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 with 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 car purchases on average by $150 per month after the change in their 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, these effects are significantly more important 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 household debt 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. In principle, changes in interest rates can work through two opposing channels. First, households who are able to refinance are going to experience a reduction in monthly payments, which is equivalent to a positive income shock. It might then boost 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). However, monetary policy can become less effective due to an increase in the households' precautionary saving motive or what we call *voluntary deleveraging*. 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 responds to lower debt service payments can be a function of their precautionary saving incentives. Moreover, the higher the households' debt levels, the higher their precautionary savings incentives.[1]

[1] A similar mechanism is proposed by Guerrieri and Lorenzoni (2011), which studies the effects of a

To identify these two effects, 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.[2] 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 the mortgage payments as well as the liabilities of more than 10 million households in the U.S., and exploit the expected changes in monthly payments of borrowers with adjustable rate mortgages (ARMs) originated between 2005 and 2007, with an interest rate only period of 5 years and an automatic reset at the end of this initial period. By restricting attention only to households with this type of mortgage, we limit potential concerns about the endogeneity of the choice between fixed-rate and adjustable-rate mortgages.[3] 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.

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 month, suggesting that indeed the monthly payments significantly changed as a function

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.

[2] 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.

[3] 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.

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, although the monetary policy implemented starting in 2008 had a significant effect on households' income, their consumption response has been attenuated by the high level of debt accumulated during the boom years and their need 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 states 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. Then, we investigate the impact of the change in the interest rates on local consumption. We find that regions that have originated a higher volume of ARMs during the 2005-2007 period experience larger consumption growth in response to the reduction in interest rates. These results remain significant even when we control for local house prices, the fraction of subprime borrowers, and county-time fixed effects. We can also directly instrument the change in the average mortgage interest rate with the interaction between the fraction of fixed-rate mortgages in 2006 and the change in the interest rate, and show that this significantly predicts durable goods consumption.

1.1 Related Literature

Bernanke and Gertler (1995) have identified two potential transmission channels for monetary policy: a bank lending channel and a balance sheet channel. They highlight the fact 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.[4] Our first contribution is to fill this gap by investigating the role of consumers' balance sheets in the transmission of monetary policy.

Our paper also contributes to the growing literature investigating the channels through which monetary policy might impact banks' risk-taking and lending decisions more generally. For instance, Jimenez et al. (2014) employ data from a credit register to show that a lower

[4]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)

overnight interest rate induces less capitalized banks to lend to riskier firms, whereas a lower long-term rate has no such effect. Jimenez and Ongena (2012) show that tighter monetary 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 securitization activity, weak supervision for bank capital and 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 aggregate level, but the effect is mitigated by the households' incentives to deleverage.[5]

Our paper also highlights the important role played by frictions in the mortgage market. This connects our study to two recent papers by Calza et al. (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. In contrast, Keys et al. (2014) 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 \$160 per month, or \$45,000 (unadjusted) over the remaining life of the loan by refinancing. Moreover, they argue that the failure to refinance during this period was a widespread phenomenon and not simply a function of 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 reset of the interest rate, responded to the positive monetary policy shock.[6] We are able to do so by employing an identification strategy similar to the one proposed by Fuster and Willen (2013). They shed light on the key factors driving a borrower's default behavior by showing that the reduction of the borrower's payment significantly reduces his hazard of becoming delinquent.

To the best of our knowledge, this is the first paper that is able to directly estimate the

[5] 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), Gagnon et al. (2011), and Bernanke et al. (2004).

[6] 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.

causal effect of the changes in the interest rates implemented in the aftermath of the financial crisis on households' consumption and saving behavior. 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 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. This highlights that there can be important dynamics in consumers' response to "lumpy" increases in income like tax rebates, working in part through balance sheet (liquidity) mechanisms.[7]

In contrast to most of the literature which focuses on anticipated shocks, Agarwal and Qian (2013) uses a panel data set of consumer financial transactions to study how consumers respond to an exogenous unanticipated income shock. Specifically, they 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), 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

[7]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.

Violante (2011) propose a quantitative framework, where households can hold two assets: a low-return liquid asset (e.g., cash, checking account) and a high-return illiquid asset that carries a transaction cost (e.g., housing, retirement account). They show that this model yields consumption responses to fiscal stimulus payments that are in line with the 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 has focused on the effect of fiscal policy, our study highlights the key role that monetary policy can play in shaping consumers' behavior. 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.

The remainder of the paper is organized as follows. Section 2 provides details on the data sources. Section 3 explains the research design and how it is made operational. Section 4 describes and interprets the main results. Section 6 presents the heterogeneity of treatment effects across regions to provide further evidence of our credit-supply mechanism. Section 5 discusses a number of robustness 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 2004 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 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 characteristics.

These loans are then matched with information from Equifax. Equifax provides us with detailed monthly information on the different loans that a borrower can have, such as, credit cards, auto loans, mortgages and student loans, but also on his current FICO score. The

two dataset 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 five years ARMs originated between 2004 and 2007, which are the most common category among the ARMs. We employ the second largest category, the ten-year ARMs, as an additional robustness check in Section 5. Second, we can construct event studies as we know the time at which the mortgages have their interest rate reset, and accurately measure the change in the monthly payment as we observe the payment made by the borrowers towards their mortgages. Interestingly, this also allow us to estimate how much of the experienced income shock will be utilized by the borrower to pay down his debt. Third, we can construct different measures of consumption for each borrower. In particular, we can measure the consumption of durable good by the change in the borrower's auto loan, whereas other measure of consumption come from the balance of their credit cards, both store cards (e.g. Best Buy card, Macy's card, etc.) and other revolving accounts (e.g. Chase credit card, Bank of America credit card, etc.). All of these measures would underestimate the effect of the changes in the interest rate as they would not capture purchases made by cash or other means not recorded in Equifax. Furthermore, 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.

Figure 1 shows the average monthly expenditure on car for the period 2006-2012. It reaches its highest point at the beginning of our sample, with more than \$500, and goes down up to \$250 during the recent crisis. The bottom plot shows the average probability of a car purchase in a month, which is between 1-2%. Figure 2, instead, depicts the way in which we are able to identify car purchases. The left panel describes the case in which the borrower has bought a car and starts paying down his car loan over time. The right panel shows the case of a consumer buying two cars in our sample, which corresponds to a spike in his auto loan balance.

We use data from a number of different sources in this paper to study how the rigidity of mortgage debt contracts might affect the transmission of interest rates onto real activity. In this subsection, we describe these datasets and summarize the data.

To analyze the aggregate effects of changes of interest rates on the county-level consumption we employ data from LPS. It provides 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 (FRM) or adjustable and hybrid (ARM); the principal balance from the latter two types mortgages are combined. For much of the analyses, we include both refinances as well as new mort-

gage originations in order to measure broadly the potential channels through interest rate movements might affect consumption.

As a county-level measure of consumption we use a dataset from R. L. Polk & Company (Polk) that records all new car sales in the United States. 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. Table 1 presents the summary statistics. The top panels show the key characteristics of the 5-year and 10-year mortgages and of the households holding them. The lower panel shows information about the key control variables that we use in Section 7 to capture county-level heterogeneity.

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. The key feature of these mortgages exploited in our study is that they usually entail an interest-only payment for the first few years, usually 10 years, and an automatic interest reset 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 resulted in a significant reduction in their monthly payment.

At the individual level, our identification strategy is designed to exploit the change in the interest rate and the automatic reset for these ARMs as a positive income shock for households holding these mortgages. At the aggregate level, we can exploit the inter-county heterogeneity in exposure to these type of contracts to analyze how a prolonged period of low interest rate have affected the households' consumption behavior. The latter will be explained in greater details in Section 7.

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, 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 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.

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 quarter of origination. These more 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 other counties. 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 2004, as the house prices increased during that period and the lending standards became laxer.

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, or 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 rate reset. 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 income, its FICO score, as proxing for his financial or liquidity constraints, 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.

We start by quantifying the average change in the monthly payment, which will constitute our income shock. Figure 3 shows an event study analysis with time zero being the time of the interest rate reset and x-axis being 10 months before and after the event. We plot the average monthly payment normalized to zero, which stays constant for the period before the event and drops significantly at the moment of the event. The magnitude of the drop is very significant as it is on average almost one thousand dollars per month. 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 2004 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 income, his 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. Finally, 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.

