How Much Are Car Purchases Driven by Home Equity Withdrawal?

Brett A. McCully, Karen M. Pence, and Daniel J. Vine[1]

December 2017

Abstract

Changes in housing wealth appear to cause changes in consumption, including, according to some studies, car sales. We show in this paper that very few households fund their car purchases with the proceeds from home equity extraction. In three different nationally representative surveys, very few households report using home equity lines of credit or the proceeds from a cash-out mortgage refinancing to purchase a car, even during the years of the housing boom in the mid-2000s. We find in credit bureau records that borrowers who extract equity have a higher probability of originating an auto loan after the extraction, suggesting that equity extraction may ease credit constraints in the auto loan market. However, we find that this indirect effect also accounts for a very small number of car purchases. The results imply that the positive correlation between home prices and car purchases observed in other studies results from car purchased with auto loans or cash, not home equity extraction.

[1] Author contact information: McCully, UCLA Department of Economics, bmcully@ucla.edu; Pence and Vine, Board of Governors of the Federal Reserve System, Karen.Pence@frb.gov, Daniel.J.Vine@frb.gov. We are grateful to Kyle Coombs and Jimmy Kelliher for extraordinary research assistance and to Ben Keys and many Federal Reserve colleagues for helpful comments. The views in this paper are the authors' alone and do not necessarily represent the views of the Board of Governors of the Federal Reserve System or its staff.

Introduction

House prices in the U.S. rose dramatically from 1998 to 2006 and then plunged thereafter, bottoming out in 2011. Several studies, which we review below, have connected these changes in housing wealth to patterns in consumer spending on other goods, in particular automobiles. Less is known, however, about how households deploy their home-equity gains in order to purchase autos.

Some narratives in the popular press suggest that households commonly use the proceeds from home equity extraction to fund auto purchases, particularly during the mid-2000s housing boom (see, e.g., Dash, 2008; Harney, 2015; Singletary, 2007). These narratives are a bit puzzling, as the most cost-effective way for most households to finance a car purchase is to use an auto loan rather than a home equity loan, even during housing booms. To evaluate these narratives, we consider two ways in which homeowners might use home equity to purchase cars. First, homeowners might use equity extraction proceeds to purchase cars outright. Second, households might use equity extraction proceeds to facilitate purchasing a car with an auto loan. In particular, credit-constrained households might use home equity proceeds to alleviate down payment constraints in the auto loan market or to pay down high-interest debt and thereby free up space in their budgets to take out an auto loan.

We find evidence that both pathways play some role in the relationship between house prices and car purchases, but neither pathway appears to have been a quantitatively important part of car purchases during the mid-2000s housing boom. We first show that very few households report purchasing cars primarily with funds from home equity lines of credit or the proceeds of cash-out refinancing, even during the housing boom years. This result is consistent across three nationally representative household surveys. We then use credit bureau data to

explore whether home equity extraction indirectly affected car purchases by facilitating new auto loans. We find relatively strong evidence of this relationship. Additional specifications suggest that the relationship is more likely a reflection of equity extraction easing down payment requirements in the auto loan market than of interactions with uncollateralized debt. But regardless of its cause, the quantitative impact of home equity extraction on car purchases through the auto loan channel is still quite small.

The identification strategy in the analysis of the credit bureau data is an event-study setup that looks for discontinuous increases in auto loan originations shortly after equity extraction. This setup allows us to distinguish the role of equity extraction in easing auto-loan credit constraints from other factors that might cause equity extraction and auto lending to move together, such as house prices and interest rates, and to assert that the relationship that we find between equity extraction and auto lending is likely causal.

Our results provide mixed support for studies in the existing literature that find that housing wealth primarily supported consumption during the 2000s by increasing the ability of households to borrow. Some patterns in the credit bureau data are consistent with this narrative, such as the stronger relationship we find between home equity extraction and subsequent auto loan origination for borrowers with low- to moderate credit scores than for other borrowers. However, individuals who report in the household surveys using home equity as their main source of funds for purchasing a car do not appear to be particularly borrowing-constrained. Because so few car purchases are funded through home equity, though, we hesitate to generalize too broadly about the implications of our findings for housing wealth and consumption.

Our results cast some doubt on stories that home equity extraction played an important role as a source of funds for auto purchases during the housing boom in the mid-2000's, but they

do not imply that housing wealth is inconsequential for auto purchases. Although few households appear to use home equity directly, or indirectly via auto loans, to purchase cars, money is to some extent fungible, and purchasing other goods and services with home equity may free up space in a household balance sheet to buy a car. We explore these thoughts in more detail in the conclusion.

Related Literature

Our paper contributes to two literatures: (1) Studies that examine the relationship between house prices and consumption, and (2) studies that explore credit constraints in the auto loan market. Turning first to house prices and consumption, one key question in this vast literature is whether increases in house prices spur consumption primarily because households are wealthier (the wealth-effects channel) or because lenders are willing to extend more credit to households after their house values rise (the borrowing-constraints channel).[2] The studies that have examined this relationship using data from the 2000s generally conclude that borrowing constraints are the more important of the two channels (see, e.g., Aladangady, 2017, Bhuttta and Keys, 2016, Cooper, 2013, and Cloyne, Huber, Ilzetzki, and Klevin, 2017).

Consistent with this general finding, several studies also indicate that borrowing constraints in the mortgage market are an important part of the link between house prices and auto sales. Mian, Rao, and Sufi (2013) and Mian and Sufi (2014) find that the relationship between house-price changes and auto sales is strongest in zip codes where a large share of the residents had high debt burdens or low incomes. Brown, Stein, and Zafar (2015) show that house price increases in the 2002-06 period were associated with increases in borrowing on both

[2] Berger, Guerrieri, Lorenzoni, and Vavra (forthcoming) provide a recent treatment of the channels between house prices and consumption.

home equity lines of credit and auto loans; the response of auto debt to house price changes was strongest for subprime borrowers. Gabriel, Iacoviello, and Lutz (2017) show that auto sales increased more in counties where California's foreclosure prevention programs were especially successful in stabilizing house prices after the 2007-09 recession; they attribute the relationship to the rise in housing wealth easing credit constraints.

Other studies find that auto loan originations increase when changes in mortgage finance conditions allow more households to tap their home equity. Beraja, Fuster, Hurst, and Vavra (2017) find that the drop in mortgage rates that ensued after the start of the Federal Reserve's large-scale asset purchase program resulted in the largest increase in auto purchases in MSAs with highest median home equity. They also find that auto loan originations increased more for individuals that had a cash-out refinancing than a non-cash-out refinancing. Laufer and Paciorek (2016) find that looser credit standards on mortgage refinancing are associated with an increase in auto loan originations among subprime mortgage borrowers.

Our contribution to this literature is to ask whether home equity extraction is the source of funding that households who experience large house price gains use to purchase cars. Other than the Beraja, Fuster, Hurst, and Vavra result referenced above that ties home equity extraction to increases in auto loan originations among households who recently refinanced their mortgages, this particular question has not been investigated very thoroughly in the extant literature. For households who appear to have purchased cars with home equity, we consider whether their characteristics are consistent with borrowing constraints having been a key factor in their choice of payment method.

