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How Do Mortgage Rate Resets Affect Consumer Spending and Debt Repayment? Evidence from Canadian Consumers*

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Abstract

One of the most important channels through which monetary policy affects the real economy is changes in mortgage rates. This paper studies the effects of mortgage rate changes resulting from monetary policy shifts on homeowners' spending, debt repayment and defaults. The Canadian institutional setting facilitates the design of identification strategies for causal inference, since the vast majority of mortgages in the country experience predetermined, periodic, and automatic contract renewals with the mortgage rate reset based on the prevailing market rate. This allows us to exploit quasi-random variation in the timing of the rate reset and present causal evidence for both rate declines and increases, with the help of detailed, representative consumer credit panel data. We find asymmetric effects of rate changes on spending, debt repayment and defaults. Our results can be rationalized by the conventional cash-flow effect in conjunction with changes in consumer expectations about future interest rates upon the reset. Given the pervasiveness of Canadian-type mortgages in many other OECD countries, our findings have broader implications for the transmission of monetary policy to the household sector.

Keywords: Mortgage rate, monetary policy, consumption, consumer expectations, household finance.

JEL Codes: D12, D14, E43, E52, G21, R31.

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1 Introduction

One of the most important channels through which monetary policy affects the real economy is changes in mortgage rates. Lower mortgages rates, for example, reduce long-term borrowing costs and debt service expenses, increase borrowers' cash flows, and stimulate consumer spending in economic downturns. A persistent challenge in evaluating the mortgage-rate channel has been the identification of exogenous mortgage rate changes and their effects on consumer spending and savings. Given the difficulty of using time series analysis to isolate the mortgage-rate channel from all other channels through which monetary policy affects aggregate spending and savings, a growing number of studies have turned to micro data and cross-sectional empirical strategies.

The work by Di Maggio et al. (2017), for example, focuses on U.S. adjustable-rate mortgage (ARM) borrowers over a declining interest rate period. Their strategy, however, cannot be applied to studying the causal effects of mortgage rate increases on consumer behavior in the U.S., because creditworthy consumers can always refinance their ARMs to avoid adjusting to higher rates, creating a selection problem in the estimation. Empirical strategies used by other related studies have relied on comparing ARM borrowers with fixed-rate mortgage (FRM) borrowers (e.g., Jappelli and Scognamiglio (2018); La Cava et al. (2016); Floden et al. (2021)), or comparing mortgage borrowers with outright homeowners (e.g. Agarwal et al. (2022)), which is prone to the selection-into-treatment concern. In addition, most studies have focused on a single episode around the global financial crisis when major central banks slashed their policy rates.[1] The reversal of the low policy rate environment since late 2021 in major economies has created interest in the corresponding effects of a monetary tightening.

These challenges motivate us to explore a different institutional setting, the Canadian mortgage market, using detailed, representative consumer credit panel data. Canada is an interesting case to consider, because the institutional setting of the mortgage market permits a clean identification design. The vast majority (about 80%) of mortgages in Canada are "short-term" FRMs that are subject to predetermined, periodic and automatic contract renewals. Specifically, the interest rates on these mortgages are fixed within a term (typically 2-5 years) and have to be reset at the end of the term based on the prevailing market rate, while the balance is automatically rolled over.

[1] The only other study that provides evidence for a monetary tightening is Agarwal et al. (2022). Unlike the strategy used by Agarwal et al. (2022) that compares mortgage borrowers with outright homeowners, our comparison is between similar mortgage borrowers that only differ in the timing of the contract renewal. Moreover, our sample is nationally and geographically representative of mortgage borrowers, whereas the sample in Agarwal et al. (2022) is representative of credit card holders.

Borrowers usually renew their contracts with their current lenders, in which case, their credit scores, loan-to-value (LTV) ratios and debt-to-income (DTI) ratios are not reassessed, unlike when originating a new mortgage. Moreover, due to large prepayment penalties, most borrowers renew their contracts and reset their rates as scheduled.

These institutional features imply that the timing of the mortgage rate reset is determined by past contract choices, and that the change in the mortgage rate upon the reset results from the change in the prevailing market rate over the contract period, rather than being driven by the borrower's financial condition, creditworthiness, or spending decisions. Intuitively, we can compare the responses of two borrowers that are similar in every aspect except that one borrower resets the mortgage rate earlier than the other borrower. Our identification strategy, therefore, exploits quasi-random variation in the timing of the rate reset in the Canadian mortgage-market setting.

Using this strategy, we provide evidence for two recent monetary policy episodes in Canada that correspond to major policy shifts during our sample period (Figure 1): the expansionary episode of 2015m1-2017m1 and the contractionary episode of 2017m7-2019m6. We start by showing that these policy changes were passed through to mortgage rates when borrowers renewed their contracts, with the magnitude of the pass-through depending on the length of the contract term before the reset. In the expansionary episode, the rate reduction ranged from 16 basis points (bps) to 113 bps, with the largest reductions experienced by borrowers who had relatively long terms (e.g., four and five years) prior to the reset. In the contractionary episode, renewing borrowers saw rate increases of 32-85 bps, with the smallest increases experienced by borrowers who had relatively long terms before the reset. Changes in rates translate to changes in interest payments. We estimate that the required mortgage payments fell (rose) by \$14-\$92 (\$34-\$83) per month in the expansionary (contractionary) episode, or by \$2,907-\$20,891 (\$7,072-\$19,165) over the remaining life of the loan, if the borrower uses the same length of time to pay it off.

Given the changes in mortgage rates and payments upon the reset, we examine their effects on consumer spending using two measures available in our data. One is newly originated auto loans that capture spending on automobiles. The other is newly originated installment loans (excluding student loans), which are often used by Canadian consumers to cover large, one-time expenses such as home improvements and purchases of durable goods (e.g., furniture and consumer electronics). Standard consumption theory predicts that consumers increase (decrease) their spending when mortgage payments fall (rise), and that liquidity-constrained borrowers are more responsive to

these cash-flow shocks (e.g., Carroll (1997), Deaton (1991), and Kaplan and Violante (2014)).

Our results for the expansionary episode are in line with this theory: Borrowers receiving the largest cash flows increased spending on automobiles by 16% and spending financed by installment loans by 18%. Young borrowers and borrowers with higher credit scores are more responsive to these shocks. In the contractionary episode, however, the types of spending measured in our data did not change significantly, suggesting that consumers are willing to smooth their consumption to a larger extent in response to negative cash flows. The asymmetric consumption responses to income shocks have been documented in other contexts. For example, the work by Baugh et al. (2021) shows that consumers increase their consumption when receiving tax refunds, but these same consumers do not cut their spending when making tax payments, regardless of whether these payments are expected or unexpected.

Another important aspect of household responses to mortgage rate changes is the balance-sheet adjustment. If lower mortgage rates cause households to deleverage on their debt because of positive cash flows, for example, the resulting strengthened balance sheets will support future consumption. We therefore examine debt-repayment responses to rate resets, distinguishing between mortgage prepayment and the paydown of revolving consumer credit, i.e., credit cards and lines of credit (LOCs). Again, we find asymmetric patterns. Borrowers renewing their contracts in the expansionary episode paid down their mortgage principal faster, by scheduling higher monthly payments than the required amount for the new term, whereas borrowers in the contractionary episode did not deviate from their required payments, implying no acceleration in the amortization. For consumer revolving debt, while we do not find a change in the overall balance in the expansionary episode, we document across-the-board repayments of this type of debt during the contractionary episode. Taken together, these results imply that consumers deleveraged on their debt in both episodes.

The asymmetric debt-repayment responses we document are new to the literature. Our findings suggest that rate resets affect consumers not only through changes in cash flows, as stressed in the previous literature, but also through other channels. Otherwise, negative cash flows in the contractionary episode would drive consumers to accumulate more debt to smooth consumption. We evaluate a number of potential explanations and provide evidence that changes in consumer expectations about future interest rates help rationalize our findings.

The third aspect of household responses we examine is the change in the likelihood of being

delinquent on payments. In line with previous studies (e.g., Fuster and Willen (2017)), we find lower delinquency rates on mortgages and consumer credit products as borrowers reset to lower rates in the expansionary episode. In the contractionary episode, however, there is no evidence for rising delinquencies, which may be explained by high expected costs of default and strict lending standards in Canadian mortgage and consumer credit markets that ensure borrowers' resilience to negative cash flows.

Lastly, given our micro-level analysis, we expect rate resets to generate sizable effects on aggregate spending when borrowers reset their rates to lower levels, and to contribute to aggregate savings when borrowers experience rate increases. Since our sample is representative of Canadian borrowers, we are able to provide estimates of the aggregate effects. Our estimates show that, between 2015m1 and 2017m1, additional auto spending caused by mortgage rate resets amounted to $2.02 billion, or 1.53% of aggregate new auto sales, while additional durable consumption financed by installment loans amounted to $1.38 billion, or 0.42% of aggregate durable consumption. In the contractionary episode between 2017m7 and 2019m6, deleveraging on revolving debt upon the rate reset raised aggregate savings by $693 million, or 1.72% of the aggregate saving.

Relation to the literature. The importance of understanding the transmission of monetary policy to households has given rise to a large number of studies on the effects of mortgage rate changes on consumption, balance sheets and defaults (e.g., Di Maggio et al. (2017), Agarwal et al. (2022), Jappelli and Scognamiglio (2018), La Cava et al. (2016), Floden et al. (2021), Tracy and Wright (2016), Fuster and Willen (2017), Ganong and Noel (2020), Agarwal et al. (2017), Ehrlich and Perry (2017), Karamon et al. (2017) and Abel and Fuster (2021)). Our paper falls into this literature.

Among these studies, our paper is most closely related to Di Maggio et al. (2017) with three major differences. First, as discussed earlier, the Canadian setting allows us to provide causal estimates not only for the effects of declining mortgage rates, as in Di Maggio et al. (2017), but also for the effects of rate increases during a monetary tightening period. Second, our results are based on a nationally and geographically representative sample of Canadian mortgage borrowers, whereas the sample underlying the main results of Di Maggio et al. (2017) is not representative of the vast majority of mortgages or borrowers in the U.S., as shown in Appendix A. Specifically, the jumbo prime interest-only ARMs in their study accounted for only 1.8% of the total U.S. mortgage origination in 2005-2007, and almost half of this type of mortgages were originated in

California alone. Whether the consumption and payment responses of these ARM borrowers can be generalized to a typical American consumer who is likely to hold a 30-year FRM is unclear. Third, as in other related studies, Di Maggio et al. (2017) interpret rate resets as cash-flow shocks, whereas our paper suggests that rate resets also affect consumer responses through expectations of future interest rates.

More broadly, our work is related to the literature on consumption and saving responses to income shocks (e.g., Baugh et al. (2021), Agarwal and Qian (2014), Agarwal et al. (2007), Johnson et al. (2006), Parker et al. (2013), and Kaplan and Violante (2014)), and the literature on the transmission of monetary policy shocks to households through housing and mortgage markets and various other channels (e.g., Kaplan et al. (2018), Cloyne et al. (2020), Beraja et al. (2019), DeFusco and Mondragon (2020), Wong (2021), Greenwald (2017), Chen et al. (2020), Hurst and Stafford (2004), Bhutta and Keys (2016) and Zhou (2022)). We discuss in more detail the relation between our work and these studies in subsequent sections.

The remainder of the paper is organized as follows. Section 2 discusses key institutional features of the Canadian mortgage market, an overview of the Canadian consumer credit market, and the credit panel data used in our analysis. Section 3 describes the empirical strategy. Section 4 examines the effects of rate resets on mortgage loan-level outcomes. Section 5 examines the effects on consumer-level outcomes, discusses and evaluates the channels through which resets affect consumers, and provides evidence from expectations survey data that supports the expectations channel. Section 6 presents estimates for the aggregate effects of rate resets on spending and debt repayment. Section 7 provides further evidence and robustness checks. Section 8 concludes.

2 Institutional Setting and Data

2.1 Canadian Mortgage Market

The Canadian mortgage market has several important institutional features that facilitate our identification design. First, unlike the U.S. mortgage market where long-term FRMs are dominant, the vast majority of Canadian mortgages have short terms (2-5 years) and long amortization periods (25-30 years).[2] The amortization period is the length of time it takes to pay off a mortgage, whereas the term is the length of time the contract, especially the mortgage rate, is in effect. Having a

[2]Our credit panel data show that 95% of FRMs in Canada have a term of 2, 3, 4 or 5 years. Since FRMs account for 80% of the market, the four products, 2-, 3-, 4- and 5-year FRMs, together account for 76% of the entire Canadian mortgage market, with 5-year FRMs most popular (accounting for 60% of FRMs). The Bank of Canada-OSFI Mortgage Origination Dataset confirms the high presence of these four products (73% of total originations since 2014).

mortgage term that is shorter than the amortization period requires the borrower to renew the contract by the end of the term. Upon the renewal, the remaining balance is rolled over and the mortgage rate is reset based on the prevailing market rate.[3] Typically, by the end of the amortization, a mortgage contract would have been renewed several times.

Consumers are allowed to change the length of the term in the renewal process. In our data, consumers holding the most common contracts, i.e., 2- and 5-year FRMs, tend to keep their previous contract length at renewal (see Appendix Table D1). For example, 65% of 2-year FRM borrowers and 68% of 5-year FRM borrowers who renewed their contracts between 2015 and 2017 chose the same term length as in the previous term. Other borrowers, such as those holding a 3- or 4-year contract, either maintained their previous term length or switched to a more common term, 2 or 5 years, that is closer to their previous term length. We defer the discussion of how the switching of contract terms can potentially affect our empirical results to Section 7.

Second, most borrowers renew their mortgage contracts with their current lender. We estimate that among borrowers who eventually renewed their mortgages between 2015 and 2017, 98% did so with their current lender. This share fell slightly to 97% in 2017-2019.[4] When a mortgage is renewed with the current lender, the lender in general does not reassess the borrower's risk measures, such as the credit score and LTV and DTI ratios. Thus, both rate increases and decreases are passed on to the borrower automatically. This feature differs from mortgage refinancing in the U.S. that almost always requires reassessing the underwriting criteria.

Third, the existence of prepayment penalties ensures that borrowers renew their mortgage contracts as scheduled. Although the penalty varies from lender to lender, it is usually the higher of (i) three months' interest on the remaining balance, and (ii) the interest differential based on the contract rate and the current market rate for a term of the same length as the remaining time left on the current term. When the mortgage rate declines, the interest-differential penalty captures all financial gains from prepaying the mortgage in full and originating a new mortgage at a lower rate. In practice, borrowers may renew their contract slightly earlier than scheduled without paying a penalty, provided that their current lender allows them to do so. As shown in Figure 2, more than

[3]Mortgage rates at the borrower level may vary slightly with the borrower's bargaining power (Allen et al. (2014, 2019)). In our analysis, we control for borrower fixed effects and a set of borrower characteristics, which help remove the sources of variation in bargaining power.

[4]These shares are computed using information in Appendix Table D2. In the expansionary episode, for example, the probability of renewing the contract with the current lender conditional on the event that the consumer eventually renewed her contract is (0.72+0.28*0.1*0.38)/(0.72+0.28*0.1)=0.98. Likewise, this probability is 0.97 in the contractionary episode.

