Monetary Policy Pass-Through: Household Consumption and Voluntary Deleveraging *

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Abstract

Did households benefit from the recent prolonged period of low interest rates? To address this question we investigate the role of monetary policy in shaping households' consumption and saving decisions. We exploit the expected changes in monthly payments for borrowers with adjustable rate mortgages originated between 2005 and 2007 featuring an automatic reset of the interest rate after five years. We show that at the moment of the interest rate adjustment the monthly payment falls on average by $900. This results in a total positive income shock to these households in the tens of thousands over the remaining life of the mortgage. We uncover two important patterns. First, households increase their monthly car purchases on average by 40 percent after the change in monthly payment. Second, the expansionary effect of the reduction in interest rate is attenuated by the borrowers' desire to voluntary deleverage, by employing a significant fraction of the increased income to repay their debts more quickly. Moreover, the marginal propensity to consume is significantly higher for borrowers that experienced a larger decline in housing wealth. To complement these findings, we employ county-level data to provide evidence that consumption, especially of non-luxury cars, responded more forcefully to a reduction in short-term interest rates primarily in counties with a greater fraction of adjustable rate mortgage debt. Altogether these results shed light on the role of debt rigidity in the transmission of monetary policy.

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1 Introduction

Five years after the financial crisis, we still observe many households being underwater, a high unemployment rate and low growth, despite the unconventional monetary policy measures adopted by the Federal Reserve. Programs like the Home Affordable Refinance Program that removed loan-to-value requirements for the refinancing of loans insured by GSEs were implemented specifically to pass on the benefits of the new monetary policy regime to households. In this paper, we investigate the pass-through of changes in interest rates to households.

The conventional wisdom argues that monetary policy can affect firms' investment and households' consumption by reducing the cost of external finance. However, a number of contractual frictions might determine the extent to which changes in monetary policy actually affect debt service and the cost of finance for households and firms. When debt contracts are rigid, such as with most fixed-rate mortgage financing, changes in interest rates have little direct effect on consumption and investment decisions at the intensive margin, because only new potential borrowers or those able to refinance their mortgages are going to be affected by these policy changes. In fact, during recent years banks remained unwilling to refinance mortgages on homes that were worth less than the amount owed on them. This resulted in a very limited pass-through of lower interest rates to households. The ineffectiveness of lowering interest rates suggests that the recession and the weak recovery that followed are as much about the large debts carried by homeowners as they are about a decline in housing wealth.

We investigate the role of monetary policy in shaping households' consumption and savings decisions. If the borrowers' marginal propensity to consume is higher than the one of lenders, a decline in interest rates results in a positive income shock which would increase consumption because of the magnitude and the prolonged effect on the households' balance sheet (i.e. lower monthly payments are likely to remain at lower levels for an extended period of time) and boost the economy.[1] However, this consumption response can be dampened by an increase in the households' precautionary saving motive or what we call *voluntary deleveraging*. Moreover, the higher the households' debt levels, the higher their precautionary savings incentives.[2]

To identify the borrowers' consumption and saving behavior to the change in the interest

[1] See Mian and Sufi (2012b), for instance, for evidence on the importance of the aggregate demand channel and its role in explaining the increase in the unemployment rate in the U.S. during the Great Recession.

[2] A similar mechanism is proposed by Guerrieri and Lorenzoni (2011), which studies the effects of a credit crunch on consumer spending and show that after an unexpected permanent tightening of consumers' borrowing capacity, the most indebted consumers need to readjust towards lower levels of debt.

rates, the key identification challenge is that the decision to refinance their mortgage is going to be correlated with other households' characteristics or geographical variation that might confound the effect of the lower mortgage rate. For instance, households' credit history, due to the bank's unwillingness to refinance a distressed borrower, and their liquidity constraints, due to the households' ability to pay the closing costs, crucially impact their refinancing decision and are also likely to determine their consumption and savings decisions.[3] Similarly, households living in counties where the housing market has experienced a more severe crash are less likely to refinance their mortgages, due to the high loan-to-value ratios, as most banks require twenty percent equity in the house.

In order to overcome these difficulties, we gathered information on households' mortgage payments and exploit the expected changes in monthly payments of borrowers with adjustable rate mortgages (ARMs) originated between 2005 and 2007, with an interest rate fixed for the first 5 years, which is then automatically adjusted at the end of this initial period. This means that borrowers will take advantage of the low interest rate environment thanks to this feature of the mortgage contract without any need to refinance. Key for our identification strategy is the possibility to exploit the timing of the interest rate adjustment. Notice that the ARMs originated in 2005 were able to take advantage in 2010 of an average reduction of 3% in the interest rate. This allows us to control for the endogeneity of the refinancing decision and to focus on the effects of the changes in monthly payments due to the lower interest rates on their consumption behavior. To this end, we collect information on the balance of all their liabilities, such as credit cards, student and auto loans, and other revolving or installment debts. To study, instead, the extent to which the refinancing resulted in faster deleveraging, we analyze data on the households' repayment behavior for both installment and revolving loans. Furthermore, by restricting attention only to households with this type of mortgage, we limit potential concerns about the households' characteristics driving the choice between fixed-rate and adjustable-rate mortgages.[4]

First of all, we study the monthly payment for households with 5-year ARMs and show that at the moment of the interest rate reset the monthly payment sharply fell by $900 on average. We provide evidence that the payments stay constant before and after the reset

[3] For instance, Hurst and Stafford (2004) shows that the households who engage in home equity extraction are more likely to have experienced an unemployment shock or to have limited initial liquid assets to draw upon. Agarwal et al. (2013) also point out that the incentives might depend on the size of the mortgage, as they estimate the spread between the current and the refinancing interest rate that justifies refinancing at 1.1–1.4% for mortgages between $100,000 and $200,000 in size. Campbell (2006) discusses these issues in further details.

[4] Campbell and Cocco (2003) show that unconstrained households prefer ARMs when inflation risk is large relative to real interest rate risk, while borrowing-constrained households might opt for them when they have low risk aversion; however, they are unattractive to risk-averse borrowing-constrained households with a high debt-to-income ratio.

month, suggesting that indeed the monthly payments significantly changed as a function of the interest rates. We control for borrower characteristics as well as county-time fixed effects, which capture any unobserved time-varying variation at the county level. We can then employ this change in the monthly payments to show three main results.

We start our analysis by examining the consumption reaction to the change in the monthly payment. We measure consumption in two different ways. First, we identify the instances in which households purchase a car by applying for an auto loan, as we observe the balance on all their debts, which constitutes our main measure of consumption of durable goods. Second, we employ information from consumer finance loans and revolving store credit cards as a measure of other forms of consumption, such as purchases at store chains like Best Buy or Macy's. We find that in both instances the households that experience a reduction in the monthly mortgage payment significantly increase their consumption in the quarter after the change. Since the change in the mortgage payments was anticipated, we observe a slight but statistically significant increase in the two quarters before the change, but the households' consumption expenses spike in the quarter after the reset and remain significantly higher in the subsequent two years. Specifically, we find that households increase their consumption on average by \$150 after controlling for household fixed effects, month fixed effects, and county-time fixed effects. In other words, if we compare a borrower with a mortgage resetting in January 2010 he will consume significantly more in the first quarter of 2010 compared to a borrower with a reset at different point in time, for instance, in June 2010. The amount invested in durable goods, and also the probability to purchase a new car spikes after the reduction in the interest rate. We confirm these results by employing our second measure of consumption derived from the retail credit cards.

We then turn to the analysis of the households' precautionary incentives. We observe all the payments made towards their mortgages and all the other debts, i.e. credit cards, auto loans and student debt. We show that a significant fraction of the increase in income experienced after the interest rate reset is invested in repaying their debts faster. Hence, this suggests that although the monetary policy implemented starting in 2008 had a significant effect on households' debt payment, their consumption response has been attenuated by the high level of debt accumulated during the boom years and their desire to deleverage.

We complement these results by analyzing the behavior of borrowers with different loan-to-value ratios and show that there is a significant difference in their consumption and saving behavior. Specifically, borrowers with a LTV in the highest tercile increase their consumption almost three times as much as borrowers in the lowest tercile. This suggests that indeed as shown by Aiyagari (1994), the most constrained borrowers are the ones that react the most to the income shock. Interestingly, however, the LTV has a non-linear effect on the borrower's

repayment decision: borrowers with a LTV between 95% and 120% are the ones that invest more towards repaying their debt while borrowers with LTV below 95% and above 120% repay their mortgage less. This confirms the intuition that borrowers with intermediate LTV ratios are the ones that can benefit the most from a reduction of their debts as they are the closest to building equity in their homes.

Finally, we investigate the implications of our findings for the aggregate economy. Our identification relies on a specific type of contract, but the underlying mechanism does not. To show that monetary policy has a significant effect on the county-level aggregate consumption we exploit the geographical variation in the presence of adjustable-rate mortgages. In fact, ARMs have been more popular in some regions in the U.S. rather than in others. Specifically, zip codes in California and Florida and in general on the two coasts have experienced higher levels of ARM origination than other regions. For this purpose, we complement our data sources with data coming from a private data provider, Lender Processing Services (LPS), on the ARMs mortgages originated at the zip code level. This allows us to construct a measure of how much each region is subject to the changes in monetary policy.

First, we show that the fraction of outstanding ARMs as of 2006 is a significant predictor of the monetary policy interest rate pass-through in the period 2007-2013. In other words, the average mortgage interest rate in regions with a higher fraction of ARMs react more to the decline in interest rates. Then, by looking at quarterly changes in car sales between 2007 and 2013, we show that changes in the interest rates tend to have a disproportionately larger effect on durable goods consumption in counties with a greater fraction of ARMs. These results remain significant even when we control for local house prices, elasticity of housing supply, the fraction of subprime borrowers, and county and time fixed effects. These results provide suggestive evidence that the importance of debt rigidity in the transmission of monetary policy is more generally related to the possibility for the households to modify their mortgage interest rates. Moreover, this empirical strategy allows us to capture the local general equilibrium effect, as we interpret these results as the sum of the direct increase in car purchases by borrowers holding ARMs, as well as the indirect increase by all the other households who can benefit from the increase in the local demand. However, to be clear our methodology cannot estimate the general equilibrium effect, such as any multiplier of the interest rate policy, because for instance, we do not observe the lenders' reaction to such changes in the interest rate.

1.1 Related Literature

Bernanke and Gertler (1995) show that households' expenditures on durable goods and residential investment are the components of GDP that respond more forcefully to changes in monetary policy. However, very few empirical studies analyze the impact of monetary policy on households' consumption behavior at the disaggregated level.[5] Moreover, the households' consumption reaction to monetary policy can be driven by a valuation channel and an income channel.[6] Our first contribution is to use household-level data to fill this gap by investigating the role of the income channel of monetary policy in shaping households' consumption and saving behavior.

Recent papers have investigated the channels through which monetary policy impacts banks' lending decisions and risk-taking behavior. For instance, Jimenez et al. (2014) show that a lower overnight interest rate induces less capitalized banks to lend to riskier firms. Jimenez and Ongena (2012) show that tighter monetary policy and worse economic conditions substantially reduce loan granting, especially from banks with lower capital or liquidity ratios. Finally, Maddaloni and Peydró (2011) find that low short-term interest rates soften standards for household and corporate loans, which is amplified by monetary policy rates that remain too low for too long. We complement these studies by uncovering the impact of low interest rates on households' consumption and saving decisions. Novel in this literature, we show that the prolonged period of low interest rates boost households' consumption both at the individual and the aggregate level, but the effect is mitigated by the households' incentives to deleverage.[7]

Hence, our paper is related to the studies measuring the size of the household consumption responses to fiscal stimulus policy or tax rebates. For instance, Souleles et al. (2006) and Parker et al. (2013) focus on the episodes of 2001 and 2008 respectively, in which the U.S. Treasury scheduled payments based on the last two digits of individual Social Security numbers. They exploit this randomized timing of the receipt of payments to conclude that households spend approximately 25 percent of rebates on nondurables in the quarter that they are received, relative to the control group of households that do not receive the rebate in that same quarter. There is also evidence of interesting dynamic effects. For instance, Agarwal et al. (2007) analyze the tax rebate of 2001 and show that consumers initially saved

[5] Evidence of financing constraints at the household level has been widely documented by, among others, Zeldes (1989), Jappelli and Pagano (1989), Campbell and Mankiw (1989), and Carroll and Dunn (1997).

[6] See Doepke and Schneider (2006) for evidence regarding the valuation channel.

[7] For other papers on the effect of the unconventional monetary policy see Swanson and Williams (2012), Romer and Romer (2013), Krishnamurthy and Vissing-Jorgensen (2011), Krishnamurthy and Vissing-Jorgensen (2012), and Gagnon et al. (2011). Recent papers by Doepke and Schneider (2006), Coibion et al. (2012) and Sterk and Tenreyro (2014) have also investigated the redistributional implications of monetary policy for the aggregate economy.

some of the rebate, by increasing their credit card payments and thereby paying down debt, however, soon afterwards their spending increased. This uncovers an important liquidity mechanism, which is confirmed by our results on the heterogeneous marginal propensity to consume of borrowers facing different wealth shocks.[8]

In contrast to most of the literature which focuses on anticipated shocks, Agarwal and Qian (2013) study how households respond to an unanticipated income shock. Specifically, Agarwal and Qian (2013) study the effect of the Growth Dividend Program, which consisted in a one-time cash payout of $1.17 billion ranging from $78 to $702 to 2.5 million Singaporeans. They find that for each dollar received, consumers on average spent 80 cents during the ten months after the announcement. Jappelli and Padula (2014), instead, study the effect of a change in the severance pay for public employees in Italy, which entails substantial losses for future generations of public employees, which can be considered as an unanticipated income shock. They find that each euro reduction in severance pay reduces the average propensity to consume by 3 cents and increases the wealth-income ratio by 0.32.

Other related papers in this literature include Jappelli and Pistaferri (2010), Kaplan and Violante (2011), Hsieh (2003), Shapiro and Slemrod (2003b), Shapiro and Slemrod (2003a), Souleles (2002) and Stephens Jr (2008). Jappelli and Pistaferri (2010) develop a theoretical framework that has several predictions for consumption response to unanticipated and anticipated income shocks depending on the persistence of the shocks and the degree of completeness of credit and insurance markets. Specifically, they argue that while consumption should not respond to anticipated income changes, it should respond to unanticipated income changes. Recently, Kaplan and Violante (2011) propose a quantitative framework, where households can hold two assets: a low-return liquid asset (e.g., cash, checking account, etc.) and a high-return illiquid asset that carries a transaction cost (e.g., housing or a retirement account). They show that this model yields consumption responses to fiscal stimulus payments that are in line with the existing empirical evidence. Hsieh (2003) provides evidence of consumption smoothing employing the Alaska permanent fund, while Shapiro and Slemrod (2003b) and Shapiro and Slemrod (2003a) provide further evidence on the tax rebate in 2001 and Souleles (2002) analyze the effects of the Reagan tax cuts. Finally, Stephens Jr (2008) examines the consumption reaction to predictable increases in discretionary income, following the final payment of a vehicle loan, to investigate whether households "smooth" consumption in response to predictable changes in income.

In sum, we contribute to this literature in two ways. First, while the existing literature

[8]Relately, Bertrand and Morse (2009) take advantage of the 2008 tax rebate to study the behavior of borrowers who use payday loans. They find that only the low-to-middle users of payday lending services (measured in terms of frequency of use in the prior year) retire debt in the pay cycles that follow the receipt of the tax rebate.

has focused on the effects of fiscal policy through tax rebates, our study highlights the key role that monetary policy can play in shaping consumers' behavior through mortgage payments and housing wealth. Second, the magnitude of the average income shock per households is significantly larger than any other previous study. In fact, our estimates do not rely on a one-time shock, but on an average effect of about $900 per month.

Finally, our paper also highlights the important role played by frictions in the mortgage market. While the existing literature on monetary policy has focused on price rigidities, we highlight the importance of debt rigidities in the transmission of monetary policy to households. This also connects our study to recent papers by Calza et al. (2013), Scharfstein and Sunderam (2013) and Keys et al. (2014). Calza et al. (2013) analyze the relationship between the structure of housing finance and the monetary transmission mechanism in several industrialized countries. They show that the size of the effect of a monetary policy shock is significantly related to indicators of flexibility in the mortgage markets and that residential investment is significantly more responsive to policy innovations in countries with a variable-rate mortgage structure. Scharfstein and Sunderam (2013) show that the strength of the housing channel of monetary policy is reduced in areas with higher concentration in mortgage lending. Keys et al. (2014), instead, examine the reasons behind the failure to refinance for households in the U.S., even when this would lead to significant savings. Specifically, they compute that the median household that is holding on to a mortgage with too high an interest rate would have saved approximately $45,000 (unadjusted) over the remaining life of the loan by refinancing. Moreover, they argue that the failure to refinance was too widespread to be simply explained by more conservative underwriting standards in the wake of the crisis.

We complement these papers by showing how households less subject to such frictions, due to an automatic adjustment of the interest rate, responded to the positive monetary policy shock.[9] We are able to do so by employing an identification strategy similar to the one proposed by Fuster and Willen (2013), who employs these changes to the mortgage monthly payments to shed light on a borrower's default behavior and show that the reduction of the borrower's payment significantly reduces his hazard of becoming delinquent.

The remainder of the paper is organized as follows. Section 2 provides details on the data sources and summary statistics. Section 3 explains the research design and how it is made operational. Section 4 describes and interprets the main results on the households' marginal propensity to consume. Section 5 presents evidence suggesting heterogeneous MPC among households facing different liquidity constraints. Section 6 discusses a number of robustness

[9] Also related is the mechanism proposed by Iacoviello (2005). He develops and estimates a monetary business cycle model with nominal loans and collateral constraints tied to real estate values as in Kiyotaki and Moore (1997). He shows how positive demand shocks by reducing the real value of borrowers' outstanding debt obligations gets amplified and propagated over time.

checks and Section 8 concludes.