Turning to the second literature, several studies have documented that borrowing constraints are an important feature of the auto-loan market (Attanasio, Goldberg, and

Kyriazidou, 2008). In particular, minimum down payments have been shown to matter a great deal for borrowers in the subprime auto loan market (Adams, Einav, and Levin, 2009). Consistent with this idea, Cooper (2010) finds a positive relationship between home equity extraction and automobile costs (which include down payments on loans and leases) in some waves of the Panel Study of Income Dynamics.

One indication of these borrowing constraints for some households is that auto purchases are sensitive to transitory changes in income. Some studies show this sensitivity by using transitory changes in income related to mortgage-market conditions. For example, Agarwal et al. (2017) and DiMaggio et al. (2017) find an increase in auto loan originations after a drop in household mortgage payments due to the Home Affordable Modification Program and mortgage-rate resets, respectively. DiMaggio et al. (2017) find a stronger response for homeowners with lower incomes and higher loan-to-value ratios. Other examples of transitory changes in income that appear to affect car sales include tax refunds (Adams, Einav, and Levin, 2009; Souleles, 1999); economic stimulus payments (Parker, Souleles, Johnson, and McClelland, 2013); an increase in the minimum wage (Aaronson, Agarwal, and French, 2012); an increase in Social Security benefits (Wilcox, 1989); and expansions of health insurance (Leininger, Levy, and Schanzenbach, 2010). We add to this literature by documenting that car purchases are responsive to increases in available liquidity in the form of equity extraction. We believe that we are also the first authors to explicitly link an easing of borrowing constraints in the mortgage market to an easing of borrowing constraints in the auto loan market.

Home Equity Extraction as a Source of Funds for Car Purchases

We begin by measuring the share of auto purchases that are funded directly by home equity. Using household surveys, we define a car purchase as "funded directly" with home

equity if a respondent indicates that she bought a new or used car and that home equity was a source of funding. Our analysis is based on three surveys: The Reuters/University of Michigan Survey of Consumers (Michigan Survey), the Federal Reserve's Survey of Consumer Finances (SCF), and the Bureau of Labor Statistics' Consumer Expenditure Survey (CE). As described in Appendix 1, the three surveys ask about home equity extraction and auto purchases in different ways, but the relationships between these events that we find are quite consistent across the surveys.

As shown in Table 1, households rarely report using home equity to purchase cars. Results from the three surveys suggest that home equity extraction funds about 1 to 2 percent of both new- and used-car purchases. If we run these tabulations on the SCF and CE using only data for homeowners, as renters cannot have home equity, the shares of car purchases funded with home equity are only about ½ percentage point higher.[3] The surveys show that households typically fund new car purchases with auto loans, which finance around 70 percent of new-car purchases and a somewhat smaller share of used-car purchases—around 40 to 50 percent. Cash or some other source of funds are used to finance the remaining 25 percent or so of new-car purchases and 50 to 60 percent of used-car purchases.[4]

Although home equity appears to directly fund only a very small share of car purchases, its use might have picked up during the housing boom and then dropped off during the financial crisis. To assess this possibility, we calculated from the CE the share of car purchases funded by

[3] In the CE: Home equity was used by 1.0 percent of homeowners who bought a new car and 1.3 percent who bought a used car. In the SCF: Home equity was used by 2.7 percent of homeowners who bought a new car and 2.5 percent who bought a used car.

[4] The shares presented in table 1, which are based on transaction counts, change only slightly if they are instead based on dollars spent. SCF tabulations indicate that the average purchase price was around $25,000 for cars funded with auto loans or home equity, and $29,000 for cars purchased with cash; the median values were even closer at $24,000 or $25,000 for all three funding methods.

a home equity loan for each year between 1997 and 2012 (figure 1). The share of cars purchased with home equity does not appear to have changed much over this period; it averaged 0.7 percent both during the housing boom (1997 to 2006) and after it (2007 to 2012).[5]

There are a few reasons why it may not be surprising that the share of car buyers that report home equity as the funding source, even during the housing boom, is so low. First, personal finance professionals often advise against using a home equity loan to purchase a car, as these loans extend maturities beyond the lengths typically recommended for cars and thus may increase the total interest paid by consumers (Singletary, 2008; Wall Street Journal). Second, the transaction costs of extracting home equity with a second lien or mortgage refinancing generally exceed those of originating an auto loan; doing so only makes sense if the homeowner plans to extract a lot of equity at once and use much of it for another purpose. Third, the primary advantage to using home equity rather than an auto loan to finance a car purchase—the tax-deductibility of the interest for loans up to $100,000—is most likely not relevant for the approximately one-third of homeowners who end up taking the standard deduction (Poterba and Sinai, 2008). Finally, auto loans were an attractive financing choice during much of the housing boom period: Auto credit appears to have been widely available, and interest rates on new car loans were generally low and often heavily discounted by the manufacturers, especially for households with low credit risk.

So who uses home equity to buy new cars? To answer this question and to explore whether borrowing constraints may be a factor in this decision, we compare the income, wealth, and credit-history characteristics of households who purchase cars with home equity with those

[5] The pattern does not appear to be substantively different for households identified in the CE as living in California, Arizona, Nevada, and Florida (states with particularly high rates of home-price appreciation during the housing boom). The share of cars purchased with home equity in these states averaged 0.4 percent from 1997 to 2006 and 0.8 percent from 2007 to 2012. These tabulations are based on smaller samples than the overall shares.

who purchase cars with auto loans or with cash or other means. We limit the sample to homeowners who purchase new cars to eliminate the differences between homeowners and renters, and between new-car purchasers and used-car purchasers.

The comparisons, which are shown in table 2, suggest that homeowners who report using home equity to buy a car do not appear to be lacking in terms of income, wealth, and access to credit. Among new-car buyers, the table shows a clear hierarchy of income, wealth, and access to credit by method of funding an auto purchase: Households who use cash have the most wealth and access to credit, followed by households who use home equity and then households who use auto loans. Most of the differences across the three groups are statistically significant, even with our very small sample of households who use home equity.

Beginning with wealth, the median of liquid assets is $42,000 for homeowners who purchase new cars with cash, $22,000 for those who use home equity, and $10,500 for those who use an auto loan.[6] Even though homeowners who use home equity are not as wealthy as those who use cash, these households are still quite affluent and have a median net worth of nearly $600,000.

Turning to access to credit, the share of homeowners who purchase new cars and answered "yes" in the survey to the question "Was there any time in the past five years that you thought of applying for credit at a particular place, but changed your mind because you thought you might be turned down?" is low across the board—a rock-bottom 2 percent for both cash and home-equity purchasers, and 10 percent for auto-loan purchasers. The share who answered "yes" in the survey to the question "In the past five years, has a particular lender or creditor turned down any request you made for credit?" is somewhat higher at 7 percent for cash

[6] Liquid assets are defined as checking, savings, and money market accounts, and call accounts at brokerages.

purchasers, 15 percent for home-equity purchasers, and 20 percent for auto-loan purchasers. But the differences between groups are not statistically significant. By either measure, homeowners who purchase new cars with home equity do not appear to be a credit-constrained group.

Similarly, the demographic characteristics that are thought to be proxies for credit access look quite similar for homeowners who purchase new cars with home equity and those who use an auto loan. Both groups have an average age of around 50, and about 43 percent of both groups are college graduates. In contrast, the average age of cash purchasers is 60, and 54 percent are college graduates.