98% of renewals in our data occurred in the six months leading up to the scheduled dates, with on-time renewals accounting for 50%.[5]

The existence of prepayment penalties also reduces the incentive of Canadian consumers to extract their home equity through cash-out refinancing, a process that involves paying off the current balance and originating a new loan secured by the same property with a higher balance. Cash-out refinancing is most likely to happen when a consumer approaches her scheduled renewal date and when prepayment penalties do not apply. Using our data, we identify cash-out refinancing activity for loans terminated before the scheduled renewal (see Table D2), and then estimate the annual cash-out refinancing propensity to gauge the quantitative importance of this activity. We estimate this propensity to be 3% in Canada between 2015 and 2017, which is much smaller than the 7%-11% propensity in the U.S. during the early-2000s refinancing boom, according to Bhutta and Keys (2016).[6] Compared to cash-out refinancing, taking out home equity lines of credit (HELOCs) is not subject to prepayment penalties and is more flexible in the amount that consumers can borrow, hence more prevalent in Canada (Ho et al. (2019)). We study the effect of rate resets on HELOC balances in Section 5.

2.2 Canadian Consumer Credit Market

A central part of our analysis is the effects of mortgage rate resets on the balances and payments of consumer credit that includes revolving debt, such as credit cards and LOCs, and non-revolving debt, such as auto, installment and student loans.[7] As in many countries, consumer credit constitutes an important part of household debt in Canada, provides indicators for changes in consumer spending and savings, and is closely watched by policymakers assessing financial risks.

The Canadian consumer credit market shares some common features with the US market. First, it accounts for a significant share of outstanding household debt in both countries, about 34% in Canada (according to Statistics Canada) and 24% in the U.S. (according to the Federal Reserve Board) since 2015. The difference is partially driven by the statistical agencies' treatment of HELOC debt, which is classified as consumer credit in Canada but as mortgage debt in the U.S.

[5] While not fully prepayable, Canadian mortgage contracts allow for an annual prepayment of up to 20% of the initial balance on top of the scheduled amortization without penalty. This partial prepayment, however, is not associated with a change in the mortgage rate, and hence does not affect our identification.

[6] We estimate the Canadian cash-out refinancing propensity as follows. According to Table D2, among borrowers scheduled to renew their mortgages, the share of cash-out refinancing borrowers is 13% (=28%*46%). In the population, the share of borrowers scheduled to renew their contracts among all FRM borrowers is 25% in a year. Taking these facts together, we estimate the annual cash-out refinancing propensity to be 3% (=25%*13%) over the 2015-2017 period. This propensity is slightly lower in the 2017-2019 period (2.6%), when interest rates moved up.

[7] For the purpose of our study, we exclude student loans, which represent 5% of the overall consumer credit balance between 2015 and 2019 and are even less important among homeowners.

Excluding HELOC debt, consumer credit accounts for 22% of Canadian household debt, much closer to the US share. Second, the per capita balances and credit utilization rates on comparable debt instruments, such as auto loans and credit cards, are similar in the two countries, after accounting for the exchange rate (by comparing the TransUnion Canada data and the New York Fed Consumer Credit Panel Reports). These features suggest broad applicability of our estimates to economies with similar consumer credit markets.

On the other hand, there are some differences between the two markets. First, apart from the classification of HELOCs, the importance of HELOC debt in overall household debt differs substantially. Whereas HELOC balances accounted for less than 4% of US household debt after 2015, it captured almost 12% of Canadian household debt over the same period. This is likely explained by the less prevalent use of cash-out refinancing as a tool for home equity extraction in Canada as discussed earlier. The second difference is the lower delinquency rates in Canada compared to the U.S. The percentage of balances delinquent for more than 90 days in the U.S., across different consumer credit products, was about four to eleven times as high as the corresponding percentage in Canada over the period we study. This is likely explained by the tight lending standards in Canadian mortgage and consumer credit markets, as well as the high expected costs of default in Canada. As we show in Section 5.5, even in the contractionary episode, delinquencies did not rise for borrowers who resett their mortgage rates to higher levels.

2.3 Data

We use granular account-level (or trade-line-level) data provided by TransUnion Canada, one of the two credit reporting agencies in Canada, which collects information on 35 million individuals and covers nearly every consumer in the country that has had a credit report. The data are available from 2009 onwards at the monthly frequency.[8] For each consumer, we merge mortgage loan-level information with consumer-level information on non-mortgage debt that is compiled by ourselves using account-level data on auto loans, installment loans, credit cards and LOCs. This bottom-up approach allows us to precisely identify the timing and the amount of a purchase that is financed by an auto loan or an installment loan.

The mortgage loan-level data have information on the origination date, initial amount, insurance

[8]The data collected by TransUnion Canada are reported in accordance with the Metro 2 format of the Canadian credit reporting guidelines, which specify the variables for reporting. To protect the privacy of Canadians, no personal information was provided by TransUnion. The TransUnion dataset was "anonymized," meaning that it does not include information that identifies individual Canadians, such as names, social insurance numbers or addresses. In addition, the dataset has a panel structure, which uses fictitious account and consumer numbers assigned by TransUnion.

status, whether the loan is taken out jointly, and whether the borrower is the primary holder of the loan, as well as other origination information. The data also include monthly updates on the current balance, scheduled payment, term duration, delinquency status and whether the loan is terminated. Information on non-mortgage debt follows a similar data structure. Moreover, the data provide information about a borrower's age, credit score, and forward sortation area (FSA, corresponding to the first three digits of a postal code).

For the purpose of our study, knowing the exact timing of a rate reset is crucial. Not all mortgages in the dataset can be associated with their renewal dates, however, because some lenders do not report the term duration information, making it impossible to infer the renewal dates of their mortgages. For this reason, we use mortgages issued by one of the largest commercial banks and their corresponding consumers as our sample. This bank is the only major bank that reports the term duration information.

Our sample is representative of the mortgages and borrowers in Canada. First, mortgages originated by the bank have very similar characteristics to those originated by other federally regulated lenders (see Table 1). Second, the bank's share in Canadian mortgage originations and in the aggregate stock of Canadian mortgages are both close to 20%. Third, the bank operates in all regions of the country and has a market share of about 20% in each Canadian province, suggesting the geographic representativeness of our sample.

2.4 Construction of Key Variables

Mortgage rates. Our analysis requires information on the mortgage rate type (i.e., fixed or variable) and the mortgage rate, which is not provided by the TransUnion data. To identify the mortgage rate type, we classify a loan as fixed-rate in a term if the scheduled monthly payment does not change during that term.[9] We then design a procedure to recover the rates associated with these FRMs. In Appendix B, we describe in detail how these rates are constructed and how we use two alternative datasets that contain information on actual mortgage rates to validate our procedure. We show that the distribution of the imputed rate based on this procedure closely matches that in the two alternative datasets.

Required monthly payments. Given the new mortgage rate upon the reset, we construct a payment schedule that is not observed in our data but measures the automatic adjustment of the monthly payment implied by the rate reset. In constructing this variable, we assume the same

[9] Although some lenders in Canada offer fixed-payment schedules for variable-rate mortgages, the lender in our sample typically does not.

remaining amortization period and the same outstanding balance as in the month prior to the reset. Comparing the change in this required payment to the change in the scheduled payment set by the borrower allows us to examine the choice between mortgage prepayment and cash withdrawal upon the reset.

Remaining amortization. If a borrower sets a higher monthly payment than the required amount, the remaining amortization period shortens. For each renewed mortgage, we first use the pre-renewal rate, balance and monthly payment to infer the remaining amortization had the mortgage not been renewed. We then use the post-renewal rate and monthly payment and the pre-renewal balance to infer the amortization after the reset.

Spending measures. We construct two measures for durable spending. First, we use newly originated auto loans as proxies for spending on automobiles.[10] Since we work directly with loan-level data, we can precisely identify the timing and the amount of a vehicle purchase that is financed by an auto loan. Second, we use newly originated installment loans (excluding student loans) to measure broader types of durable spending. In Canada, these loans are designed to cover large one-time expenses and are typically used for home improvements and purchases of furniture or other durable goods.

Classifying HELOCs. The original account-level data do not distinguish between HELOCs, which are secured by borrowers' homes, and unsecured LOCs. While both types of LOCs are revolving debt products, the former have lower rates and provide a more important source for homeowners to smooth their consumption.[11] Hence, we are particularly interested in understanding changes in HELOC balances upon the rate reset. We follow the industry practice in classifying HELOCs as LOCs that have initial credit limits of at least $50,000. Our empirical results are robust to changing this threshold.

Delinquency measures. Given loan-level information on the delinquency status, we create consumer-level measures of delinquency on each type of debt as follows. First, we create an indicator at the loan level that takes the value of one if the loan in the current month approaches a certain level of delinquency (60 or 90 days). We then count the number of newly delinquent accounts for each type of debt. Finally, we convert the number of newly delinquent accounts into a dummy

[10] According to Watts (2016), as of 2016, 83% of new motor vehicles in Canada were obtained with financing, and the trend of financed vehicle sales has closely tracked that of total sales. In addition, historical data show that the average LTV ratio of motor vehicles in Canada is close to 100%.

[11] Bailliu et al. (2012) estimate that 40%-50% of the funds extracted from home equity is used for consumption and home improvement in Canada.

variable that indicates new delinquency on at least one account of a given debt category.

Constructing LTV ratios. Since the credit panel data do not provide borrower-level information on house prices, we instead construct the FSA-level LTV ratio and include its lag as a control variable in our regressions. Specifically, we use the FSA-level median house price in 2014Q1 (from the Bank of Canada-OSFI mortgage originations dataset) multiplied by the growth rate of the Teranet quarterly FSA-level house price index to obtain the FSA's current-quarter house price. We then divide the median mortgage balance of the FSA's consumers by the imputed current-quarter house price of the FSA to obtain the LTV ratio.

2.5 Summary Statistics

Table 2 shows the summary statistics of key variables at the mortgage loan level and at the consumer level.[12] We perform the analysis on loans renewed in 2015m1-2017m1 for the expansionary episode, and on loans renewed in 2017m7-2019m6 for the contractionary episode. For tractability, we restrict our analysis to FRMs that have (pre-renewal) terms of 2, 3, 4 or 5 years, which jointly account for 95% of the FRM market. Summary statistics are presented for each term separately. Our analysis is restricted to primary mortgage holders. Borrowers that have more than one mortgages at the same time are excluded. In total, we have 88,328 loans renewed during the expansionary episode and 85,376 loans renewed during the contractionary episode.

3 Empirical Strategy

Our empirical strategy is designed to exploit variation in the predetermined timing of mortgage rate resets in the two episodes. In essence, we compare the responses of two borrowers who are similar in every aspect except that one borrower resets her mortgage rate earlier than the other borrower. Our analysis is carried out separately for each mortgage term in each episode, so we can focus on borrowers with similar contracts and avoid the potential concern of selection into specific terms.

The panel structure of our data allows us to include a set of borrower-level characteristics, borrower fixed effects, and month-of the-sample fixed effects that may confound the effects of rate resets. Our baseline specification is

$$y_{j,t} = \gamma_j + \delta_t + \alpha_1 PostRenew_{j,t} + \alpha_2 \mathbf{x}_{j,t} + \varepsilon_{j,t}, \tag{1}$$

where $y_{j,t}$ is an outcome of borrower (or loan) j in month t. $PostRenew_{j,t}$ is the indicator for

[12] To limit the effect of outliers in our data, we eliminate the top 1% observations for balance and payment variables. Our empirical results are robust to using alternative thresholds such as the top 0.5%, 2.5% and 5%.

the months after borrower j's contract renewal. $\mathbf{x}_{j,t}$ is a vector of the borrower's characteristics, including the lagged credit score, age and the previous-quarter FSA-level LTV ratio. γ_j is the borrower fixed effect that absorbs unobserved heterogeneity potentially correlated with the borrower's choices. δ_t is the month-of-the-sample fixed effect designed to capture the trend in the aggregate economy and to control for the confounding effects of aggregate shocks. α_1 is the key parameter of interest that captures the effect of the rate reset. The standard errors are clustered at the borrower level.[13]

Economy theory suggests that consumers may respond differently to the same mortgage rate shocks due to heterogeneity in their wealth and access to credit markets. We consider three empirical measures to quantify these heterogeneous responses. First, we use the average credit score over the preceding 12 months as a proxy for the borrower's access to new credit. Second, we use the average utilization rate of revolving credit over the preceding 12 months as a proxy for constraints on existing, available credit. Third, we use ages under 45 or above 65 as a proxy for low liquidity levels compared to middle-aged consumers. This choice is consistent with the prediction of standard life-cycle theory and the patterns in household survey data (e.g., the Survey of Consumer Finances and Panel Study of Income Dynamics). We interact each of these empirical measures with the post-renewal indicator, $PostRenew_{j,t}$, for the estimation of heterogeneous effects.

Consumers may change their spending and savings before the reset in anticipation of a rate change upon the reset. To evaluate the importance of this anticipation effect, we estimate the dynamic version of equation (1) that includes a set of quarterly dummies to replace the post-renewal indicator. Specifically, we estimate the α_1^q's from

$$y_{j,t} = \gamma_j + \delta_t + \sum_{q \in Q} \alpha_1^q \mathbf{1}_j(t \in q) + \alpha_2 \mathbf{x}_{j,t} + \varepsilon_{j,t}, \tag{2}$$

where $\mathbf{1}_j(t \in q)$ is an indicator equal to one if month t is in the qth quarter since the mortgage renewal. We set the quarter before the renewal as quarter zero and estimate the responses in the three quarters before and five quarters after the renewal relative to quarter zero.

One potential concern with our baseline strategy is its inability to account for the mortgage-age effect. For example, consumers may be less likely to buy a car at the time when they buy a house, perhaps because they have used up their savings to make the mortgage down payment, or because

[13] Our results are robust to including the province-by-quarter fixed effects or the cohort-by-quarter fixed effects. The first set of fixed effects controls for region-specific time trends. For example, the effect of oil price shocks may vary substantially across regions, as the oil sector is geographically concentrated in Canada (see Kilian and Zhou (2020)). The second set of fixed effects controls for unobserved heterogeneity across cohorts.

they are too leveraged to be qualified for a new auto loan. As consumers accumulate savings after the home purchase, they are more likely to buy a car. This means that consumers' auto spending increases with the age of their mortgage. The existence of this mortgage-age effect threatens our identification, because we might attribute the increase in auto spending to the effect of the rate reset. Ideally, we would include a set of dummy variables indicating the age of the mortgage. These variables would be collinear with the post-renewal indicator, so we cannot control for them.

We therefore implement two alternative difference-in-difference (DID) strategies for robustness. First, we consider a design that introduces FRMs with long terms (7 or 10 years) as the control group. These mortgages were previously renewed at the same time as mortgages in our sample. Essentially, this strategy compares two mortgages that were both previously renewed in, say, 2010m1. One was renewed again in 2015m1, while the other had to wait for another two years. In the second design, we introduce as the control group mortgages having the same terms as the treatment group but not renewed in the episode. For example, in the expansionary episode, we use 5-year FRMs previously renewed in 2012m1-2013m1 (hence not renewed in the expansionary episode) as the control group for 5-year FRMs renewed in this episode. This approach mitigates the selection concern arising from comparing different types of mortgage contracts.

Both designs can be implemented by estimating the following specification:

$$y_{j,t} = \gamma_j + \delta_t + \beta_1 Renew_j \times PostRenew_{j,t} + \beta_2 \mathbf{x}_{j,t} + \varepsilon_{j,t}, \tag{3}$$

where $Renew_j$ is the indicator for loan j to be renewed in an episode. Other variables are similarly defined as in equation (1). The parameter of interest is β_1, which captures the DID effect. As we discuss in Section 7, the estimates using the baseline strategy are similar to these DID estimates.