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, which

mostly focused on one-time payments to households in the order of few hundred dollars, 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 the effect on their debt-repayment strategy.

4.1 The Consumption Response

We employ two main measures of consumption. First, we employ the 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. Second, we measure the change in the balance of store credit cards, e.g. Macy's and Best Buy credit cards, as an additional measure of consumption.

We start our analysis with Figure 4 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. We plot the average monthly amount spent on car purchases through an increase in auto loans. The plot shows that the household increases its consumption of cars starting one year before the interest rate reset, allocating on average \$50 to car purchases. This shows that indeed households were anticipating the reduction in the monthly payment and started increasing their consumption before the reset date. Interestingly, the effect is increasing in the subsequent quarters with an average effect reaching \$200 one year after the reset date.

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 \$48 more towards durable goods. However, in the quarter after the reset the households triple their consumption spending almost \$140, with this effect increasing up to about \$217 the year after the event. Column (2) controls for the borrower's FICO score, his income, 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, borrowers with a higher FICO score and higher income tend to consume more than borrowers which are more financially constrained. Column (3) 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 borrowers' consumption decisions can be significantly affected by the local economic conditions. Finally, Column (4) introduces 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 impact on our estimates.

The richness of our data allows us to analyze the impact of monetary policy on a different measure of consumption. 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 Best Buy 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. The results are statistically significant at 1% level, but as expected the magnitude is lower than the car purchase estimates. Finally, in column (5) we show that also the likelihood of purchase a new car significantly increases in the quarter after the interest rate reset. Formally, borrowers who experience an interest rate adjustment are 6% more likely to purchase a car in the subsequent year.

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. 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.

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.

Figure 5 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. We plot 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 usually coincide with the house being sold or the mortgage being refinanced. The plot shows an interesting dynamics. Since the change in the interest rate is fully anticipated, the borrowers starts allocating on average \$30-\$40 per month towards a faster repayment of their mortgage. However, after the reset this amount increases in magnitude reaching about \$130 per month in the quarter after the reset and stays at that level for the first two years after the event.

Table 4 reports the coefficients estimated using a similar regression to (1), which allows us to complement the findings of Figure 5 by including several fixed effects. 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 \$70 to repay the principal of their mortgage in the first quarter after the interest rate reset, while only \$8 in the quarter before the reset. This coefficient slightly increases over time up to \$82 two years after the change in the monthly payment. Column (2) shows that the effect is robust to controlling for FICO score, income and the log of house prices for the county where the borrower resides. It shows that income and FICO score positively predict an increase in the borrowers' voluntary deleverage. Moreover, borrowers in counties with higher housing prices are the ones that are more eager to reduce their debts. These results suggest that the less financially constrained borrowers are willing to deleverage faster than the others.

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 \$100 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.

The results presented so far are 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 rather 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 Columns (5) and (6). 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.

5 Difference-in-Differences Results

In this section, we further test the validity of our identification strategy.

In order to more sharply identify the effect of the change in the interest rate, and reduce the possibility that our results are attenuated by the change in consumption and saving decisions generated by the borrowers' expectation about experiencing a positive income shock in the near future, we include in our control group also the mortgages that will experience an interest rate reset after 10 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, 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 2004 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.

6 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 size of the change in the monthly payment. We showed in Table 2 that the reduction is on average \$1050 per month. However, households with larger mortgages are going to benefit the most from the change in interest rate as they are going to experience a significantly larger positive income shock. Table 6 empirically analyze this possibility. Odd columns consider the sample for which the change in the mortgage monthly payment on the adjustment date is below median, while even columns focus on the sample for which it is above the median. First of all, Columns (1) and (2) show

the average reduction in monthly payment for the two groups, which is $520 for the below median and $1450 for the above median ones.

Columns (3) and (4) explore the consumption behavior for the two different groups of borrowers. Those that experience a larger positive income shock are also the ones consuming the most, with a monthly consumption of durable goods of about $235 within the first year from the reset date compared to $110 of the borrowers with lower income shocks. We then turn to the prepayment behavior. Columns (5) and (6) also show that borrowers with a larger reduction in the monthly payment tend to prepay their mortgage faster, by investing up to $145 per month towards it, compared with the $60 invested by the borrowers with smaller monthly payments.

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 three subsamples of our data based on the borrower's LTV. We consider households with a LTV below 95%, between 95% and 120% and above 120%. 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 income, FICO score and the log of house prices. Columns (1)-(3) show that there is no significant difference in the reduction of the monthly payment as it is around $1000 for all three subsample. However, there is a significant difference in their consumption behavior. In fact, borrowers with a LTV above 120% consume almost three times the amount consumed by borrowers with LTV below 95%. 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 show that their saving decision is affected by the LTV in a non-linear fashion. Specifically, while borrowers with the highest and lowest LTV invest about $60 per month to repay their mortgages, the borrowers with an LTV in the intermediate region tend to repay their mortgages by allocating almost $100 a month towards it. Intuitively, borrowers with lower LTVs have the weakest incentive to reduce their debt because they are not underwater. 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.

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 Conclusion

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 2004 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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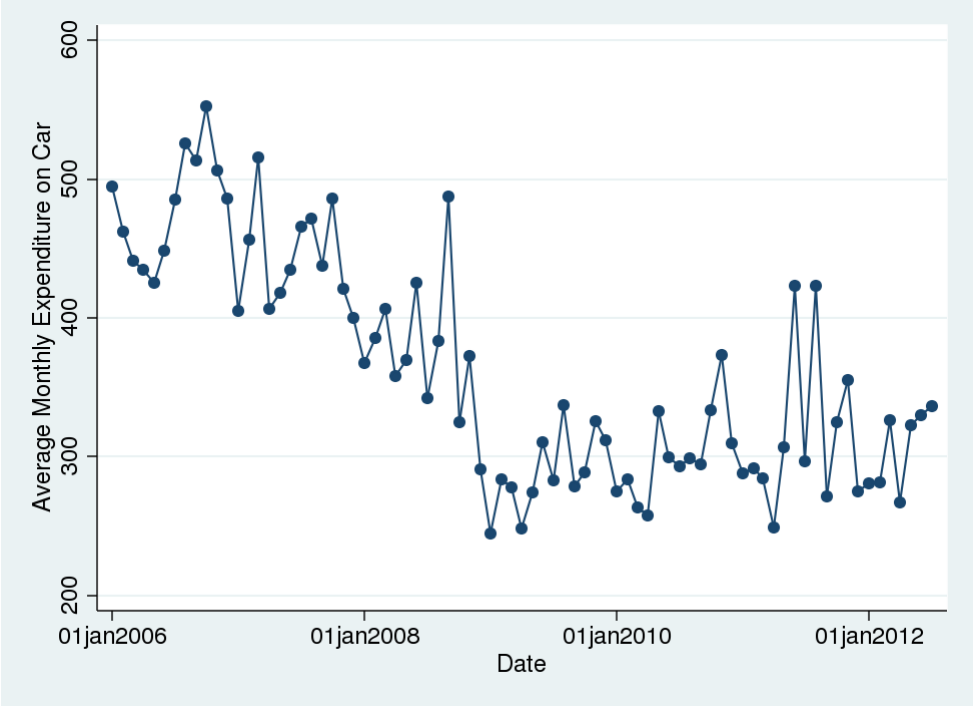
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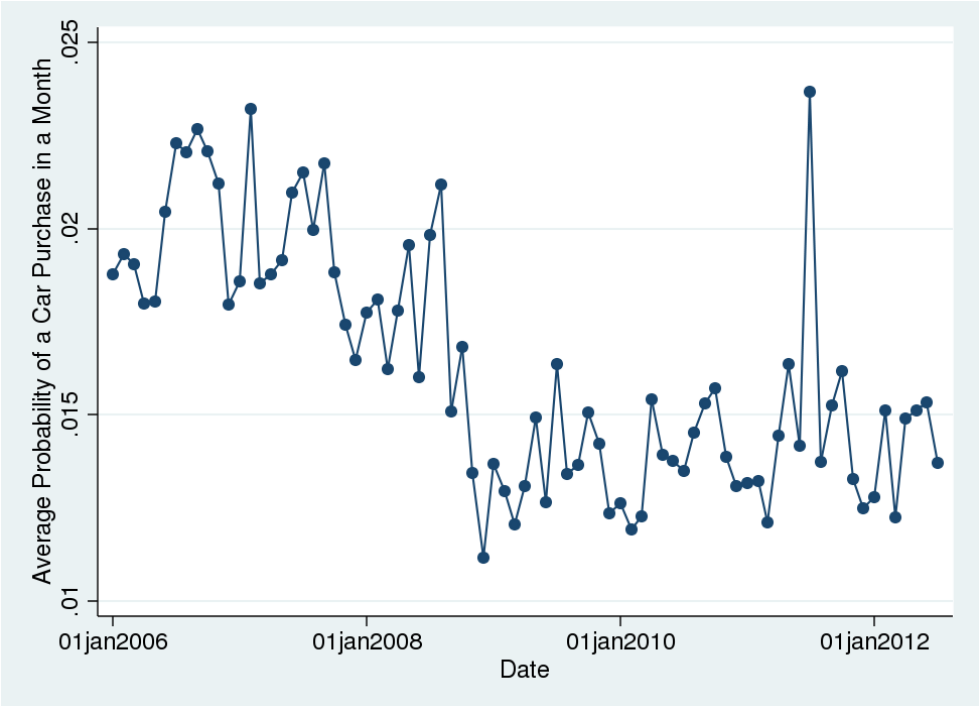