Home Equity Extraction as a Facilitator of Auto Loans

As noted above, very few households report directly using home equity to purchase a car. However, it could be the case that a larger share of households use the proceeds of a recent home equity extraction to overcome down payment requirements or other credit constraints when purchasing a car with an auto loan. In this section, we use an event-study set up to examine whether home equity extraction might play an important indirect role in facilitating car purchases. Specifically, we estimate whether homeowners are more likely to take out an auto loan right after extracting home equity.[7]

For households that extract home equity and originate an auto loan within a relatively short period of time, we can use the order of these two events to help distinguish the presence of credit constraints from other possible reasons for the relationship. As described in the literature review, one common way to detect the presence of borrowing constraints is to test whether auto purchases rise after a household receives a temporary boost to income. In our case, we test

[7] Other papers that have used similar event-study approaches include Benmelech, Guren, and Melzer (2017) and Beraja, Fuster, Hurst, and Vavra (2017).

whether the likelihood of originating an auto loan is higher after households extract home equity. The portion of this relationship that reflects the presence of borrowing constraints in the auto loan market is identified by using an event window that is sufficiently short, so shocks that affect both home equity extraction and auto loan originations—such as a rise in house prices or a change in interest rates—are equally likely to affect auto loan originations both before and after home equity is extracted. However, if equity extraction eases a constraint in the auto lending market, that portion of the total effect of equity extraction on auto loan originations can only occur after the extraction. Using this event-study setup, we interpret the additional increase in the probability of originating an auto loan *after* home equity is extracted relative to the probability observed *before* equity is extracted as reflecting the role of home equity extraction in easing of credit constraints in the auto loan market.

Our analysis uses credit bureau data from the Federal Reserve Bank of New York Consumer Credit Panel (CCP).[8] The panel is a randomly selected anonymized 5 percent sample of credit records from the credit bureau Equifax. The data include individuals' credit scores, debt balances, payment histories, age, and geographic location (down to the Census block level). Individuals are followed over time with quarterly snapshots of their data, although the sample is periodically refreshed so that it remains representative of all individuals with a credit record and a social security number. We use data from 1999 to 2015, and for computational ease we select a 20 percent subsample; all told, our dataset is a 1 percent sample of the universe of credit records. An observation *i* in our sample is the data for a given individual in a given quarter.

We construct a sample of individuals who could plausibly have extracted equity at any time in the event window, which spans three quarters before and three quarters after the quarter

[8] See Lee and van der Klaauw (2010) for more information on the FRBNY Consumer Credit Panel.

in which we observe the individual. Specifically, we select borrowers who have mortgage debt and are current on that debt throughout the event window. As explained in more detail below, we drop from each sample households who moved during the event window or who appeared to have been property investors. Our final dataset has approximately 31.5 million person-quarter observations from 1999 to 2015.

Auto loan originations and home equity extractions are not directly reported in the CCP data, and so we infer these extensions of new credit from information on the number of open accounts for each borrower and their loan balances. For auto loans, we infer that a new loan was originated when the number of open auto loan accounts for a borrower increases from one quarter to the next or when the borrower's total auto indebtedness rises.[9, 10] The inference for home equity extractions is more complicated, because mortgage balances can rise for reasons other than equity extraction. For example, mortgage balances can rise when an individual purchases a residential or investment property or when a borrower is delinquent on the mortgage balance and the interest and fees associated with the missed payments are rolled into the loan balance.

To infer that a home equity extraction took place in the CCP data, we first select a pool of potential extractions that consists of borrowers with mortgage debt in two consecutive quarters and the total mortgage debt increases by at least 5 percent (and by at least $1,000) from the first

[9] Our auto loan origination code is based on the definitions used in *The Quarterly Report on Household Debt and Credit*, available at https://www.newyorkfed.org/microeconomics/hhdc.html, and was generously provided by FRBNY staff. We build on their work by excluding balance increases associated with delinquent loans. The starting point for our home equity extraction code is Bhutta and Keys (2016), which is available on the American Economic Review web site at https://www.aeaweb.org/articles?id=10.1257/aer.20140040. We build upon these authors' work by excluding balance increases associated with delinquent loans and by addressing servicing transfers. We thank all these authors for their generosity in providing their code.

[10] The auto loan field in credit bureau data includes auto leases as well as loans collateralized by both new and used vehicles.

to the second quarter. Next, to prevent purchases of primary residences, property investment transactions, or transitions of mortgages into delinquency from being counted as equity extractions, we drop borrowers who move (as determined by a change in the census block of residence from quarter-to-quarter), borrowers with more than one first-lien mortgage or home equity line of credit on the credit bureau file (and thus presumably is a property investor),[11] and borrowers with delinquent mortgages.[12] We also flag apparent changes in the loan servicer, which can result in the reported balance on the loan dropping to zero for a quarter until the new servicer begins reporting to the credit bureau. In these cases, we replace the zero balance with the average of the balances from the prior and subsequent quarters; doing so prevents our algorithm from recording these servicing transfers as equity extractions.[13] Data limitations preclude us from following a similar procedure for auto loans.[14]

The sample restrictions that we use to exclude property purchases will also result in some misclassifications of legitimate equity extractions. For example, we will remove from the pool of potential equity extractions situations such as when a homeowner without any mortgage debt takes out a HELOC or other lien, or when a homeowner extracts equity as part of a property purchase. These restrictions will also result in property-purchasers being disproportionately concentrated in our non-extractor sample, which could bias our estimates if property purchases are correlated with auto loan originations. To avoid this bias, we drop movers and investors from our full sample; following similar logic, we also drop individuals who are delinquent on their mortgages.

[11] Census blocks are the smallest unit of geography that the Census Bureau uses to tabulate decennial data. Generally blocks are quite small; in urban areas, for example, a census block often corresponds to a city block.
[12] We follow a similar procedure for auto loans.
[13] Adjusting for servicing transfers reduces the number of equity extractions by approximately 11 percent in 1999-2001, and by 1 to 6 percent in 2002-2015.
[14] The CCP contains individual records for each loan ("tradelines") for mortgages and HELOCs but not for auto loans.

Using the CCP dataset and the rules described above, we estimate equation 1 to determine the initial baseline likelihood that an individual takes out an auto loan, conditional on whether she has extracted home equity recently or will do so in the near future. The dependent variable $Auto_i$ equals 1 if she originated an auto loan in the quarter associated with observation i and 0 otherwise. The independent variables include an intercept and a sequence of 7 indicator variables that correspond to the three quarters before the reference quarter associated with observation i {q = -3, -2, or -1}; the reference quarter itself {q=0}; and the three quarters after the reference quarter {q = 1, 2, or 3}. Each indicator variable equals 1 if the individual extracted home equity in that quarter and zero otherwise.

$$(1) \qquad Auto_i = \alpha + \Sigma^{3}_{q=-3} \beta_q \, 1_i\{Extracted\ equity\ in\ quarter\ q\} + \varepsilon_i$$

We estimate equation 1 as a linear probability model and report the coefficient estimates in the first column of table 3. As indicated by the estimate of the intercept, about 3.6 percent of individuals who did not extract home equity at any point in the relevant seven-quarter window originated an auto loan in the current quarter. The estimates of the β_q coefficients, when $q < 0$, measure the additional probability that an individual takes out an auto loan if they have extracted home equity q quarters ago; when $q > 0$, these estimates measure the additional probability that an individual takes out an auto loan if they will extract home equity q quarters in the future. Individuals are about 1.1 percentage points more likely to take out an auto loan if they extracted home equity three or two quarters ago (β_{-3} and β_{-2}). Individuals are 1.3 and 1.7 percentage points more likely to originate an auto loan if they extracted equity one quarter earlier or in the same quarter (β_{-1} and β_0). Individuals are about 1.1 percentage points more likely to originate an auto loan if they will extract home equity either 1, 2, or 3 quarters in the future (β_1, β_2, and β_3); these coefficients are essentially identical to the β_{-3} and β_{-2} coefficients.