4 Mortgage Loan-Level Adjustments

We start by estimating the changes in the mortgage rate and required monthly payment upon the reset, and then turn to the change in the monthly payment scheduled by the borrower. The latter reflects the borrower's choice of whether to pay down the mortgage principal faster by deviating from the required payment. Heterogeneity in this choice across borrowers shows support for the prediction of standard consumption theory.

4.1 Changes in Mortgage Rate and Required Payment

Column (1) of Table 3 shows the change in the mortgage rate for each term. In the expansionary episode, borrowers renewing their mortgages experienced substantial downward adjustment in the

rate. The magnitude, however, depends on the term prior to the reset. Mortgages with relatively longer terms had larger declines in rates. For example, the average decline was 113 bps for 5-year FRMs, but 16 bps for 2-year FRMs. This difference is due to the fact that the prevailing market rate had already been declining before the episode started, leading to larger cumulative changes for mortgages with longer terms.

Lower mortgage rates imply savings on required interest payments. In column (2), we estimate the change in the required monthly payment, which quantifies the maximum payment reduction per month the borrower can realize in the new term. Consistent with the rate-change pattern, 5-year FRM borrowers had the largest reduction in the new required payment, $92 per month on average, whereas the reduction for 2-year FRM borrowers was only $15 per month. Given the remaining amortization for each type of mortgage, we estimate the total interest savings upon the reset, assuming that the amortization and mortgage rate do not change. This ranged from a modest amount of $2,907 to a substantial amount of $20,891, depending on the pre-renewal term (see Table 4). As we show in Section 4.2, borrowers also shortened their amortization upon the reset, implying further interest savings.

In the contractionary episode, borrowers renewing their mortgages experienced rate increases. The magnitude decreases with the term prior to the reset, due to the reversal of the declining rate trend. Borrowers with 2-year FRMs, for example, experienced the largest rate increase of 85 bps, whereas borrowers having 5-year FRMs encountered a 32-bp rate increase on average. We estimate that the monthly required payment increased by $34-$83, depending on the pre-renewal term. Assuming the amortization and current rate unchanged, the total increase in interest payments upon the reset in this episode ranged from $7,072 for 5-year FRM borrowers to $19,165 for 2-year FRM borrowers.

These estimates represent the average changes experienced by borrowers who renewed their mortgages in an episode. At the individual level, however, the changes may differ depending on the timing of the renewal. In the contractionary episode, for example, the prevailing market rate increased gradually following the policy rate movements (Figure 1), implying that borrowers renewing their mortgages early in the episode experienced smaller increases in rates and payments than borrowers renewing their mortgages later, even though they held the same type of contract. Our estimates put more weight on mortgages renewed early in an episode (due to more observations of these loans in the post-renewal period), which could cause us to underestimate the true average

increases in rates and payments.

To address this concern, we provide estimates using the sample that restricts the post-renewal observations to be within four quarters for each loan. The results are shown in Appendix Table D4. For the contractionary episode, the average increases in rates and payments are indeed larger than the baseline estimates, with differences of 20 bps in rates and $20 in required payments. For the expansionary episode, the average decreases in rates and payments are smaller than the baseline estimates. These loan-level differences, however, do not affect much our borrower-level outcomes, i.e., durable consumption and debt repayment, as shown in Section 5.

4.2 Changes in Scheduled Payment and Amortization

When renewing the mortgage contract, a borrower, given the new rate, may choose a different monthly payment from the required amount. In principle, the payment chosen by the borrower must not fall below the required level. Scheduling a higher monthly payment than the required amount allows the borrower to pay down the mortgage principal faster and to shorten the amortization. Comparing the change in the required payment to the change in the scheduled payment, therefore, allows us to infer the borrower's decisions on mortgage prepayment and liquidity withdrawal.

In the expansionary episode, we find that, indeed, borrowers did not set their new payments to the low levels required by lenders (Table 3, column 3). For example, 5-year FRM borrowers on average only lowered their monthly payments by $46, despite the maximum possible reduction of $92 per month. A similar pattern is found for other types of renewing mortgages. This implies that only part of the interest savings were realized, and that the rest were used to pay down the principal faster. How much faster? We estimate the change in the remaining amortization in column (4) of Table 3. Depending on the term, the amortization period was shortened by 4-14 months. Taking this into account, we estimate that total interest savings upon the reset ranged from $4,830 to $23,925 for renewing borrowers (Table 4).

In the contractionary episode, we find that borrowers set their new monthly payments to the levels required by the lenders, leaving the amortization essentially unchanged. The asymmetric responses of scheduled payments are not surprising, given that lenders in general do not allow borrowers to schedule a payment lower than required, nor do they permit extensions of the amortization.

Another way of paying down the mortgage principal is to make a large, one-time payment at the point of the renewal. The data, however, do not seem to support the prevalence of such large

prepayments upon the reset. We find that, only 3.7% of borrowers reduced their balances by more than 5% upon the reset in the expansionary episode, and that this fraction dropped to 3.2% in the contractionary episode. In addition, the fraction of borrowers who reduced their balances by more than 20% is at most 1% in each episode.

4.3 Heterogeneity in Mortgage Payment Choices

We showed that, in the expansionary episode, borrowers used part of their interest savings from the reset to pay down their mortgage principals faster. There are reasons to believe that this pattern varies across borrowers. Standard consumption theory predicts that liquidity-constrained borrowers would allocate more of their interest savings to spending and less to debt prepayment. Here we focus on borrowers who experienced large payment declines (i.e., 4- and 5-year FRM borrowers) and examine whether constrained borrowers responded differently from others. Liquidity constraints are measured using the credit score, credit utilization and age, as described in Section 3.

Table 5 supports the theoretical prediction. We compute the ratio of the change in the scheduled payment to the change in the required payment as a measure of liquidity realization. Consider two groups of borrowers who renewed their 5-year FRMs, one with high credit scores and the other with low credit scores. Our estimates show that the liquidity realization ratio for high-credit-score borrowers is 37% (=30.02/82.24), whereas it is 65% (=[30.02+32.90]/[82.24+14.09]) for low-credit-score borrowers. Similarly, this ratio is 37% for borrowers with low credit utilization and 68% for borrowers with high credit utilization. Likewise, this ratio is 57% for young borrowers, 47% for middle-aged borrowers, and 58% for old borrowers. Turning to borrowers renewing 4-year FRMs, we find the similar pattern that liquidity-constrained borrowers converted more of their interest savings to liquidity than other borrowers.

In contrast, we do not find heterogeneity in this ratio in the contractionary episode (not shown to conserve space). Borrowers set their scheduled payments to the required levels and left the amortization unchanged, regardless of the liquidity measure. The lack of heterogeneity in the payment choice in this episode may again be explained by lenders' policy that the scheduled payment in general cannot fall below the required level.

5 Mortgage Rate Resets and Consumer-Level Responses

This section examines the effects of rate resets on consumer spending, debt repayment, and defaults. We find interesting asymmetric responses that cannot be fully explained by the cash-flow channel

of the rate reset. This motivates the discussion of alternative channels. We evaluate a number of possible explanations and provide evidence for the consumer expectations channel using household survey data.

5.1 Consumer Spending

We find that consumers experiencing the largest rate and payment reductions, i.e., 5-year FRM borrowers, increased their durable spending significantly in the expansionary episode. On average, monthly auto spending and spending financed by installment loans rose by $19 and $44, respectively, equivalent to a 16% and an 18% increase relative to the sample mean (Table 6, columns 1 and 3). The results also show that rate resets led some consumers who otherwise would not have spent on these goods to do so. For example, the likelihood of purchasing an automobile increased by 7 bps in a month (column 2), equivalent to a 19% increase from the mean; the likelihood of taking a new installment loan increases by 14 bps in a month (column 4), equivalent to a 15% increase from the mean.[14]

We also address the question of whether these borrowers may have already raised their spending before the reset, and whether their spending was completely reversed after the initial increase. The dynamic responses in Figure 3 show that sharp increases in auto and installment-loan-financed spending occurred in the quarter of the reset. The two types of spending remained high for the next few quarters. In five quarters, total spending reached $400 for automobiles and $500 for that financed by installment loans, suggesting somewhat lasting effects of rate resets on spending.

Before turning to the contractionary episode, we examine spending heterogeneity, focusing on 5-year FRM borrowers. Standard consumption theory predicts that liquidity-constrained borrowers would be more responsive to positive cash flows. On the other hand, since interest savings are not realized immediately but over the course of the new term, difficulties in obtaining new credit may create a hurdle for some consumers who would have borrowed to finance their current spending. Our findings can be summarized into three points (see Table 7). First, while all borrowers increased their spending upon the reset, low-credit-score borrowers were less responsive, suggesting that they may have limited access to new credit or face high borrowing costs. Second, young borrowers are more responsive than other age groups, consistent with the theory. Third, there is no significant heterogeneity across credit utilization, which may be explained by the inability of high-credit-usage borrowers to obtain more credit.

[14] We do not find significant spending responses of borrowers renewing other terms of mortgages. This is not surprising, given that the size of the rate reduction is small for these borrowers.

In the contractionary episode, interestingly, we do not find decreases in spending. In fact, with one exception, spending did not change significantly. The only exception is the change in the likelihood of auto purchases for 2-year FRM borrowers, which is positive, not negative. Nor did spending decrease at longer horizons (5 quarters). Among borrowers with the same type of contract, the only noticeable heterogeneity is that low-credit-score borrowers reduced their spending relative to others, confirming the role of credit market access in explaining spending divergence.

The lack of spending responses in the contractionary episode raises the question of whether our measures of spending are inadequate for capturing overall consumption responses to negative cash flows. This is possible, given that our data only measure durable spending financed by auto or installment loans. However, asymmetric consumption responses have also been documented in other studies using more comprehensive consumption measures. Baugh et al. (2021), for example, using detailed account-level data on spending made by credit cards, debit cards, and checking and savings accounts, find that consumers respond asymmetrically to positive and negative cash flow shocks. Specifically, while consumers increase their consumption upon receiving tax refunds, these same consumers do not cut their spending when making tax payments in other years, regardless of whether these payments are expected or unexpected.[15]

5.2 Revolving Debt Balances

Previous studies have documented debt repayment as an important use of positive cash flows (e.g., Di Maggio et al. (2017), Bhutta and Keys (2016), and Baugh et al. (2021)). Our results in Section 4.2 showed that consumers pay down their mortgage principal faster when resetting to lower rates, in line with these studies. We now examine the responses of the balances on revolving credit, i.e., credit cards and LOCs.

In the expansionary episode, we find that consumers on average paid down their credit card debt by about \$130-\$250 upon the reset (or 3%-6% of the mean balance), as shown in column (6) of Table 6. Deleveraging on credit card debt, however, was completely reversed by rising LOC balances (column 7), and in particular by higher HELOC balances (column 8). The rise in HELOC balances indicates that homeowners extract their home equity in response to lower rates (see Bhutta and Keys (2016)). As a result, the total revolving balance did not change significantly (column 5). Figure 4 shows the dynamic responses of credit card and LOC balances for 2- and 5-year FRM

[15] One may also be concerned that the insignificant estimates are driven by the lack of power of our tests. Recall that we find strongly statistically significant spending responses in the expansionary episode for 5-year FRM borrowers. For the contractionary episode, we apply exactly the same estimation strategy on the sample of a similar size, so the insignificant spending responses in this episode cannot be attributed to a lack of power.

borrowers. Credit card balances fell sharply in the quarter of the reset and stayed roughly flat for the next few quarters, whereas LOC balances rose gradually.

The change in the revolving balance displayed substantial heterogeneity across borrowers. Panel I of Table 8 shows the results for 5-year FRM borrowers (with similar patterns observed for other renewers). Overall, high-credit-score, low-credit-usage and old borrowers deleveraged more. The fact that low-credit-score and high-credit-usage borrowers deleveraged less, sometimes even raising their leverage, suggests that these borrowers may rely more on existing credit to smooth their consumption in response to positive cash flows. This can also be seen from the relatively smaller reduction in their credit utilization rate compared to other borrowers.[16]

Turning to the contractionary episode, our findings for the responses of revolving debt balances to rising mortgage rates and payments are novel to the literature. We find that consumers paid down their credit card debt by about \$210-\$270 upon the reset, equivalent to 5%-6% of the average balance (Table 6, column 6). Unlike in the expansionary episode, credit card deleveraging was not offset by rising LOC balances (column 7). Nor do we observe equity extraction through HELOCs (column 8). Even over longer horizons, LOC balances did not rise (Figure 4, panel b). As a result, the revolving balance fell by \$260-\$900 upon the reset, except for 4-year FRM borrowers who displayed no significant change. Among borrowers with the same type of contract, high-credit-score, low-credit-usage and old borrowers deleveraged more, similar to the patterns observed for the expansionary episode (Table 8).

5.3 Other Channels of Rate Resets

While our results at the consumer level for the expansionary episode support the conventional interpretation of rate resets being cash-flow shocks, the findings for the contractionary episode reveal that other channels are at work in driving consumer responses. This is because, if the cash-flow effect dominates when rates increase, consumers are expected to cut their spending or to raise their debt to smooth the effect of negative cash flows, according to standard consumption theory. In contrast, we find spending unchanged and revolving balances reduced. We consider several potential explanations of this fact and evaluate their plausibility.[17]

[16] Regarding heterogeneity in the age dimension, first, we find that old borrowers deleveraged more than other borrowers on both credit cards and LOCs, consistent with the prediction of life-cycle theory. Second, young borrowers deleveraged less on credit card debt than other borrowers, but more on LOCs than middle-aged borrowers. The second finding may be explained by the fact that young borrowers have high LOC utilization (90%), compared to credit-card utilization (55%).

[17] The fact that rate increases led to higher mortgage payments, that consumer spending was unchanged, and that revolving debt was paid down means that consumers must have reduced their savings to finance these increased payments. We do not observe household assets in our data, but evidence in Baugh et al. (2021) supports this point

First, one may argue that changes in revolving debt balances simply reflect changes in expenditures not captured by our data (e.g. nondurables and services), and that the reduction in these balances means lower consumption. This would support the view that negative cash flows are the main channel through which rate resets affected consumers in the contractionary episode. This explanation, however, is challenged by two facts. First, it cannot explain why consumers who experienced the largest negative cash-flow shocks (i.e., 2-year FRM borrowers) did not deleverage more than borrowers who experienced the smallest cash-flow losses (e.g., 5-year FRM borrowers). Second, it implies that liquidity-constrained borrowers would cut their spending more and hence reduce their debt balances more than other borrowers, which is the opposite to what we find in the data.

Second, lenders may force borrowers to deleverage on revolving debt when borrowers reset their mortgage rates to higher levels, due to the concern that borrowers' repayment ability may be undermined by rising mortgage payments. We test this hypothesis by estimating changes in banks' credit supply to consumers in response to rate resets in the contractionary episode. Columns (1) and (2) of Table 9 show the change in the likelihood of experiencing a more than $1,000 increase in the credit limit. This likelihood did not fall, but increased, for credit card debt and for LOC debt. Columns (3) and (4) show the dollar changes in these credit limits, confirming the patterns in the previous two columns. Lastly, we estimate the change in the required-payment-to-balance ratio, which reflects the interest rate on the debt (especially for interest-only products). We do not observe any significant change in this ratio (columns 5 and 6). To summarize, we do not find supporting evidence for deleveraging driven by the lender-side tightening of credit in the contractionary episode.