2 Data and Summary Statistics

In our paper we take advantage of two main source of information, one on the characteristics of the mortgages and one on the households' balance sheets. Specifically, we collect data on mortgage loans originated every month from 2005 to 2013 through Blackbox Logic, a private company that provides a comprehensive, dynamic dataset with information on 21 million privately securitized Subprime, Alt-A, and Prime loans. These loans account for about 90% of all privately securitized mortgages from that period. This dataset allows us to keep track of the information about the mortgage and the borrowers at origination, such as the loan type, the initial interest rate, the FICO score at origination and the amount of the loan, but more importantly it provides us with monthly updates about, for instance, the status of each mortgage, the monthly payments, the current balance and several other important information. Furthermore, since we know the borrower location we can employ the zip-code house prices and the information about the current balance on the mortgage to construct a current loan to value ratio for each borrower.

These loans are then matched with credit bureau reports from Equifax. Equifax provides us with detailed households' balance sheets information, specifically, the monthly information on all the loans that a borrower has, such as, credit cards, auto loans, mortgages, and home equity line of credit, but also on his current FICO score. The two datasets allow us to construct our main variables of interest. First, we can precisely identify the mortgages that should be affected by changes in monetary policy. Specifically, we focus on prime five-year ARMs originated between 2005 and 2007, which are among the most common categories within the ARMs. We also employ the second largest category, the ten-year ARMs, as control group to provide an additional robustness check in Section 6. Second, we can accurately measure the change in the mortgage monthly payment as we observe the payment made by the borrowers towards their mortgages in each month. By observing this balance sheet information over time, we can also estimate how much of the experienced income shock will be utilized by the borrower to pay down his debts. Finally, we can construct a measure of consumption for each borrower. In particular, we can measure the consumption of durable goods by the change in the borrower's auto loan. We also augment this with another measure of consumption coming from the balance of the borrowers' store credit cards (e.g. Best Buy card, Macy's card, etc.) to provide further evidence on the households' consumption response.

To be clear, these measures underestimate the increase in consumption resulting from

the decline in interest rate, because they cannot capture purchases made by cash, check or other means not recorded in Equifax. At the same time, we cannot observe the decision of the households to save part of the reduction in the monthly payment in their checking or saving accounts. However, this makes it even more striking that we are able to account for a significant fraction of the positive income shock.

Let us start by describing the main variable of interest. Figure 1 shows the distribution of the changes in the monthly payment at the time of the interest rate adjustment for our sample of ARMs. In other words, the average monthly positive income shock is about one thousand dollar which, as we will show in the next section, corresponds to half of the monthly payment. However, depending on the size of the loan, there are also some borrowers experiencing a decrease in the monthly payment of more than three thousand dollars. We are going to take into account this heterogeneity by analyzing the behavior of households subject to a different intensity of the treatment.

This change in the monthly payment is triggered by the mechanical reduction of the mortgage interest rates. In our sample, mortgage rates are computes as a fixed spread over an index. Since these are all prime borrowers, the spread is relatively low with a range of 2%-4%. The majority of loans are indexed to the 6-month LIBOR, then the second largest category comprised those indexed to the 1-year LIBOR, and finally a small fraction of mortgages are indexed to the 1-year Treasury bill rate. Figure 2 shows the cumulative distribution function for the change in the mortgage interest rate between the origination and the date of the adjustment. The average decline in the interest rates is about 3.3%. Moreover, considering our sample period for the post-adjustment period 2010-2012, the majority of these loans will experience these lower interest rates for a prolonged period of time.

We can now turn to our main measure of consumption: car purchases. Figure 3 is a representation of the way in which we are able to identify car purchases through two examples drawn from our sample. We plot the balance of the auto loans and the measure of new car purchase that we use in our analysis. The left panel describes the case in which the borrower has bought a car before the beginning of our sample, and starts paying down his auto loan over time. This explains why our measure stays constant at zero for the whole period, while the blu dots described the decreasing auto loan balance. The right panel, instead, the more relevant case in which a consumer bought two cars in our sample. These events correspond to a clear spike in his auto loan balance. Our measure of car purchase is equal to the change in the auto loan balance at the time of purchase.

Figure 4 complements the previous description by showing the average monthly expenditure on car for the period 2006-2012. It starts from its highest level at the beginning of our sample, with about $400 per month spent on car purchases, and declines to $250-$300

during the Great Recession. The bottom plot shows, instead, the average probability of a car purchase in a month, which is between 1.3%-2.1%. These data are going to be useful to interpret the magnitude of our consumption response.

Before discussing the summary statistics, we also plot the average monthly partial mortgage prepayment in Figure 5. This captures the amount allocated by the borrower to repay the mortgage. It is on average $40 during the pre-adjustment period 2007-2010, but then increases up to $120 in the later years in our sample. This latter increase reflects the fact that starting in 2005, a significant fraction of these mortgages experienced the adjustment in the interest rate and, as we will show in the next section, they will allocate on average an additional $60 to repay their mortgages.

Table 1.A reports the summary statistics for the main variables employed in our analysis. We consider both 5-year and 10-year ARMs, since the latter will be used as an additional control group in Section 6. Our sample comprised prime borrowers with an average FICO score of 736, an average original mortgage balance of $357k, and a loan-to-value ratio at origination of 77%. The interest rate at origination is on average 6.4%, and it declines to 3% after the adjustment, with a corresponding decrease in the average monthly payment from $1.9k to $915. We also computed that the average monthly expenditure on a new car by these borrowers equals $319, and their monthly probability of purchasing a new car is 1.5%. Next we can compare these characteristics with the 10-year ARMs. The main difference is that 10-year ARMs tend to be larger, with an average mortgage size of $536k and a monthly payment of $2.7k, but the borrowers' consumption and saving behavior is very similar.

To analyze the aggregate effects of changes of interest rates on the county-level consumption we use a dataset from R. L. Polk & Company (Polk) that records all new car sales in the United States.[10] Beginning in 2002, for each new car purchased in the United States, the dataset identifies the make and model of the car. For example: Ford (make) Focus (model) or Toyota (make) Camry (model), and whether the car was purchased by a private consumer (a retail purchase), a firm (commercial purchase), or by the government. It also gives the county, year and quarter in which the car was registered.

The lower panel of Table 1.A shows information about the key control variables that we use in Section 7 to capture county-level heterogeneity. We collected information on median income, population, household leverage, inequality as captured by the Gini coefficient, poverty rate, fraction of African-American and, more importantly for our analysis, the fraction of ARMs in 2006. The latter exhibits a significant variation as it is on average 17%, but it ranges from 3% to 63%.

For the households' balance sheet information we employ data from LPS. It provides

[10] This same data has been previously used by Mian et al. (2013).

loan-level information collected from the major mortgage servicers in the US, covering about 60 percent of the mortgage market. We use this loan level information to construct the total stock of outstanding mortgage debt in each county, disaggregating the principal balance by whether the mortgage is fixed rate or adjustable rate mortgages; where we combine the principal balances for adjustable and hybrid mortgages. We include both refinances as well as new mortgage originations in order to measure broadly the potential channels through interest rate movements might affect consumption. The main advantage of this dataset over the one we use for the loan-level analysis is the higher coverage, because it includes also non-securitized loans and loans insured by GSEs. However, we cannot employ this dataset throughout in the paper, because it does not contain credit bureau information from which we derive our measure of consumption and prepayment.

We can take advantage of the larger sample in LPS to check if the borrowers in BlackBox differ from households holding other types of mortgages in any significant way. Table 1.B provides information first on the characteristics of almost 20 million mortgages originated between 2005 and 2008, and then for three main subgroups: borrowers holding fixed-rate mortgages, adjustable rate mortgages and 5-year ARMs (which are not restricted to hybrid mortgages only). Comparing data from Table 1.A with the one provided in Table 1.B we can notice that in our sample the borrowers have a slightly better FICO (736) compared to the average borrower (703), or borrowers holding a fixed-rate mortgage (705), but very similar to the sample of 5-year ARMs in LPS (721). The same is true for the interest rate at origination, the initial monthly payment and the loan-to-value ratio. The only important difference between these different type of mortgage holders is the average size of the loan. In LPS we have an average size of \$349k, compared to \$196k and \$239k for fixed-rate mortgages and the average borrower respectively. However, this is very close to what we report in Table 1.A for our sample of 5-year ARMs in BlackBox (\$357k). This evidence reassures us that the main mortgage characteristics of the borrowers who experienced the automatic adjustment of the interest rate mirror the ones of the more general population of households holding a mortgage in U.S.

3 Research Design

The monetary policy implemented in the aftermath of the crisis could have benefited existing homeowners through the possibility to refinance mortgages at a lower interest rate and boost in this way aggregate consumption. However, a substantial fraction of homeowners have not been able to take advantage of the low interest rates due to the collapse in house prices, which resulted in spiking loan-to-value ratios and the consequent inability to refinance. This

paper starts with the observation that during the boom period 2004-2006 an important part of the mortgages originated were adjustable rate mortgages.[11] The key feature of these mortgages exploited in our study is that they entail an interest-only payment for the first 10 years, and an automatic adjustment of the interest rate after 5 or 10 years after the origination. In other words, no matter the local house prices, these households would see their mortgages refinanced at much lower interest rates, which would result in a significant reduction in their monthly payment. Key for our identification strategy is the fact that the reduction of the monthly interest rate is a feature of the contract and not an endogenous choice of the borrower.

At the individual level, our identification strategy is designed to exploit the timing of the change in the interest rate and the automatic reset for these ARMs as a positive income shock for households holding these mortgages.[12] The estimation methodology employed for the individual-level is a version of the difference-in-differences estimator (DD). Specifically, in each month t the treatment group include all the households holding 5 years ARMs who have their mortgages reset in month t, while the control group comprised the households holding the same type of mortgage, but that did not experience the change in their interest rate. In other words, we estimate the consumption response of the households who experienced a reduction in the interest payment, relative to that of households holding the *same* mortgage, but with a different reset date. This identification strategy has several advantages. First, by restricting attention to households holding the same ARMs, we are sure not to pick up any difference in preferences that could drive the choice of an ARM rather than a fixed-rate mortgage. Second, this strategy allows us to exploit the timing of the change which is likely to be uncorrelated with the households' consumption behavior. In particular, the underlying assumption is that households whose mortgage resets in May 2010 are comparable to households that will experience their reset, for instance, in December 2010. Third, thanks to the panel nature of our data, we can control for households and time fixed effects in all our specifications, as well as, a vector of characteristics that would absorb potential heterogeneity correlated with their consumption and saving behavior.

Moreover, as a further robustness check, we can include also county-month fixed effects and cohort-year fixed effects, where cohort is defined as the year of origination.[13] These more

[11] By 2006 they reached over 12% of all originations and close to 40% of mortgages in some well-performing markets (see Krainer and Laderman (2014), Piskorski and Tchistyi (2010) and Garmaise (2013)).

[12] At the aggregate level, we can exploit the inter-county heterogeneity in exposure to these type of contracts to analyze how the prolonged period of low interest rate have affected the households' consumption behavior. The latter will be explained in greater details in Section 7.

[13] Since in our specifications we estimate the consumptin and saving response with quarterly dummies before and after the interest rate adjustment, we are not able to estimate different trends for quarters of origination.

conservative specifications correct for two potential confounding effects. First, we allow for heterogeneous trends for different regions, which control for potential differential responses to the reduction in the interest payment due to changing local economic conditions. For instance, households living in counties that experienced a more severe bust in housing prices and real economic activities can have a different consumption behavior than households living in counties less affected by the Great Recession.

Second, we allow for heterogeneous trends for different cohort of origination, which capture unobserved variation across cohort that might affect the households' response to the interest rate reset. For instance, mortgages originated in 2007 had a higher loan-to-value ratio than loans originated in 2005, as the house prices increased during that period and the lending standards became laxer. This means that households who purchased a house in 2007, with a higher monthly payment, are going to be differentially treated by the interest rate adjustment, both because of the higher income shock and for potential characteristics correlated with their consumption behavior, such as their creditworthiness and their expectations about future income growth.

Formally, our main specification is the following

$$Y_{i,t,g,\tau} = \sum_{\theta=-8}^{8} \beta_\tau 1\{\tau = \theta\} + \lambda_i + \eta_{g,t} + \Gamma X_{i,t} + \varepsilon_{i,t,\tau}, \tag{1}$$

where i denotes the households, g the county, t the month or the quarter and τ the quarter since the interest rate adjustment. The main outcome variables $Y_{i,t,g,\tau}$ analyzed in the next section are the increase in consumption of durables, as proxied by the purchase of a car or by purchases made with store credit cards, and the increase in voluntary prepayment of the existing debts. The main coefficients of interest are the β_τ which capture, for instance, the consumption response to the change in the interest payment one quarter, two quarters or even two years before and after the adjustment of the interest rate. λ_i captures the households fixed effects, whereas $\eta_{g,t}$ is the county-month fixed effects. Finally, $X_{i,t}$ is a vector of borrower's characteristics aimed to capture any residual individual heterogeneity not captured by the household fixed effect. This includes the borrower's FICO score, as proxing for his financial constraints or creditworthiness, and the zipcode-level house prices to capture the local economic conditions. Alternatively, instead of controlling for the county-month fixed effect we can control for the cohort-year fixed effect. To analyze heterogeneity in the response to the decline in the mortgage monthly payment, we interact $1\{\tau = \theta\}$ with indicators for different types of households. We correct the standard errors to allow for arbitrary heteroskedasticity and we cluster them at the household level.

We start by quantifying the average change in the monthly payment, which will constitute

our income shock. Figure 6 shows an event study analysis with time zero being the time of the interest rate reset and the x-axis being quarters before and after the interest rate adjustment. In the top graph, we plot the average monthly payment which we normalized to zero in the pre-period, which stays constant for the period before the event and drops significantly at the moment of the event. The bottom graph, instead, shows the change in the monthly payment once we normalize it by the monthly payment at origination. The magnitude of the drop is very significant as it is on average almost one thousand dollars per month, or equivalently, half of the monthly payment. This figure also highlights one important feature of our setting, that is, the fact that the reduction in the payment is not temporary, but lasts for the whole post period. This is due to the fact that even if these ARMs usually reset the interest rate every year after the initial fixed-rate period, the low interest rate regime started in December 2008 and is still in place.

Now we can present our estimation results. Table 2 shows the regression of interest payments on the time dummies for the four quarters before and after the change in the interest rate as in (1). Each coefficient captures the dollar reduction in the interest payment in that quarter for the sample of all 5-year ARMs with a 10-year interest-only payment originated between 2005 and 2007. In Column (1) we control for households and month fixed effects and show that in the quarter after the event there is a significant reduction in the interest payment of about $1045. Similar estimates are presented for the subsequent quarters. The presence of small changes in the pre-period is due to the possibility of voluntary payment or adjustments by the households. However, the coefficient jumps from -$47 to -$1044, which highlights how important the change in the interest rate has been for the households' balance sheets.

Column (2) confirms similar results once we control for the borrower's FICO score and the log of house prices for the county where the borrower resides. Column (3) is a more restrictive specification as we control for county-month fixed effects as well as household fixed effects. Even when we capture this time-varying heterogeneity at the county level, both the economic magnitude and the statistical significance are unaffected. Our preferred specifications are those provided in Columns (4) and (5). Column (4) includes households fixed effects and origination cohort-year fixed effects. As it is evident from the magnitude and statistical significance of our results, the estimated coefficients are not affected by potential heterogeneity across mortgages originated in different time periods.

The reduction in the monthly payment tends to go down from $920 in the first quarter after the adjustment to $720 two years after the adjustment. However, this is driven by the fact that for later quarters the only borrowers for which we have the data two years after the adjustment are those originated earlier in our sample, but these are mortgages with lower

monthly payment than the later cohorts. This is easily taken into account in Column (5), where we allow for differential trends depending on the size of the initial monthly payment. Once we do that, the reduction in the monthly payment is very stable around $920 for the all post-adjustment period. Finally, we run a similar specification to the one in Column (4), with the only difference being that we normalize the monthly payment by the size of the monthly payment at origination. Intuitively, the estimated coefficients capture the size of the reduction in the monthly payment in percentage points. While there is no economically significant reduction in the monthly payment before the interest rate adjustment, it is reduced by 53% in the first quarter after the adjustment and this effect persists for the next two years as well.

In sum, the possibility of an automatic reset of the interest rates, constituted a significant positive income shocks for these households. In contrast to the existing literature on households consumption response to income shocks, which mostly focused on one-time payments, such as tax rebates, to households in the order of few hundred dollars, in this paper we have the opportunity to exploit a positive income shocks of tens of thousands dollars per year.

4 Main Results

We start by investigating the effect of the change in the interest payments on the households' consumption behavior and then we turn to the analysis of its effect on their debt-repayment strategy.