All seven β coefficients are positive and statistically different from zero, indicating that individuals who have extracted home equity recently or will do so in the near future are more likely to take out an auto loan than are other individuals. This relationship may reflect factors such as rising housing wealth or low interest rates overall, which boost the likelihood of both equity extraction and auto loan origination, or characteristics of the borrowers that affect the likelihood of both activities.[15]

In addition, the β coefficients that correspond to auto loans originated in the quarter of equity extraction and in the quarter after are larger than the other β coefficients, indicating that equity extraction has eased credit constraints in the auto loan market. The idea is that if some borrowers use the proceeds of home equity extraction to overcome credit constraints in the auto loan market, they cannot originate the auto loan before receiving home equity proceeds. Assuming that factors not directly related to equity extraction are unlikely to have changed much around the point of extraction, we interpret the extra rise in the probability of originating an auto loan after the equity extraction as the portion of the increase in the probability of originating an auto loan that was caused by the equity extraction. In terms of equation 1, the β_{-1} coefficient is 0.2 percentage points higher than the other βs, and β_0 is 0.6 percentage points higher. The difference between β_0 and β_{-1} is statistically significant and is large relative to the 4 percent unconditional probability in this sample of originating an auto loan in a typical quarter.[16] The magnitude of the effect that we measure is also similar to the increase in the probability of taking out an auto loan after equity extraction measured in Beraja et al (2017).[17]

[15] Parker (2017), for example, links the propensity of households to increase spending in response to the arrival of predictable, lump-sum payments to persistent household traits.
[16] Specifically, an F-test rejects at the 1 percent level the hypotheses that β_0 and β_1 are equal.
[17] See Figure 7 in Beraja et al (2017).

One concern with using this identification scheme with these data is that quarterly data may be too coarse to assert that home equity extractions predated the auto loan originations when both occurred in the same quarter. The results in Beraja et al. (2017) assuage this concern. In their credit bureau data—which unlike ours are measured at a monthly frequency—auto loan originations begin to rise in the month after equity extraction, with the peak occurring two months after the extraction.

Next, we add person fixed effects to the probability model to control for each individual's innate probability of taking out an auto loan. Other than the intercept that now varies across individuals, this model, shown in equation 2, is the same as equation 1.

$$(2) \qquad Auto_i = \alpha_i + \Sigma^{3}_{q=-3} \beta_q \, 1_i\{Extracted\ equity\ in\ quarter\ q\} + \varepsilon_i$$

The coefficient estimates from this specification are shown in the second column of table 3. The estimates of $\beta_{-3}, \beta_{-2}, \beta_1, \beta_2$, and β_3 are around 0.4 percentage point, and β_0 is 1.0 percentage point. These β coefficients are all about 0.7 percentage points below the estimated levels from equation 1, a comparison that indicates that individual heterogeneity explains much of the correlation between auto loan origination and home equity extraction. However, even with the additional controls, individuals who extract home equity are still 0.6 percentage points more likely to originate an auto loan in the same quarter of the extraction than in the quarter before the extraction, and this gap remains statistically significant. So the evidence that equity extraction is easing borrowing constraints in the auto loan market is robust to the inclusion of person fixed effects.

Finally, in equation 3 we add year fixed effects to the model in equation 2 to capture omitted factors that vary over time but not individuals and affect both equity extraction and auto

loan originations, such as the national unemployment rate. Coefficient estimates from this specification are in the third column of table 3.

$$(3)\ Auto_i = \alpha_i + \Sigma^{3}_{q=-3}\, \beta_q\, 1_i\{Extracted\ equity\ in\ quarter\ q\} + \Sigma^{2014}_{y=2001}\, \pi_y 1_i\{Year = y\} + \varepsilon_i$$

The estimates of the β_{-3}, β_{-2}, β_1, β_2, and β_3 coefficients are even lower in this specification than in equation 2—around 0.2 percentage points. Although the coefficients are still statistically significantly different from zero, for practical purposes home equity extraction in this specification affects the probability of originating an auto loan only in the quarter of extraction and the quarter thereafter. The probability of originating an auto loan is 0.7 percentage points higher in the extraction quarter and 0.3 percentage points higher in the subsequent quarter than in the quarter before equity extraction.[18]

Additional Evidence of Borrowing Constraints in the Auto-Loan Market

If home equity extraction boosts the likelihood of taking out an auto loan because it eases credit constraints in the auto loan market, we would expect the relationship to be stronger for borrowers with lower credit scores. We test this hypothesis by adding variables to the event-study probability model that allow the coefficients on the equity extraction time indicators to vary for six credit score categories, indexed by c.[19] As in equation 3, this specification includes person and year fixed effects.

[18] We also ran a specification with quarter-year fixed effects; the results were essentially the same as the year fixed effects specification.

[19] The credit score on the CCP is the Equifax 3.0 risk score. The Equifax 3.0 score has a range from 280 to 850; values are roughly comparable to FICO credit score. Our score ranges are: deep subprime, 280-579; subprime, 580-619; near prime, 620 to 659; prime, 660 to 699; super-prime, 700 to 759; and ultra-prime, 760 to 850. We thank Hank Korytkowski for help in determining these ranges. Consumer Financial Protection Bureau (2012) provides a comparison of the different types of credit scores. We omit borrowers with "deep subprime" credit scores from figure 2 because the very few households in this category who own homes likely have credit scores too low to qualify for additional mortgage credit.

$$(4)\ Auto_i = \alpha_i + \Sigma^{6}_{c=-1} \Sigma^{3}_{q=-3} \beta_{qc}\ 1_i\{Extracted\ equity\ in\ quarter\ q\}*1_i\{CredCat = c\} + \Sigma^{2014}_{y=2001}\ \pi_y 1_i\{Year = y\} + \varepsilon_i.$$

The β_{qc} coefficients are graphed in Figure 2. Extracting home equity raises the probability of taking out an auto loan in the current and subsequent quarters for individuals in all of the credit score groups, but the magnitudes of the increases vary substantially. For individuals with the highest (ultra-prime) credit scores, the difference in the probability of taking out an auto loan in the quarter of equity extraction (β_0) over doing so in the quarter before extraction (β_1) is a very small 0.2 percentage points. In contrast, the difference is 1.2 percentage points for individuals with subprime credit scores. For individuals with credit scores between these two extremes, the difference is around 1 percentage point. The large effects for subprime individuals are consistent with credit constraints underlying the relationship between equity extraction and auto loan originations.