Third, we consider a monthly debt-service-ratio hypothesis that predicts that consumers act to maintain a constant debt service ratio, i.e., the ratio of monthly debt service payments over monthly income. Testing this hypothesis is equivalent to testing the hypothesis of constant debt service payments, provided that consumers' monthly income does not change.[18] When mortgage payments rise, for example, the latter hypothesis suggests that consumers pay down their non-mortgage debt to keep their total debt service expenses unchanged. We test this hypothesis by estimating the change in monthly total debt service payments (on mortgages, auto and installment loans, and revolving debt) to the rate reset. The null hypothesis is no change. The results are shown in

by showing that consumers make account transfers, rather than reduce their consumption, in response to net income losses resulting from tax payments.

[18]The two hypotheses are equivalent in our setting because our empirical strategy exploits variation in the timing of the rate reset which is exogenous to changes in consumers' income (e.g., labor, government transfers, etc.).

Appendix Table D3. We find that total monthly payments moved closely with monthly mortgage payments, with the difference mainly driven by payments on revolving debt. In the contractionary episode, in particular, the declines in revolving debt expenses were too small to offset the rising mortgage payments. Hence, we do not find strong support for this hypothesis.

Lastly, we consider an explanation which postulates that, when consumers reset their mortgage rates to higher levels in the contractionary episode, they expect interest rates to increase in the future as well.[19] Since revolving debt often has variable rates, the expectations about rising future rates drive consumers to pay down this type of debt. Our credit panel data do not contain information on expectations, so we employ an alternative dataset for the expectations of representative Canadian consumers to evaluate this hypothesis in Section 5.4.

This expectations channel is closely related to the standard intertemporal-substitution (IS) channel that predicts that consumers pay down their debt (or equivalently, increase their net savings) when the current interest rate rises. The expectations channel generalizes the standard IS channel in two dimensions. First, it links the deleveraging response not only to the current interest rate but also to the expected future interest rates. Second, it does not necessarily imply symmetric interest-rate expectations or symmetric deleveraging responses, consistent with our findings.[20]

5.4 Consumer Expectations

We use the Canadian Survey of Consumer Expectations (CSCE) to evaluate the expectations channel in explaining consumer deleveraging in the contractionary episode. The CSCE data are collected every quarter since 2014Q4 from a nationally representative household sample. The survey asks questions related to households' financial conditions and their expectations about macroeconomic variables. A detailed description of the data, the survey questions underlying our analysis, and key summary statistics can be found in Appendix C.

For comparability with our consumer credit panel data, we restrict the CSCE survey sample to homeowners with mortgages. We establish two sets of results using the CSCE data that jointly

[19] The fact that borrowers holding 2-year FRMs were more likely to switch to longer terms in the contractionary episode than in the expansionary episode suggests that these borrowers may expect rates to rise for an extended period (Appendix Table D1).

[20] These differences are driven by the standard assumption in rational expectations dynamic equilibrium models that interest rates are constant over time. This assumption gives the standard Euler equation: $u^{'}(c_t) = \beta(1 + r)\mathbb{E}_t u^{'}(c_{t+1}) = ... = \beta^T(1 + r)^T\mathbb{E}_t u^{'}(c_{t+T})$. By construction, the expected future rates are equal to the current rate and are symmetric in these models. In contrast, a more general model that relaxes the constant-rate assumption implies the Euler equation: $u^{'}(c_t) = \beta(1+r_t)\mathbb{E}_t u^{'}(c_{t+1}) = ... = \beta^T(1+r_t)\mathbb{E}_t\left[\prod_{j=1}^{T-1}(1 + r_{t+j})u^{'}(c_{t+T})\right]$, which shows that both the current rate and the expectations about future rates matter for the current saving decisions and that expectations may not be symmetric.

support the expectations channel. First, consumers who perceive that interest rates have risen over the past 12 months tend to expect the interest rates to be even higher for an extended period (at least 5 years). Second, in response to their expectations about rising future rates, consumers are more likely to pay down debt, cut spending and save more. These patterns persist in the overall sample and, in particular, in the contrationary episode.

To establish the first fact, we estimate the following fixed-effect linear probability model (LPM) that relates consumers' perception of recent interest rate changes to their expectations of the rate in the next 12 months,

$$ExpectH_{i,t} = \gamma_i + \delta_t + \theta_1 CurrentH_{i,t} + \mathbf{x}_{i,t}\theta_2 + \epsilon_{i,t}, \tag{4}$$

where $ExpectH_{i,t}$ is an indicator equal to 1 if consumer i in quarter t expects the average interest rate to be higher in the next 12 months. $CurrentH_{i,t}$ is an indicator equal to 1 if the consumer perceives that interest rates have risen over the past 12 months. $\mathbf{x}_{i,t}$ is a vector of consumer characteristics (i.e., age, gender, marital status and education). γ_i and δ_t are consumer and time fixed effects. The standard errors are clustered at the consumer level. Column (1) of Table 10 shows that consumers who perceive that interest rates have risen are more likely to expect rates to be higher in the next 12 months.

We next consider expectations at longer horizons. The survey asks consumers about their expected levels of interest rates in one, two and five years, which allows us to construct indicators for the rising path of expected future rates. Specifically, we construct an indicator for expecting rates to rise in the next two years, which equals one if the consumer (i) expects rates to be higher in the next 12 months, and (ii) reports the level of the expected rate in two years greater than the level of the expected rate in one year. Likewise, an indicator for expecting rates to rise in the next five years is constructed, which equals one if the consumer meets conditions (i) and (ii), and reports the level of the expected rate in five years above the level of the expected rate in two years. The results in columns (2) and (3) of Table 10 show that consumers who perceive current rates to have risen are also more likely to expect future rates to increase for an extended period.

To establish the second fact, we take advantage of the survey question that asks consumers about the actions they are taking or plan to take in response to their interest rate expectations, including paying down debt, cutting spending/saving more, postponing major purchases, and bringing forward major purchases. Respondents can choose multiple actions, so we estimate a series of LPMs similar to equation (4) with one action being a dependent variable at a time.

Columns (4) to (7) in Table 10 show that consumers who perceive rates to have risen are more likely to pay down their debt, as well as to cut their spending/save more, providing direct support to the expectations channel in explaining deleveraging in the contractionary episode.

For the expectations channel to explain our earlier results based on the consumer credit panel data, we have to argue that rate resets must have helped consumers to better understand the current interest rate, which then triggers changes in their expectations about future rates. This is not unreasonable, given that mortgage renewals are one of the most important financial decisions for consumers that require their attention. Moreover, interactions with the lender in the process are likely to draw consumers' attention to the current market rate. At other times, consumers are less likely to pay attention to movements in interest rates, as inattention in general is a well known problem in the household finance literature (e.g., Keys et al. (2016), Andersen et al. (2020) and Agarwal et al. (2016)).

We use the CSCE data to provide some evidence for the effect of rate resets on household expectations. Since the survey does not ask questions about mortgage renewal, we use the indicator for having a variable-rate mortgage, $VRM_{i,t}$, as a proxy for frequent rate resets, and the indicator for taking out a new mortgage within the past 12 months, $New_{i,t}$, as a proxy for recent rate resets, to predict the likelihood of (correctly) perceiving the recent trends in interest rates. We estimate the following fixed-effect LPM regression, with the omitted group being FRM borrowers who have taken out the mortgage for more than one year,

$$CurrentH_{i,t} = \gamma_i + \delta_t + \eta_1 VRM_{i,t} + \eta_2 New_{i,t} + \mathbf{x}_{i,t}\eta_3 + \epsilon_{i,t}. \tag{5}$$

The results support our hypothesis. For the contractionary episode, the point estimates, $\hat{\eta}_1 = 0.1$ and $\hat{\eta}_2 = 0.07$ (both strongly statistically significant at the 1% level), imply that borrowers that frequently or recently reset their mortgage rates are more likely to perceive interest rates to have risen. For the expansionary episode, the point estimates, $\hat{\eta}_1 = -0.03$ and $\hat{\eta}_2 = -0.01$, suggest that these borrowers are also more likely to perceive interest rates to have fallen over this episode.

One more piece of evidence supporting the expectations channel is that the average consumer does not seem to have symmetric expectations about future interest rates. Appendix Table C1 shows that, in the contractionary episode, the majority of consumers perceived rates to have risen (76%), and that 81% of these consumers expected rates to be higher in the next year. In contrast, in the expansionary episode, while the majority of consumers perceived rates to have fallen or unchanged (82%), only 49% of them expected rates to be lower or unchanged in the next year.

These patterns suggest that, while expectations played a key role in explaining deleveraging in the contractionary episode, they may not have a symmetric effect on debt accumulation in the expansionary episode, which is consistent with our findings in the credit panel data.

5.5 Mortgage and Consumer Credit Delinquency

Previous studies using U.S. data have found that lower mortgage rates help reduce mortgage defaults, shedding light on the policy design that aims to support households in the aftermath of the global financial crisis.[21] As major economies start to move away from the low policy rate environment, additional research on the impact of rising interest rates on credit defaults is called for.

There has not been a causal-inference based study of this issue, however. One challenge in using U.S. data is that, before the financial crisis, ARM resets in the U.S. almost always led borrowers to increase their monthly payments, and many borrowers responded by refinancing (Fuster and Willen (2017)). This introduces a selection problem, because borrowers in poor credit conditions are unlikely to refinance. Thus, comparing ARM borrowers who end up resetting to higher rates (i.e., who are unable to refinance) with ARM borrowers who are still in the initial rate-fixation periods could overestimate the effect of rate increases on default. In fact, this selection problem poses an identification challenge not only for estimating the effect on default, but also for the spending and savings responses using ARM resets.

Focusing on the Canadian mortgage borrowers allows us to circumvent this problem, as discussed in Section 2.1. The results are shown in Table 11. In the expansionary episode, we find that lower mortgage rates through the reset reduced mortgage delinquencies, especially for 5-year FRM borrowers, in line with studies using U.S. data. We also find that delinquencies on other types of debt fell for these borrowers. However, we do not find that delinquencies change significantly for other renewing borrowers.

In the contractionary episode, we do not find that delinquencies increase for borrowers resetting their rates to higher levels. This is consistent with our earlier finding that consumers deleveraged on revolving debt over this period. It may seem surprising that higher mortgage payments did not cause rising delinquencies. One explanation is that strict lending standards in Canada ensure borrowers' resilience to negative cash-flow shocks ex post. For mortgages, for example, the regulatory and supervisory framework has successfully kept mortgage delinquencies at very low levels even during

[21] See, e.g., Tracy and Wright (2016), Fuster and Willen (2017), Ehrlich and Perry (2017), Agarwal et al. (2017), Ganong and Noel (2020), Karamon et al. (2017), and Abel and Fuster (2021).

the global financial crisis, with the highest arrears rate being only 0.45% in January 2011 according to the Canadian Bankers Association. After the global financial crisis, the government tightened mortgage qualification rules, further pushing down the delinquency rate. Another explanation is the high expected cost of default. For example, almost all mortgages in Canada have recourse provisions (Crawford et al. (2013)).

The Canadian consumer credit market also faces tight lending standards. The subprime loans have been a very small segment of the market, effectively reducing delinquencies on auto loans and credit cards, for example. Moreover, the prevalent use of HELOCs as consumer credit means that this credit is secured by properties, lowering the overall delinquency rate.

In both episodes, we find that the average credit score increased upon the reset across all contract types. This is consistent with our findings that (i) in the expansionary episode, borrowers who reset their rates paid down mortgage debt, and (ii) in the contractionary episode, borrowers who reset their rates paid down revolving debt.

6 Aggregate Effects of Mortgage Rate Resets

Given our micro-level analysis, we expect mortgage rate resets to generate sizeable effects on aggregate spending when borrowers reset their rates to lower levels, and to contribute to aggregate savings when borrowers experience rate increases. Since our credit panel data are representative of Canadian borrowers, we are able to estimate the aggregate effects on spending and savings.

Specifically, the effect of rate resets on aggregate spending or savings at time t can be computed by integrating the corresponding effects across borrowers with different types of FRMs who renew their mortgages at t,

$$\sum_{D} \Delta R_t^D \times \epsilon_t^D \times \phi_t(D), \tag{6}$$

where D denotes the pre-renewal mortgage term. ΔR_t^D is the average change in the mortgage rate upon the reset for borrowers with term-D FRMs. ϵ_t^D is the interest rate semi-elasticity, i.e., the change in spending or savings for a 100-bp change in the mortgage rate. $\phi_t(D)$ is the total number of borrowers who renew their term-D FRMs at t. We next describe how this formula is computed for each category: (i) auto spending, (ii) durable consumption, (iii) mortgage pay-down, and (iv) revolving debt pay-down. A summary of these aggregate effects can be found in Table 12.

Aggregate effect on auto spending. We estimate that the total increase in auto spending caused by rate resets in the expansionary episode (2015m1-2017m1) was $2.02 billion, equivalent

to 1.53% of the Canadian aggregate new auto sales over this period. This spending estimate is obtained as follows. ΔR_t^D is set to the corresponding rate change in Table 3 (column 1, panel I). The interest rate semi-elasticity of auto spending, ϵ_t^D, is set to \$1,380 for all borrowers.[22] $\phi_t(D)$ is estimated using Census data on the total number of mortgages in Canada, multiplied by the share of term-D FRMs, further multiplied by the fraction of renewers among term-D FRM borrowers. We estimate this effect for 2-, 3-, 4- and 5-year FRM borrowers, add these effects together, and divide this sum by 95% to reflect the share of these four products in the Canadian FRM market.

We also estimate a lower bound for the aggregate auto-spending effect, which is solely based on the effect of 5-year FRM renewals, setting the effects of all other renewals to zero. This gives an increase in aggregate auto spending of \$1.55 billion, or 1.17% of Canadian aggregate new auto sales over this period. For the contractionary episode, since we do not find a significant causal change in auto spending at the micro level, the estimated aggregate effect is zero.

Aggregate effect on durable consumption. A similar calculation is used for the effect on aggregate durable consumption. The only difference is the calibration of ϵ_t^D, which is set to \$942.[23] We estimate that the total increase in durable consumption caused by rate resets in the expansionary episode (2015m1-2017m1) was \$1.38 billion, equivalent to 0.42% of Canadian aggregate durable expenditures over this period. The aggregate effect of 5-year FRM renewals, which may be viewed as the lower bound for this effect, was \$1.06 billion (0.32% of aggregate durable expenditures). For the contractionary episode, the aggregate effect was zero, given that no causal evidence was found for a change in durable expenditures financed by installment loans at the micro level.

Aggregate effect on mortgage pay-down. As shown in Section 4, in the expansionary episode, borrowers used part of their monthly interest savings to pay down their mortgage faster. Here we assess the total mortgage principal paid down over the lengths of borrowers' new contracts upon the resets. For each term D, we multiply the difference between the required and scheduled payments (Table 3) by the length of the new term (assumed to be D). The aggregation is similar to that for estimating aggregate spending. We estimate that \$3.56 billion of mortgage debt was paid down in borrowers' new terms due to the resets in the expansionary episode. Most of this effect came from the contribution of 5-year FRM borrowers, who paid down \$2.71 billion of mortgage debt in their

[22] This semi-elasticity is computed using the estimated monthly increase in auto spending of 5-year FRM borrowers (\$18.56) multiplied by 84 to reflect the length of auto loans (usually 7 years), further divided by the rate change of 5-year FRM borrowers upon the reset (113 bps) for normalization.