Figure 1 – Car Purchases of Households with 5 ARMs over Time

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 botton panel shows the fraction of these households who purchased a car in each single month.

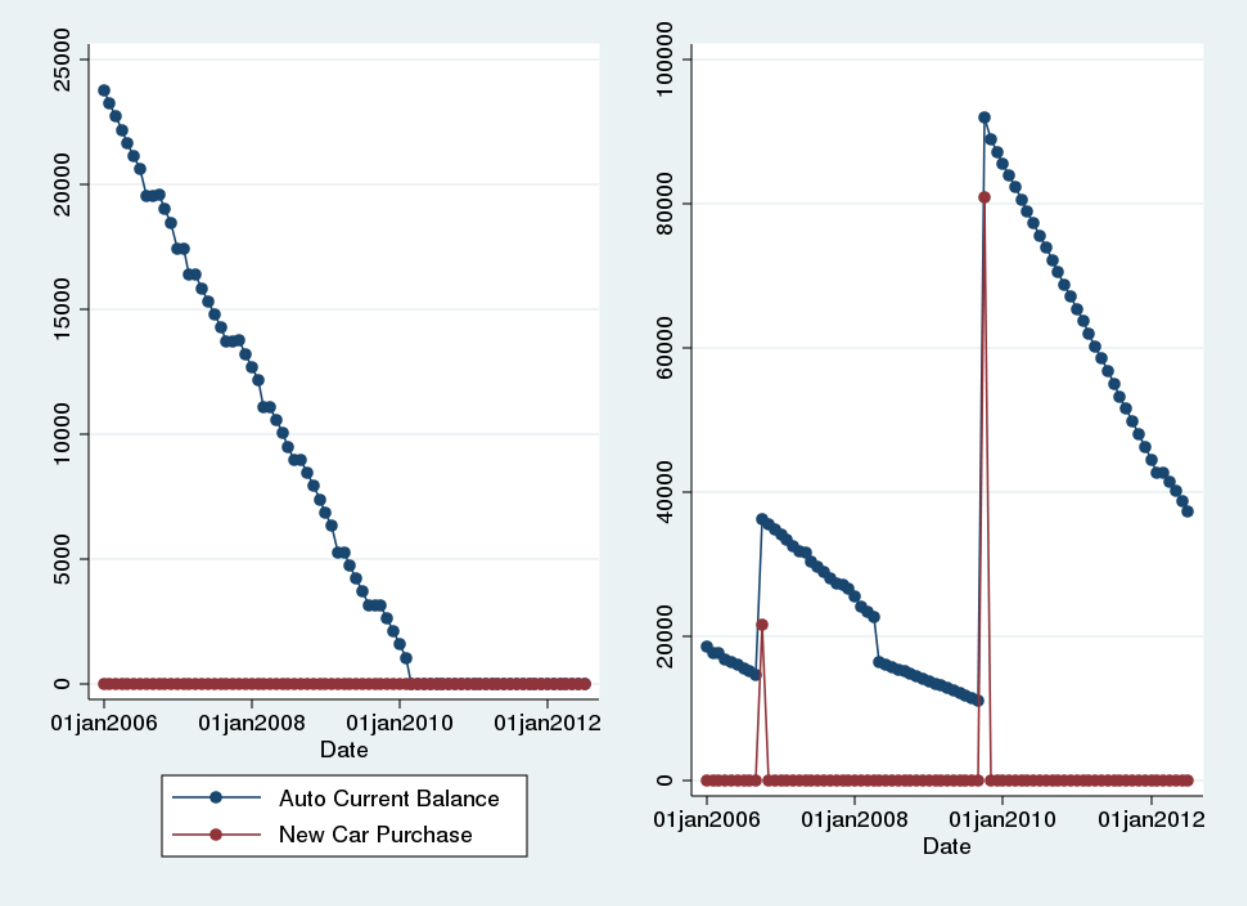
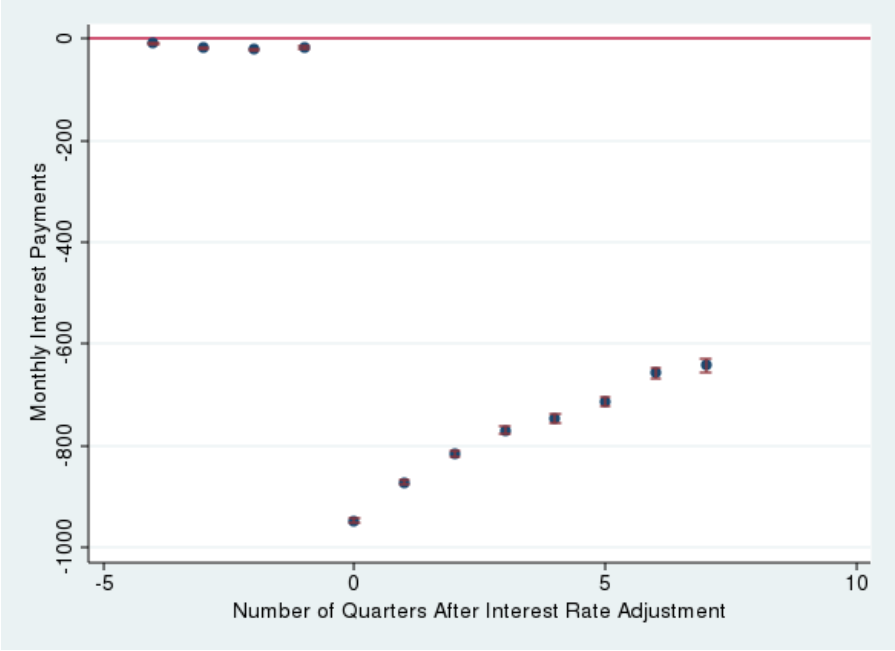


Figure 2 –Households Auto Loan Balances and Construction of Auto Sales Measure

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 increase in the auto loan balance at the time of purchase.



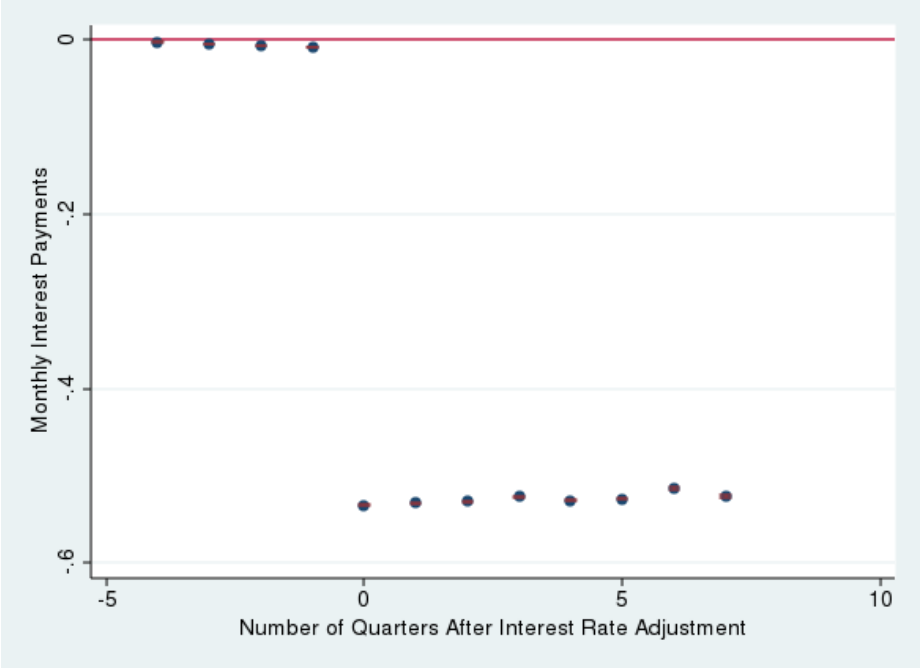


Figure 3 – Reduction in Monthly Payments

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.