4.1 The Consumption Response

We employ data on auto loans to capture the purchase of a car in response to the reduction in the monthly interest payment. Specifically, we can track the changes in the auto loan balance to identify all the instances in which households purchased a car using financing.[14]

We start our analysis with Figure 7 which shows an event study analysis with time zero being the time of the interest rate reset and x-axis being the quarters before and after the event. The top graph plots the average monthly amount spent on car purchases through an increase in auto loans. It shows that households increase their consumption of cars starting one year before the interest rate reset, allocating on average of $50 to it. This result shows that households were anticipating the reduction in the monthly payment and started increasing their consumption before the reset date. Interestingly, however, the

[14] In Section 6 we shall complement these results employing a different measure of consumption derived from store credit cards.

effect is increases in the subsequent quarters with an average effect reaching $200 one year after the interest rate adjustment. The bottom graph plots the same coefficients once we normalize them by the initial monthly payment. The households' who expect the reduction in the monthly payment allocate about 5% of the positive income shock to purchase a car in the quarter before the adjustment, but then this effect becomes significantly increase in magnitude in the next quarters reaching more than 20% one year after the adjustment.[15]

Table 3 confirms the previous results controlling for several potential confounding effects. Column (1) presents the coefficients of interest controlling for households and month fixed effects. It shows that starting one year before the change in the interest rate, the households start spending about $40 more towards durable goods. However, in the quarter after the reset the households more than double their consumption spending almost $100, with this effect increasing up to about $203 two years after the interest rate adjustment. Column (2) controls for the borrower's FICO score and the log of house prices for the county where the borrower resides. It shows that both the statical and economic magnitude of the estimates remain unaffected. Intuitively, higher FICO scores predicts higher consumption, because they capture the credit availability for these borrowers.

In Column (3) we saturate the model with county-month fixed effect, by showing that even allowing for differential trends across different counties has no impact on our estimates. This is particular important for this estimation, because households' consumption decisions can be significantly affected by the local economic conditions. For instance, households living in counties hit more significantly by the financial crisis, such as those that experienced a larger decline in house prices or a spike in job losses, will have a different marginal propensity to consume than households living in less affected regions. In Column (4), instead, we introduce origination cohort-year fixed effects. The coefficients are robust to such inclusion, which shows that the differential conditions at origination, such as the different equity in the house, have no significant impact on our estimates. In fact, households start consuming $52 before the interest rate adjustment, but this then increases to $93 in the quarter after and to $150 one year after the reset date.

Column (5) provides the estimated coefficients for the specification in which we allow for different trends for different quartile of the monthly payment at origination. This captures in a non linear fashion the possibility that households facing different monthly payments followed heterogeneous trends. This captures the possibility that, for instance, households with higher monthly payment might have higher income and own a larger house, which can

[15] Note that the coefficients are normalized by the initial monthly payment and we know from Table 2 that it declines by 50%. Hence, we need to double our point estimate to capture the fraction of the monthly reduction in payment allocated towards car purchases.

also lead them to have different consumption responses to the positive income shocks. The magnitude of these effects is particularly large if compared with the data in the top plot of Figure 4. Since we are examining the consumption behavior of households with mortgages originated between 2005 and 2007, we are investigating the households' consumption behavior in the period 2010-2012. Then, if we consider the monthly expenditure on cars for that same period, the top panel of Figure 4 shows that it is on average $300 per month. Our estimates suggest that after the interest rate adjustment the households car purchases increase by at least 30%, and up to 55%, after the interest rate adjustment.

In Column (6) we estimate a linear probability model to estimate how the likelihood to purchase a car is affected by the change in the monthly payment, which provides us with an estimate of the households response on the extensive margin. It shows that this probability increases by 0.8% a month in the first quarter after the adjustment, which becomes 1.3% two years after. This is an economically significant effect, because as shown by the bottom panel of Figure 4, the average monthly probability of buying a car in the 2010-2012 period is about 1.3%. Hence, households increase their monthly probability of purchasing a car by at least 60%.

Finally, Column (6) reports the coefficient estimates of the monthly car purchases once we normalize them by the size of the monthly mortgage payment at origination controlling for households and origination cohort-time fixed effects. Households spend 10% of the income shock the first quarter after the interest rate adjustment, but then this effect increases over time reaching 20% one year after the reset date.

Interestingly, these effects together show a different reaction of durable consumption from its response to the fiscal stimulus recently identified by Mian and Sufi (2012a). They evaluate the impact of the 2009 "Cash for Clunkers" program on short and medium run auto purchases and show that the resulting boost in aggregate demand is quite short-lived. In fact, they find that almost all of the additional purchases under the program were pulled forward from the near future. In our case, instead, the reduction of monthly payment has significantly increased aggregate demand and we find no evidence of intertemporal substitution. This follows from the fact that we do not find that in the quarters before the interest rate adjustment households decreased their consumption, nor we find that the effect is short lived, quite the opposite, we find that it increases over time. We believe that it is due to the different features of the underlying income shock. In contrast to Mian and Sufi (2012a), which is a one-time subsidy to purchase prices, in our case the shock is larger and lasts several quarters. Hence, as we shall show in Section 5, our effect is likely to operate through wealth and liquidity effects. Moreover, since the shock is less temporary than in Mian and Sufi (2012a), households do not just change the timing of their consumption, but can actually

change its level.

More generally, we can compare our estimates with the existing literature on households consumption response to income shocks. Parker et al. (2013) analyzes the households consumption reaction to the Economic Stimulus Act (ESA) of 2008, which consisted in tax credit of $300-$1200 depending on the households size. They find that households spent about 12 to 30 percent of their stimulus payments on nondurable consumption goods, and another 38 to 60 percent on the purchase of vehicles, which is only slightly smaller in magnitude than the response to the 2001 tax rebates (see for instance Johnson et al. (2009)). On the one hand, we find a smaller in magnitude effects if you compare the $150 spent on vehicle with the estimates provided by Parker et al. (2013). On the other, we find that due to the very different source of the income shock these effects last for up to two years after the interest rate adjustment, which makes the overall consumption spending significantly larger. Moreover, in the next section we shall provide evidence of one important reason why households might not spend the additional income on consumption: their attempt to voluntary deleverage.

4.2 Voluntary Deleveraging

The way in which monetary policy can affect households' behavior crucially depend on their precautionary saving motive. In general, we would expect that if households are liquidity constrained, then a decrease in debt service payments is likely to be associated with an increase in consumption. However, the extent to which households' consumption respond to lower debt service payments can be a function of their precautionary saving incentives, i.e. higher the income risk lower will be the consumption response to the payment reduction.[16]

To estimate this effect, we record the changes in the debt balance for the households affected by the automatic reset in the interest rates. This allows us to track down their incentive to invest the savings generated by the lower monthly payment in a faster repayment of their loans. To be clear, we are not able to capture other forms of savings such as retirement accounts or deposits on savings account, then we are doomed to underestimate the households' precautionary incentives. However, we do think that given the collapse in house prices experienced in the U.S. and the high loan-to-value ratios for the majority of the households in our sample, repaying their mortgage faster and build equity in their homes might constitute an important way in which the additional income is spent.

Figure 8 shows an event study analysis with time zero being the time of the interest rate reset and x-axis being the quarters before and after the event. The top panel shows

[16] Consistent with this intuition, Agarwal et al. (2007) analyze tax rebate of 2001 and show that consumers initially saved some of the rebate, by increasing their credit card payments and thereby paying down debt, however, soon afterwards their spending increased.

the average monthly amount invested in voluntary repaying the principal on the borrowers' mortgages. We only consider partial prepayment of the mortgage, because a full repayment coincides with the house being sold or the mortgage being refinanced. The plot shows that, in contrast to the consumption response presented in Figure 7, even if the change in the monthly payment is anticipated, the borrowers starts allocating an economically significant amount of money only in the quarters after the interest rate adjustment. Specifically, households allocate on average \$60 per month towards a faster repayment of their mortgage, with this amount increasing in the following quarters. The bottom panel shows that this corresponds to about 15% of the positive income shock.

Table 4 reports the coefficients estimated using a similar regression to (1), which allows us to complement the findings of Figure 8 by controlling for several other factors that could contaminate our results. The dependent variable is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. Column (1) controls for households and month fixed effects and shows that borrowers invest about \$60 to repay the principal of their mortgage in the first quarter after the interest rate reset, while we find no significant pre-trend as captured by the insignificant coefficient for the quarter before the adjustment. Column (2) shows that the effect is robust to controlling for FICO score and the log of house prices for the county where the borrower resides. It shows that FICO score positively predict an increase in the borrowers' voluntary deleverage. Moreover, higher housing prices which are correlated with general economic conditions tend to be correlated with a faster deleverage.

Columns (3) and (4) show the robustness of our results to the inclusion of county-month fixed effects and cohort-year fixed effects respectively. In fact our effect is even larger reaching almost \$80 two years after the interest rate reset. These tests further reassure us that our results are not driven by heterogeneity at the county level or at the time of origination that might drive the households' saving decisions. In column (5) we show the results for the specification in which we allow for different trend for households with different monthly payments. Even in this case the statistical and economic significance of our estimates remain unaffected. Finally, in Column (6) we estimate a similar specification to the one in Column (4) but after we normalized the prepayment by the mortgage monthly payment at origination. We find that on average 10% of the income shock is invested in repaying their mortgage.

To gauge these results, we can compare them with the average amount allocated by households to repay their mortgages in the pre-adjustment period as shown in Figure 5. Up to 2010, which is the first year in our sample when these households started experiencing the interest rate adjustment, the average amount devoted to deleverage was \$40 over the period 2007-2010. This means that after the interest rate adjustment, households more than double

their efforts to reduce their debt level.

5 Heterogeneous Effects

In this section we analyze the heterogeneity in the households' consumption and saving decision in response to the income shock generated by the change in the mortgage monthly payment.

An important source of heterogeneity is the households' access to credit. Since we measure durable consumption with leveraged car purchases, we should expect that households who have less access to the credit market tend to spend less on vehicles. We proxy credit availability with the borrower's FICO score one year before the interest rate adjustment. We divide the sample between the borrowers with above and below median FICO score. Since we also need to report the interactions, we restrict attention to one year before, one and two years after the reset date. We find the households with higher FICO score have a monthly payment reduction only 3% higher than the ones with lower FICO, but tend to consume and deleverage significantly more than the more constrained borrowers. This is consistent with what mentioned above about the consumption measure.

Theoretically, Aiyagari (1994) shows that another important source of heterogeneity is the tightness of the borrowing constraint. Specifically, we should expect the households with tighter borrowing constraints to react more to income shocks. Consistent with this view, Gross and Souleles (2002) show that consumers whose credit card limits get increased rise their debt, with the effect being larger for consumers near their current limit, which is consistent with binding liquidity constraints. We complement these results by analyzing the behavior of borrowers with different loan-to-value ratio.

Table 7 shows the least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination for two subsamples of our data, above and below median, based on the borrower's average LTV in the two years before the interest rate adjustment. As before, in all specifications we control for households fixed effects and origination cohort-time fixed effects to capture unobserved heterogeneity at the household level and to allow for differential trends across different cohorts, as well as borrower's FICO score and the log of house prices. Borrowers with a LTV above median consume almost double the amount consumed by borrowers with LTV below median. This suggests that indeed as shown by Aiyagari (1994), the most constrained borrowers are the ones that react the most to the income shock. Next we also investigate how the saving decision is affected by the borrower's LTV. We find that borrowers with a higher LTV tend to deleverage significantly less than other borrowers.

Intuitively, borrowers that are deep underwater have weak incentives to employ the reduction of the monthly payment to repay their debts as well, because they do not expect to be able to build equity in their homes any time soon. In contrast, the households who have an intermediate LTV can really benefit from the reduction in the interest rate as a smaller repayment can switch them from being underwater to be able to build equity in their homes.

6 Further Evidence

In this section we present further evidence corroborating our previous findings and testing their robustness.

6.1 Selection Bias

One potential concern with our estimates is the they might be contaminated by some form of selection bias. This is an important concern, especially if we consider our sample period and the fact that these hybrid ARMs might have had an even harder time during the Great Recession than less risky mortgage types. In Table 1.B we have compared the characteristics of the mortgages and of the households experiencing automatic interest rate adjustment with those of the larger sample of loans in LPS which include both fixed-rate mortgages and more general form of ARMs, and we have not found any significant difference except for the mortgage size. In this section, however, we want to examine if within our sample at origination there is some form of selection into the treatment, that is, the decline in the monthly payment.

We start by reporting in Figure 9 the attrition in our sample. Specifically, this plot shows the number of active loans, liquidated loans due to foreclosure, bankruptcy or real estate owned and paid off mortgages, due to prepayment or refinancing during the 2008-2012 period. This figure shows that about 40% of the borrowers active in 2008 or become delinquent or pay off their mortgage, with the first effect dominating the second one. In fact, the number of liquidated loans significantly increase over time from almost zero at the beginning of 2008 to almost forty thousand loans in July 2012. The number of paid loans, however, is significantly lower at about fifteen thousands.

We start investigating what drives this finding. BlackBox does not report information on the current loan to value ratio (CLTV), however, we can compute it by using information on the mortgage balance and house prices at the zip code level. Then, in Figure 10 we plot the cumulative distribution for the current loan to value ratio for these three categories of loans: active, liquidated and paid off. What is immediately clear is that paid off loans have

significantly lower CLTV than the active or defaulted loans. Specifically, one quarter before these loans drop out of our sample the median CLTV is 78%, which corresponds to the vertical line in the graph. This is exactly below the common threshold of 80% employed by financial institutions. Moreover, this is significantly higher than the 110% or 115% CLTV of active and defaulted loans.[17]

This figure suggests two observations. First, the decision to refinance a mortgage is mainly driven by the CLTV, which means that households living in counties less affected by the housing market collapse will have access to this opportunity, while those living in the most affected regions are not going to be eligible for refinancing. Second, the fact that there is not a significant difference between the CLTV of active and defaulted mortgages is very consistent with the double trigger hypothesis attributing mortgage default to the joint occurrence of negative equity and a life event like job loss. Gerardi et al. (2013) shows that individual unemployment is the strongest predictor of default. Moreover, they also that only very small fraction of defaulters have both negative equity and enough assets to make one month's mortgage payment, which suggests that "strategic" defaults were relatively rare. Similarly, Elul et al. (2010) found that both negative equity, illiquidity, as measured by high credit card utilization, and unemployment shocks are associated with higher default risk, with the latter strongly interacting with CLTV.

6.2 Difference-in-Differences Results

In this section, we further test the validity of our identification strategy. One potential concern with the consumption and deleveraging estimates presented in Section 4 is that there might be a trend which might drive part of the results. In particular, in the previous specification we cannot control for the age of the mortgage, which might be correlated with my consumption or prepayment behavior. For instance, households might be more inclined to purchase a new car twelve months after they bought a house, or they might have a higher incentive to prepay their mortgage once they have built enough equity in it. In order to correct for this possibility, instead of exploiting the timing of the interest rate adjustment, we consider as control group the mortgages that will experience an interest rate reset after 10 years from origination rather than 5 years.

This allows us to compare the behavior of the borrowers who experienced a reduction in the monthly payment with that of borrowers who bought a house during the same period,

[17] Notice also that our measure of CLTV tend to underestimate it. Elul et al. (2010) have access to a measure of total household debt, that is its combined LTV, and they show that for the households with a second mortgage, using only the first-mortgage LTV underestimates their total CLTV by 15 percentage points.

and employing a similar mortgage contract, but that are not anticipating any positive income shock. Table 5 reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. In contrast to the previous estimations, in this case the sample includes both 5-year and 10-year mortgages originated between 2005 and 2007 as provided by BlackBox Logic.

Columns (1)-(2) shows a reduction in the monthly payment of $900 on average, which is comparable to the one presented in Table 2. Columns (3)-(4) analyzes the borrower's consumption decision. It shows that borrowers who experienced a reduction in the monthly payment tend to increase their consumption of cars by about $163-$200 within the first year of the reset compared to the borrowers holding a similar mortgage but that did not experience such a decrease. Finally, Columns (5)-(6) shows that borrowers employ about 10% of the additional income resulted from the reduction in the monthly payment to repay their debt faster.

One drawback of this alternative specification is that households with different characteristics might endogenously sort in different contract type, 10-ARM versus 5-ARM. However, notice that we allow for differential trends for different cohort of origination and loan type. That is, our estimates do not rely on the assumption that households who decided to purchase a house, for instance in the first quarter of 2005, with a 10-ARM will follow a similar trend to the households that purchase a house, for example in the last quarter of 2006.

6.3 Alternative Consumption and Deleveraging Measures

The richness of our data allows us to analyze the impact of monetary policy on different measures of consumption and deleveraging. We observe the balance on all the borrower's revolving accounts and focus on the retail cards, e.g. credit cards issued by large store chains such as Amazon and Macy's. We can track the consumption expenditures of the households by analyzing significant changes in the balance on these accounts. Table A.1 shows the coefficient estimates of a least square regression relating the amount spent on retail credit cards with the reset in the interest rate. Columns (1) and (2) control for household and time fixed effects, while Column (3) includes county-month fixed effects. Even in this case we uncover a similar spending pattern, with households starting to increase their consumption three to four quarters before the interest rate reset and keep consuming more after the event date. Column (4) allows for heterogeneous trends depending on the cohort of origination. The results are still statistically significant at 1% level, but as expected the magnitude is lower than the car purchase estimates.

We can also provide evidence that households' tendency to voluntary deleverage is not restricted to the mortgages. In fact, the results presented so far are likely an underestimation of the fraction of the positive income shock allocated by borrowers to repay their debts, because they might decide to repay other debts other than the mortgage. For instance, borrowers might repay the more expensive loans, such as equity loans and home equity line of credit. We investigate this possibility in Table A.2. We find that in the quarter after the interest rate reset, borrowers tend to allocate a total of $35 per month towards the repayment of these two other debts, with very little variation across specifications. These results confirm and reinforce the main results presented in Section 4 about the households consumption and saving decisions.

7 Aggregate Results

Up to now we have focused only on a small subset of ARMs to sharply identify the effect of a change in the interest rates on the households' consumption and saving decision. However, we would expect that regions with a higher fraction of fixed-rate mortgages respond less to changes in the interest rates than regions with a higher fraction of adjustable rate mortgages. This is what we investigate next.