[23] This semi-elasticity is computed using the estimated monthly increase in spending financed by installment loans of 5-year FRM borrowers (\$44.36) multiplied by 24 to reflect non-auto durable consumption in 2015m1-2017m1, further divided by the rate change of 5-year FRM borrowers upon the reset (113 bps) for normalization.

new 5-year term. The aggregate mortgage principal paid down due to resets in the contractionary episode was much smaller, about $0.4 billion at most.

Aggregate effect on revolving debt pay-down. We apply formula (6) to estimate this effect. ΔR_t^D and $\phi_t(D)$ are calibrated similarly as before. ϵ_t^D is term-specific, set to the corresponding change in total revolving debt (Table 6, column 5) divided by the change in the mortgage rate (Table 3, column 1) for normalization. The aggregation shows that, in the contractionary episode, $693 million of revolving debt was paid down, accounting for 1.72% of aggregate saving over this period. The contribution from 5-year FRM renewing borrowers was relatively small, about $300 million, as deleveraging was across the board (except for 4-year FRM renewers). Since we do not find significant change in revolving debt upon the reset in the expansionary episode, the aggregate effect was zero for that episode.

Time variation in aggregate effects and policy implications. Formula (6) suggests that the aggregate effect of rate resets may vary over time due to the change in the rate upon the reset, ΔR_t^D, even though the interest rate semi-elasticity, ϵ_t^D, and the distribution of borrower types, $\phi_t(D)$, are stable over time. The Canadian interest rates have been declining since the global financial crisis, so there were other periods when borrowers experienced sizeable rate changes upon the reset. It is useful to understand the effects of rate rates in the historical context. To this end, we extend our analysis from the two recent episodes to the entire period for which the credit panel data are available and apply formula (6) at the monthly frequency.

Panel (a) of Figure 12 shows the change in the mortgage rate for 5-year FRM borrowers upon the reset, which displays substantial time variation. The largest decline occurred around December 2012, about 250 bps. These borrowers previously reset their rates in late 2007, right before the Bank of Canada slashed the policy rate in response to the global financial crisis. This sharp decline in the mortgage rate led to substantial aggregate spending effects, as shown in panels (b) and (c). For example, total spending on automobiles increased by about $180 million in December 2012, accounting for almost 6% of the Canadian aggregate new auto sales in that month. Similar patterns are observed for durable consumption.

These patterns are consistent with those in the related studies: Mortgage borrowers resetting their rates after the global financial crisis through adjustable-rate mortgages in the U.S. (Di Maggio et al. (2017)) or through variable-rate mortgages in Australia (La Cava et al. (2016)) experienced substantial consumption growth. Our analysis also suggests that, as countries have been staying

in the low-policy-rate environment for a long time since the financial crisis, and as the room for cutting the conventional policy rate becomes constrained, the reduction in the mortgage rate for borrowers who experience resets may be limited, weakening the potency of the rate-reset channel of monetary policy (Berger et al. (2021)).

7 Further Evidence and Robustness Analysis

This section provides additional analysis and robustness checks that support our findings in Sections 4 and 5. They help address a number of potential concerns arising from the switching of terms, issues with the baseline identification strategy, the anticipation effects, and institutional features of the Canadian mortgage market.

Switching of terms. As discussed in Section 2.1, some borrowers switch to a different term length during the renewal, while others stay with the same length as in the previous contract. For the baseline estimates, we do not restrict the term length to be the same before and after the reset. Thus, these estimates capture the average effects across all post-renewal terms. One concern is that if borrowers with shorter-term FRMs systematically switch to longer-term FRMs at the renewal or vice versa, our baseline estimates of rate changes, for example, would be confounded by the rate spreads between different types of mortgages. As shown in Table 2, the mortgage rate is increasing in the mortgage term.

To address this concern, we redo the analysis in Sections 4 and 5 with the sample that restricts the term length to be the same before and after the reset. Table D5 shows the results. As expected, the rate reduction for 2-year FRM borrowers is larger than the baseline in the expansionary episode, and the rate increase is smaller in the contractionary episode. Changes in rates for other FRM borrowers are similar to the baseline estimates. The responses of payment choices, consumption and debt repayment are similar to the baseline estimates. For example, borrowers use part of their interest savings to pay down mortgage debt in the expansionary episode. In addition, 5-year FRM borrowers increase their spending when rates decline. Spending does not change when rates increase. We also see that borrowers deleverage on revolving debt in the contractionary episode and find no evidence of rising delinquencies.

Difference-in-difference (DID) estimates. As discussed in Section 3, one concern with our baseline strategy is the inability to account for the mortgage-age effect that could confound the effect of rate resets. To address this concern, we employ a DID design with the control group being 7- and 10-year FRMs previously reset at the same time as the FRMs in our baseline sample.

Table D6 shows the results using this approach. At the loan level, it confirms that mortgages reset in the two episodes experienced substantial changes in rates and payments with the magnitudes varying with the pre-renewal term. The asymmetric mortgage prepayment choices are preserved as in Section 4.2. The consumer-level responses of spending, debt repayment and delinquencies are quantitatively similar to the baseline estimates. The only noticeable difference is that, in the expansionary episode, deleveraging appears on both credit card debt and LOC debt.

The main reason why we do not use this alternative specification as the baseline strategy is that the size of the control group is small, as not many Canadian borrowers take longer-term FRMs. In the data, 7- and 10-year FRMs account for only 2% of the mortgage stock. In addition, one might be concerned about the endogenous selection into these mortgage products. For these reasons, we estimate a second DID specification with the control group being FRMs that had the same terms as the treatment group but were not renewed in the two episodes. As shown in Table D7, these DID estimates are similar to the baseline estimates and to the first set of DID estimates. One caveat of the second DID approach is that we are unable to obtain a control group for 2-year FRMs, because all existing 2-year FRMs would be renewed in a 2-year episode.

Anticipation effects. An interesting question is whether the consumer-level responses in Section 5 should be interpreted as the responses to anticipated mortgage rate changes. Economic theory suggests that unconstrained, rational-expectations consumers respond to the news of the shock, not the anticipated realizations of the shock. It is possible that consumers may have already anticipated the change in their mortgage rates before the actual reset. If this is true and if consumers are not liquidity constrained, in the expansionary episode, we would see a jump in their spending before the actual reset. This is not what we see in the data, however. Spending increased only when consumers actually reset their rates. One may argue that this is due to the presence of the liquidity constraint that prevents consumers from reacting before the cash flow arrives. This is unlikely, because liquidity-constrained consumers only account for a small fraction of the population.

Another way of assessing the importance of the anticipation effect is to compare consumers' responses in a period when mortgage rate changes are unexpected to the responses in a period when rate changes are of similar sizes but more likely to be anticipated. The monetary policy rate

cut in January 2015 was widely considered as a surprise to the market.[24] We therefore compare the responses of borrowers who renewed their mortgages in 2015Q1 to the responses of borrowers who renewed their mortgages in 2015Q2. Our premise is that, if the anticipation effect is important, borrowers in the former group should have stronger responses than in the latter group. We do not find significantly different responses across the two groups of borrowers. This pattern holds even when we compare borrowers who who renewed their mortgages in February 2015 to those who renewed their mortgages in March 2015. These results suggest that anticipation effects, if they exist, are weak and are unlikely to alter our estimates.[25]

Ahead-of-schedule renewals. As shown in Figure 2, about 50% of borrowers renew their mortgages earlier than scheduled. This raises the question of whether on-time renewals and ahead-of-schedule renewals result in different responses to the same shock. We perform additional analysis to address this question. First, we restrict the sample to borrowers who renew their contracts on time and estimate their responses to rate resets. The results are similar to the baseline estimates. Second, we interact the post-renewal indicator with a set of dummies that indicate the months ahead of the scheduled renewal. Again, we do not find different responses of borrowers making ahead-of-schedule renewals. We do find, however, that the mortgage rates from early renewals are slightly lower than on-time renewals, but the differences are small compared to the overall rate changes.

Mortgages renewed in both episodes. When assessing the asymmetric effects of rate resets, we would ideally focus on the same borrowers who experienced resets in both episodes. Due to the timing of the two episodes, we only observe a subset of 2- and 3-year FRM borrowers who experienced resets in both episodes. None of the 4- or 5-year FRM borrowers in our sample had two resets with one in each episode. Nevertheless, we perform a robustness check using the sample of the 2- and 3-year FRM borrowers who experience both resets. In unreported results, we show that the loan-level and consumer-level responses are very similar to those in Table D5.

[24] Although the monetary policy statement makes it explicit that the decision was in response to the sharp drop in oil prices, the decision, when it came, was unexpected by many observers. In fact, the market had been predicting a rate increase later that year. See, for example, Shecter (2015), "Bank of Canada's surprise rate cut seen hurting Canadian banks' profits," *Financial Post*, January 21, 2015; "Bank of Canada shocks markets with cut in key interest rate," *CBC Business News*, January 21, 2015.

[25] This finding may be explained by consumers' inattention to movements in interest rates or the uncertainty about the realizations of the mortgage rate change.

8 Conclusion

One of the most important channels through which monetary policy affects the real economy is changes in mortgage rates. This channel is particularly relevant for policymakers in countries dominated by variable-rate mortgages, adjustable-rate mortgages and Canadian-type fixed-rate mortgages, as changes in the policy rate in these countries are passed through automatically to most homeowners, affecting their consumption and savings.

We study the effects of mortgage rate changes driven by monetary policy shifts on consumer spending, debt repayment, and defaults in Canada, taking advantage of the institutional features of the Canadian mortgage market. This setting facilitates the design of a clean identification strategy for causal inference. In addition, the high-quality consumer credit panel data allow us to examine changes in a consumer's entire credit portfolio at a monthly frequency. Most importantly, we are able to provide a detailed analysis of how consumers respond to rate increases and decreases.

Our findings for the expansionary episode, while new, are broadly in line with those using data from other countries. Consumers increase durable spending, pay down mortgage debt, and reduce the likelihood of being delinquent. In the cross-section, liquidity-constrained borrowers obtain more cash from their interest savings, but their ability to use debt to finance durable spending is limited by their access to new credit. Since cash flows resulting from lower mortgage payments are realized over the course of several years, the difficulty in accessing credit markets may dampen the immediate effect of monetary stimulus on consumer spending.

Our findings for the contractionary episode call into question the conventional wisdom. Specifically, we do not find that durable spending decreases when mortgage rates increase. This implies that consumers either dissave to maintain their consumption or cut other types of spending. We also document a robust pattern that consumers lower, rather than increase, their revolving debt level, which cannot be reconciled with the cash-flow interpretation of rate resets. We provide evidence that this pattern is explained by changes in expectations about future rates. Finally, we do not see rising delinquencies or tightening of credit supply for borrowers who reset their rates to higher levels.

Our analysis of the contractionary episode suggests that mortgage rate resets do not appear to discourage durable spending, render consumers more leveraged or increase the likelihood of defaults, as commonly asserted in the financial press. Of course, our paper examines only one aspect of mortgage rate changes, namely, the resets experienced by existing homeowners. There are other

channels through which mortgage rate changes may affect households, for example, home sales and house prices, wealth effects resulting from changing asset prices, and home equity extraction. We leave these issues for future research.

The Canadian-type short-term FRMs we focus on are quite common in other OECD countries. Previous studies of the relationship between mortgage payments and consumer behavior have largely relied on data from the U.S.. It is unclear whether the U.S. evidence can be generalized to other countries. The U.S. is unique in having an unusually high share of long-term FRMs, the extensive use of securitization in housing finance, and the absence of prepayment penalties (see Lea (2010)). Although our estimates may depend on the choice of the episodes and the Canadian socio-economic conditions, our qualitative insights should apply more broadly to other countries.

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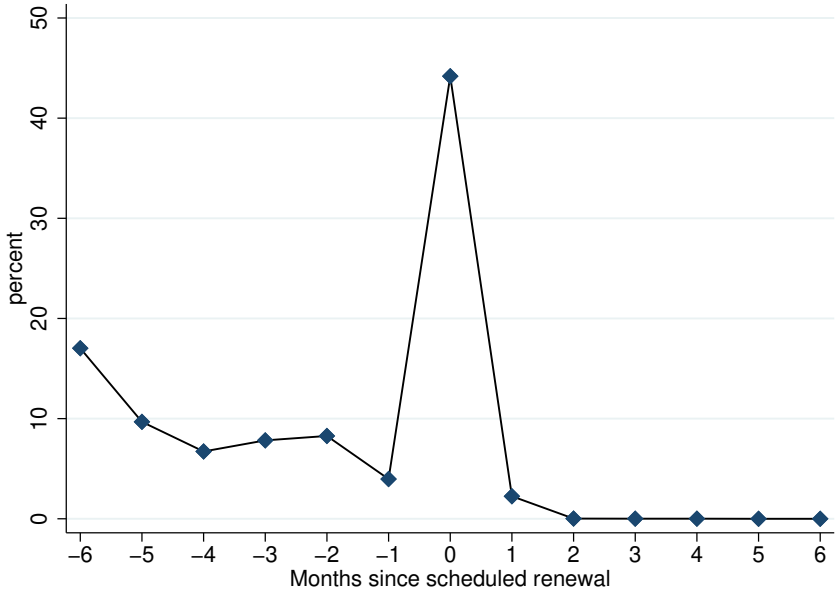
Figure 1: Bank of Canada policy rate (overnight target rate)

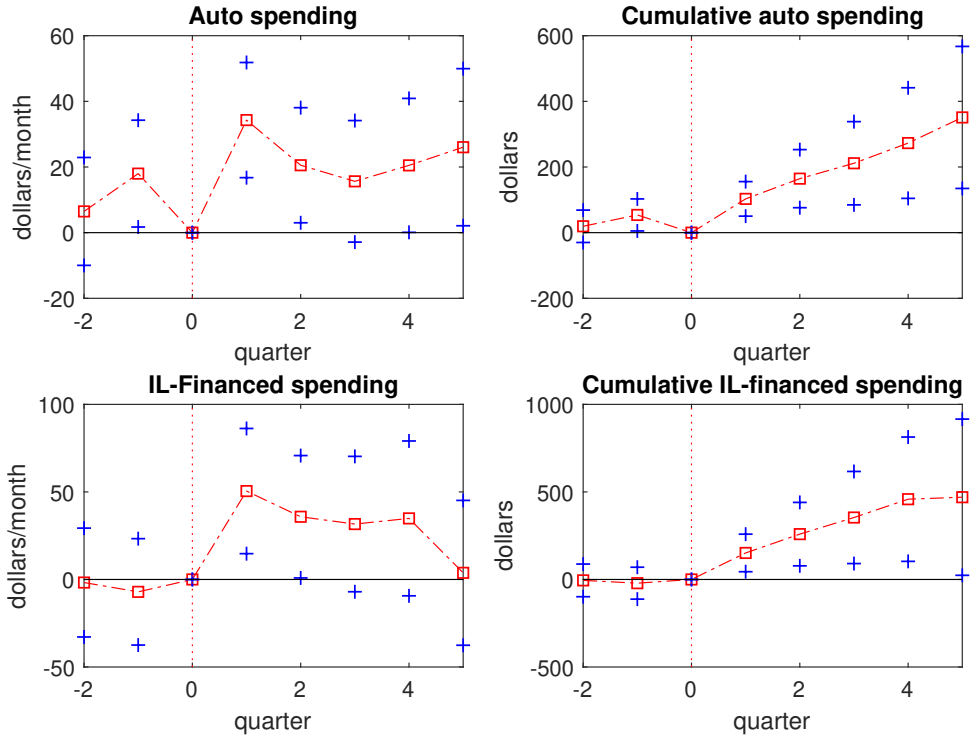
Source: Bank of Canada. The overnight rate is the interest rate at which major financial institutions borrow and lend one-day (or "overnight") funds among themselves. The Bank of Canada sets a target level for that rate, often referred to as the Bank's policy rate. The first vertical line indicates the beginning of our micro data. The other two lines indicate the beginning of the two episodes in our study, 2015m1 and 2017m7.