Although our data do not reveal much about how home equity extraction eases credit constraints in the auto loan market, one theory we can test is whether borrowers who extract home equity appear to use the proceeds to pay down high-interest consumer debt. Such a maneuver could make a household a better credit prospect by reducing its credit utilization rate (which counts toward a borrower's credit score) and its debt service relative to income (which might be a factor in auto loan underwriting).[20] Independent of the lender's determination, the borrower might feel a greater capacity to take out an auto loan after paying down higher-interest debt. Previous research has shown that credit card debt decreases only slightly after a home

[20] Replacing $10,000 in credit card debt with $10,000 in mortgage debt, for example, would net a household $250 in savings per month, assuming a thirty-year fixed-rate mortgage at a rate of 4 percent and a monthly minimum payment requirement of 3 percent on the credit card debt.

equity extraction, on average, but the decreases have been shown to be larger and more persistent for individuals with lower credit scores (Bhutta and Keys, 2016).

To look for evidence of consumer debt paydown, we construct an indicator variable CC_Pay_i that equals 1 if the individual pays down half or more of their existing uncollateralized consumer debt in the quarter associated with observation *i*, and it is set to 0 otherwise.[21] We then assess whether individuals who took this action are more likely than other equity extractors to purchase cars. The exercise is shown as equation 6, which includes a term that interacts CC_Pay_i with an indicator that equity was extracted in the reference quarter.[22] A positive and significant estimate of η would suggest that consumer debt paydown is part of the relationship between home equity extraction and auto loan originations.

$$(5)\ Auto_i = \alpha_i + \Sigma^{3}_{q=-3}\, \beta_q\, 1_i\{\text{Equity extracted in quarter } q\} + \delta\, CC\_Pay_i +$$
$$\eta\, CC\_Pay_i * 1_i\{\text{Equity extracted in } q=0\} + \Sigma^{2014}_{y=2001}\, \pi_y 1_i\{Year = y\} + \varepsilon.$$

The coefficient estimates for equation 6 (column 4, Table 3) show no detectable role for consumer debt paydown in the relationship between equity extraction and auto lending. The estimate of δ indicates the likelihood that an individual takes out an auto loan rises 0.5 percentage point if she pays down uncollateralized debt in the same quarter, but the miniscule and insignificant estimate of η suggests this probability is nearly unaffected by whether the individual also extracts home equity in that quarter. More flexible specifications that interact leads and lags of credit-card paydown with leads and lags of home equity extraction also find essentially no relationship between these factors.

[21] Uncollaterized consumer debt is defined as total balances on credit cards issued by banks and consumer finance companies and on retail cards as well as uncollateralized consumer installment loans.

[22] Specifications that interact credit-card paydown and home equity extraction with credit score category also find essentially no relationship between these factors. We also established that our results are robust to using an indicator variable for whether the individual paid down a fourth or more of their existing uncollateralized debt in the quarter associated with observation *i*.

This result is perhaps not surprising, as the existing literature is more consistent with down payment requirements being the constraint that eases after equity extraction. These studies identify down payments as a major credit constraint in the auto lending market (Adams, Einav, and Levin, 2009) and find a relationship between equity extraction and increased spending on auto loan down payments (Cooper, 2010).

How Important is Home Equity Extraction in the Auto Loan Market?

Having established that home equity extraction has a statistically significant effect on auto loan originations, we now ask whether equity extraction could have played a quantitatively important role in aggregate auto loan originations. We begin by estimating the annual number of home equity extractions. Our data suggest that around 3 million households extracted home equity each year in 2001 and 2002, and 4 to 5 million households extracted equity annually in the peak housing boom years from 2003 to 2006. [23] These estimates are consistent with the estimates of Canner, Dynan, and Passmore (2002) for the 2001-02 period.[24]

To calculate the effect of these equity extractions on car purchases, we apply to these extraction volumes the coefficients from our preferred specification (equation 4), which indicate that each instance of home equity extraction raises the probability of an auto loan origination by 0.9 percentage point. (Note that this effect is the incremental auto loan originations associated with the extraction quarter ($\beta_0 - \beta_1 = 0.65$) plus the incremental originations associated with the

[23] We use the fact that our sample is a 1 percent extract of all credit-bureau records to scale our national estimates to national aggregates. One complication is that about three-fourths of the home equity extractions that we observe are co-signed loans, which implies that the same loan will be observed twice in credit bureau records. As a result, when we aggregate we assign each co-signed loan a weight of 0.5.

[24] Canner, Dynan, and Passmore (2002) find that 4.6 percent of a sample of 2,240 homeowners surveyed by the Michigan Survey of Consumers had engaged in a cash-out refinancing in 2001 or the first half of 2002. They note that multiplying that fraction by the total number of U.S. homeowners at that time leads to an estimated 4.9 million cash-out refinancings in 2001 and the first half of 2002 (an annual rate of around 3 million).

previous quarter ($\beta_{-1} - \beta_1 = 0.25$)).[25] Applying this 0.9 percentage point effect to 4.5 million extractions during the peak housing boom years suggests that home equity extraction facilitated about 40,000 auto loans annually during this period. By comparison, various sources peg the total number of auto loan originations during the past several years as varying from a low of around 15 million in 2009 to a high of around 30 million in 2016.[26] This comparison suggests that home equity extraction was likely not a quantitatively important factor in total auto loan originations or in the changes in loan originations during this period.

Conclusions

In this paper, we demonstrate that home equity extraction does not appear to be the direct source of funding for many car purchases. Estimates from three nationally representative surveys indicate that very few households purchase cars directly with home equity. Further, the share of those who report doing so did not appear to vary with the housing cycle.

Home equity extraction is associated, however, with an increase in auto loan originations. Using an event-study framework and credit bureau data, we show that home equity extraction plays a statistically significant and causal role in determining auto loan originations, and this role is distinct from the effects of house prices, interest rates, and other factors that would cause the two behaviors to move together. The effect of home equity extraction on auto loan originations is more pronounced among borrowers with lower credit scores, a finding consistent with the idea that home equity extraction eased down payment or other credit constraints in the auto loan market. In contrast, we find no evidence that equity extraction increased auto loan originations

[25] We rounded these estimates to 0.7 and 0.3, respectively, in the earlier discussion of the regression results.
[26] See Consumer Financial Protection Bureau, "Origination Activity," https://www.consumerfinance.gov/data-research/consumer-credit-trends/auto-loans/origination-activity/, and Equifax, "Quarterly U.S. Consumer Credit Trends," https://investor.equifax.com/~/media/Files/E/Equifax-IR/reports-and-presentations/events-and-presentation/consumer-credit-trends-report-q1-2017-revised-pdf.pdf.

by allowing households to pay down high-interest debt and thereby free up space in their budgets for auto-loan payments. Regardless of the mechanism, though, our estimates indicate that the number of additional auto loan originations attributable to home equity extraction during this period is very small.

Our results cast doubt on stories that home equity extraction played an important role as a source of funds for auto purchases during the housing boom in the mid-2000's, but they do not imply that housing wealth is inconsequential for auto purchases. At least two other (not mutually exclusive) channels may account for a relationship between auto purchases and home equity. First, as discussed in the literature review, households are wealthier when their homes increase in value, and their ability to borrow should rise when the value of their housing collateral is higher. As a result, their demand for cars should also increase. Households with more housing wealth—or more ability to tap their housing wealth—need not necessarily purchase more cars directly with home equity, as different types of wealth are, to some extent, interchangeable. For example, paying for other goods and services with home equity may free up balance-sheet space to purchase a car with cash or an auto loan.