Figure 6 shows that FRMs account for the vast majority of the stock of mortgage debt in the US , but that the use of FRMs has increased after the housing collapse and the financial crisis. It also shows that since the housing boom in 2006, the variation across counties in the use of FRMs has decreased substantially, perhaps reflecting post-crisis changes in the supply of mortgage credit. Figure 7 illustrates the county-level variation in fixed rate mortgages at the peak of the boom in 2006, as well as in 2013. Figure 7 shows that these types of contracts tend to predominate in the middle of the country, and are relatively less frequent along the coast, where housing costs are generally higher.

As a measure of consumption, we use data from Polk about car purchases. Figure 8 plots the year-on-year quarterly change in both retail and firm sales; these two variables evince substantial co-movement, suggesting that car sales at both the firm and household level likely respond similarly to aggregate economic shocks, such as interest rate movements.

However, if the rigidity of mortgage contracts shape the transmission of interest rate movements onto the real economy, then we would expect that a decline in short rates relative to longer term rates will likely have a bigger impact on household consumption in those areas that use ARMs more intensively relative to FRMs. Of course, as Figure 7 illustrates, the cross-sectional variation in the fraction of FRMs is not random, but tends to be higher away from the higher-cost coasts. It is then possible than the variation in the fraction of FRMs

could be correlated with some unobserved factors that might explain the transmission of monetary policy onto the local economy.

Table 1 for example provides summary statistics and simple correlations for the fraction FRMs in a county in 2006 and county-level observables from the same period. Higher income counties tend to have a lower fraction of FRM debt. Likewise, counties with more leveraged households—a higher median debt to income ratio—tend to also have a lower fraction of FRM debt. FRM debt is in contrast in more common in counties with a higher poverty rate. Economic theory observes that many of these factors could also shape the transmission of interest rate movements onto household consumption. Higher income households may for example have easier credit access, and be better placed to buffer any changes in the cost of credit.

Therefore, in our baseline specification, we interact the term premium—the difference between the 10-year Treasury bond and the three month Treasury bill—with the fraction of FRM observed in 2006, as well with all of the variables described in Table 1. We also include these variables linearly in many specifications, or absorb them when using county fixed effects. Our sample period extends from 2007 to 2013, and because households can adjust at the margin to changing economic conditions, throughout we use county-level variables observed in 2006 to avoid including endogenous responses when measuring the impact of interest rate movements on county-level economic outcomes. Figure 9 also shows that over our sample period, there is substantial variation in the term premium, creating a very useful environment in which to measure the impact of these aggregate movements on local economies.

Table 8 presents our estimation results. In column (1), we estimate how the term premium in the previous quarter might affect the change in car sales within a county. The term premium is interacted with the fraction of FRMs in the county in 2006, along with the other control variables such as the log of median income, the Gini coefficient, the poverty rate, the fraction of African-American, the log of population, and the median household leverage in 2006. All variables are also linearly included, along with state fixed effects, and time fixed effects to absorb the impact of aggregate economic shocks that might simultaneously affect counties. Standard errors are clustered at the state level, and column (1) uses a lagged dependent variable to absorb any persistence in the quarterly change in the number of retail new car transactions.

The interaction term between the fraction of fixed rate debt and the term premium is negative and significant at the one percent confidence level. After a one standard deviation increase in the term premium, the point estimate suggests that relative to a county at the 25th percentile of FRMs, the growth in car sales falls by about 0.3 percentage points more

for a county at the 75th percentile of FRM debt in the next quarter. Given that the mean growth rate in sales is about 0.5 percent, these effects appear economically large, and suggests that movements in longer term interest rates relative to short maturity rates tend to have a disproportionately larger effect on durable goods consumption in counties with a greater fraction of fixed-rate mortgage debt. These results are little changed if we drop the lag dependent variable and use county fixed effects, as in Column (2).

Of course, these results could be driven by movements in aggregate economic conditions and could be unrelated to the household liquidity constraints and mortgage debt. We have already seen that firm and retail sales are highly correlated in the aggregate (Figure 8), and using the growth in firm sales as the dependent variable provides a useful falsification test. If indeed these findings reflect the pass-through of changes in the term premium on household balance sheets and spending, then the impact on firm behavior should be limited. However, if the fraction of FRMs in a county reflects some general unobserved county level variable—economic structure, credit availability—that might shape the pass-through of interest rate movements should also affect firms similarly. From column (3), when using the growth rate in firm sales as the dependent variable, the coefficient on the interaction term between the fraction of FRM debt and the term premium is the opposite sign, insignificant and close to zero.

Polk provides information on the make and mode of the cars sold in the county, and this information can further help in understanding the underlying mechanism behind these results. The car market is highly segmented, with higher income households the main buyers of luxury and larger vehicles, while the cheaper smaller and midsize cars are bought by lower income households. In the latter case, durable good consumption by these households are likely to be most sensitive to liquidity constraints. Thus, if these results reflect the pass-through of changes in the term premium on household balance sheets and spending, then we would expect them to be larger for the cheaper cars aimed at lower income households. This is indeed what we find in columns (4)-(6).

The loan level data in LPS provides information on the interest rate for each loan, thereby allowing us to construct relatively direct tests of the pass-through channel. In column (1) of Table 9, we aggregate this information to create the weighted average interest rate on mortgage debt in each county. Consistent with the evidence in Table 8, we see that the term premium has a larger positive impact on the change in interest rates in counties with a higher fraction of FRMs. Monthly mortgage payments help determine whether households can afford durable goods, and column (2) uses the change in retail car sales as the dependent variable, instrumenting the change in the average mortgage interest rate in the county with the fraction of FRM interacted with the term premium. Consistent with the liquidity

constraints hypothesis, the point estimate is large and significant. A one standard deviation increase in the interest rate change the previous quarter is associated with a 0.36 standard deviation drop in car sales the next quarter.

8 Discussion and Concluding Remarks

We investigate if households benefited from the prolonged period of low interest rates, by analyzing how the significant change in the interest rate shaped the households' consumption and saving decisions. One important challenge of any such study is trying to correct for the possibility of borrower selection among those who are able to refinance their mortgage and to take advantage of the lower interest rates. Our identification strategy exploits the expected change in monthly payments for borrowers with adjustable rate mortgages originated between 2005 and 2007, with an automatic reset of the interest rate after five years. By focusing only on this type of mortgage, we also avoid the possibility that our results are confounded by differences between borrowers holding fixed-rate and adjustable-rate mortgages.

In a nutshell, we show that at the moment of the interest rate reset the monthly payment falls on average by $1050. This is a positive income shock of a significantly larger magnitude than the ones examines by the literature on tax rebates, as the total positive income shock amounts to tens of thousands dollars over the remaining life of the mortgage. We uncover two important patterns. First, households increase their consumption on average by $200 per month after the change in the monthly payment, by increasing their consumption of durable goods. Second, the expansionary effect of the reduction in interest rate is attenuated by the borrowers' desire to voluntary deleverage, by employing a significant fraction of the increased income to repay their debts faster. Furthermore, these effects are significantly more important for borrowers with tighter financial constraints.

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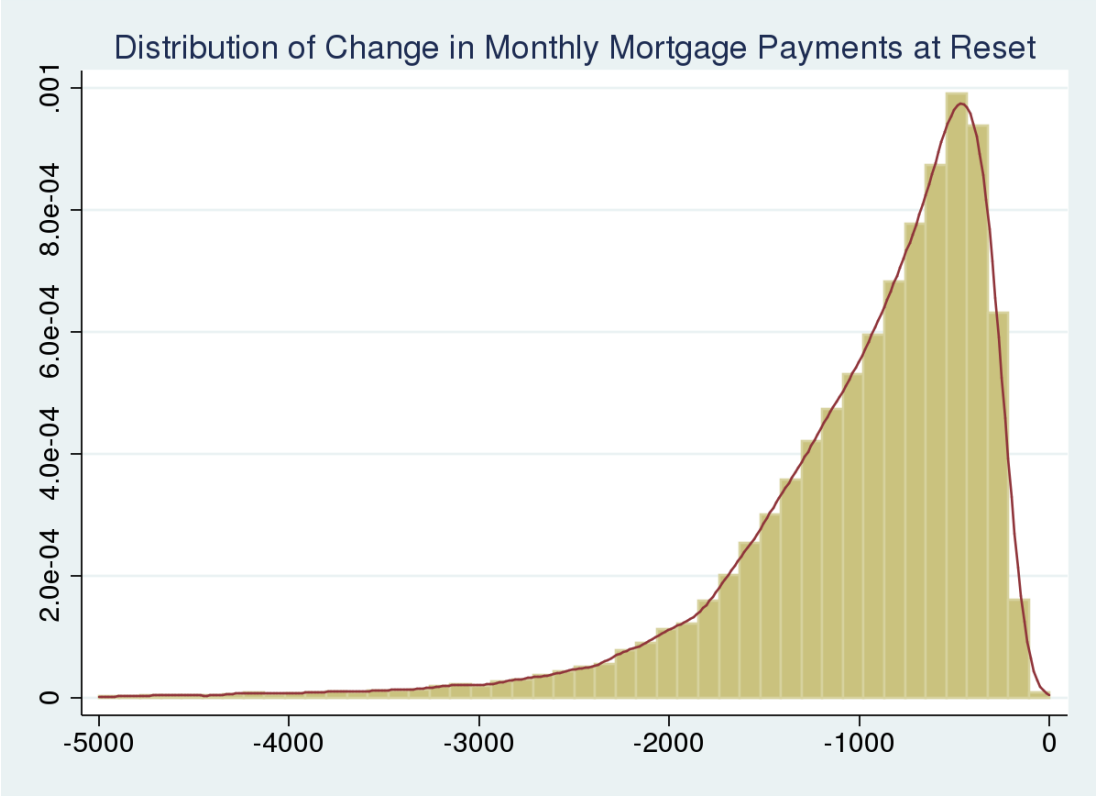

Figure 1 –Change in the Monthly Payment

This figure shows the average change in the monthly payment at the time of the interest rate adjustment, for our sample of hybrid ARMs with an interest-only period of 10 years and a reset date 60 months after origination.

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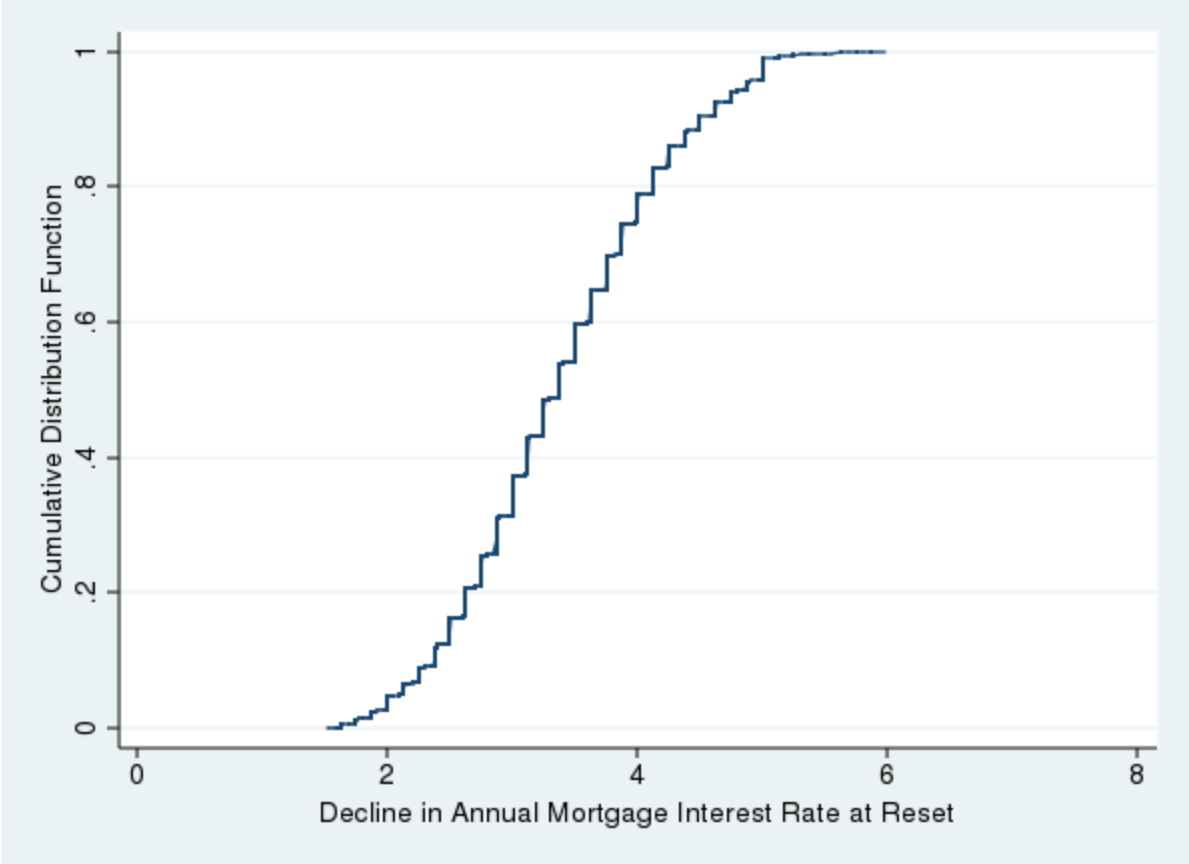

Figure 2 – Change in the Mortgage Interest Rate

This figure shows the cumulative distribution for the change in the mortgage interest rate between origination and the date of the adjustment, for our sample of 5-year ARMs with an interest-only period of 10 years and a reset date 60 months after origination. On average the interest rate declines by 3.3%.

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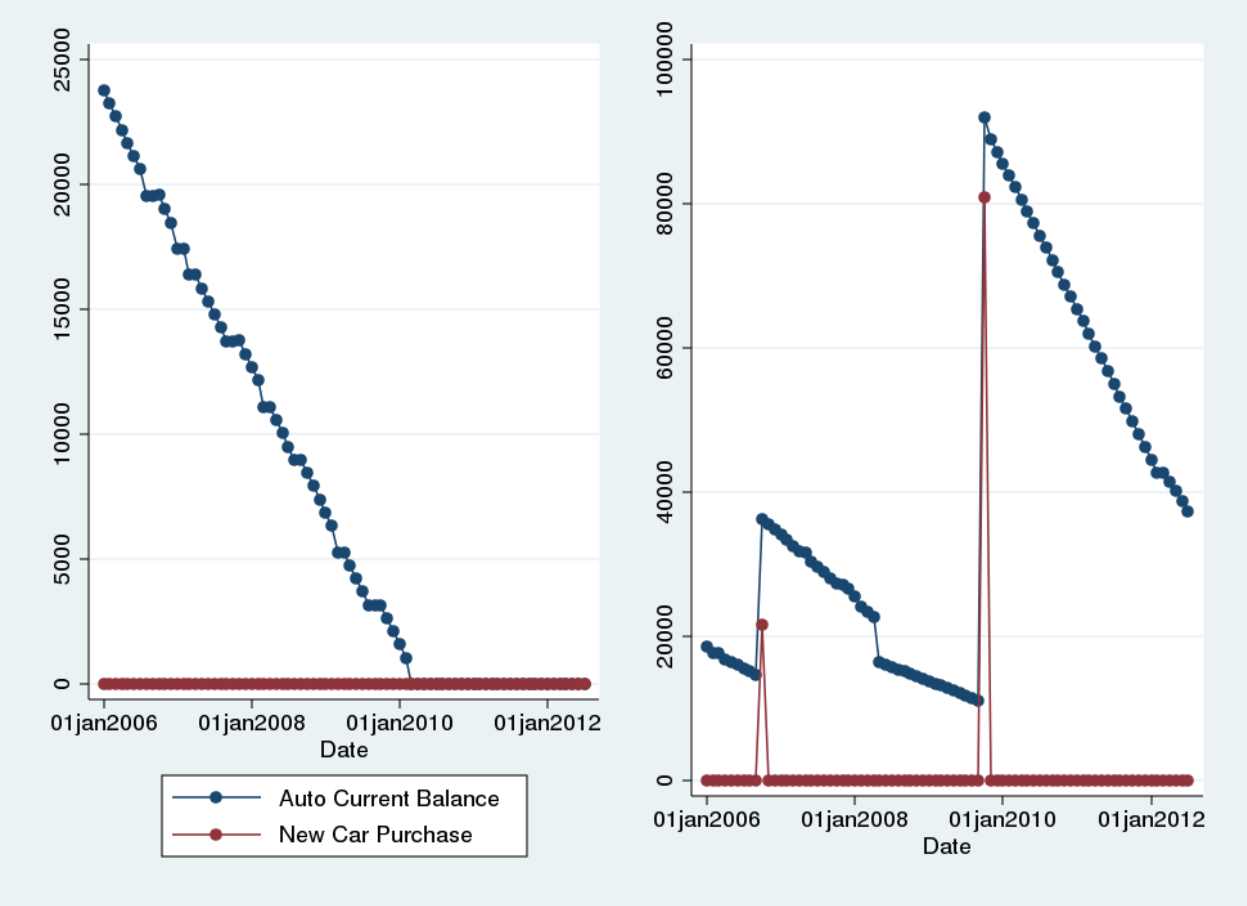

Figure 3 –Households Auto Loan Balances and Construction of Auto Sales Measure

The left panel is an example of individual who purchased her car before January 2006 and did not purchase any car until July 2012. The household in the right panel purchased two cars during the period. We assumed the value of the new car to be equal to the change in the auto loan balance at the time of purchase.