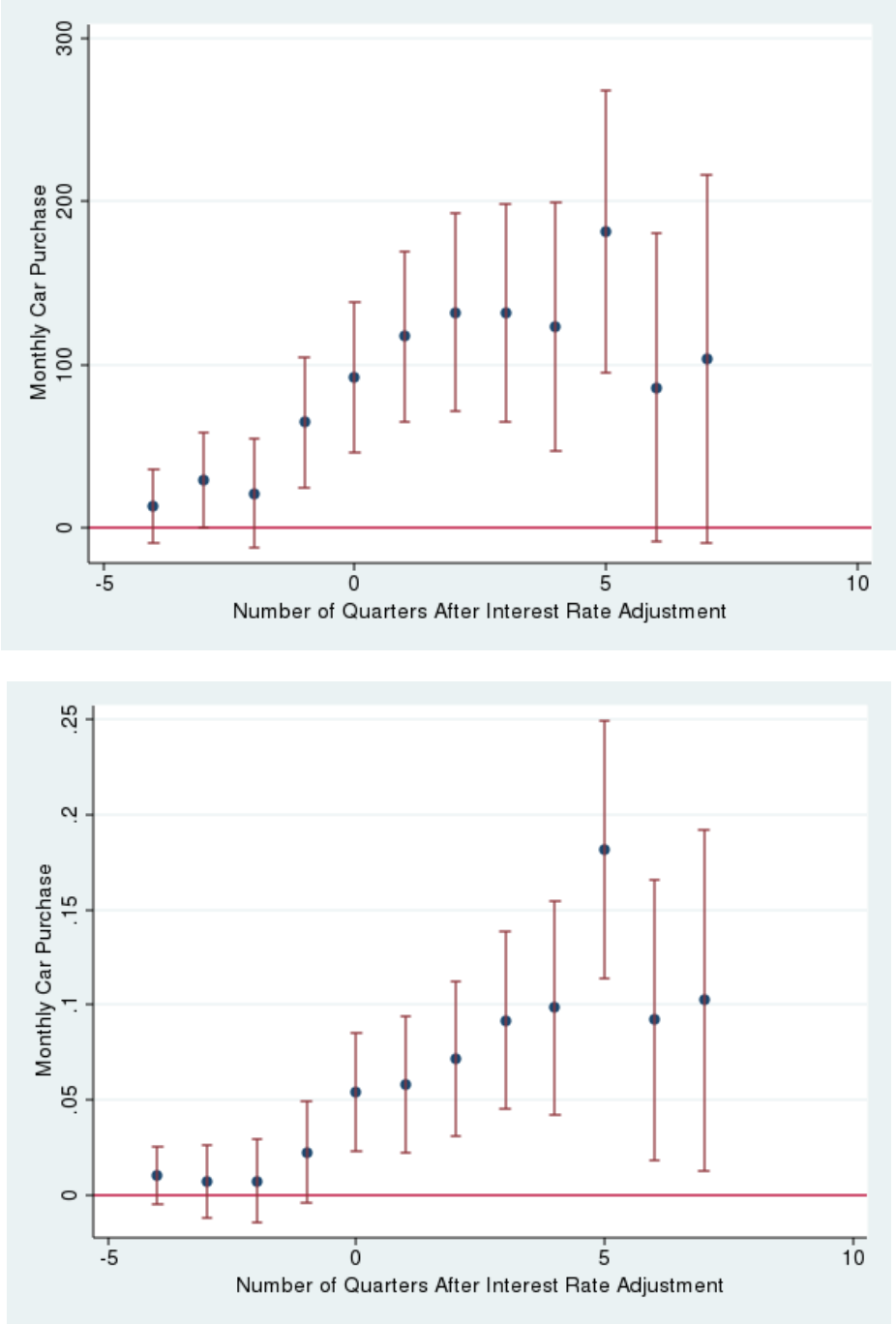


Figure 4 – Car Purchase

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.

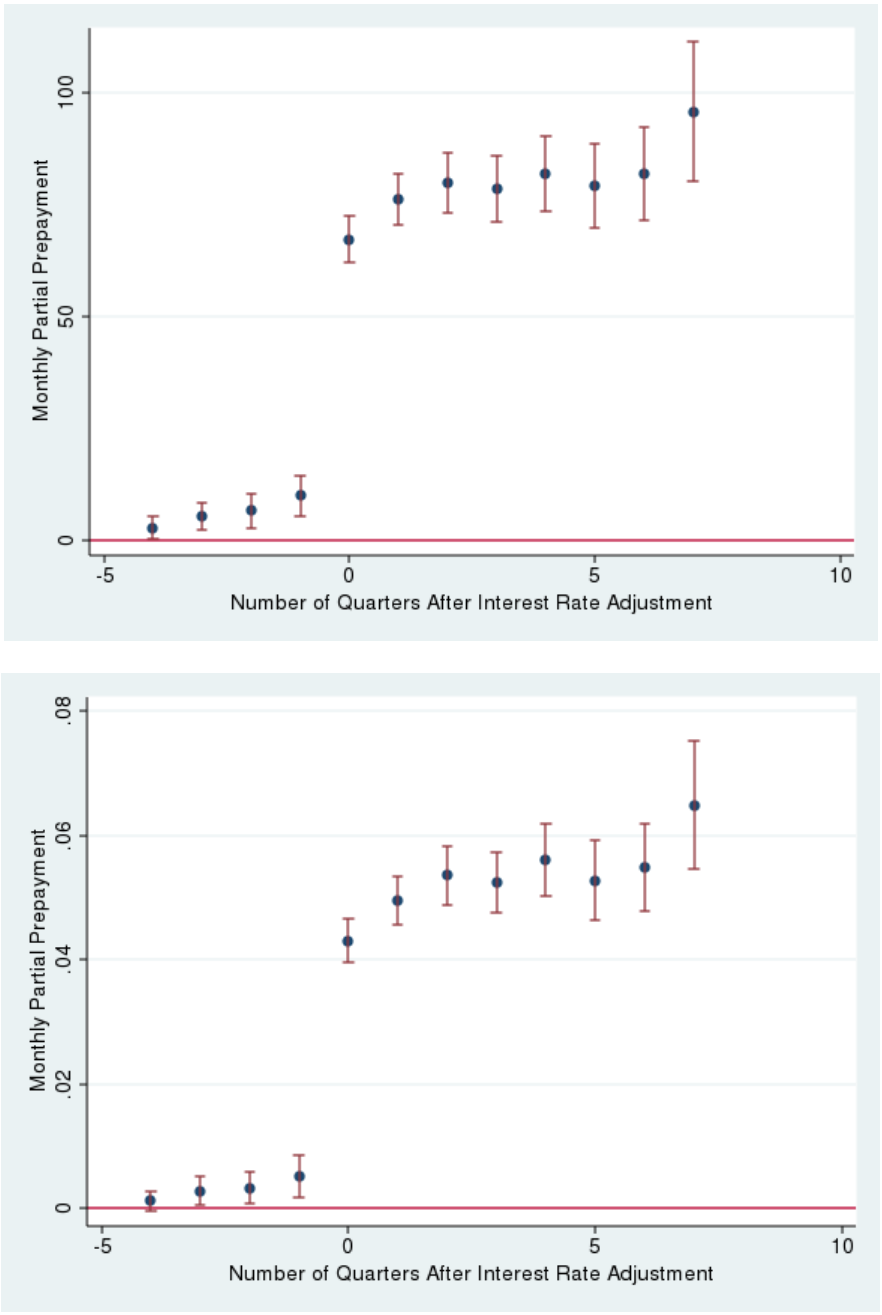


Figure 5 – Deleveraging

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.

