX, Audi Q5, Audi Q7, BMW X3, BMW X5, BMW X6, Buick Rainier, Buick Rendezvous, Cadillac Escalade, Cadillac SRX, Chrysler Pacifica, Hummer 4-PSGR Wagon, Hummer H2, Hummer H3, Infiniti EX, Infiniti FX35, Infiniti FX45, Infiniti FX50, Infiniti QX56, Land Rover LR4, Land Rover Range Rover, Lexus GX, Lexus LX, Lexus RX, Lincoln MKT, Lincoln MKX, Lincoln Navigator, Mercedes-Benz G-class, Mercedes-Benz GL-class, Mercedes-Benz GLK, Mercedes-Benz M-class, Mercedes-Benz R-class, Mercury Mountaineer, Porsche Cayenne, Saab 9-7X, Subaru Tribeca, Toyota Land Cruiser, Volkswagen Touareg, Volvo XC60, Volvo XC70, Volvo XC90.

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SUPPLEMENTARY MATERIAL

An Online Appendix for this article can be found at *The Quarterly Journal of Economics* online.

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