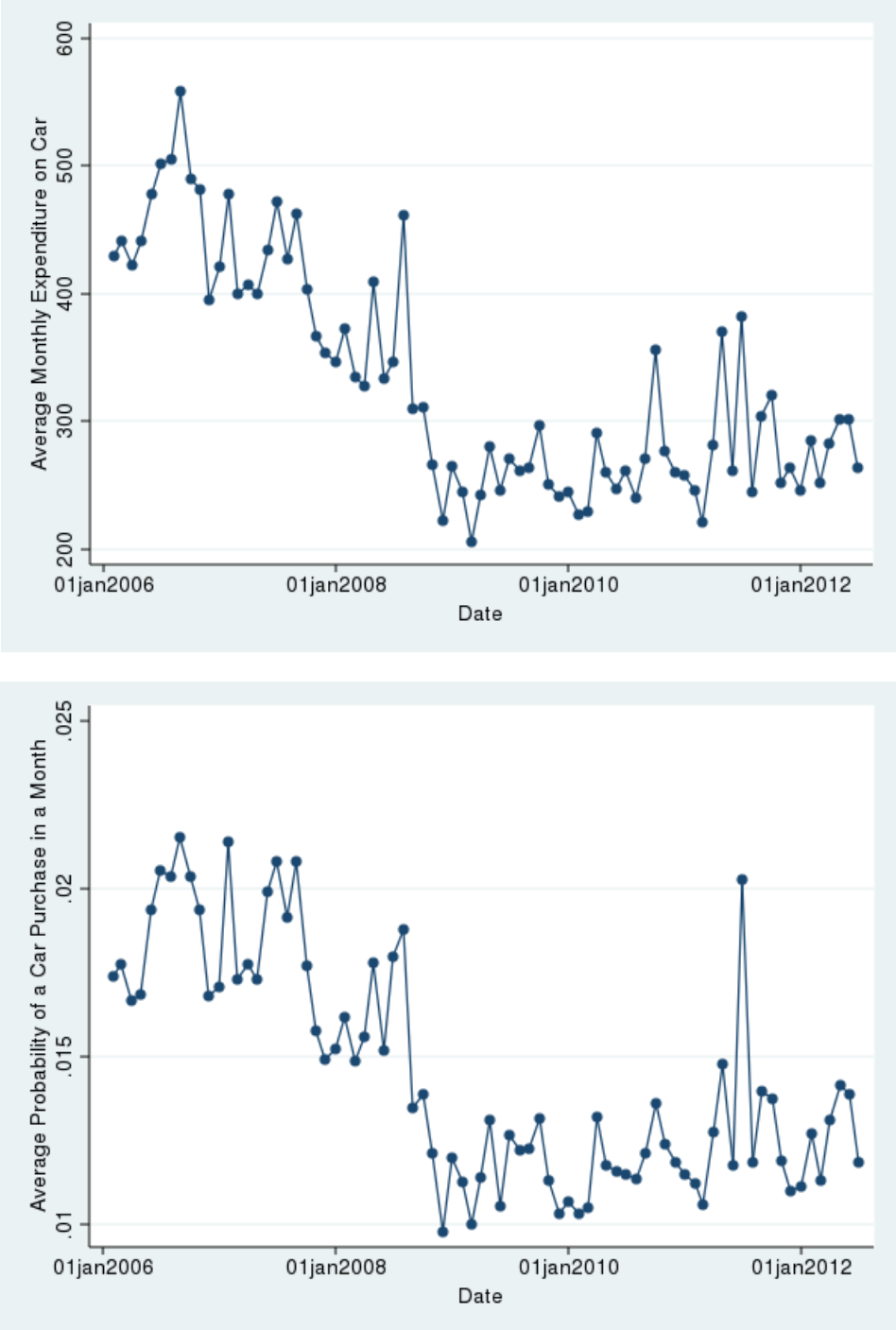

Figure 4 – Car Purchases of Households with 5 ARMs over Time

The top panel shows the average monthly car expenditure from January 2006 to July 2012 for those households who had a 5-year ARM mortgage originated between 2005 and 2007. The bottom panel shows the fraction of these households who purchased a car in each single month.

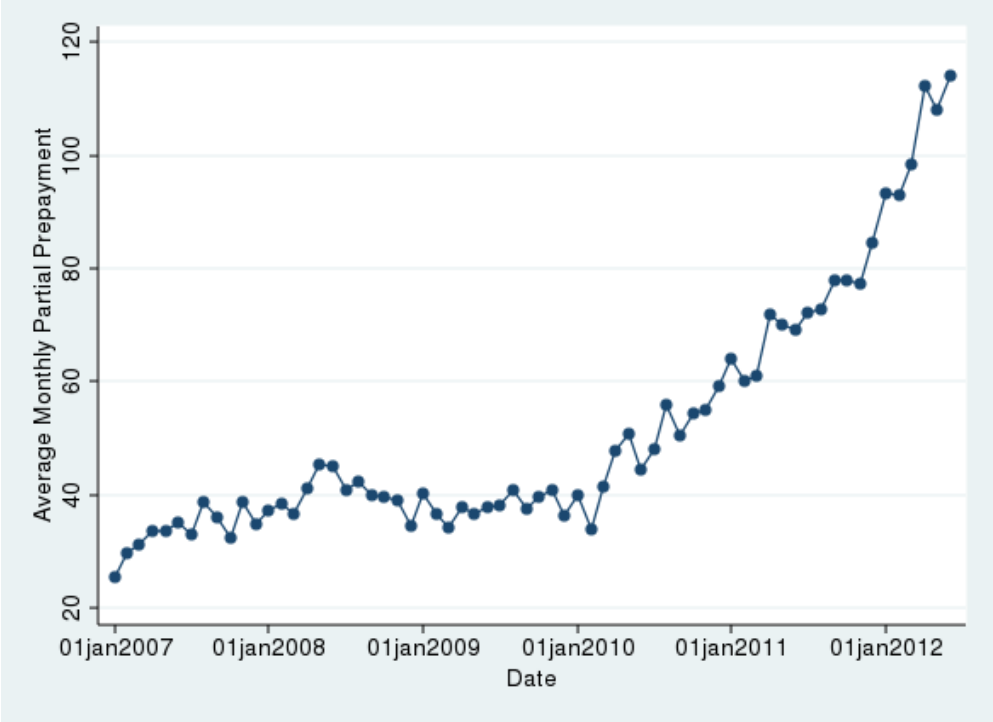

Figure 5 – Mortgage Partial Prepayment

This figure shows the average monthly prepayment of the mortgage for borrowers holding 5-year ARMs originated during the 2005-2007 period.

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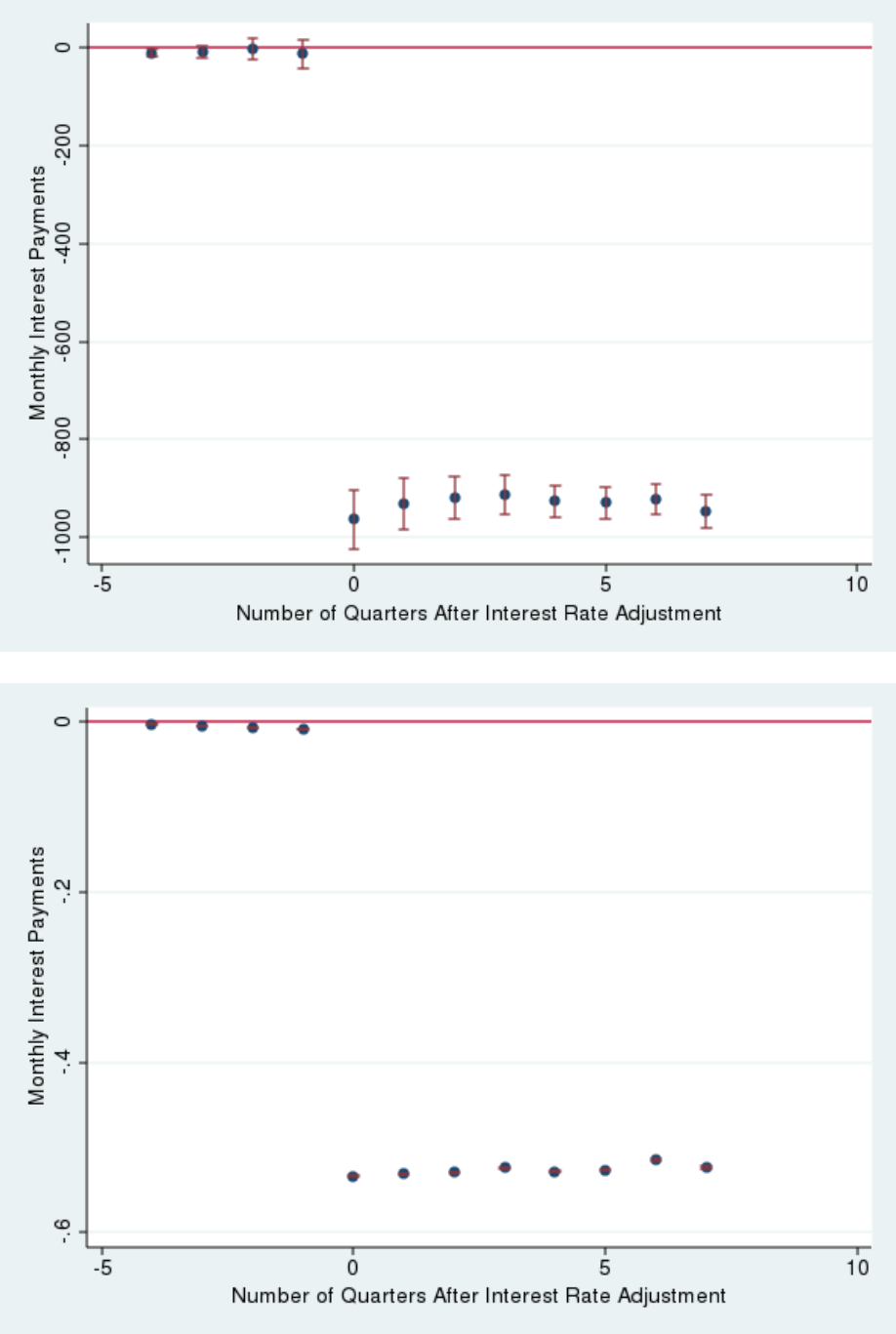


Figure 6 – Reduction in Monthly Payments

Interest rate adjustment and the monthly interest payments for 5-year ARMs originated during the 2005-2007 period. Top panel shows the change in dollars, while the bottom panel normalized it by the size of the monthly payment of the mortgage at the origination.

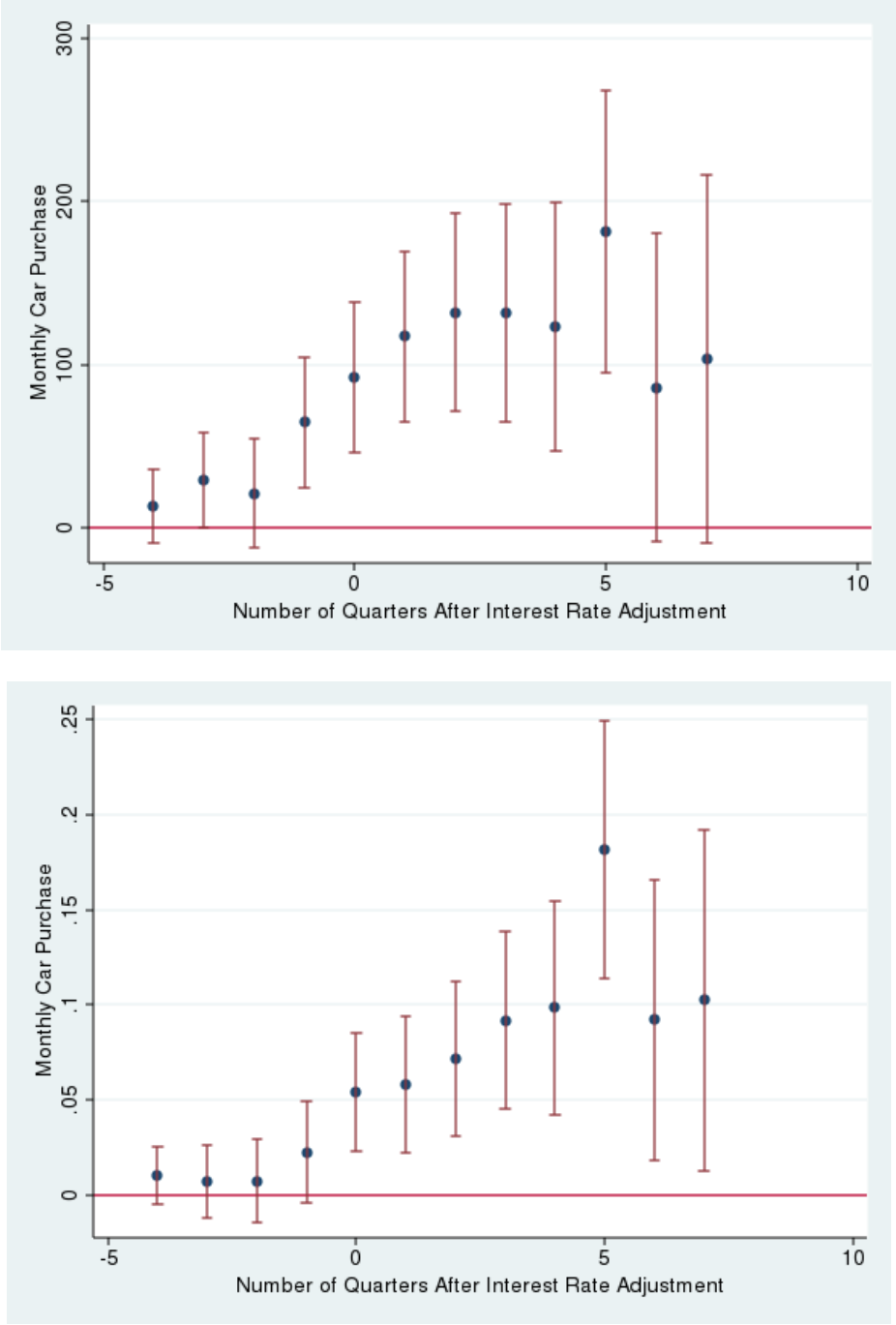


Figure 7 – Car Purchase

Monthly car purchase and interest rate adjustment for 5-year ARMs originated during the 2005-2007 period. Top panel shows the change in dollars, while the bottom panel normalized it by the size of the monthly payment of the mortgage at the origination.

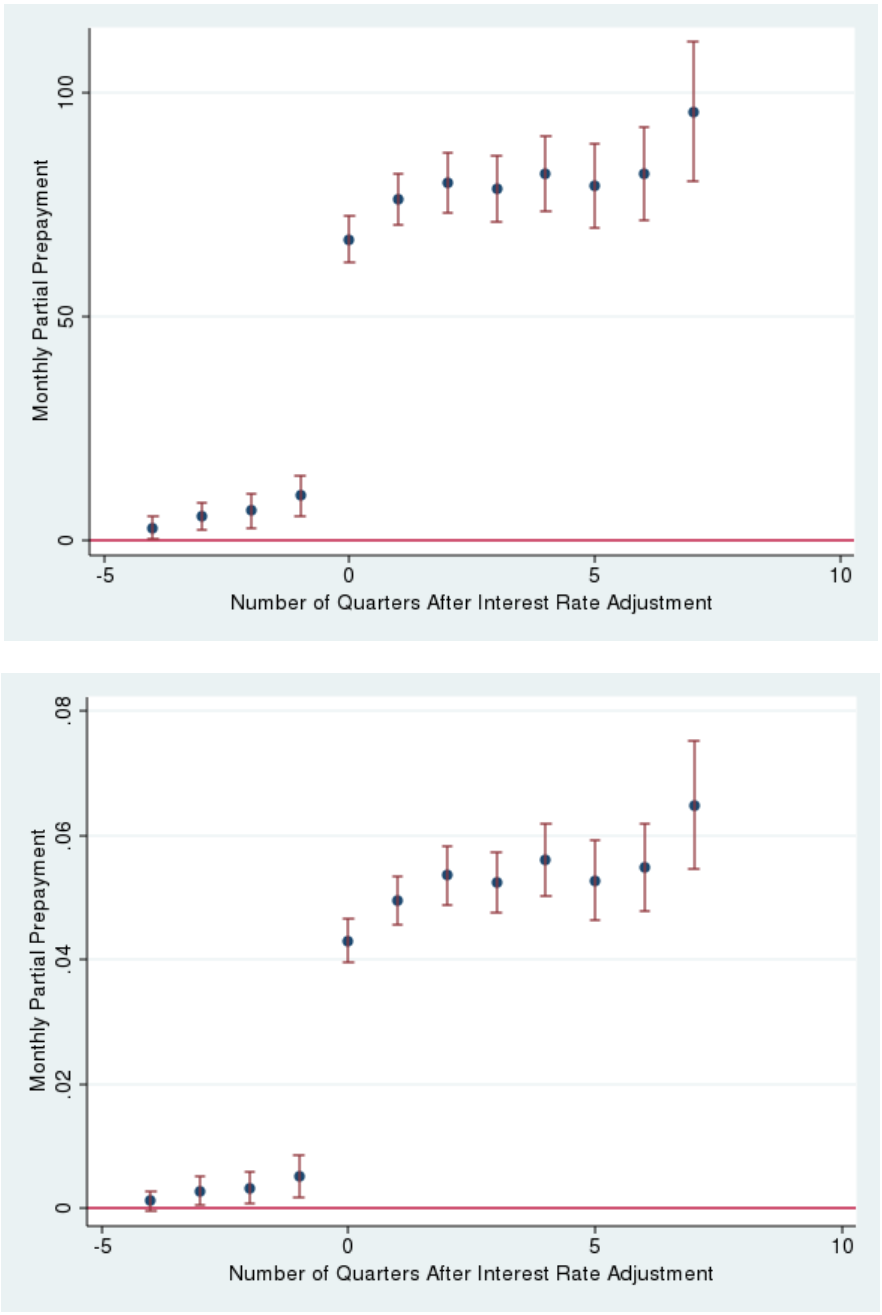


Figure 8 – Deleveraging

Monthly voluntary partial principal repayment and interest rate adjustment for 5-year ARMs originated during the 2005-2007 period. Top panel shows the change in dollars, while the bottom panel normalized it by the size of the monthly payment of the mortgage at the origination.