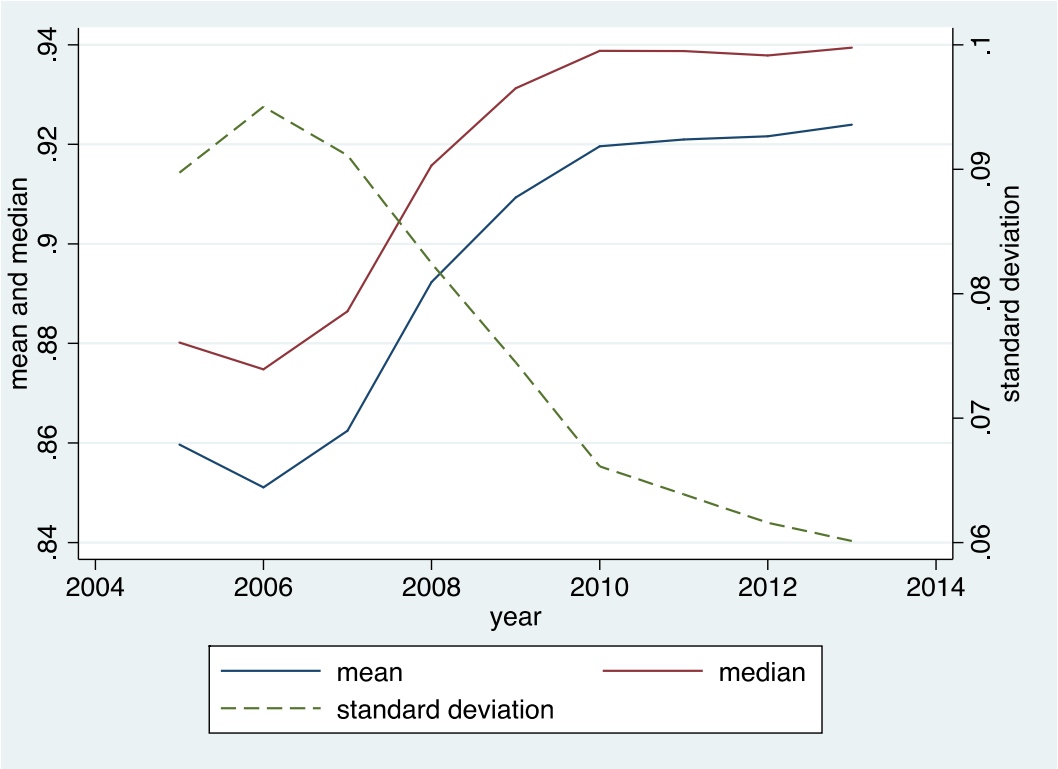
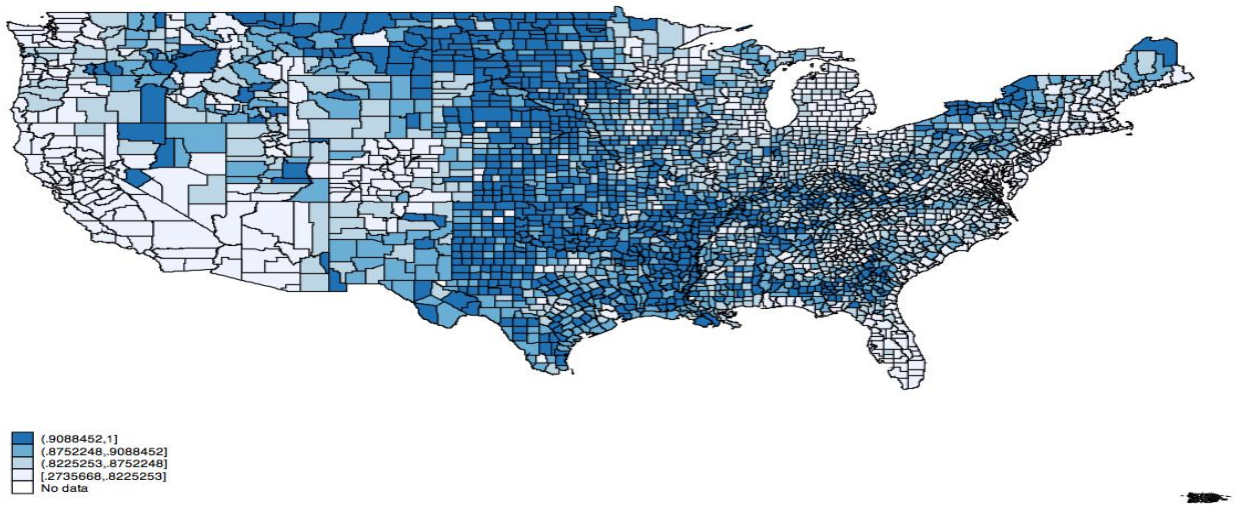