Second, home equity might indirectly facilitate auto loans if lenders become more willing to extend credit to households in neighborhoods with rising house prices. Home equity is typically not considered directly in the underwriting of auto loans, but lenders may take local economic conditions into account more generally, which can be correlated with house prices. Alternatively, lenders may have an easier time raising capital in areas of the country that are booming. Households in these markets may also be more likely to retain their good credit standing when their income is disrupted, because they can more easily refinance their mortgages or sell their homes. Ramcharan and Crowe (2013) show that peer-to-peer lenders were less

willing to extend unsecured credit to homeowners in areas with declining house prices; a similar dynamic may occur in the auto credit market, although we are not aware of any research on this topic.

References

Aaronson, D., S. Agarwal, and E. French (2012). "The Spending and Debt Response to Minimum Wage Hikes." *American Economic Review*, 102(7): 3111-3139.

Adams, W., L. Einav and J. Levin (2009). "Liquidity Constraints and Imperfect Information in Subprime Lending." *American Economic Review*, 99(1): 49-84.

Agarwal, Sumit, Gene Amromin, Zahi Ben-David, Souphala Chomsisengphet, Tomasz Piskorski, and Amit Seru (2017). "Policy Intervention in Debt Renegotiation: Evidence from the Home Affordable Modification Program." *Journal of Political Economy*. 125 (3), 654–712.

Aizcorbe, Ana, Benjamin Bridgman, and Jeremy Nalewaik (2009). "Heterogeneous Car Buyers: A Stylized Fact." *Economics Letters*, 109 (1), pp. 50-53.

Aladangady, Aditya (2017). "Housing Wealth and Consumption: Evidence from Geographically Linked Microdata." *American Economic Review*, 107(11): 3415-46.

Attanasio, O., P. Goldberg and E. Kyriazidou (2008). "Credit Constraints in the Market for Consumer Durables: Evidence from Micro Data on Car Loans." *International Economic Review*, 49(2): 401-436.

Benmelech, Efraim, Adam Guren, and Brian T. Melzer (2017). "Making the House a Home: The Stimulative Effect of Home Purchases on Consumption and Investment." NBER Working Paper No. 23570.

Berger, David, Veronica Guerrieri, Guido Lorenzoni, and Joseph Vavra (forthcoming). "House Prices and Consumer Spending." *Review of Economic Studies.*

Beraja, Martin, Andreas Fuster, Erik Hurst, and Joseph Vavra (2017). "Regional Heterogeneity and Monetary Policy." NBER Working Paper No. 23270.

Bhutta, Neil, and Ben Keys (2016). "Interest Rates and Home Equity Extraction During the Housing Boom." *American Economic Review*, 106(7): 1742-74.

Brown, Meta, Sarah Stein, and Basit Zafar (2015). "The Impact of Housing Markets on Consumer Debt: Credit Report Evidence from 1999 to 2012." *Journal of Money, Credit, and Banking*, 47(S1):175-213.

Canner, Glenn, Karen Dynan, and Wayne Passmore (2002). "Mortgage Refinancing in 2001 and Early 2002." *Federal Reserve Bulletin* (88).

Cloyne, James, Kilian Huber, Ethan Ilzetzki, and Henrik Kleven, "The Effect of House Prices on Household Borrowing: A New Approach." Bank of England Staff Working Paper no. 650.

Consumer Financial Protection Bureau (2012). "Analysis of Differences between Consumer- and Creditor-Purchased Credit Scores." http://files.consumerfinance.gov/f/201209_Analysis_Differences_Consumer_Credit.pdf

Cooper, Daniel (2010). "Did Easy Credit Lead to Overspending? Home Equity Borrowing and Household Behavior in the Early 2000s," Federal Reserve Bank of Boston Public Policy Discussion Paper No 09-7, revised March 2010.

Cooper, Daniel (2013). "House Price Fluctuations: The Role of Housing Wealth as Borrowing Collateral." *Review of Economics and Statistics* 95(4): 1183-1197.

Dash, Eric (2008). "Auto Industry Feels the Pain of Tight Credit," *New York Times*, May 28. http://www.nytimes.com/2008/05/27/business/27auto.html

Dettling, Lisa, Sebastian Devlin-Foltz, Jacob Krimmel, Sarah Pack, and Jeffrey Thompson (2015). "Comparing Micro and Macro Sources for Household Accounts in the United States: Evidence from the Survey of Consumer Finances." Finance and Economics Discussion Series 2015-086. Washington: Board of Governors of the Federal Reserve System, http://dx.doi.org/10.17016/FEDS.2015.086.

DiMaggio, Marco, Amir Kermani, Ben Keys, Tomask Piskorski, Rodney Ramcharan, Amit Seru and Vincent Yao (2017). "Monetary Policy Pass-Through: Household Consumption and Voluntary Deleveraging." *American Economic Review*, 107(11):3550-3588.

Gabriel, Stuart, Matteo Iacoviello, and Chandler Lutz (2017). "A Crisis of Missed Opportunities? Foreclosure Costs and Mortgage Modification During the Great Recession." Working Paper.

Greenspan, Alan, and James Kennedy (2008). "Sources and Uses of Equity Extracted from Homes." *Oxford Review of Economic Policy*, vol. 24 (1), pp. 120-144.

Harney, Kenneth (2015). "Boom in Equity Allows Homeowners to Cash in and Even Cash Out." The Washington Post, September 29. http://www.washingtonpost.com/realestate/boom-in-equity-allows-homeowners-to-cash-in-and-even-cash-out/2015/09/28/7cfb940c-660d-11e5-9223-70cb36460919_story.html

Johnson, Kathleen, Karen Pence, and Daniel Vine (2017). "The Effect of Credit Conditions on Vehicle Purchases: Evidence from Consumer Sentiment."

Laufer, Steven and Andrew Paciorek. "The Effects of Mortgage Credit Availability: Evidence from Minimum Credit Score Lending Rules." Finance and Economics Discussion Series 2016-098. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2016.098.

Lee, Donghoon, and Wilbert van der Klaauw (2010). "An Introduction to the FRBNY Consumer Credit Panel." Federal Reserve Bank of New York *Staff Reports* no. 479.

Leininger, L., H. Levy, and D. Schanzenbach (2010). "Consequences of SCHIP Expansions for Household Well-Being." *Forum for Health Economics and Policy*, 13(1).

Mian, Atif, Kamalesh Rao, and Amir Sufi (2013). "Household Balance Sheets, Consumption, and the Economic Slump." *Quarterly Journal of Economics*, vol. 128 (4), pp. 1687-1726.

Mian, Atif and Amir Sufi (2014). "House Price Gains and U.S. Household Spending from 2002 to 2006." Fama-Miller Working Paper.

Parker, Jonathan (2017). "Why Don't Households Smooth Consumption? Evidence from a 25 Million Dollar Experiment." *American Economic Journal: Macroeconomics*. 9(4): 153–183.

Parker, J., N. Souleles, D. Johnson, and R. McClelland (2013). "Consumer Spending and the Economic Stimulus Payments of 2008." *American Economic Review*, 103(6): 2530-2553.