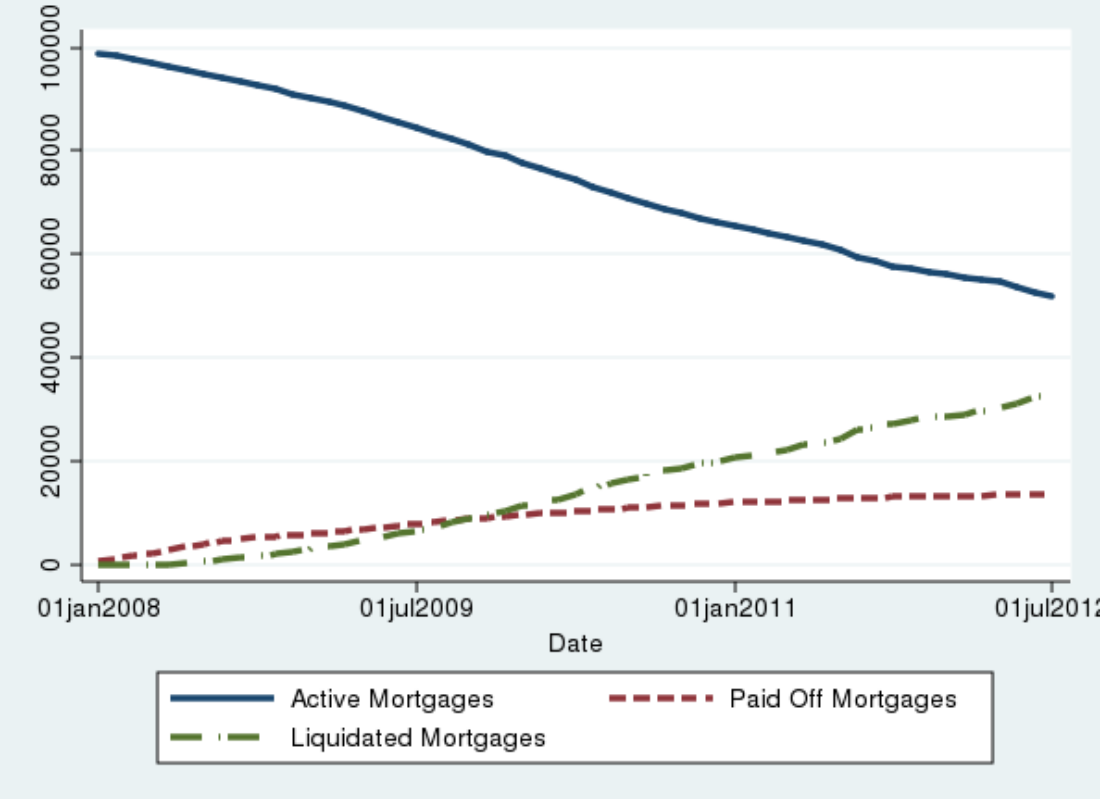


Figure 9 – Attrition

This plot shows the number of active loans (blue solid line), liquidated loans due to foreclosure, bankruptcy or real estate owned (green dash line) and paid off mortgages due to prepayment or refinancing (dash-dot line) over time.

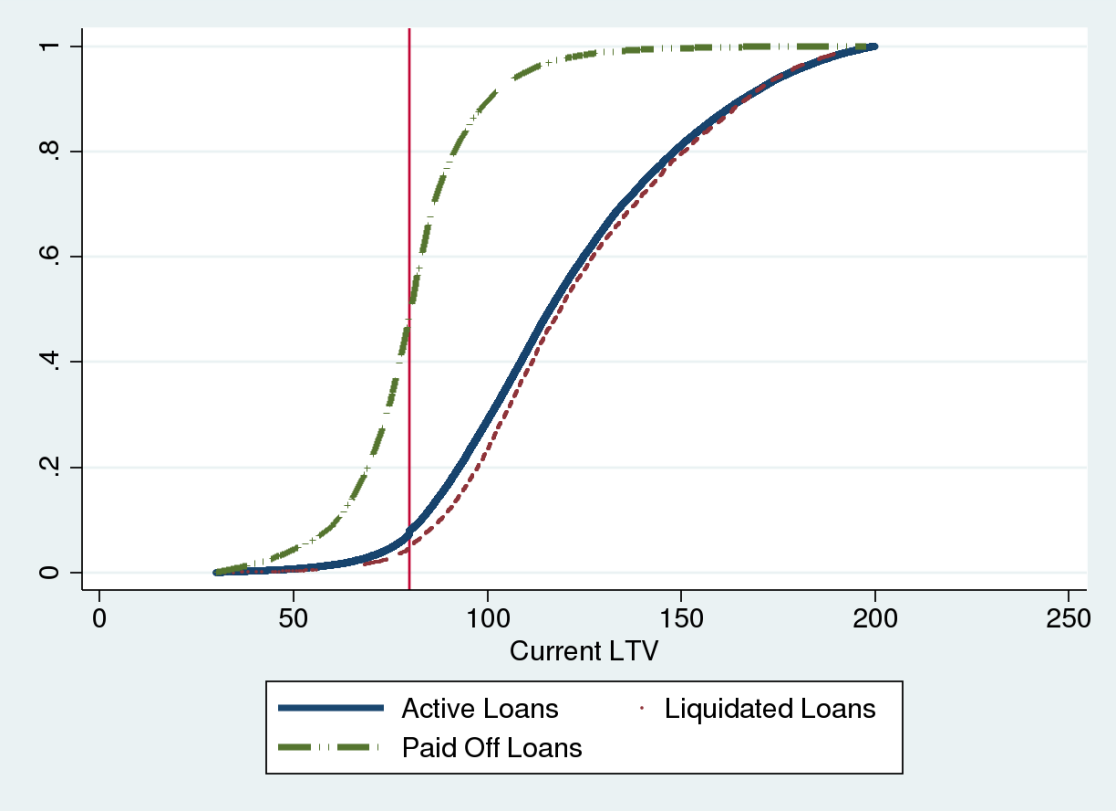


Figure 10 – Attrition and Current LTV

This plot shows the cumulative distribution of the number of active loans, liquidated loans due to foreclosure, bankruptcy or real estate owned and paid off mortgages due to prepayment or refinancing as a function of the current loan-to-value ratio. The vertical line shows a current LTV of 80%, which corresponds to the median of the current LTV for the paid off loans.

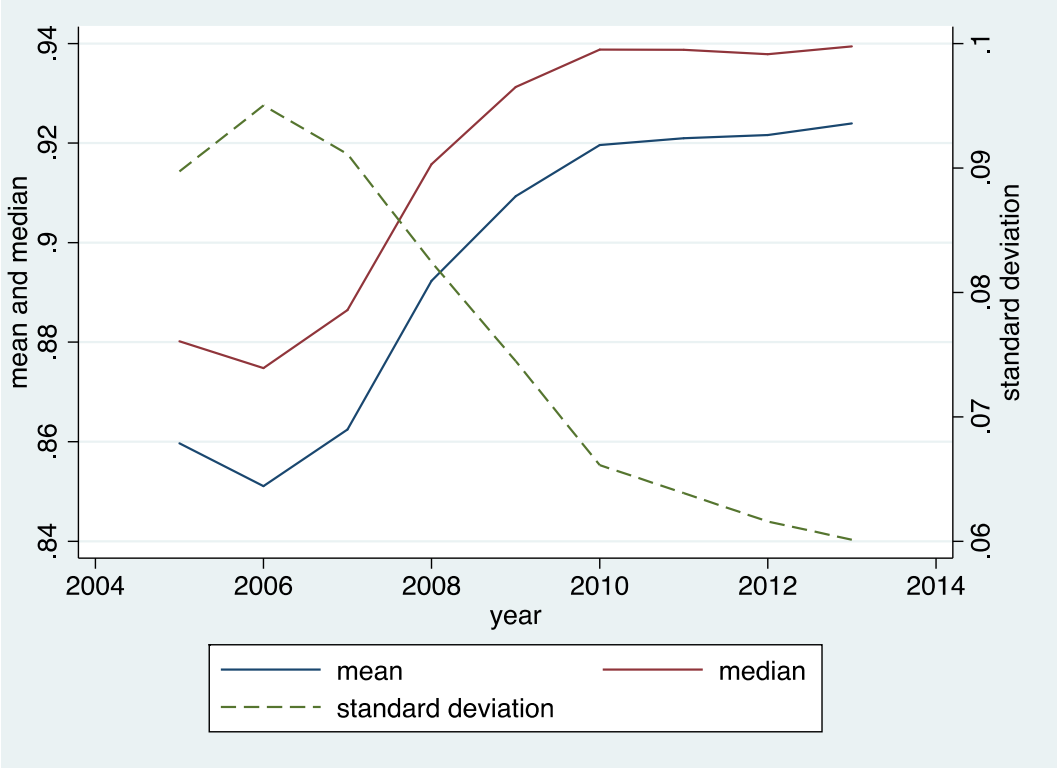
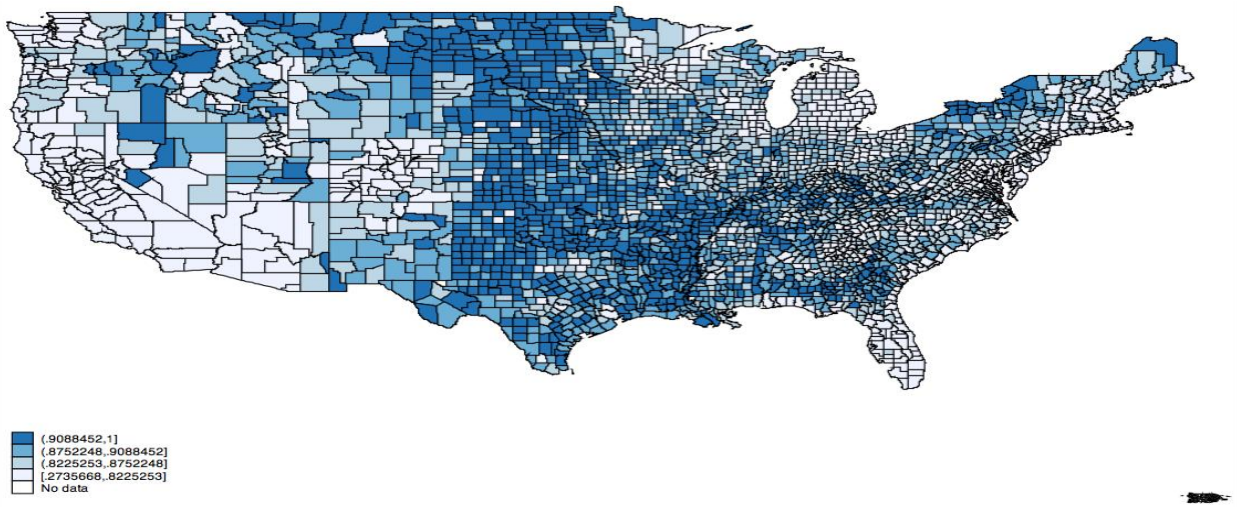


Figure 11 -- The Ratio of Fixed Rate Mortgages, 2006-2013

The mean and the median fraction of fixed rate mortgage debt for US counties over time. The dashed line is the standard deviation of this ratio computed across all counties for each year.

2006



2013

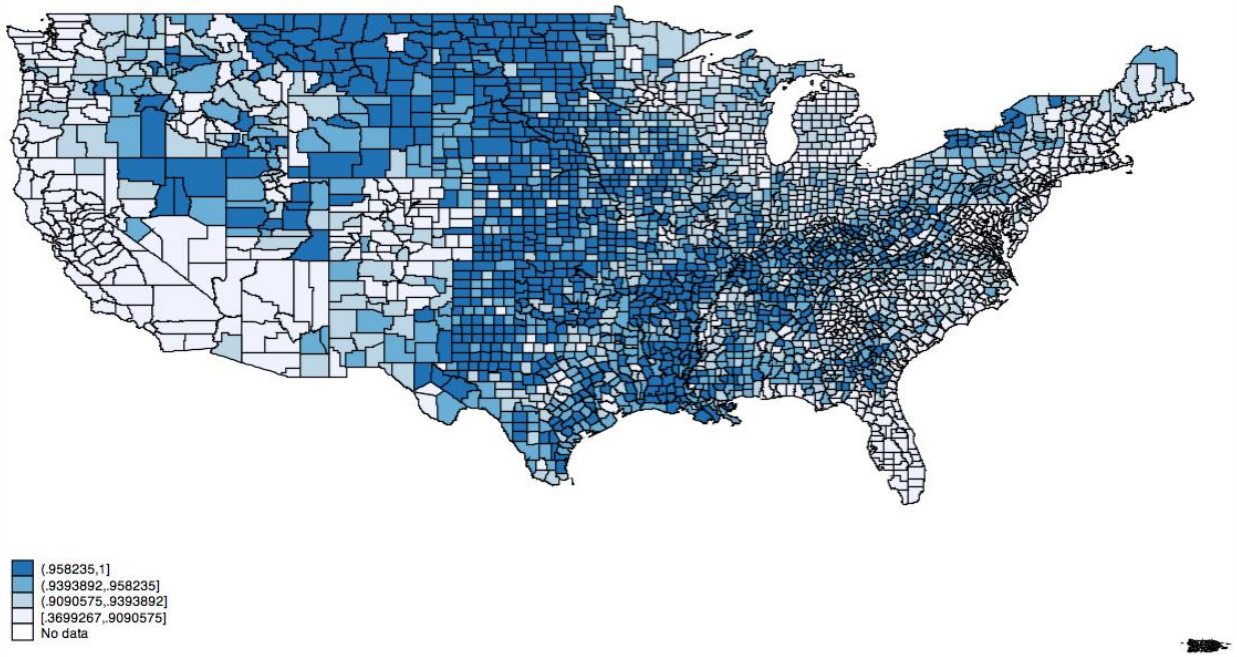


Figure 12 -- County-Level Variation in Fixed Rate Mortgages

These figures plot the fraction of FRMs originated in each county in 2006 and 2013.

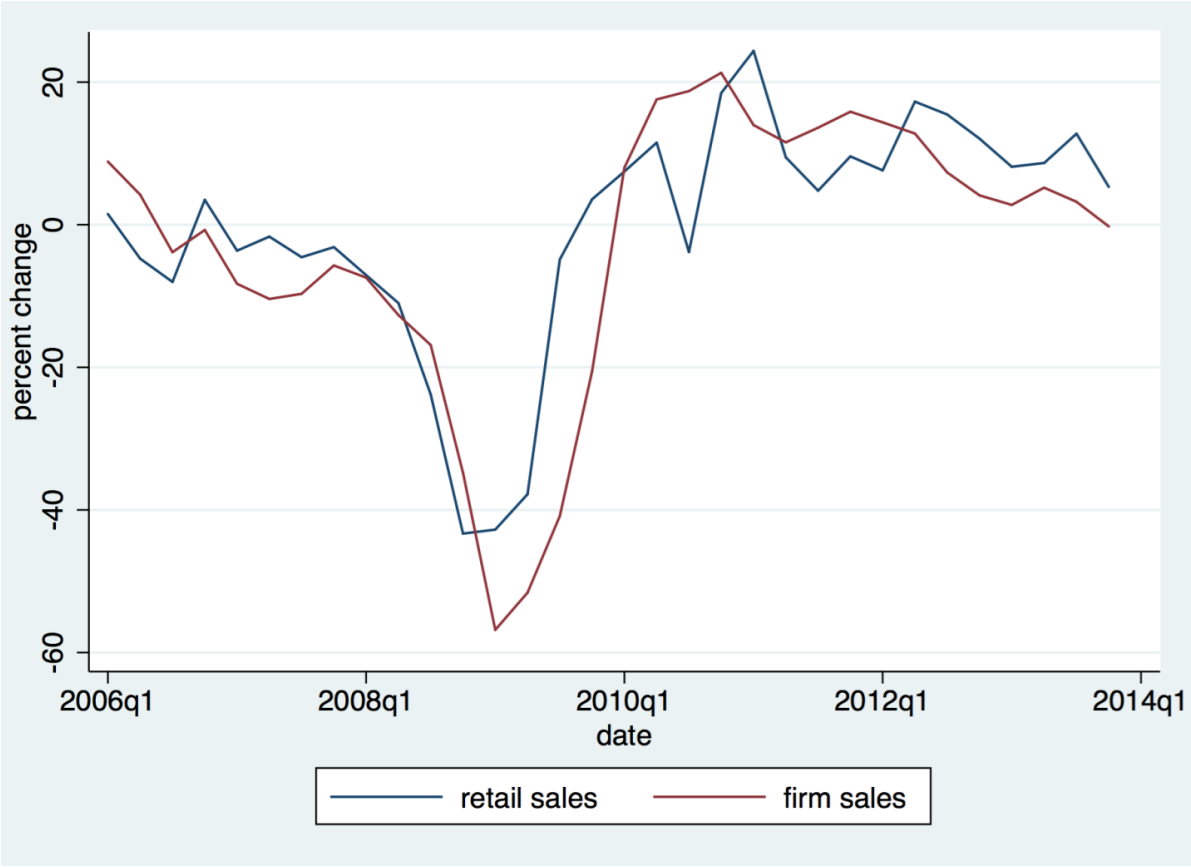


Figure 13 – Car Sales

The figure plots the change in the quarterly car sales, for retail buyers and firms for the period 2006-2013.