Figure 6 -- The Ratio of Fixed Rate Mortgages, 2006-2013

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

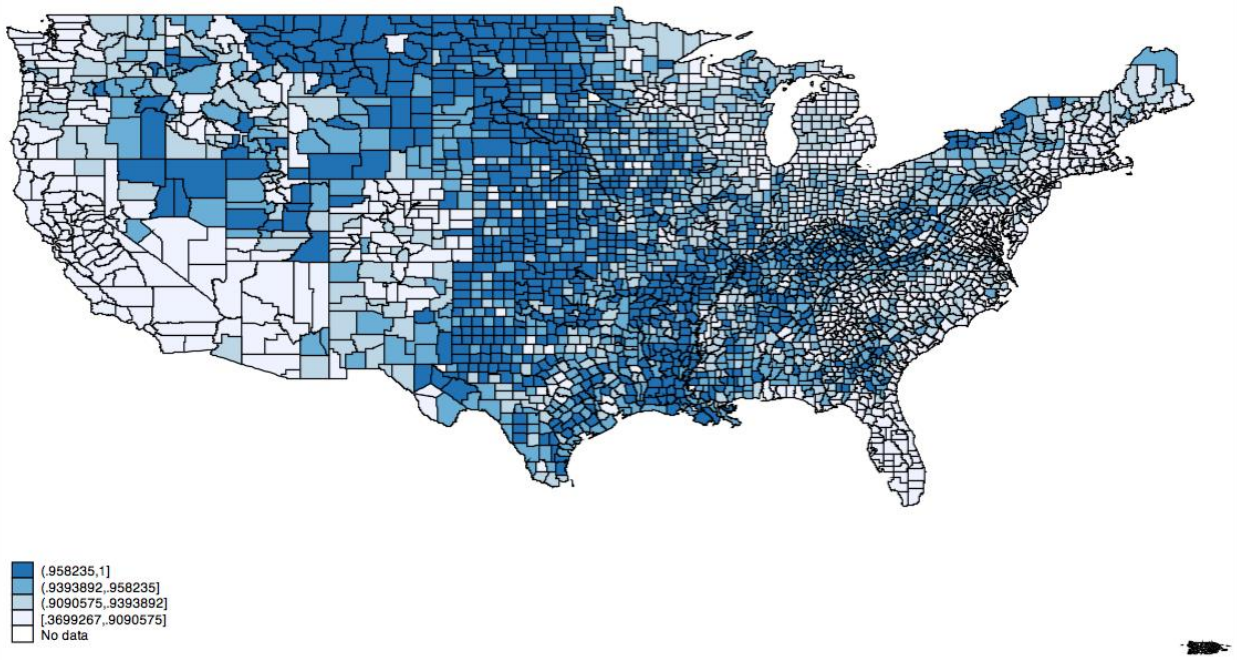


Figure 7 -- County-Level Variation in Fixed Rate Mortgages

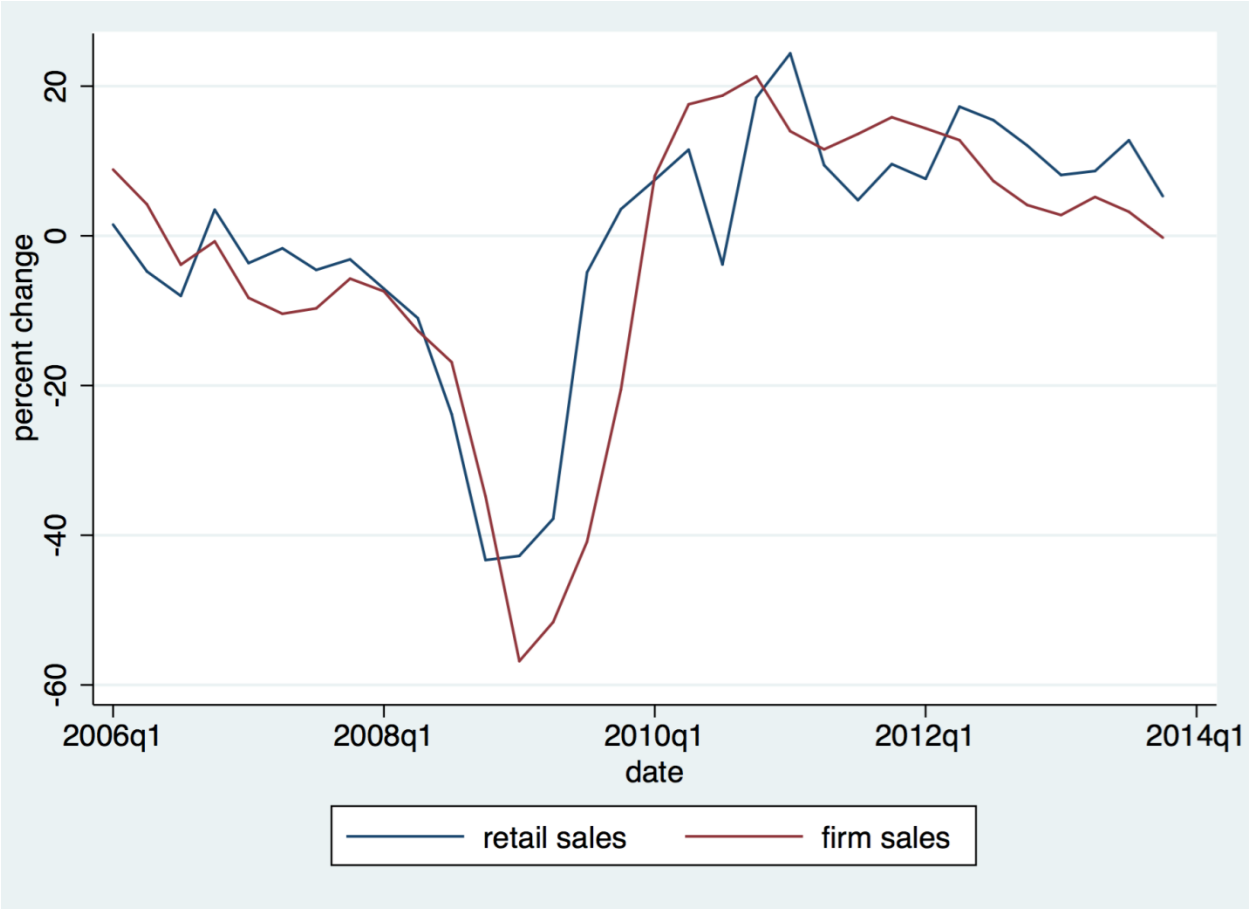


Figure 8 – Car Sales

Change in quarterly car sales, for retail buyers and firms for the period 2006-2013.

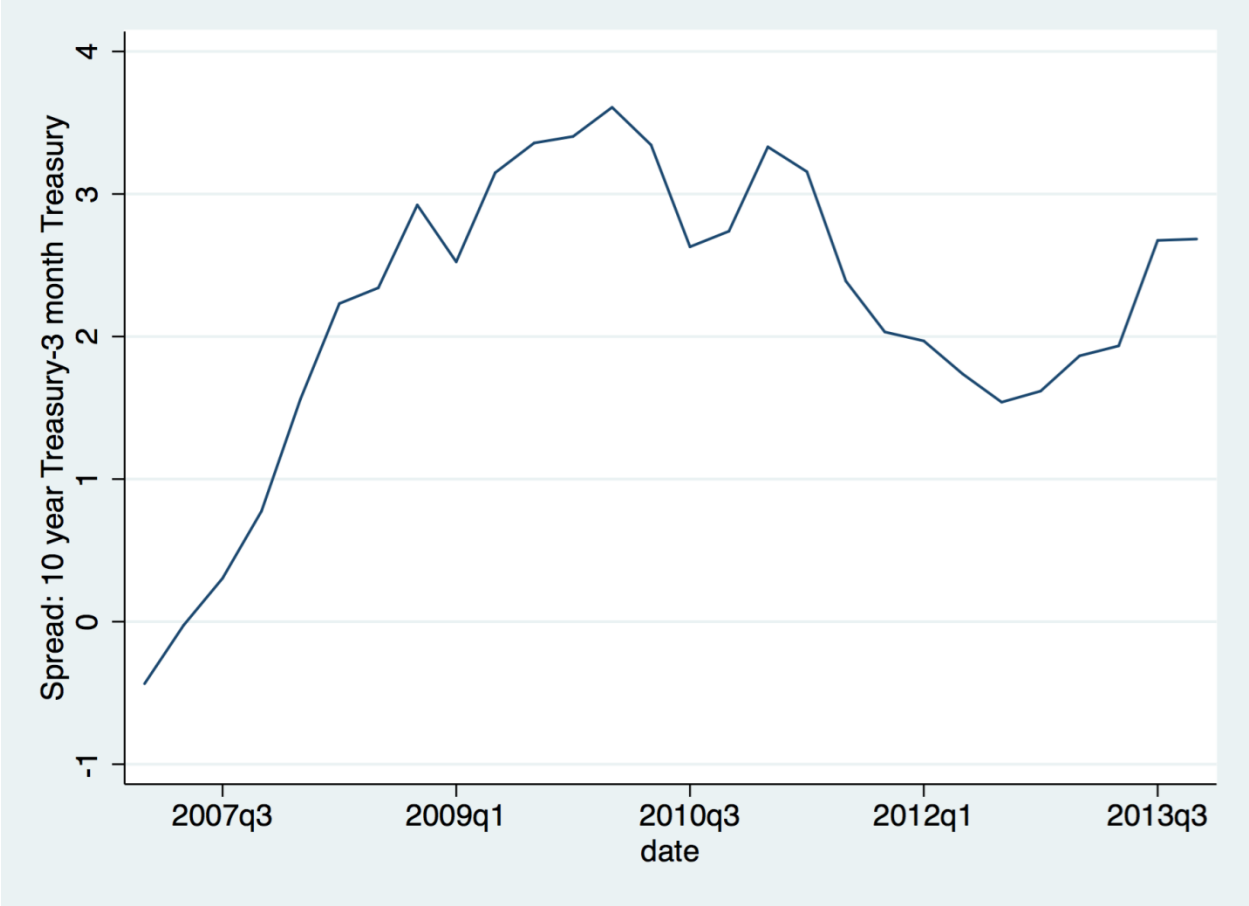


Figure 9 -- Term Premium

Table 1
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-year Mortgage 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-year mortgages

	N	Mean	St. Dev.	p1	p10	p50	p90	p99
Monthly Expenditure on New Car	3.117e+06	319.7	3,266	0	0	0	0	14,037
Whether The Household Purchased a Car	3.118e+06	0.0153	0.123	0	0	0	0	1
Partial Prepayment	2.989e+06	8.303	4,086	0	0	50.98	200	1,000
Retail Sale	3.117e+06	35.14	346.5	0	0	0	0	1,102

10-year Mortgage 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-year mortgages

	N	Mean	St. Dev.	p50	p75	p90	p95	p99
Monthly Expenditure on New Car	1.847e+06	376.7	3,758	0	0	0	0	16,418
Whether The Household Purchased a Car	1.850e+06	0.0161	0.126	0	0	0	0	1
Partial Prepayment	1.758e+06	206.7	6,861	0	0	135.4	402.5	1,750
Retail Sale	1.847e+06	41.22	402.6	0	0	0	0	1,239

Panel B: County Level Characteristics:

	N	Mean	St. Dev.	Min	Max
Log(Median income)	2208	10.70	0.25	9.88	11.65
Gini coefficient	2208	0.43	0.03	0.33	0.60
Poverty rate	2208	15.04	5.93	2.00	46.90
Fraction of African American	2208	0.10	0.14	0.00	0.82
Log(Population)	2208	10.68	1.13	9.17	15.82
Median household leverage in 2006	2208	1.57	0.58	0.58	4.93
Fraction of Fixed Rate Mortgage debt in 2006	2208	0.83	0.09	0.27	0.97