Figure 2: Distribution of the timing of mortgage renewal



Notes: This figure plots the fraction of borrowers who renew their mortgages x months after the scheduled renewal, where $x = 0$ refers to on-time renewal.

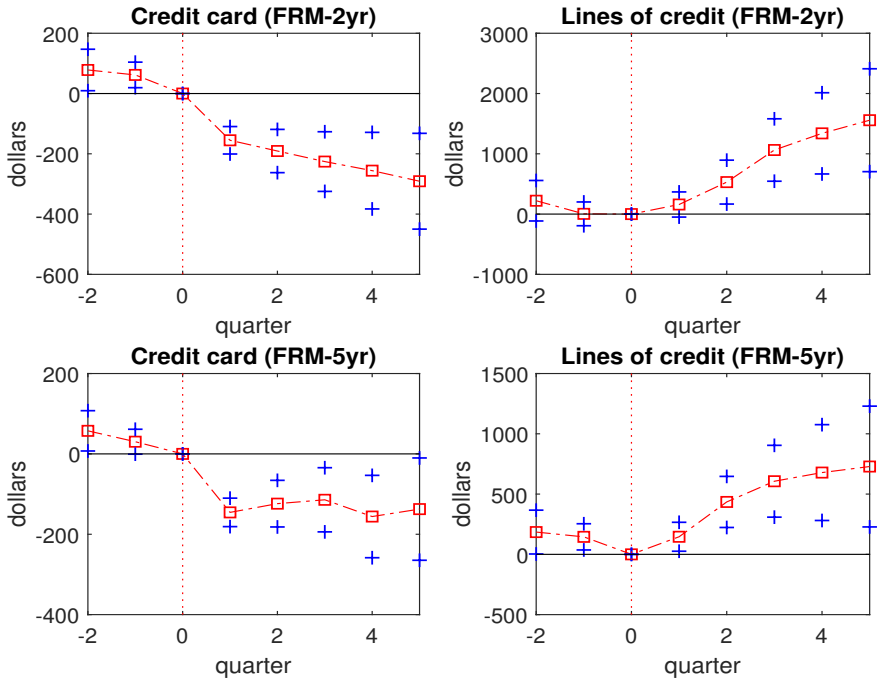
Figure 3: Spending responses of 5-year FRM borrowers around the reset in the expansionary episode



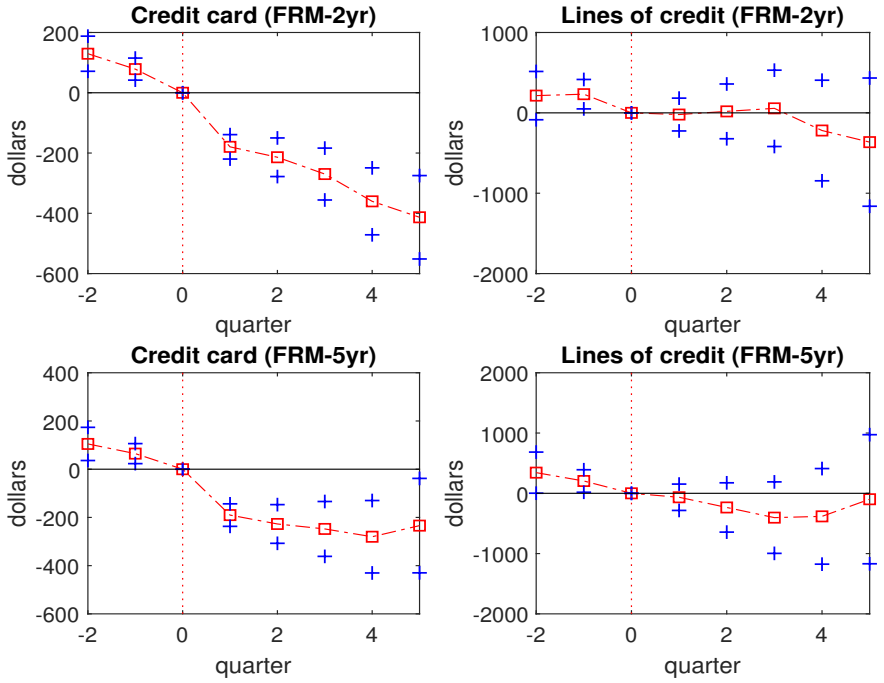
Notes: Point estimates and 95% confidence intervals obtained by estimating equation (2) for 5-year FRM borrowers in the expansionary episode. The left column shows the dynamic responses of monthly auto spending and monthly spending financed by installment loans (IL) to rate resets. The right column shows the dynamic responses of cumulative spending.

Figure 4: Responses of revolving debt balances around the reset

(a) Expansionary episode



(b) Contractionary episode

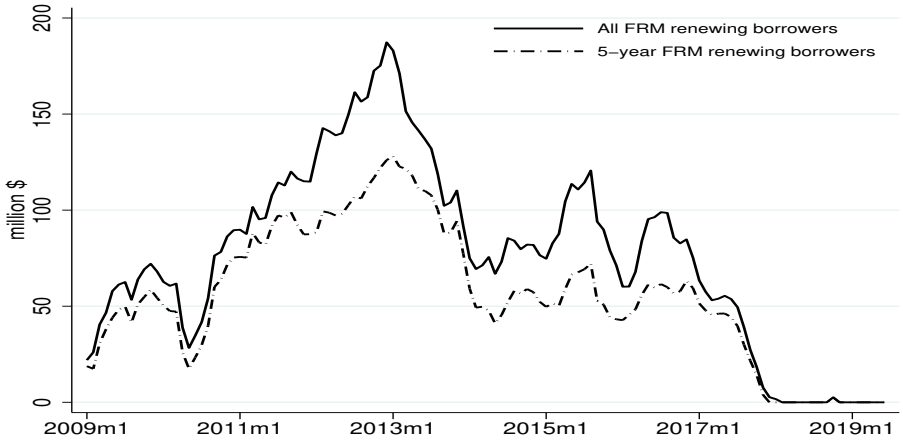


Notes: Point estimates and 95% confidence intervals obtained by estimating equation (2) for 2-year and 5-year FRM borrowers in the expansionary (panel a) and contractionary episode (panel b).

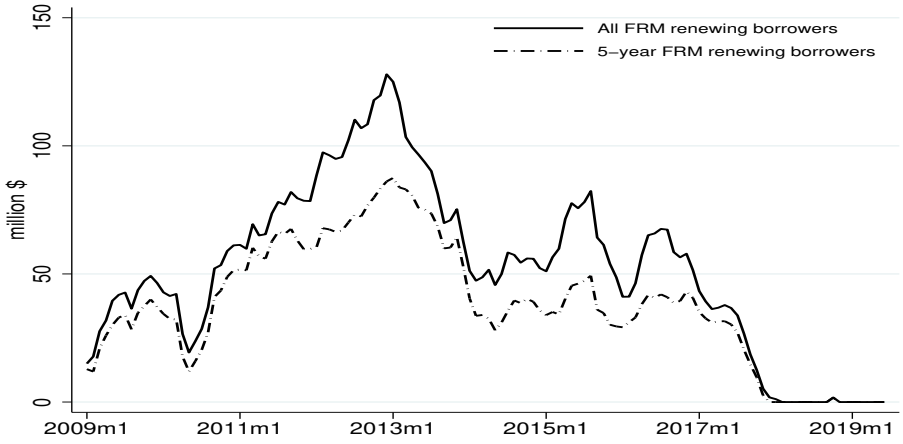
Figure 5: Mortgage rate resets and aggregate spending effects, 2009-1019

(a) Average change in the mortgage rate upon the reset, 5-year FRM borrowers

(b) Effect of rate resets on aggregate auto spending



(c) Effect of rate resets on aggregate durable consumption



Notes: Panel (a) depicts the average change in the mortgage rate experienced by 5-year FRM borrowers who renewed their contracts in a given month. Panels (b) and (c) plot the estimated aggregate spending effects using the methodology described in Section 6.

Table 1: Mortgage characteristics at origination

	Bank of the sample		Other lenders	
	Mean	Median	Mean	Median
All FRMs				
Market share (%)	18	-	82	-
Contract rate (%)	2.89	2.84	2.90	2.79
Outstanding balance ($)	289,766	248,541	302,050	255,745
LTV ratio (%)	78.6	80.0	77.9	80.0
DTI ratio (%)	329.0	302.1	334.8	296.8
Credit score	768	771	756	763
Borrower age	42.5	41.0	41.9	40.0
Fraction of insured mortgages (%)	33.1	-	35.9	-
Fraction of FRM-5yr (%)	64.1	-	58.0	-
FRM-5yr				
Market share (%)	19	-	81	-
Contract rate (%)	2.90	2.82	2.88	2.79
Outstanding balance ($)	307,691	266,540	291,600	255,272
LTV ratio (%)	80.0	80.5	80.7	80.0
DTI ratio (%)	352.3	332.3	340.7	313.9
Credit score	765	768	756	762
Borrower age	41.4	39.0	41.0	39.0
Fraction of insured mortgages (%)	38.5	-	45.4	-

Source: Bank of Canada-OSFI mortgage originations dataset. This table shows the characteristics of the mortgages originated by the bank of our sample and by all other federally regulated lenders between 2014 and 2018 for the purpose of home purchases.

Table 2: Summary statistics

	FRM-2yr		FRM-3yr		FRM-4yr		FRM-5yr	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel I: FRMs renewed in 2015m1-2017m1								
Current balance ($)	160,192	131,466	166,744	128,491	181,191	125,649	169,687	119,397
Mortgage rate (%)	2.55	0.34	2.66	0.33	2.79	0.34	3.58	0.69
Scheduled payment ($/month)	950	626	987	610	1,070	604	995	585
Number of loans	23,023		17,105		7,251		40,949	
Corresponding consumers								
Age	51.31	12.82	50.51	12.83	49.70	12.68	48.34	13.00
Credit score	770	103	767	104	776	100	749	113
Credit utilization rate	0.37	0.35	0.37	0.35	0.34	0.33	0.44	0.36
Auto spending ($/month)	121	2,186	123	2,179	127	2,227	114	2,078
Prob. of an auto purchase (%)	0.38	6.15	0.40	6.28	0.41	6.37	0.38	6.15
Installment loan-financed spending ($/month)	237	3,797	222	3,650	212	3,320	240	3,486
Prob. of an installment loan origination (%)	0.86	9.25	0.83	9.09	0.80	8.90	0.97	9.79
Credit card balance ($)	4,195	6,910	4,279	7,001	4,117	6,849	4,215	6,831
Lines of credit balance ($)	19,179	38,836	18,559	37,841	17,612	36,238	14,601	29,649
60-day mortgage delinquency rate (‰)	0.74	27.2	0.90	30.0	0.83	28.3	1.87	43.2
60-day auto loan delinquency rate (‰)	0.15	12.1	0.09	9.5	0.08	8.9	0.16	12.5
60-day installment loan delinquency rate (‰)	0.32	18.0	0.36	19.0	0.30	17.2	0.66	25.8
60-day credit card delinquency rate (‰)	3.23	56.7	3.52	59.3	2.87	53.5	4.70	68.4
60-day lines of credit delinquency rate (‰)	0.84	28.9	0.98	31.2	0.83	28.8	1.12	33.4
Panel II: FRMs renewed in 2017m7-2019m6								
Current balance ($)	195,534	209,237	162,626	117,453	155,373	104,203	199,594	132,347
Mortgage rate (%)	2.51	0.49	2.66	0.42	2.83	0.32	3.12	0.38
Scheduled payment ($/month)	1,059	938	968	597	947	529	1,141	642
Number of loans	30,606		7,056		16,476		31,238	
Corresponding consumers								
Age	51.91	13.17	51.79	12.95	51.64	14.41	49.14	13.10
Credit score	767	106	761	110	766	106	759	110
Credit utilization rate	0.37	0.35	0.39	0.35	0.40	0.35	0.40	0.35
Auto spending ($/month)	152	2,592	131	2,352	122	2,335	121	2,268
Prob. of an auto purchase (%)	0.44	6.65	0.39	6.26	0.36	6.01	0.37	6.07
Installment loan-financed spending ($/month)	300	5,775	265	4,128	277	4,116	277	4,442
Prob. of an installment loan origination (%)	0.99	9.89	0.95	9.70	0.98	9.87	1.01	10.02
Credit card balance ($)	4,587	7,333	4,593	7,281	4,416	7,154	4,799	7,484
Lines of credit balance ($)	20,802	44,112	19,377	40,181	18,863	37,361	18,045	39,517
60-day mortgage delinquency rate (‰)	0.59	24.3	0.91	30.2	0.77	27.7	1.29	36.0
60-day auto loan delinquency rate (‰)	0.16	12.5	0.14	11.8	0.13	11.2	0.16	12.7
60-day installment loan delinquency rate (‰)	0.46	21.4	0.49	22.1	0.48	21.9	0.54	23.3
60-day credit card delinquency rate (‰)	3.16	56.1	3.26	57.0	3.42	58.3	4.16	64.4
60-day lines of credit delinquency rate (‰)	0.63	25.0	0.73	27.0	0.76	27.5	0.82	28.7

Source: TransUnion Canada account-level data.

Table 3: Mortgage loan-level adjustments upon the reset

	Mortgage rate (p.p.) (1)	Required payment ($/month) (2)	Scheduled payment ($/month) (3)	Amortization (months) (4)
Panel I: Expansionary episode				
FRM-5yr				
PostRenew	-1.13***	-92.03***	-46.47***	-13.97***
	(0.004)	(0.55)	(0.64)	(0.20)
FRM-4yr				
PostRenew	-0.38***	-34.17***	-9.90***	-6.05***
	(0.007)	(0.82)	(1.85)	(0.36)
FRM-3yr				
PostRenew	-0.18***	-13.91***	-2.19	-4.44***
	(0.004)	(0.51)	(1.17)	(0.21)
FRM-2yr				
PostRenew	-0.16***	-14.74***	-1.76**	-4.87***
	(0.003)	(0.38)	(0.88)	(0.18)
Panel II: Contractionary episode				
FRM-5yr				
PostRenew	0.32***	34.00***	39.23***	-1.64***
	(0.003)	(0.45)	(0.73)	(0.11)
FRM-4yr				
PostRenew	0.49***	36.29***	40.37***	-1.09***
	(0.003)	(0.34)	(0.77)	(0.13)
FRM-3yr				
PostRenew	0.70***	54.98***	49.49***	0.66***
	(0.006)	(0.77)	(1.31)	(0.24)
FRM-2yr				
PostRenew	0.85***	83.33***	84.49***	-1.38***
	(0.003)	(0.66)	(0.81)	(0.12)

Notes: Each cell presents the results from estimating one regression using equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the loan level. All regressions include a set of control variables (see Section 3), month fixed effects, and loan fixed effects.