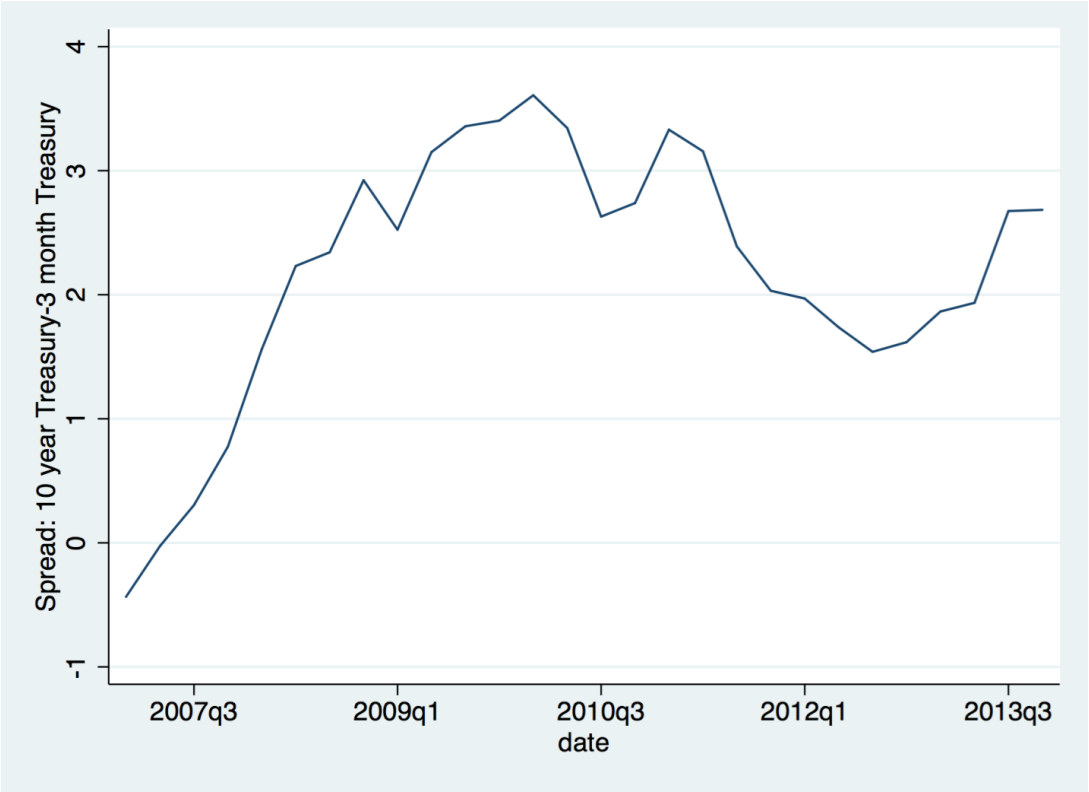


Figure 14 -- Term Premium

The figure plots the spread between the 10-year and the 3-month Treasury rate.

Table 1.A
Summary Statistics

The table reports descriptive statistics for the main variables employed in our analysis. In the top panel, we present the main mortgage characteristics at origination, as provided by BlackBox, for ARMs originated between 2005 and 2007 with an interest rate adjustment after five and after ten years of origination. The bottom panel presents county-level characteristics, computed aggregating loan-level data from LPS, for the period 2007-2013.

Panel A. Individual Level Characteristics

5-ARM Characteristics at Origination:

	N	Mean	St. Dev.	p1	p10	p50	p90	p99
FICO at Origination	46,578	736.2	348.5	661	673	719	781	809
Original Balance	46,578	357,949	271,600	79,200	132,000	288,000	630,000	1.393e+06
Original LTV	46,397	77.11	10.01	40.98	65	80	80	100
Original Interest Rate	46,497	6.449	0.765	5	5.500	6.375	7.500	8.375
Original Monthly Payment	45,424	1,921	1,471	427.5	697.8	1,547	3,392	7,309
Interest Rate After Adjustment	45,156	3.096	0.480	2.375	2.625	3	3.625	5.250
Monthly Payment After Adjustment	44,941	915.8	721.9	129.8	314.8	725.3	1,669	3,561

Data on Borrowers holding 5-ARM

	N	Mean	St. Dev.	p1	p10	p50	p90	p99
Monthly Expenditure on New Car	2,894,000	305.1	3,161	0	0	0	0	13,507
Fraction of Households Who Purchased a Car Each Month	2,894,000	0.0137	0.116	0	0	0	0	1
Partial Prepayment	2,627,000	52.21	400.1	0	0	59.61	210.8	1,004
Retail Sale	3,117,000	35.14	346.5	0	0	0	0	1,102

10-ARM Characteristics at Origination:

	N	Mean	St. Dev.	p1	p10	p50	p90	p99
FICO at Origination	26,543	793.7	736.3	661	681	737	790	815
Original Balance	26,538	536,342	347,622	89,600	186,000	486,280	928,000	1.866e+06
Original LTV	26,518	72.82	12.05	30.61	55.90	79.40	80	95
Original Interest Rate	24,348	6.149	0.525	5	5.500	6.125	6.800	7.625
Original Monthly Payment	23,765	2,700	1,819	488.0	936.5	2,430	4,623	9,465

Data on Borrowers holding 10-ARM

	N	Mean	St. Dev.	p50	p75	p90	p95	p99
Monthly Expenditure on New Car	1,702,000	364.4	3,711	0	0	0	0	16,000
Fraction of Households Who Purchased a Car Each Month	1,703,000	0.0148	0.121	0	0	0	0	1
Partial Prepayment	1,668,000	88.49	619.6	0	0	128.2	390.1	1,535
Retail Sale	1,847,000	41.22	402.6	0	0	0	0	1,239

Panel B: County Level Characteristics:

	N	Mean	St. Dev.	Min	Max
Log(Median income)	2,208.00	10.70	0.25	9.88	11.65
Gini coefficient	2,208.00	0.43	0.03	0.33	0.60
Poverty rate	2,208.00	15.04	5.93	2.00	46.90
Fraction of African American	2,208.00	0.10	0.14	0.00	0.82
Log(Population)	2,208.00	10.68	1.13	9.17	15.82
Median household leverage in 2006	2,208.00	1.57	0.58	0.58	4.93
Fraction of Fixed Rate Mortgage debt in 2006	2,208.00	0.83	0.09	0.27	0.97

Table 1.B
External Validity

The table reports descriptive statistics for the main variables employed in our analysis, but for different types of mortgages as provided by Lender Processing Services, which covers about 64% of the origination count reported under the Home Mortgage Disclosure Act (HMDA) over the period 2005–07. We first report the statistics for the whole sample, and then we focus on different subsamples comprising fixed-rate mortgages, adjustable rate mortgages (ARMs) and 5-year ARMs. We only consider home-owners.

	N	Mean	St. Dev.
Mortgages Originated between 2005 and 2008			
FICO	15,520,963	703.76	68.55
Interest Rate at Origination	19,104,660	6.27	1.23
Loan-to-Value Ratio	18,452,315	74.53	17.51
Mortgage Size	19,106,272	239043.24	202721.63
Initial Monthly Payment	17,300,637	1654.32	1514.99
Fixed-Rate Mortgages Originated between 2005 and 2007			
FICO	10,754,081	705.16	68.68
Interest Rate at Origination	13,263,190	6.30	0.89
Loan-to-Value Ratio	12,729,960	74.23	19.05
Mortgage Size	13,264,696	196125.18	139312.44
Initial Monthly Payment	11,812,181	1485.49	1258.87
Adjustable-Rate Mortgages Originated between 2005 and 2007			
FICO	2,039,025	687.97	73.22
Interest Rate at Origination	2,521,322	6.06	2.35
Loan-to-Value Ratio	2,441,813	76.06	13.77
Mortgage Size	2,521,297	312466.01	271243.03
Initial Monthly Payment	2,426,317	1765.34	1770.98
5-ARMs Originated between 2005 and 2007			
FICO	308,927	720.97	51.96
Interest Rate at Origination	341,728	5.92	0.71
Loan-to-Value Ratio	340,398	73.99	13.61
Mortgage Size	341,728	349099.78	287061.08
Initial Monthly Payment	334,572	2077.86	1831.93

Table 2
Monthly Payment and Interest Rate Reset

The table reports coefficient estimates of least square regressions relating the monthly payment of 5-year adjustable rate mortgages with a 10-year interest only period to the reset of interest rate 5 years after the origination. The dependent variable is the mortgage monthly payment for mortgages originated between 2004 and 2007 and is based upon data from BlackBox Logic. The main independent variables are dummies identifying different time periods before and after the reset date. Column (6) normalizes the monthly payment by the size of the monthly payment of the mortgage at the origination. "FICO" is provided monthly by Equifax. "Income" is the income predicted by BlackBox employing the household's balance sheet information. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the quarter of origination of the mortgage. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4	5	6
	Monthly Interest Payment					Normalized by Payment Size at Origination
Four Quarters Before	-11.27**	-5.429	-10.58**	-11.77***	-10.81**	-0.00265***
	(5.363)	(4.184)	(4.692)	(3.000)	(4.903)	(0.000683)
Three Quarters Before	-0.392	4.967	-4.113	-21.11***	-7.803	-0.00474***
	(7.425)	(6.222)	(6.745)	(4.614)	(7.659)	(0.000923)
Two Quarters Before	18.54*	20.48**	7.885	-25.73***	-0.651	-0.00690***
	(11.11)	(10.18)	(10.84)	(5.267)	(12.93)	(0.00103)
One Quarter Before	45.49***	28.59*	9.389	-23.22***	-12.30	-0.00897***
	(15.90)	(14.77)	(15.86)	(6.940)	(18.06)	(0.00161)
One Quarter After	-940.4***	-889.5***	-927.4***	-926.2***	-963.2***	-0.534***
	(34.33)	(34.42)	(34.43)	(43.03)	(36.47)	(0.00607)
Two Quarters After	-885.4***	-821.7***	-873.7***	-854.9***	-932.0***	-0.531***
	(30.23)	(25.92)	(26.21)	(33.57)	(31.28)	(0.00574)
Three Quarters After	-815.3***	-771.0***	-832.1***	-801.8***	-918.8***	-0.529***
	(23.57)	(18.62)	(19.15)	(32.67)	(26.46)	(0.00724)
Four Quarters After	-754.5***	-730.8***	-799.4***	-761.3***	-912.8***	-0.525***
	(19.11)	(14.86)	(16.88)	(33.58)	(23.77)	(0.00681)
Two Years After	-612.5***	-659.3***	-746.5***	-726.3***	-927.1***	-0.528***
	(30.83)	(17.14)	(17.85)	(33.99)	(18.54)	(0.00744)
FICO Score		-0.0182***	-0.0274***	-0.0200***	-0.0541***	-3.41e-05***
		(0.00641)	(0.00502)	(0.00588)	(0.00493)	(2.49e-06)
Log(House Prices)		-0.135***	-0.416***	-0.145***	-0.0476***	-5.82e-05***
		(0.0401)	(0.0648)	(0.0407)	(0.0112)	(3.91e-06)
Time Fixed Effects	Yes	Yes				
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
County X Time Fixed Effect			Yes			
Origination Cohort X Time Fixed Effect				Yes		Yes
Origination X Time Fixed Effect					Yes	
Observations	2,853,421	2,256,015	2,154,533	2,256,015	2,223,212	2,223,212
R-squared	0.962	0.975	0.633	0.976	0.981	0.781

Table 3
Car Purchases and Interest Rate Reset

The table reports coefficient estimates of least square regressions relating the monthly car purchases to the reset of interest rate 5 years after the origination. The dependent variable in columns (1)-(5) is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan. In Column (6) the dependent variable is the probability to purchase a car and we report the coefficients in percentage points, while in Column (7) we have normalized the car expenditures by the size of the monthly payment of the mortgage at the origination.. The main independent variables are dummies identifying different time periods before and after the reset date. "FICO" is provided monthly by Equifax. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the quarter of origination of the mortgage. Monthly Payment at Origination identifies the quartiles of the monthly payment. In Column (3)-(5) we allow in turn for different trends for each county, for each origination cohort, and for different monthly payments at origination. The sample includes mortgages originated between 2005 and 2007 provided by BlackBox Logic. Robust standard errors, clustered at the month level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4	5	6	7
	Car Purchase					Likelihood to Purchase a Car in %	Normalized by Payment Size at Origination
Four Quarters Before	43.30***	29.80**	20.19*	19.66*	23.20*	0.116**	0.00918
	(11.26)	(11.22)	(11.51)	(11.66)	(12.64)	(0.000440)	(0.00808)
Three Quarters Before	68.31***	41.88***	29.44**	33.13**	31.68**	0.174***	0.00862
	(11.71)	(12.00)	(13.54)	(13.08)	(12.60)	(0.000530)	(0.00912)
Two Quarters Before	43.24***	21.28*	9.460	17.62	14.21	0.120**	0.00798
	(9.841)	(10.78)	(10.66)	(14.55)	(11.52)	(0.000591)	(0.00983)
One Quarter Before	77.64***	47.45***	43.25***	52.44***	38.25**	0.222***	0.0231
	(12.29)	(13.69)	(14.97)	(18.92)	(14.48)	(0.000822)	(0.0150)
One Quarter After	101.0***	76.59***	66.67***	92.82***	66.91***	0.348***	0.0531***
	(12.27)	(13.51)	(13.40)	(20.16)	(13.77)	(0.000721)	(0.0145)
Two Quarters After	119.1***	92.91***	87.44***	117.2***	80.84***	0.450***	0.0579***
	(14.38)	(16.71)	(17.35)	(25.05)	(16.92)	(0.000900)	(0.0190)
Three Quarters After	146.3***	111.0***	90.68***	144.6***	101.5***	0.454***	0.0733***
	(18.67)	(21.23)	(22.21)	(29.10)	(22.14)	(0.000895)	(0.0201)
Four Quarters After	166.6***	113.6***	91.57***	152.5***	96.28***	0.526***	0.0954***
	(17.51)	(18.06)	(18.10)	(31.53)	(19.75)	(0.00117)	(0.0253)
Two Years After	203.0***	137.1***	107.9***	166.1***	117.5***	0.572***	0.116***
	(18.09)	(17.82)	(20.16)	(34.75)	(19.63)	(0.00144)	(0.0277)
FICO Score		1.797***	1.793***	1.789***	1.784***	6.99e-05***	0.00112***
		(0.0641)	(0.0692)	(0.0644)	(0.0634)	(2.00e-06)	(3.58e-05)
Log House Prices		0.192	0.380	0.161	0.167	1.16e-06	-1.99e-05
		(0.143)	(0.227)	(0.143)	(0.136)	(5.52e-06)	(0.000108)
Time Fixed Effects	Yes	Yes					
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County X Time Fixed Effect			Yes				
Origination Cohort X Time Fixed Effect				Yes		Yes	Yes
Monthly Payment at Origination X Time Fixed Effect					Yes		
Observations	2,893,823	2,291,225	2,188,424	2,291,225	2,223,758	2,252,352	2,223,758
R-squared	0.027	0.031	0.019	0.031	0.031	0.001	0.026

Table 4
Voluntary Deleveraging and Interest Rate Reset

The table reports coefficient estimates of least square regressions relating the monthly mortgage prepayment to the reset of interest rate 5 years after the origination. The dependent variable in columns (1)-(5) is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. In Column (6) we have normalized the partial prepayment of the mortgage by the size of the monthly payment of the mortgage at the origination. The main independent variables are dummies identifying different time periods before and after the reset date. "FICO" is provided monthly by Equifax. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the year of origination of the mortgage. Monthly Payment at Origination identifies the quartiles of the monthly payment. In Column (3)-(5) we allow in turn for different trends for each county, for each origination cohort, and for different monthly payments at origination. The sample includes mortgages originated between 2005 and 2007 provided by BlackBox Logic. Robust standard errors, clustered at the month level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4	5	6
	Partial Prepayment					Normalized by Payment Size at Origination
Four Quarters Before	1.033	1.457	1.736	2.658	1.441	0.00104
	(1.195)	(1.306)	(1.299)	(1.615)	(1.266)	(0.000900)
Three Quarters Before	1.935	2.030	2.981*	5.006***	3.042**	0.00268*
	(1.340)	(1.404)	(1.574)	(1.799)	(1.432)	(0.00154)
Two Quarters Before	1.961	1.400	2.103	6.234**	3.493*	0.00303**
	(1.487)	(1.664)	(1.742)	(2.410)	(1.829)	(0.00151)
One Quarter Before	2.094	3.021**	4.907***	9.403***	6.668***	0.00496**
	(1.396)	(1.363)	(1.524)	(2.502)	(1.410)	(0.00211)
One Quarter After	61.33***	57.36***	60.83***	66.36***	64.10***	0.0430***
	(2.849)	(2.366)	(2.514)	(3.602)	(2.152)	(0.00238)
Two Quarters After	65.35***	63.05***	67.92***	75.11***	72.80***	0.0493***
	(2.733)	(2.382)	(2.311)	(4.054)	(2.366)	(0.00300)
Three Quarters After	61.40***	64.59***	70.10***	78.59***	76.93***	0.0533***
	(2.717)	(2.763)	(2.728)	(5.045)	(2.833)	(0.00353)
Four Quarters After	57.89***	61.56***	68.93***	77.20***	77.28***	0.0525***
	(2.437)	(2.649)	(2.643)	(5.440)	(2.775)	(0.00355)
Two Years After	56.20***	58.75***	68.80***	79.42***	79.75***	0.0553***
	(2.744)	(3.341)	(3.151)	(6.361)	(2.886)	(0.00415)
FICO Score		0.131***	0.135***	0.132***	0.132***	7.87e-05***
		(0.00987)	(0.0105)	(0.00995)	(0.0103)	(6.37e-06)
Log House Prices		0.0688***	0.0186	0.0722***	0.0566***	3.75e-05***
		(0.0161)	(0.0252)	(0.0160)	(0.0149)	(1.10e-05)
Time Fixed Effects	Yes	Yes				
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
County X Time Fixed Effect			Yes			
Origination Cohort X Time Fixed Effect				Yes		Yes
Monthly Payment at Origination X Time Fixed Effect					Yes	
Observations	2,626,647	2,101,428	2,006,743	2,101,428	2,038,591	2,038,591
R-squared	0.229	0.238	0.022	0.238	0.241	0.154