Poterba, James, and Todd Sinai (2008). "Tax Expenditures for Owner-Occupied Housing: Deductions for Property Taxes and Mortgage Interest and the Exclusion of Imputed Rental Income." *American Economic Review Papers and Proceedings* vol. 96 (2).

Ramcharan, Rodney, and Christopher Crowe (2013). "The Impact of House Prices on Consumer Credit: Evidence from an Internet Bank." *Journal of Money, Credit, and Banking* vol. 45 (6), pp. 1085-1115.

Singletary, Michelle (2007). "Loan Loser: Home-Financing a Car." The Washington Post, March 18. Available at http://www.washingtonpost.com/wp-dyn/content/article/2007/03/17/AR2007031700104.html

Souleles, N. (1999). "The Response of Household Consumption to Income Tax Refunds." *American Economic Review*, 89(4): 947-58.

Wall Street Journal. "How to Finance an Auto Purchase." Available at http://guides.wsj.com/personal-finance/buying-a-car/how-to-finance-an-auto-purchase/

Wilcox, D. (1989). "Social Security Benefits, Consumption Expenditures, and the Life Cycle Hypothesis." *Journal of Political Economy*, 97: 288-304.

Tables and Figures

Table 1. Percent of Cars Purchased with Each Source of Funds

	New cars			Used cars		
Funded with:	Michigan Survey	SCF	CE	Michigan Survey	SCF	CE
Home equity	1	2.3	0.9	2.6	1.6	0.6
Auto loan	72	69	75	53	40	44
Cash/other	27	28	24	44	58	56
Memo:						
N	830	1,864	14,385	1,062	2,118	36,718

Note: Table excludes leases. Estimates from the Michigan Survey are based on data from 2003 to 2014. Estimates from the SCF are based on data from 2004, 2007, 2010, and 2013. Estimates from the CE are based on data from 1997 to 2012. Figures in the table are calculated with sample weights provided by each survey.

Table 2: Summary Statistics for Homeowners who Buy New Cars

Summary statistic:	Method of funding new car purchase		
	Home equity	Auto loans	Cash/other
Median family income (2013 dollars)	114,026	99,909	129,204
Median net worth (2013 dollars)	598,906	291,000***	1,057,283***
Median liquid assets (2013 dollars)	21,909	10,500***	42,134**
Own stock directly (Percent)	39	24*	48
College graduate (Percent)	43	43	54
Avg. age of household head (Years)	50	48	60***
Turned down for credit in past five years (Percent)	15	20	7
Did not apply b/c worried turned down for credit (Percent)	2	10***	2
Memo: N	29	686	992

Note: Authors' calculations from Survey of Consumer Finances data (2004, 2007, 2010, and 2013). Figures are calculated with sample weights. Figures in 2013 dollars are calculated with the Consumer Price Index from the Bureau of Labor Statistics. Summary statistic is significantly different from that for those who purchase a car with home equity at the *10 percent **5 percent ***1 percent level. Statistical significance is based on standard errors bootstrapped with 999 replicates drawn in accordance with the SCF sample design and adjusted for imputation uncertainty.

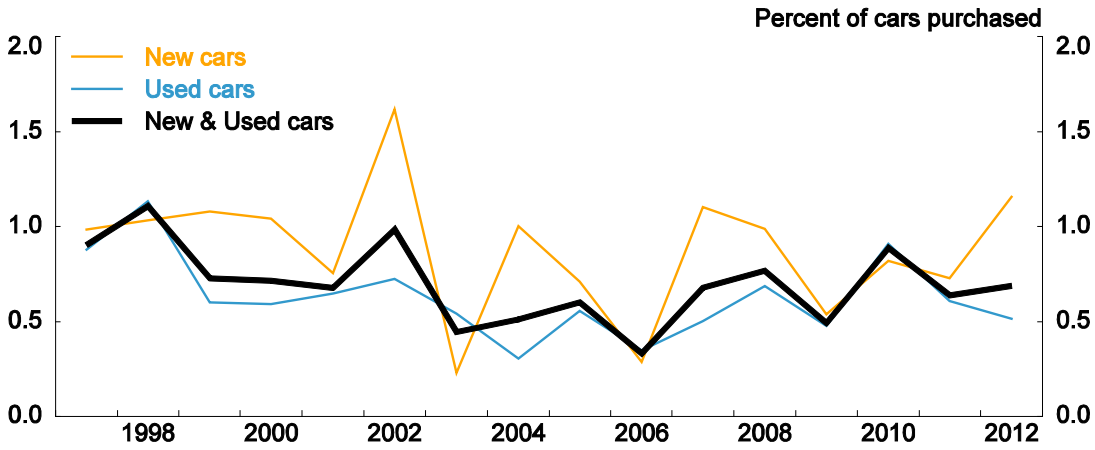
Table 3: Coefficient Estimates for Equation 1 with Added Control Variables

Dependent variable: Indicator for originating an auto loan in the current quarter

	Coefficients / standard errors for specifications			
Variables	(1)	(2)	(3)	(4)
Constant	0.036***	0.037***	0.049***	0.049***
	(0.00003)	(0.00003)	(0.00021)	(0.00021)
Extracted home equity *q* quarters before the current quarter				
Extracted before current quarter				
β_{-3} (q=-3)	0.011***	0.004***	0.003***	0.003***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
β_{-2} (q=-2)	0.011***	0.004***	0.002***	0.002***
	(0.0003)	(0.0004)	(0.0004)	(0.0004)
β_{-1} (q=-1)	0.013***	0.006***	0.005***	0.004***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Extracted during current quarter				
β_0 (q=0)	0.017***	0.010***	0.009***	0.009***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Extracted after current quarter				
β_1 (q=1)	0.011***	0.004***	0.002***	0.002***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
β_2 (q=2)	0.010***	0.004***	0.002***	0.002***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
β_3 (q=3)	0.011***	0.004***	0.002***	0.002***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Uncollateralized debt paydown in quarter 0				0.005***
				(0.0002)
Uncollateralized debt paydown & extract in quarter 0				0.0002
				(0.0014)
Other control variables:				
Borrower fixed effects?	N	Y	Y	Y
Year fixed effects?	N	N	Y	Y
Memo:				
R^2	.0005	0.07	0.07	0.07
N	31,542,509	31,542,509	31,542,509	31,542,509