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 (5) 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
	Monthly Interest Payment				
Four Quarters Before	-17.47***	-4.276***	-7.488***	-11.07***	-0.00302***
	(0.775)	(0.516)	(0.802)	(0.620)	(0.000285)
Three Quarters Before	-31.66***	6.295***	-1.238	-19.84***	-0.00533***
	(0.972)	(0.599)	(0.853)	(0.790)	(0.000344)
Two Quarters Before	-40.07***	18.40***	6.297***	-26.64***	-0.00774***
	(1.188)	(0.713)	(0.916)	(0.981)	(0.000406)
One Quarter Before	-22.73***	22.37***	1.775*	-25.10***	-0.0103***
	(1.469)	(0.838)	(0.998)	(1.242)	(0.000466)
One Quarter After	-1,037***	-901.1***	-934.1***	-929.3***	-0.535***
	(2.525)	(2.174)	(1.104)	(2.635)	(0.000532)
Two Quarters After	-970.9***	-833.6***	-880.1***	-864.5***	-0.533***
	(3.011)	(2.217)	(1.229)	(3.050)	(0.000601)
Three Quarters After	-905.5***	-790.6***	-848.6***	-820.4***	-0.531***
	(3.513)	(2.267)	(1.364)	(3.560)	(0.000669)
Four Quarters After	-839.5***	-749.9***	-820.1***	-780.6***	-0.527***
	(3.956)	(2.305)	(1.510)	(4.112)	(0.000748)
Two Years After	-763.7***	-689.7***	-784.0***	-749.0***	-0.530***
	(4.392)	(2.025)	(1.491)	(4.797)	(0.000851)
FICO Score		-0.0641***	-0.0702***	-0.0615***	-2.75e-05***
		(0.00368)	(0.00343)	(0.00368)	(9.43e-07)
Log(House Prices)		-0.256***	-0.832***	-0.269***	-4.68e-05***
		(0.01000)	(0.0200)	(0.00999)	(2.64e-06)
Time Fixed Effects	Yes	Yes			
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes
County X Time Fixed Effect			Yes		
Origination Cohort X Time Fixed Effect				Yes	Yes
Observations	2,273,339	1,908,627	1,908,627	1,908,627	2,211,780
R-squared	0.963	0.978		0.978	0.897

Table 3.A
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)-(4) is the monthly amount spent on car purchase and is computed based on the balance of the household's auto loan. In Column (5) the dependent variable is the probability to purchase a car, while in Column (6) 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. 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	5	6
	Car Purchase				Likelihood to Purchase a Car	Normalized by Change of Payment
Four Quarters Before	20.60	36.05***	32.71**	17.59	0.00135**	0.00937
	(12.90)	(11.25)	(12.76)	(13.51)	(0.000532)	(0.01000)
Three Quarters Before	34.35**	57.82***	55.75***	40.85**	0.00221***	0.00613
	(16.46)	(12.75)	(13.57)	(17.41)	(0.000657)	(0.0121)
Two Quarters Before	27.05	43.89***	41.90***	31.64	0.00189**	0.00677
	(18.99)	(12.96)	(14.56)	(20.09)	(0.000777)	(0.0142)
One Quarter Before	76.99***	78.83***	77.70***	75.84***	0.00305***	0.0218
	(22.51)	(14.95)	(15.87)	(24.05)	(0.000902)	(0.0163)
One Quarter After	101.2***	97.80***	98.03***	102.8***	0.00423***	0.0538***
	(25.24)	(16.39)	(17.54)	(27.77)	(0.00106)	(0.0186)
Two Quarters After	125.4***	117.5***	122.5***	126.5***	0.00512***	0.0573***
	(28.22)	(18.25)	(19.53)	(31.37)	(0.00120)	(0.0210)
Three Quarters After	162.3***	128.7***	127.2***	141.2***	0.00506***	0.0703***
	(32.50)	(22.90)	(21.66)	(36.92)	(0.00135)	(0.0234)
Four Quarters After	180.1***	134.6***	128.9***	145.7***	0.00586***	0.0887***
	(35.15)	(23.29)	(23.99)	(40.71)	(0.00152)	(0.0261)
Two Years After	184.3***	151.1***	146.4***	151.7***	0.00645***	0.116***
	(38.48)	(22.35)	(23.62)	(46.90)	(0.00177)	(0.0297)
FICO Score		0.513***	0.508***	0.481***	1.97e-05***	0.00115***
		(0.0541)	(0.0544)	(0.0543)	(2.01e-06)	(3.25e-05)
Log House Prices		0.239	0.246	0.165	8.82e-06	-8.25e-05
		(0.163)	(0.316)	(0.163)	(5.97e-06)	(8.86e-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	Yes
Observations	2,307,100	1,939,756	1,939,756	1,939,756	1,939,766	2,323,031
R-squared	0.030	0.034		0.034	0.029	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)-(4) is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. iIn Column (5) we have normalized by the size of the monthly payment of the mortgage at the origination. The dependent variable in Columns (6) and (7) is he prepayment of equity loan and home equity line of credit, respectively. 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. 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	5	6	7
		Partial Prepayment			Normalized by Change of Payment	Equity Loan	HELOC
Four Quarters Before	2.377*	1.607	2.871**	2.762*	0.000996	0.286	-0.0969
	(1.422)	(1.216)	(1.325)	(1.493)	(0.00111)	(0.997)	(1.993)
Three Quarters Before	5.117***	2.296*	5.634***	5.317***	0.00256*	0.369	-3.072
	(1.684)	(1.314)	(1.602)	(1.806)	(0.00133)	(1.229)	(2.421)
Two Quarters Before	7.181***	1.451	6.762***	6.607***	0.00294*	-0.977	-1.645
	(2.141)	(1.469)	(1.897)	(2.289)	(0.00156)	(1.479)	(2.880)
One Quarter Before	8.760***	3.168*	11.55***	10.24***	0.00474***	-1.247	-0.343
	(2.495)	(1.627)	(2.198)	(2.710)	(0.00180)	(1.734)	(3.357)
One Quarter After	70.27***	55.85***	71.83***	65.24***	0.0426***	8.622***	21.56***
	(2.801)	(1.727)	(2.526)	(3.046)	(0.00204)	(2.088)	(3.862)
Two Quarters After	79.50***	63.44***	83.98***	75.05***	0.0489***	8.509***	22.82***
	(3.122)	(2.056)	(2.848)	(3.451)	(0.00230)	(2.362)	(4.362)
Three Quarters After	81.56***	65.40***	88.10***	79.14***	0.0530***	9.702***	23.53***
	(3.552)	(2.473)	(3.187)	(4.093)	(0.00256)	(2.751)	(4.881)
Four Quarters After	79.92***	61.66***	91.25***	77.31***	0.0518***	6.569**	24.07***
	(3.852)	(2.543)	(3.580)	(4.563)	(0.00285)	(3.148)	(5.441)
Two Years After	84.26***	58.33***	93.55***	78.50***	0.0544***	7.131*	19.92***
	(4.188)	(2.384)	(4.113)	(5.193)	(0.00324)	(3.711)	(6.209)
FICO Score		0.0827***	0.0883***	0.0836***	8.05e-05***	0.0760***	0.129***
		(0.00403)	(0.00473)	(0.00406)	(3.72e-06)	(0.00433)	(0.00905)
Log House Prices		0.0476***	0.192***	0.0501***	3.68e-05***	0.108***	0.175***
		(0.0142)	(0.0271)	(0.0142)	(1.02e-05)	(0.0174)	(0.0333)
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	Yes
Observations	2,626,647	2,065,312	1,775,021	2,065,312	2,077,875	476,929	359,319
R-squared	0.229	0.239		0.239	0.087	0.433	0.464