Table 5
Difference-in-Differences Results

The table reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. The sample includes both 5-year and 10-year mortgages originated between 2005 and 2007 as provided by BlackBox Logic. The dependent variable in Column (1) is the mortgage monthly payment. The dependent variable in Column (2) is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan.. The dependent variable in Column (3) is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. Columns (3)-(6) show the results when we normalized the dependent variables by the size of the monthly payment of the mortgage at the origination. The main independent variables are dummies identifying different time periods before and after the reset date, and effectively compare the mortgage payments, car purchases and principal prepayment for the 5-year mortgages that have their interest rate reset with the 10-year mortgages that do not. "FICO" is provided monthly by Equifax. "Log(House Prices)" is the logarithm of zip-level house prices. Mortgage age fixed effects are the quarters since origination. Origination cohort is the quarter of origination of the mortgage, and loan type identifies the 5-year and 10-year ARMs. We allow for different trends for each loan type originated in different years. Robust standard errors, clustered at the month level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4	5	6
				Normalized by Payment Size at Origination		
	Interest Payment	Car Purchase	Prepayment	Interest Payment	Car Purchase	Prepayment
Four Quarters Before	-10.75***	40.11*	8.442**	-0.00194**	0.0152	0.00312
	(3.135)	(21.58)	(3.206)	(0.000772)	(0.0133)	(0.00194)
Three Quarters Before	-19.75***	26.13	6.935	-0.00355***	0.00703	0.00272
	(4.852)	(31.32)	(4.462)	(0.00101)	(0.0154)	(0.00245)
Two Quarters Before	-23.72***	48.57	12.12***	-0.00508***	0.0207	0.00641***
	(5.342)	(34.26)	(4.511)	(0.00114)	(0.0154)	(0.00227)
One Quarter Before	-20.74***	99.45***	10.61**	-0.00668***	0.0356*	0.00436
	(7.376)	(33.88)	(4.931)	(0.00180)	(0.0197)	(0.00288)
One Quarter After	-922.3***	146.7***	66.26***	-0.530***	0.0601***	0.0402***
	(43.58)	(46.24)	(6.329)	(0.00626)	(0.0225)	(0.00406)
Two Quarters After	-848.7***	162.3***	75.30***	-0.527***	0.0682**	0.0436***
	(33.86)	(46.17)	(6.956)	(0.00598)	(0.0313)	(0.00413)
Three Quarters After	-793.6***	187.3***	71.74***	-0.523***	0.0740**	0.0445***
	(33.06)	(42.69)	(7.501)	(0.00743)	(0.0298)	(0.00478)
Four Quarters After	-750.6***	186.1***	67.25***	-0.517***	0.104**	0.0429***
	(33.88)	(60.19)	(8.844)	(0.00704)	(0.0401)	(0.00537)
Two Years After	-713.5***	137.7*	62.21***	-0.518***	0.0949**	0.0431***
	(34.58)	(80.01)	(9.658)	(0.00766)	(0.0419)	(0.00647)
FICO Score	-0.0266***	1.803***	0.152***	-2.91e-05***	0.00104***	7.71e-05***
	(0.00495)	(0.0564)	(0.0101)	(2.16e-06)	(3.22e-05)	(5.58e-06)
Log(House Prices)	-0.141***	0.157	0.129***	-5.51e-05***	3.42e-05	5.69e-05***
	(0.0262)	(0.139)	(0.0165)	(3.34e-06)	(9.04e-05)	(9.69e-06)
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Origination Cohort X Loan Type X Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Mortgage Age Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,530,401	4,596,110	4,294,354	3,507,231	3,563,218	3,368,065
R-squared	0.977	0.030	0.243	0.987	0.033	0.253

Table 6
Heterogeneous Effects: Fico Score

The table reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. The sample includes 5-year ARMs originated between 2005 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1) is the mortgage monthly payment, while in column (2) it is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan and in column (3) the dependent variable is the monthly partial prepayment and is computed based on data from BlackBox. The main independent variables are dummies identifying different time periods before and after the reset date. "One Year Before" identifies the twelve months before up to one month before the interest rate adjustment. "One Year After" includes the month of the adjustment up to twelve months after. "Two Years After " "High FICO" is a dummy equal to one if the FICO one year before the adjustment is greater than 666. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the year of origination of the mortgage. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)
	Interest Payment	Car Purchase	Prepayment
One Year Before	-0.00547***	-0.00532	0.000264
	(0.000575)	(0.0124)	(0.00150)
One Year After	-0.548***	0.00312	0.0247***
	(0.000867)	(0.0186)	(0.00223)
Two Years After	-0.547***	0.0255	0.0326***
	(0.00138)	(0.0297)	(0.00350)
One Year Before X High FICO	0.00324***	0.0178	0.00125
	(0.000611)	(0.0131)	(0.00159)
One Year After X High FICO	0.0317***	0.0592***	0.0263***
	(0.000888)	(0.0191)	(0.00230)
Two Years After X High FICO	0.0290***	0.0648**	0.0176***
	(0.00135)	(0.0290)	(0.00346)
FICO	-1.99e-05***	0.00105***	7.72e-05***
	(1.60e-06)	(3.45e-05)	(4.18e-06)
Log(House Prices)	-5.26e-05***	-7.81e-05	2.86e-05***
	(4.26e-06)	(9.14e-05)	(1.09e-05)
Households Fixed Effects	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes
High FICO X Time Fixed Effects	Yes	Yes	Yes
Low FICO X Time Fixed Effects	Yes	Yes	Yes
Observations	2,212,779	2,213,325	2,029,757
R-squared	0.781	0.026	0.155

Table 7
Heterogeneous Effects: Loan to Value Ratio

The table reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. The sample includes 5-year ARMs originated between 2005 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1) is the mortgage monthly payment, while in column (2) it is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan and in column (3) the dependent variable is the monthly partial prepayment and is computed based on data from BlackBox. The main independent variables are dummies identifying different time periods before and after the reset date. "One Year Before" identifies the twelve months before up to one month before the interest rate adjustment. "One Year After" includes the month of the adjustment up to twelve months after. "Two Years After " "High LTV" is a dummy equal to one if the LTV one year before the adjustment is greater than the median LTV. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the year of origination of the mortgage. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)
	Interest Payment	Car Purchase	Prepayment
One Year Before	0.00132**	-0.00850	0.000969
	(0.000609)	(0.0115)	(0.00140)
One Year After	-0.520***	0.0303*	0.0417***
	(0.000929)	(0.0176)	(0.00211)
Two Years After	-0.525***	0.00982	0.0438***
	(0.00155)	(0.0293)	(0.00346)
One Year Before X High LTV	-0.00958***	0.0339**	0.000368
	(0.000745)	(0.0141)	(0.00176)
One Year After X High LTV	-0.0377***	0.0485**	-0.00814***
	(0.00110)	(0.0209)	(0.00259)
Two Years After X High LTV	-0.0398***	0.111***	-0.000578
	(0.00179)	(0.0338)	(0.00410)
FICO	-3.41e-05***	0.00108***	7.20e-05***
	(1.78e-06)	(3.37e-05)	(4.19e-06)
Log(House Prices)	1.18e-05**	4.01e-05	2.83e-05**
	(5.90e-06)	(0.000112)	(1.36e-05)
Households Fixed Effects	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes
High LTV X Time Fixed Effects	Yes	Yes	Yes
Low LTV X Time Fixed Effects	Yes	Yes	Yes
Observations	1,838,722	1,838,983	1,666,847
R-squared	0.732	0.025	0.147

Table 8
Heterogeneous Effects: Debt-Service Ratio

The table reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. The sample includes 5-year ARMs originated between 2005 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1) is the mortgage monthly payment, while in column (2) it is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan and in column (3) the dependent variable is the monthly partial prepayment and is computed based on data from BlackBox. The main independent variables are dummies identifying different time periods before and after the reset date. "One Year Before" identifies the twelve months before up to one month before the interest rate adjustment. "One Year After" includes the month of the adjustment up to twelve months after. "Two Years After " "High Debt Service Ratio" is a dummy equal to one if the debt to service, defined as the ratio of monthly payment over income averaged over 2 years to 1 year before the adjustment, is greater than the median DSR. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the year of origination of the mortgage. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)
	Interest Payment	Car Purchase	Prepayment
One Year Before	0.00103**	0.00794	0.00178
	(0.000521)	(0.0112)	(0.00132)
One Year After	-0.512***	0.0609***	0.0469***
	(0.000780)	(0.0168)	(0.00197)
Two Years After	-0.512***	0.0852***	0.0436***
	(0.00114)	(0.0244)	(0.00284)
One Year Before X High Debt Service Ratio	-0.00810***	0.00207	-0.00192
	(0.000617)	(0.0133)	(0.00159)
One Year After X High Debt Service Ratio	-0.0325***	-0.0349*	-0.0147***
	(0.000902)	(0.0194)	(0.00232)
Two Years After X High Debt Service Ratio	-0.0340***	-0.0218	0.00400
	(0.00140)	(0.0300)	(0.00355)
FICO	-2.58e-05***	0.00115***	7.79e-05***
	(1.53e-06)	(3.28e-05)	(3.99e-06)
Log(House Prices)	-3.26e-05***	9.46e-05	2.12e-05*
	(4.33e-06)	(9.30e-05)	(1.11e-05)
Households Fixed Effects	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes
High DSR X Time Fixed Effects	Yes	Yes	Yes
Low DSR X Time Fixed Effects	Yes	Yes	Yes
Observations	2,213,765	2,214,311	2,030,646
R-squared	0.781	0.026	0.154

Table 9
Heterogeneous Effects: Income

The table reports coefficient estimates of least square regressions relating the monthly mortgage payment, car purchases and mortgage principal prepayment to the reset of interest rate 5 years after the origination. The sample includes 5-year ARMs originated between 2005 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1) is the mortgage monthly payment, while in column (2) it is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan and in column (3) the dependent variable is the monthly partial prepayment and is computed based on data from BlackBox. The main independent variables are dummies identifying different time periods before and after the reset date. "One Year Before" identifies the twelve months before up to one month before the interest rate adjustment. "One Year After" includes the month of the adjustment up to twelve months after. "Two Years After " "High Income" is a dummy equal to one if the household income, averaged over 2 years to 1 year before the adjustment, is greater than the median income. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the year of origination of the mortgage. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)
	Interest Payment	Car Purchase	Prepayment
One Year Before	-0.00554***	0.0273**	6.86e-05
	(0.000523)	(0.0112)	(0.00135)
One Year After	-0.543***	0.0706***	0.0369***
	(0.000787)	(0.0169)	(0.00201)
Two Years After	-0.545***	0.137***	0.0435***
	(0.00121)	(0.0260)	(0.00305)
One Year Before X High Income	0.00358***	-0.0405***	0.00165
	(0.000581)	(0.0125)	(0.00151)
One Year After X High Income	0.0303***	-0.0529***	0.00967***
	(0.000835)	(0.0179)	(0.00216)
Two Years After X High Income	0.0307***	-0.124***	0.00183
	(0.00124)	(0.0266)	(0.00317)
FICO	-2.87e-05***	0.00111***	8.21e-05***
	(1.53e-06)	(3.28e-05)	(3.99e-06)
Log(House Prices)	-5.25e-05***	-5.68e-05	2.73e-05**
	(4.29e-06)	(9.22e-05)	(1.10e-05)
Households Fixed Effects	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes
High Income X Time Fixed Effects	Yes	Yes	Yes
Low Income X Time Fixed Effects	Yes	Yes	Yes
Observations	2,213,765	2,214,311	2,030,646
R-squared	0.781	0.026	0.154

Table 10
Aggregate Evidence

The table reports coefficient estimates of least square regressions relating the quarterly change in car sales within a county to the fraction of fixed-rate mortgages in a county and the change in the interest rate. The sample includes car sales between 2007 and 2013. Fraction of $FRMs_{2006}$ is the fraction of fixed-rate mortgages originated in each county in 2006. Term premium is the difference between the 10-year Treasury bond and the three-month Treasury bill in the previous quarter. All columns include the following set of controls: the log of median income, Gini coefficient, poverty rate, the fraction of African American, the Log of the county area, Log of population, and the median household leverage in 2006 interacted with the term premium in the previous quarter. Column (1) also includes the one quarter lagged car sales. Robust standard errors, clustered at the state level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4	5	6	7
	Retail Car Sales	Retail Car Sales	Firms Car Sales	Small Cars	Mid-Sized Cars	Large Cars	Luxury Cars
Fraction of $FRMs_{2006}$ X Term $Premium_{t-1}$	-0.0241**	-0.0205***	0.0013	-0.0268**	-0.0279*	-0.0341**	-0.00982
	(0.00914)	(0.00734)	(0.0125)	(0.011)	(0.0162)	(0.0152)	(0.0163)
Fraction of $FRMs_{2006}$	0.0592***						
	(0.0189)						
County-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes						
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Fixed Effects		Yes	Yes	Yes	Yes	Yes	Yes
Observations	44,160	44,160	44,068	44,146	44,154	41,428	40,620
R-squared	0.683	0.609	0.054	0.578	0.409	0.062	0.066

Table 11
Aggregate Evidence: IV

The table reports coefficient estimates of least square and IV regressions relating the quarterly change in car sales within a county to the fraction of fixed-rate mortgages in a county and the change in the interest rate. The sample includes car sales between 2007 and 2013. Fraction of $FRMs_{2006}$ is the fraction of fixed-rate mortgages originated in each county in 2006. Term premium is the difference between the 10-year Treasury bond and the three-month Treasury bill in the previous quarter. All columns include the following set of controls: the log of median income, Gini coefficient, poverty rate, the fraction of African American, the Log of the county area, Log of population, and the median household leverage in 2006 interacted with the term premium in the previous quarter. Column (1) is the first stage and predicts the change in the average mortgage interest rate with the interaction between the fraction of FRMs and the term premium. Column (2) shows the coefficient estimate when we instrument the change in the average mortgage interest rate with the interaction between the fraction of FRMs and the term premium. Robust standard errors, clustered at the state level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1 Change in Average Mortgage Interest Rate	2 Car Sales
	First Stage	*Second Stage*
Fraction of $FRMs_{2006}$ X Term $Premium_{t-1}$	0.00220***	
	(0.00061)	
Change in average mortgage interest $rate_{t-1}$		-8.358***
		(1.293)
Observations	44,160	44,160
R-squared	0.839	0.587

Table A.1
Retail Consumption and Interest Rate Reset

The table reports coefficient estimates of least square regressions relating the monthly car purchases to the reset of interest rate 5 years after the origination. The dependent variable is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan. The main independent variables are dummies identifying different time periods before and after the reset date. "FICO" is provided monthly by Equifax. "Income" is the income predicted by BlackBox employing the household's balance sheet information. "Log(House Prices)" is the logarithm of zip-level house prices. Origination cohort is the quarter of origination of the mortgage. The sample includes mortgages originated between 2004 and 2007 provided by BlackBox Logic. Robust standard errors, clustered at the household level, are below the coefficients in parenthesis. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	1	2	3	4
	Retail Consumption			
Four Quarters Before	-0.156	2.449**	3.064**	0.173
	(1.381)	(1.175)	(1.368)	(1.468)
Three Quarters Before	1.412	5.029***	6.170***	2.016
	(1.745)	(1.362)	(1.455)	(1.854)
Two Quarters Before	-0.317	3.711***	4.954***	0.189
	(1.922)	(1.203)	(1.561)	(2.042)
One Quarter Before	4.434**	8.862***	10.29***	5.250**
	(2.250)	(1.456)	(1.701)	(2.388)
One Quarter After	6.492**	11.27***	12.53***	7.810***
	(2.555)	(1.600)	(1.881)	(2.803)
Two Quarters After	6.650**	12.04***	13.06***	8.551***
	(2.839)	(1.754)	(2.094)	(3.108)
Three Quarters After	10.34***	14.27***	15.71***	10.82***
	(3.253)	(2.181)	(2.323)	(3.597)
Four Quarters After	10.71***	16.01***	17.16***	12.36***
	(3.533)	(2.116)	(2.573)	(3.931)
Two Years After	15.27***	23.27***	24.15***	17.67***
	(3.870)	(2.286)	(2.532)	(4.443)
FICO Score		0.00517	0.00272	0.00178
		(0.00659)	(0.00583)	(0.00662)
Log House Prices		0.0445***	-0.114***	0.0365**
		(0.0170)	(0.0339)	(0.0171)
Time Fixed Effects	Yes	Yes		
Household Fixed Effect	Yes	Yes	Yes	Yes
County X Time Fixed Effect			Yes	
Origination Cohort X Time Fixed Effect				Yes
Observations	2,307,100	1,939,756	1,939,756	1,939,756
R-squared	0.062	0.066		0.067