Table 4: Estimated cash flows from the rate reset

	Panel I: Expansionary episode			*Panel II: Contractionary episode*		
	Remaining months	Interest savings ($)	Amortization-adjusted interest savings ($)	Remaining months	Interest savings ($)	Amortization-adjusted interest savings ($)
FRM-5yr	227	+20,891	+23,925	208	-7,072	-6,242
FRM-4yr	208	+7,107	+8,485	197	-7,149	-6,889
FRM-3yr	209	+2,907	+4,830	205	-11,271	-11,904
FRM-2yr	219	+3,228	+4,998	230	-19,165	-17,880

Notes: The first column in each panel shows the remaining time for paying off the mortgage before the reset. The second column in each panel shows the unadjusted total interest savings from the rate reset (obtained by multiplying the change in the required monthly payment by the remaining months). The third column in each panel shows the total interest savings adjusted for the change in the amortization.

Table 5: Heterogeneity in the mortgage payment choice (expansionary episode)

	Required payment	Scheduled payment	Realization rate (%)	Required payment	Scheduled payment	Realization rate (%)	Required payment	Scheduled payment	Realization rate (%)
FRM-5yr									
PostRenew	-82.24***	-30.02***	36.5	-82.11***	-29.94***	36.5	-83.11***	-39.30***	47.3
	(0.63)	(1.07)		(0.62)	(1.05)		(0.67)	(1.07)	
PostRenew ×LowScore	-14.09***	-32.90***	65.3						
	(0.92)	(1.44)							
PostRenew ×HighUse				-16.18***	-36.53***	67.6			
				(0.95)	(1.46)				
PostRenew ×Young							-23.83***	-21.40***	56.8
							(1.00)	(1.55)	
PostRenew ×Old							22.87***	3.92**	58.7
							(1.15)	(1.90)	
FRM-4yr									
PostRenew	-35.18***	-8.33***	23.7	-34.98***	-7.53***	21.5	-32.37***	-6.90***	21.3
	(0.77)	(2.24)		(0.77)	(2.16)		(0.91)	(2.17)	
PostRenew ×LowScore	2.60**	-4.20	38.5						
	(1.28)	(2.77)							
PostRenew ×HighUse				3.14**	-8.68***	50.9			
				(1.38)	(2.84)				
PostRenew ×Young							-7.09***	-6.92**	35.0
							(1.41)	(3.00)	
PostRenew ×Old							5.15***	-7.19	51.8
							(1.50)	(3.98)	

Notes: LowScore refers to borrowers whose average credit score in the previous 12 months is below the median of the distribution. HighUse refers to borrowers whose average credit utilization rate in the previous 12 months is greater than 0.5. Young and old borrowers refer to ages below 45 and ages above 65, respectively. The realization rate is obtained by dividing the change in the scheduled monthly payment by the change in the required monthly payment.

Table 6: Responses of spending and revolving debt balances

	Auto spending ($/m) (1)	Auto purchase prob. (%) (2)	IL-Financed spending ($/m) (3)	IL-Financed purchase prob. (%) (4)	Tot revolving debt ($) (5)	Credit card debt ($) (6)	LOC debt ($) (7)	HELOC debt ($) (8)
Panel I: Expansionary episode								
FRM-5yr								
PostRenew	18.56***	0.073***	44.36***	0.141***	101.31	-160.90***	251.98**	449.60***
	(6.09)	(0.017)	(12.03)	(0.029)	(124.59)	(32.54)	(120.79)	(104.53)
FRM-4yr								
PostRenew	-21.53	-0.053	19.83	0.111	193.69	-133.00**	247.81	501.49
	(19.61)	(0.054)	(30.63)	(0.084)	(352.90)	(65.79)	(353.62)	(306.57)
FRM-3yr								
PostRenew	13.81	0.036	30.25	0.051	-329.1	-247.60***	3.22	155.89
	(10.29)	(0.029)	(17.55)	(0.043)	(191.67)	(38.99)	(188.11)	(164.79)
FRM-2yr								
PostRenew	-4.24	-0.008	33.88	0.088**	49.02	-167.40***	246.69**	138.14
	(10.30)	(0.029)	(20.20)	(0.044)	(124.86)	(25.78)	(123.34)	(112.42)
Panel II: Contractionary episode								
FRM-5yr								
PostRenew	7.09	0.024	22.36	0.036	-438.20**	-246.90***	-278.80	-37.03
	(8.34)	(0.022)	(15.55)	(0.035)	(213.42)	(40.73)	(210.50)	(186.23)
FRM-4yr								
PostRenew	6.34	-0.002	11.77	0.079	167.26	-247.60***	428.15	193.13
	(12.57)	(0.033)	(23.68)	(0.056)	(226.53)	(48.94)	(220.17)	(199.38)
FRM-3yr								
PostRenew	16.90	0.048	41.46	0.087	-900.70***	-273.90***	-596.50	-238.13
	(18.57)	(0.049)	(28.89)	(0.075)	(323.86)	(64.12)	(312.23)	(277.38)
FRM-2yr								
PostRenew	20.52	0.066**	44.59	0.068	-261.60**	-213.30***	-44.50	196.35
	(10.73)	(0.027)	(23.73)	(0.040)	(133.72)	(24.36)	(131.97)	(121.76)

Notes: Each cell presents the results from estimating one regression using equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the consumer level. All regressions include a set of control variables (see Section 3), month fixed effects, and consumer fixed effects.

Table 7: Heterogeneity in the spending responses (expansionary episode, FRM-5yr)

	Auto spending ($/m)	IL-Financed spending ($/m)	Auto spending ($/m)	IL-Financed spending ($/m)	Auto spending ($/m)	IL-Financed spending ($/m)
PostRenew	24.69***	73.24**	17.67***	31.88**	15.55**	32.95**
	(6.64)	(14.34)	(6.73)	(12.81)	(6.87)	(13.82)
PostRenew	-11.21	-49.29***				
×LowScore	(6.64)	(12.73)				
PostRenew			-1.75	16.39		
×HighUse			(7.10)	(12.85)		
PostRenew					7.04	42.72***
×Young					(7.69)	(14.36)
PostRenew					-4.79	-29.16**
×Old					(7.85)	(14.67)

Notes: LowScore refers to borrowers whose average credit score in the previous 12 months is below the median of the distribution. HighUse refers to borrowers whose average credit utilization rate in the previous 12 months is greater than 0.5. Young and old borrowers refer to ages below 45 and ages above 65, respectively.

Table 8: Heterogeneity in the responses of revolving debt balances

	Revolving ($)	CC ($)	LOC ($)	Credit Utilization	Revolving ($)	CC ($)	LOC ($)	Credit Utilization	Revolving ($)	CC ($)	LOC ($)	Credit Utilization
Panel I: Expansionary episode												
FRM 5-yr												
PostRenew	-509.27***	-407.72***	-137.33	-0.033***	-3100***	-566.32***	-2600***	-0.042***	825.97***	-237.46***	1110***	-0.021***
	(166.40)	(37.91)	(162.58)	(0.002)	(155.20)	(37.37)	(151.30)	(0.002)	(169.64)	(41.48)	(164.39)	(0.002)
PostRenew ×LowScore	1080***	409.52***	724.74***	0.023***								
	(202.65)	(46.63)	(197.75)	(0.002)								
PostRenew ×HighUse					6878***	759.84***	6244***	0.051***				
					(210.24)	(51.25)	(205.04)	(0.002)				
PostRenew ×Young									-1100***	254.92***	-1500***	0.000
									(207.00)	(48.43)	(200.84)	(0.002)
PostRenew ×Old									-2100***	-140.09**	-2100***	0.007**
									(290.76)	(69.82)	(289.53)	(0.003)
Panel II: Contractionary episode												
FRM-2yr												
PostRenew	-589.50***	-277.23***	-340.14	-0.017***	-389.32**	-268.95***	-106.29	-0.004***	390.15	-185.31***	580.06***	-0.011***
	(202.81)	(30.88)	(199.91)	(0.001)	(177.75)	(29.21)	(175.31)	(0.001)	(201.19)	(34.01)	(197.70)	(0.001)
PostRenew ×LowScore	490.53	85.09	461.19	0.006***								
	(288.80)	(49.93)	(282.29)	(0.002)								
PostRenew ×HighUse					469.92	156.48**	310.75	-0.018***				
					(314.78)	(64.17)	(305.56)	(0.002)				
PostRenew ×Young									-497.17	141.08***	-638.29***	0.005
									(305.52)	(53.98)	(299.28)	(0.002)
PostRenew ×Old									-2100***	-192.69***	-1900***	-0.006**
									(389.55)	(64.43)	(380.15)	(0.003)

Notes: LowScore refers to borrowers whose average credit score in the previous 12 months is below the median of the distribution. HighUse refers to borrowers whose average credit utilization rate in the previous 12 months is greater than 0.5. Young and old borrowers refer to ages below 45 and ages above 65, respectively. Credit utilization rate is the ratio of the total revolving balance over the total revolving credit limit.

Table 9: Responses of revolving credit supply (contractionary episode)

	Prob. higher CC limit (1)	Prob. higher LOC limit (2)	CC limit ($) (3)	LOC limit ($) (4)	CC payment-to-balance ratio (5)	LOC payment-to-balance ratio (6)
FRM-5yr						
PostRenew	0.002	0.010***	-109.70	2553***	0.007	0.002
	(0.001)	(0.001)	(66.17)	(312.88)	(0.005)	(0.018)
FRM-4yr						
PostRenew	0.005***	0.013***	68.17	2899***	-0.003	0.030
	(0.001)	(0.001)	(74.91)	(329.10)	(0.007)	(0.018)
FRM-3yr						
PostRenew	0.004	0.015***	114.41	2369***	0.001	0.001
	(0.002)	(0.002)	(96.23)	(486.41)	(0.009)	(0.030)
FRM-2yr						
PostRenew	0.003***	0.010***	-62.4	2492***	0.002	-0.014
	(0.001)	(0.001)	(34.54)	(181.70)	(0.004)	(0.023)

Notes: Columns (1)-(2) show changes in the likelihood of increasing the credit limit by more than $1,000. Columns (3)-(4) show changes in the credit limit. Columns (5)-(6) show changes in the required payment to balance ratio.

Table 10: Evidence from the Canadian Survey of Consumer Expectations

	Rates higher in 1 year (1)	Rates higher in 1&2 years (2)	Rates higher in 1,2 &5 years (3)	Pay down debt (4)	Cut spending save more (5)	Postpone purchases (6)	Bring fwd. purchases (7)
Panel I: All periods							
Rates rising recently	0.217***	0.215***	0.166***	0.096***	0.078***	0.029***	-0.009
	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.011)	(0.007)
Controls	Y	Y	Y	Y	Y	Y	Y
Quarter fixed effects	Y	Y	Y	Y	Y	Y	Y
Household fixed effects	Y	Y	Y	Y	Y	Y	Y
Panel II: Contractionary episode							
Rates rising recently	0.228***	0.261***	0.194***	0.155***	0.063***	-0.005	-0.019**
	(0.016)	(0.017)	(0.016)	(0.017)	(0.016)	(0.014)	(0.009)
Controls	Y	Y	Y	Y	Y	Y	Y
Quarter fixed effects	Y	Y	Y	Y	Y	Y	Y
Household fixed effects	Y	Y	Y	Y	Y	Y	Y

Notes: Results obtained from estimating equation (4) using data from the Canadian Survey of Consumer Expectations (CSCE). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the consumer level.

Table 11: Responses of delinquencies (‰) and credit scores

	Mortgages		Auto loans		Installment loans		Credit cards		Lines of credit		Credit
	60-day	90-day	60-day	90-day	60-day	90-day	60-day	90-day	60-day	90-day	score
Panel I: Expansionary episode											
FRM-5yr											
PostRenew	-1.10***	-0.14	-0.13	0.00	-0.13	-0.23**	0.00	-0.44	0.02	-0.18	3.26***
	(0.20)	(0.07)	(0.07)	(0.00)	(0.09)	(0.11)	(0.00)	(0.26)	(0.15)	(0.12)	(0.48)
FRM-4yr											
PostRenew	-0.13	-0.08	0.00	0.00	0.05	0.06	0.09	0.17	-0.12	-0.10	3.13***
	(0.36)	(0.17)	(0.00)	(0.00)	(0.55)	(0.16)	(0.09)	(0.30)	(0.27)	(0.20)	(0.95)
FRM-3yr											
PostRenew	-0.23	0.07	0.00	0.00	-0.22	-0.05	-0.53	-0.06	0.05	0.13	1.62***
	(0.19)	(0.07)	(0.00)	(0.00)	(0.13)	(0.05)	(0.34)	(0.21)	(0.17)	(0.09)	(0.59)
FRM-2yr											
PostRenew	0.20	0.03	0.00	0.00	-0.02	-0.02	-0.13	0.02	0.02	-0.07	0.84**
	(0.15)	(0.07)	(0.00)	(0.00)	(0.09)	(0.08)	(0.30)	(0.17)	(0.14)	(0.08)	(0.39)
Panel II: Contractionary episode											
FRM-5yr											
PostRenew	-0.27	0.01	-0.06	0.00	-0.16	-0.09	-0.42	-0.17	-0.01	0.00	1.21**
	(0.19)	(0.06)	(0.08)	(0.07)	(0.12)	(0.06)	(0.26)	(0.15)	(0.11)	(0.07)	(0.53)
FRM-4yr											
PostRenew	0.24	0.08	0.00	-0.01	-0.20	0.00	0.40	0.16	0.12	-0.13	2.07***
	(0.18)	(0.07)	(0.06)	(0.03)	(0.15)	(0.09)	(0.35)	(0.21)	(0.13)	(0.09)	(0.63)
FRM-3yr											
PostRenew	-0.40	0.05	-0.05	-0.09	0.22	-0.01	-1.10**	-0.40	-0.32	0.02	0.19
	(0.40)	(0.15)	(0.08)	(0.08)	(0.21)	(0.10)	(0.47)	(0.32)	(0.23)	(0.16)	(0.91)
FRM-2yr											
PostRenew	0.12	0.01	-0.04	0.04	0.07	0.01	-0.44	-0.02	-0.18	-0.18**	0.36
	(0.13)	(0.06)	(0.06)	(0.03)	(0.12)	(0.07)	(0.25)	(0.15)	(0.10)	(0.08)	(0.35)

Notes: Delinquencies are measured by the probability of reaching 60 days or 90 days of delinquency on at least one account of a debt category. Each cell presents the results from estimating one regression using equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the consumer level. All regressions include a set of control variables (see Section 3), month fixed effects, and consumer fixed effects.

Table 12: Aggregate effects of rate resets

(in billion dollars)	Auto spending	Durable consumption	Mortgage pay-down	Revolving debt pay-down
Expansionary episode				
All renewers	2.02	1.38	3.56	0
FRM-5yr renewers	1.55	1.06	2.71	0
Contractionary episode				
All renewers	0	0	0.40	0.69
FRM-5yr renewers	0	0	0.36	0.30

Notes: Aggregate effects obtained from applying formula (6). See detailed descriptions of the estimation procedure for each category in Section 6.