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 2004 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. 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. 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
	Interest Payment	Interest Payment	Car Purchase	Car Purchase	Prepayment	Prepayment
Four Quarters Before	-14.68***	-9.598***	41.31*	41.39*	6.324**	7.849**
	(0.883)	(0.784)	(22.48)	(24.66)	(3.126)	(3.420)
Three Quarters Before	-28.21***	-17.52***	24.73	25.07	5.801	6.542
	(1.129)	(1.017)	(28.47)	(31.26)	(3.852)	(4.234)
Two Quarters Before	-35.09***	-23.18***	31.90	48.42	14.15***	11.95**
	(1.465)	(1.298)	(32.62)	(36.01)	(4.508)	(5.003)
One Quarter Before	-18.86***	-20.53***	91.44**	92.26**	12.90**	11.04*
	(1.939)	(1.648)	(37.52)	(42.14)	(5.301)	(5.935)
One Quarter After	-994.0***	-897.2***	120.7***	141.5***	74.76***	63.55***
	(2.922)	(2.744)	(42.66)	(48.83)	(6.148)	(7.046)
Two Quarters After	-929.7***	-832.1***	138.1***	157.1***	85.22***	74.11***
	(3.399)	(3.154)	(47.65)	(55.07)	(6.867)	(7.915)
Three Quarters After	-866.7***	-785.7***	171.1***	182.9***	83.37***	70.70***
	(3.877)	(3.675)	(52.61)	(61.46)	(7.770)	(9.093)
Four Quarters After	-804.1***	-743.2***	187.5***	187.0***	80.47***	67.77***
	(4.398)	(4.301)	(57.36)	(68.45)	(8.428)	(9.997)
Two Years After	-733.9***	-712.5***	163.5***	143.9*	79.84***	63.13***
	(5.029)	(5.061)	(63.44)	(80.50)	(9.298)	(11.21)
FICO Score		-0.0383***		0.432***		0.102***
		(0.00252)		(0.0436)		(0.00404)
Log(House Prices)		-0.149***		0.234*		0.106***
		(0.00644)		(0.126)		(0.0146)
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	3,507,231	4,596,110	3,563,218	4,294,354	3,368,065
R-squared	0.977	0.987	0.030	0.033	0.243	0.253

Table 6
Heterogeneous Effects I: Change in Payment

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 2004 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1)-(2) is the mortgage monthly payment. The dependent variable in Columns (3)-(4) 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 Columns (5)-(6) is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. 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. Odd columns consider the sample for which the change in the mortgage monthly payment on the adjustment date is below median, while even columns focus on the sample for which it is above the median. 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
	Change in Payment below the Median			*Change in Payment above the Median*		
	Interest Payment	Car Purchase	Prepayment	Interest Payment	Car Purchase	Prepayment
Four Quarters Before	-2.897***	27.64	1.765	-10.46***	2.645	1.575
	(0.575)	(17.57)	(1.961)	(1.405)	(24.91)	(2.656)
Three Quarters Before	-4.662***	43.62**	3.444	-19.42***	35.42	5.863*
	(0.689)	(21.09)	(2.349)	(1.718)	(30.44)	(3.210)
Two Quarters Before	-6.371***	37.08	3.594	-27.71***	19.84	9.058**
	(0.812)	(24.84)	(2.764)	(2.035)	(36.04)	(3.785)
One Quarter Before	-5.990***	51.58*	2.985	-30.57***	89.17**	20.44***
	(0.934)	(28.57)	(3.178)	(2.359)	(41.79)	(4.384)
One Quarter After	-518.2***	85.32***	45.37***	-1,450***	106.6**	97.46***
	(1.060)	(32.44)	(3.603)	(2.759)	(48.85)	(5.084)
Two Quarters After	-508.1***	102.3***	51.13***	-1,415***	134.7**	121.4***
	(1.185)	(36.23)	(4.023)	(3.158)	(55.90)	(5.799)
Three Quarters After	-498.2***	72.42*	54.90***	-1,399***	235.7***	132.0***
	(1.313)	(40.16)	(4.456)	(3.600)	(63.67)	(6.577)
Four Quarters After	-480.0***	112.6**	56.97***	-1,386***	173.9**	135.6***
	(1.456)	(44.53)	(4.937)	(4.165)	(73.65)	(7.564)
Two Years After	-464.7***	114.9**	59.82***	-1,439***	171.9*	145.1***
	(1.640)	(50.15)	(5.556)	(4.988)	(88.28)	(9.008)
FICO Score	0.0228***	0.262***	0.0648***	-0.107***	0.624***	0.108***
	(0.00212)	(0.0647)	(0.00725)	(0.00479)	(0.0845)	(0.00926)
Log(House Prices)	0.100***	0.0441	-0.00635	-0.513***	0.276	0.0641**
	(0.00536)	(0.163)	(0.0182)	(0.0145)	(0.255)	(0.0272)
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes		Yes	Yes
Observations	900,844	911,065	882,599		1,020,090	883,972
R-squared	0.961	0.025	0.261	0.979	0.037	0.236

Table 7
Heterogeneous Effects II: 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 2004 and 2007 as provided by BlackBox Logic. The dependent variable in Columns (1)-(3) is the mortgage monthly payment. The dependent variable in Columns (4)-(6) 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 Columns (7)-(9) is the monthly reduction in the mortgage balance and is computed based on data from BlackBox. For each dependent variable, each column considers, in turn, the sample of mortgages with the LTV ratio in the lowest, middle and highest tercile. 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. 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	7	8	9
		LTV<95%			*95%<LTV<120%*			*LTV>120%*	
	Interest Payment	Car Purchase	Prepayment	Interest Payment	Car Purchase	Prepayment	Interest Payment	Car Purchase	Prepayment
Four Quarters Before	-5.053*	-34.11	2.795	-8.631***	42.03	3.412	-12.66***	36.48	-0.406
	(2.820)	(33.87)	(4.869)	(1.679)	(30.56)	(2.664)	(1.268)	(26.39)	(2.128)
Three Quarters Before	-8.901**	-25.46	3.247	-15.38***	83.37**	4.386	-23.44***	64.24**	4.690*
	(3.473)	(41.70)	(5.988)	(2.076)	(37.78)	(3.281)	(1.556)	(32.39)	(2.585)
Two Quarters Before	-13.96***	-42.32	6.174	-22.04***	55.90	6.430*	-32.60***	61.37	7.874***
	(4.117)	(49.44)	(7.091)	(2.464)	(44.85)	(3.888)	(1.846)	(38.41)	(3.050)
One Quarter Before	-21.67***	45.50	12.27	-29.31***	91.58*	10.94**	-39.04***	93.99**	6.710*
	(4.755)	(57.08)	(8.182)	(2.851)	(51.90)	(4.495)	(2.137)	(44.45)	(3.526)
One Quarter After	-962.2***	64.97	65.45***	-1,016***	117.2*	77.23***	-971.5***	154.7***	55.65***
	(5.462)	(65.57)	(9.375)	(3.305)	(60.14)	(5.186)	(2.481)	(51.60)	(4.054)
Two Quarters After	-903.0***	113.8	69.15***	-946.2***	169.8**	88.36***	-905.1***	180.4***	63.03***
	(6.154)	(73.84)	(10.55)	(3.755)	(68.33)	(5.881)	(2.826)	(58.75)	(4.601)
Three Quarters After	-857.9***	72.60	68.18***	-894.7***	174.4**	94.57***	-860.0***	245.5***	68.36***
	(6.892)	(82.66)	(11.80)	(4.250)	(77.33)	(6.641)	(3.207)	(66.64)	(5.194)
Four Quarters After	-813.8***	65.01	67.23***	-847.1***	212.4**	87.39***	-808.7***	204.2***	70.47***
	(7.829)	(93.92)	(13.38)	(4.923)	(89.59)	(7.667)	(3.762)	(78.17)	(6.041)
Two Years After	-810.3***	86.93	86.82***	-814.5***	109.8	80.52***	-789.8***	262.1***	62.55***
	(9.273)	(111.3)	(15.83)	(5.991)	(109.0)	(9.281)	(4.739)	(98.55)	(7.524)
FICO Score	0.0133	0.610***	0.0896***	-0.0914***	0.376***	0.0763***	-0.0839***	0.443***	0.0706***
	(0.0105)	(0.126)	(0.0182)	(0.00582)	(0.106)	(0.00931)	(0.00403)	(0.0835)	(0.00686)
Log(House Prices)	-0.194***	0.128	-0.0907*	0.148***	0.143	-0.0122	0.0677***	0.161	0.0595***
	(0.0320)	(0.383)	(0.0551)	(0.0206)	(0.372)	(0.0323)	(0.0134)	(0.278)	(0.0221)
Household Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origination Cohort X Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	432,294	439,223	421,931		544,802	504,250	624,390	634,743	538,671
R-squared	0.975	0.037	0.273	0.982	0.034	0.197	0.983	0.027	0.191

Table 8
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 9
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, previous quarter		-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