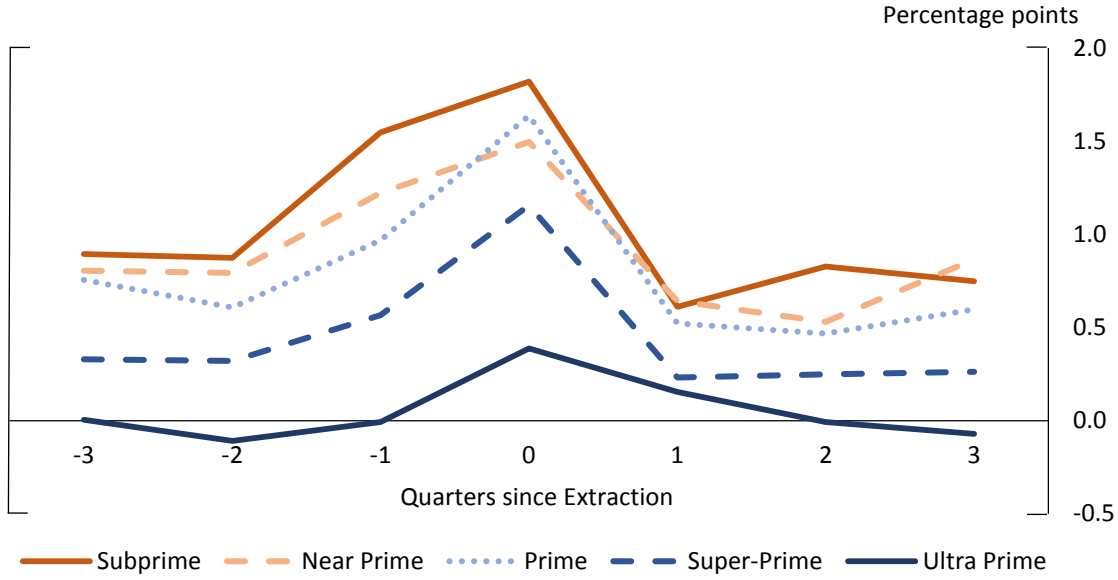
Notes. Each column in the table shows the estimated coefficients from an ordinary least squares regression. Robust standard errors are displayed in parentheses underneath each coefficient. The dependent variable in each regression is an indicator variable for whether the individual originated an auto loan in the quarter of the observation. The regressions with individual fixed effects include 1,219,680 such intercepts. Coefficient estimates are statistically significantly different from zero at the ***1 percent level.

Figure 1: Share of Cars Purchased with a Home Equity Loan



Note: Authors' calculations based on data from the Consumer Expenditure Survey. Figure shows the percent of car purchases for which the respondent cites a home equity loan as a source of financing. Shares are calculated with sample weights.

Figure 2: Effect of Home Equity Extraction on the Probability of Originating an Auto Loan by Borrower Credit Risk Group and Quarter relative to Equity Extraction



Note: Authors' calculations based on data from the Equifax Consumer Credit Panel. Figure shows the β_{qc} coefficient estimates from equation 4.

Appendix 1: Survey Data

Michigan Survey. The Michigan survey data come from a special module that the Federal Reserve has sponsored three times per year since 2003. Survey respondents are asked if they purchased a car in the previous six months, and if so, whether they borrowed money to purchase the car or paid cash. If the answer is "cash," respondents are asked whether the source of the cash was savings or investments, a home equity loan, a mortgage refinancing, or "somewhere else."[27] Respondents can cite multiple sources of the cash, although this is rare. We define the car purchase as a home equity extraction if the respondent identifies a home equity loan or mortgage refinancing as the source of the cash. We define the purchase as an auto loan if the respondent indicates that a car was purchased with borrowed money. We define all other purchases as cash/other. The data span the 2003 to 2014 period and include 2,388 purchases of new and used cars.

Consumer Expenditure Survey. In the CE, households are asked about the vehicles that they currently own. We focus on cars purchased in the survey year. For each car owned, households are asked whether any portion of the purchase price was financed.[28] If so, they are asked whether the source of credit was a home-equity loan. Households are not asked if the car was purchased with the proceeds from a cash-out refinancing, and so we will miss these purchases.

[27] According to the Michigan survey staff, some respondents who purchase autos with home equity appear to consider these purchases as funded with "borrowed" money rather than "cash." If so, the survey instrument will miss some car purchases funded by home equity extraction. The survey staff catch many of these instances and recode the answers as cash/home equity. We do not think that this aspect of the question structure leads to a significant understatement of home-equity funded purchases because the Michigan results are in line with the results from the other two surveys, which have different question structures.

[28] The CE asks households a separate set of questions about the vehicles they purchased during the reference period. Our analysis is based on the set of questions about vehicles owned (in the EOVB files) because these data include questions about how the purchases were financed.

We define the purchase as a home equity extraction if the respondent identifies a home equity loan as a source of credit. We define the purchase as an auto loan if the respondent financed the purchase but does not indicate they used a home equity loan. We define all other purchases as cash/other. The data cover the 1997 to 2012 period and include 28,290 car purchases.

SCF. In the SCF, like in the CE, households are asked about the cars that they own at the date of the interview. We focus on cars that were likely purchased recently. For used cars, the date of purchase is known from a survey question, and we select cars purchased during the survey year. For new cars, we must deduce the date of purchase, because the survey asks only about the model year of the car. We define a new car as recently purchased if its model year corresponds to the survey year or the subsequent year. Most new car purchases covered by this definition will have occurred during the survey year, although some of these purchases will have occurred during the previous calendar year. The reason is that new models are introduced during the previous calendar year and are not fully phased out until the subsequent calendar year. For the same reason, our definition will miss the small volume of new cars still being sold from earlier model years.[29]

The definitions described above yield a sample of car purchases from the SCF that have occurred mostly within a year of the interview. Taking advantage of this relatively short look-back window, we match households' recent car purchases to the answers from separate questions asked about outstanding auto loan balances and recent activities with home mortgages. Unlike

[29] In the 2013 SCF, for example, our definition would include new cars from the 2013 or 2014 model years, about 75 to 80 percent of which likely occurred in 2013 and 20 to 25 percent in 2012. Our definition misses new cars from the 2012 or earlier model years that were purchased in 2013, a volume that is likely only about 3 percent of the new-car sales in our sample. These estimates are based on monthly sales by model year from JD Power and Associates and are adjusted to reflect the fact that SCF interviews are conducted from April of the survey year to the following February. Dettling et al (2015) document that auto sales in the SCF line up well with the NIPA aggregates once the timing and model-year issues are taken into account.

the CE, the SCF does not ask households whether their cars were purchased with home equity, and so we infer these purchases when an SCF respondent both appears to have purchased a car recently and reports having used the proceeds from a recently originated cash-out refinancing, second or third lien, or HELOC to buy a car.[30] If a household does not appear to have used home equity but does report having an auto loan outstanding, we assume the car was purchased with an auto loan. All other purchases are defined as cash/other.

One potentially important consequence of using the definitions described above is that households who buy the newest models early in the model year are likely overrepresented in our SCF sample of new-car purchases. And, as noted earlier, we also miss a few purchases of older car models. All told, these factors may bias upward some of the sample statistics on new-car buyers, such as average income and wealth, because new car prices decline over the course of the model year (Aizcorbe, Bridgman, and Nalewaik, 2009) and can drop when newer models are introduced.[31] These price dynamics suggest that households who buy new cars immediately upon the model release are likely more affluent than those who purchase later in the model year.

We use data from the 2004, 2007, 2010, and 2013 surveys, which include 3,929 purchases of new and used cars.

[30] We consider the origination of a cash-out refinancing or second lien to be recent if it occurred in the survey year or in the year prior. We include the prior year because, as described earlier, our sample of recent vehicle purchases likely includes some cars purchased in the previous year, and because there may be a lag between the cash-out refinance and the purchase of the car. We assume that a HELOC funded a recent car purchase if the proceeds of the most recent draw were used for a car. The SCF does not ask when that draw took place; depending on the timing, our definition could either understate or overstate the share of vehicle purchases funded with HELOCs.

[31] The SCF and CE samples also miss vehicles purchased during the calendar year but sold (or scrapped) before the date of the survey. We assume, given our short look-back period, that this bias is small.