Not-for-Publication Appendix

A. U.S. Jumbo Prime ARMs

Table A1: Summary statistics of jumbo prime 10-year interest-only ARMs originated in 2005-2007

	Di Maggio et al. (2017) BlackBox Logic data				Our replication CoreLogic data			
	Borrower with five-year ARMs		Borrower with ten-year ARMs		Borrower with five-year ARMs		Borrower with ten-year ARMs	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
FICO	723.3	39.4	736	39.7	737.8	42.5	743.8	41.6
Loan balance	357,949	271,600	536,342	347,622	568,253	415,143	652,719	427,126
LTV ratio	77.11	10.01	72.82	12.05	73.66	11.80	69.70	13.60
Initial interest rate	6.44	0.76	6.14	0.52	5.98	0.56	6.01	0.47
Fraction of loans originated in California					46.05		45.55	
Fraction of loans originated in Florida					6.78		5.92	
Fraction of loans originated in Virginia					5.91		4.57	
Fraction of loans terminated within 5 years					50.12		43.26	
Fraction of loans terminated within 5 years: Voluntary payoff					35.82		38.01	
Fraction of loans terminated within 5 years: Foreclosure					10.15		8.12	
Number of borrowers	46,578		26,543		37,716		69,949	

Source: CoreLogic; Di Maggio et al. (2017).

Di Maggio et al. (2017) provided a comprehensive analysis of the effects of ARM resets on consumer spending and mortgage repayment in the U.S. during the Great Recession. The sample underlying their main results consists of mortgages in a specific segment of the U.S. mortgage market: jumbo prime ARMs. Their study finds large, persistent increases in durable spending at the micro level, which argues for the potency of the mortgage rate channel of monetary policy in stimulating the U.S. economy. To assess the aggregate effects of ARM resets and to provide policy prescriptions, however, it is important to understand the representativeness of the mortgages in their study.[26]

To shed light on this issue, we accessed the CoreLogic Private Label Securities-MBS dataset through the Federal Reserve System's RADAR Data Warehouse. The dataset covers over 90 percent of the loans of prime jumbo securities in the market. We first assess the share of the loans underlying the main results of Di Maggio et al. (2017) in the U.S. mortgage market, i.e., jumbo prime 10-year interest-only ARMs originated in 2005-2007 with an initial fixed interest-rate period of 5 years. We estimate that these loans accounted for about 1.8% of the overall U.S. mortgage originations at the

[26] Another issue with assessing the aggregate effects of ARM resets during periods of declining rates in the U.S. is that long-term FRM borrowers would also take advantage of the low rates to refinance their mortgages, confounding the effects of ARM resets on aggregate outcomes.

time.[27]

We next examine loan characteristics of these ARMs. The summary statistics are shown in Table A1. Overall, the distributions of the credit score, LTV ratio and initial interest rate are similar in the two datasets. The main difference is the balances of 5-year ARMs, which are \$570K on average in our data, compared to \$360K in the BlackBox Logic data. This discrepancy is not driven by the outliers in our data. The 25th percentile of the balance distribution, for example, is \$350K in our data. Despite this difference, the average loan balances in both datasets are much larger than that on representative agency FRMs, which was between \$214K and \$275K in 2005-2007, according to Freddie Mac.

A somewhat surprising finding is the geographic concentration of this type of loans. California alone accounted for 46% of its originations (compared to the state's population share of 12%). Another state that disproportionately originated these loans was Virginia. In addition, we find that these loans had high prepayment rates, about 50%. About 70% of the prepayments were voluntary payoffs and 20% were foreclosures.

To conclude, the small share of these loans in the U.S. mortgage market and their distinct features and geographic concentration suggest that the behavior of the corresponding borrowers may not be representative of a typical American consumer who is likely to hold a 30-year FRM contract. This also highlights that more research and broader evidence might be needed to understand the rate reset channel of monetary policy.

[27] This market share is computed as follows. The share of jumbo loans originated in 2005-2007 is close to 30% of the market (see, FDIC Quarterly Volume 13(4), 2019). In our prime-jumbo sample, 10-year interest-only ARMs over the same period accounted for 20%, of which loans with an initial fixed interest-rate period of 5 years are about 30%. The market share, therefore, is 1.8% (=30%×20%×30%).

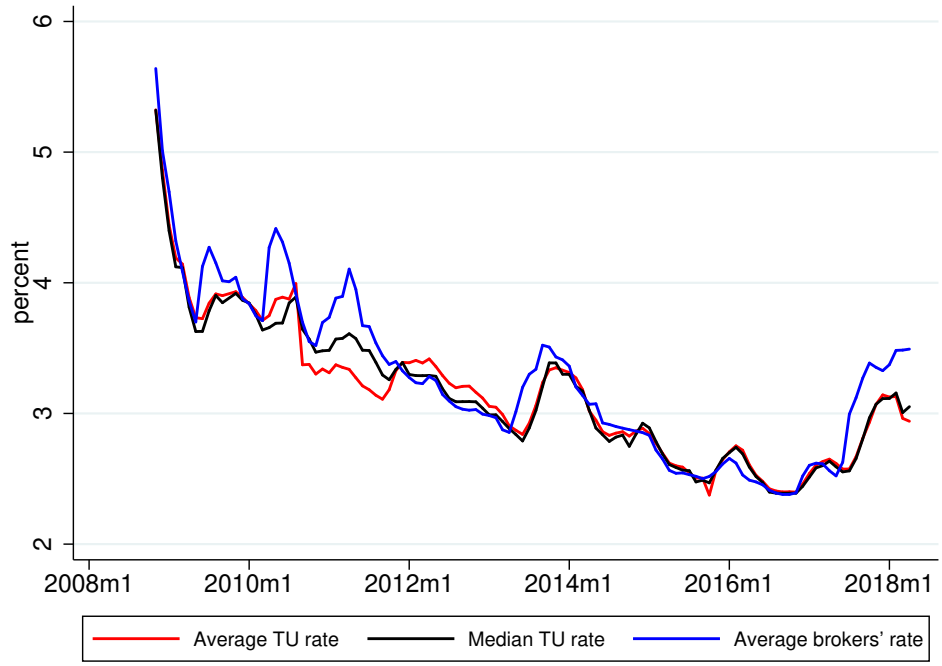
B. Construction of Mortgage Rates

We take a series of steps to impute the rates associated with the FRMs in our sample. First, assuming no prepayment in addition to scheduled payments, the outstanding balances and scheduled payments can be used to pin down the mortgage rate (adjusted to annual rate). Second, from the rates obtained in the first step, we remove the ones that are either too low (most likely due to prepayment beyond the amortization schedule) or too high (most likely due to delays in payments). Third, we take the median of the remaining rates within each term of a mortgage as the contracted rate. Finally, we winsorize our contracted rates using the 1% cutoff at the top and bottom the distribution. A minor caveat of this procedure is that we are unable to recover the rates for a small fraction of loans that feature either systematic prepayment or frequent delays in payments.

To externally validate our procedure, we compare the imputed rates in our data with the actual rates reported in two datasets. One is the average 5-year FRM rate quoted by national mortgage brokers, and the other is the loan-level rate recorded in the Bank of Canada (BOC)-OSFI mortgage originations dataset. The broker data span a long time period, but do not have a cross-sectional dimension. The BOC-OSFI dataset allows us to further break down the data by mortgage insurance status and purpose, but is available only since 2014. Mortgages in both sources are new originations, so we compare their rate distributions with those of the new originations in our sample.

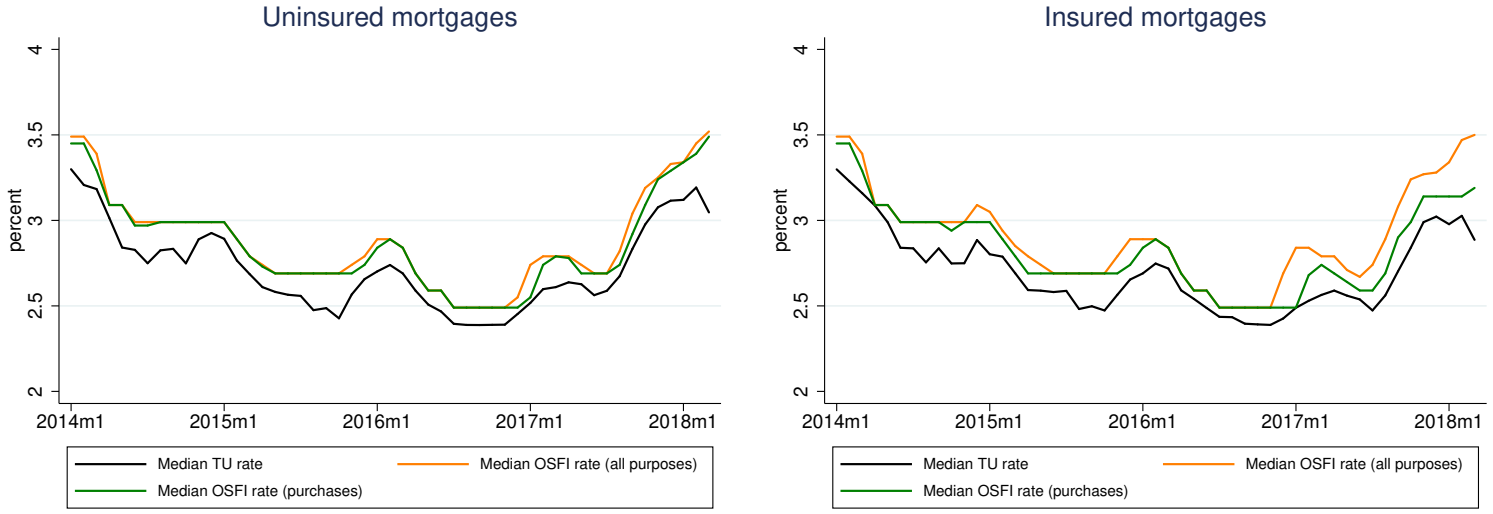
Figure B1 shows that the average and median of our imputed rates track the brokers' rate quite closely over time. Classifying mortgages by their insurance status, Figure B2 shows that the imputed rates are similar to the rates in the BOC-OSFI dataset, and that the rate differentials for insured and uninsured mortgages are small. Although our sample does not distinguish between loan purposes, the BOC-OSFI dataset suggests that the rates for home purchases and for cash-out refinances are similar, especially for uninsured mortgages. We also compare the standard deviations of our imputed rates with those in the BOC-OSFI dataset by insurance status. The standard deviations are similar, with a gap of about 20-30 bps over the sample period.

Figure B1: Imputed TransUnion rates and national mortgage brokers' rate, 5-year FRMs



Sources: Bank of Canada mortgage broker rate; TransUnion Canada account-level data; authors' calculations.

Figure B2: Imputed TransUnion rates and BOC-OSFI origination rates, 5-year FRMs



Sources: Bank of Canada-OSFI mortgage originations dataset; TransUnion Canada account-level data; authors' calculations.

C: Canadian Survey of Consumer Expectations

The Canadian Survey of Consumer Expectations (CSCE), launched by the Bank of Canada in 2014Q4, provides comprehensive information about consumer expectations of inflation, interest rates, labor markets, credit markets and housing markets. The survey also collects information on households' demographics, employment situation and financial conditions. Data are collected from a nationally representative sample of 1,000-2,000 household heads every quarter. The survey has a rotating panel structure with respondents participating in the panel for up to a year. The design of the survey largely follows that of the New York Fed's Survey of Consumer Expectations. See Gosselin and Khan (2015) for a detailed description of the CSCE.

For our analysis in Section 5.4, we restrict the sample to homeowners with mortgages to make it comparable with our consumer credit panel data. Summary statistics of the regression variables are presented in Table C1. The following survey questions are used to construct the key variables in the regressions.

1. *"How would you say interest rates on things such as mortgages, bank loans and savings have changed over the last 12 months? Fallen a lot, fallen a little, about the same, risen a little, risen a lot?"* We use the answer to this question to construct an indicator variable for perceiving that interest rates have risen. The indicator equals one if the consumer answers risen a lot or risen a little.

2. *"What do you think is the percent chance that 12 months from now the average interest rate on things such as mortgages, bank loans and savings will be higher than it is now?"* We use the answer to this question to construct an indicator variable for expecting the rates to be higher in the next 12 months. The indicator equals one if the consumer gives a numerical answer greater than 50%.

3. *"At what level do you think that interest rates on things such as mortgages, bank loans and savings will be in...?" Please enter a number.*

   (a) One year from now, interest rates will most likely be ___%
   (b) Two years from now, interest rates will most likely be ___%
   (c) Five years from now, interest rates will most likely be ___%

   We construct an indicator for a consumer expecting rates to rise in the next two years, which equals one if the consumer (i) expects rates to be higher in the next 12 months (based on the

answer to question 2), and (ii) reports the level of the expected rate in two years (answer to question 3b) greater than the level of the expected rate in one year (answer to question 3a). An indicator for expecting rates to rise in the next five years is constructed similarly, equal to one if the consumer meets conditions (i) and (ii), and reports the level of the expected rate in five years (question 3c) greater than the level of the expected rate in two years (question 3b).

4. *"Which, if any, of the following actions are you taking, or planning to take, in light of your expectations for interest rates?" Select all that apply.*

   - *Bring forward major purchases (such as furniture or appliances)*
   - *Postpone major purchases*
   - *Cut back spending and save more*
   - *Pay debt*
   - *Take no action*

   We construct a series of indicators for taking a specific action.

Table C1: Summary statistics of CSCE variables

	Both episodes		Expansionary		Contractionary	
	Mean	SD	Mean	SD	Mean	SD
Household characteristics						
Age	44.8	13.1	44.4	12.9	45.1	13.2
Male (%)	50.0	50.0	50.0	50.0	50.0	50.0
Married (%)	74.3	43.7	74.9	43.3	73.9	43.9
Bachelor degree or above (%)	47.9	49.9	47.9	49.9	47.9	49.9
Existing FRM borrowers (%)	69.4	46.1	67.3	46.9	70.8	45.4
Existing VRM borrowers (%)	21.9	41.3	23.3	42.3	20.9	40.7
New FRM/VRM borrowers (%)	8.7	28.2	9.4	29.2	8.2	27.5
Expectations						
Perceiving rates risen in past 12M (%)	53.8	49.9	18.1	38.5	75.8	42.8
Expecting rates higher in next 12M (%)	67.0	47.0	56.3	49.6	73.7	44.0
cond. on perceiving rates risen (%)	79.7	40.2	74.2	43.8	80.6	39.6
cond. on perceiving rates fallen (%)	51.0	50.0	50.9	50.0	51.1	50
Expected interest rates in one year (pp)	5.5	7.5	4.4	4.9	6.3	9.1
Expected interest rates in two years (pp)	6.6	8.6	5.2	5.5	7.3	9.8
Expected interest rates in five years (pp)	7.4	9.0	6.5	7.3	8.2	10.4
Actions						
Pay down debt (%)	53.1	49.9	52.9	49.9	53.2	49.9
Cut spending/save more (%)	44.3	49.7	38.5	48.7	47.9	49.9
Postpone purchases (%)	18.5	38.9	15.3	36.0	20.5	40.4
Bring forward purchases (%)	7.3	25.9	6.3	24.2	7.9	26.9

Notes: Summary statistics for homeowners with mortgages in the CSCE data. Statistics on the expected interest rates in one, two and five years are computed after dropping the top 1% of the sample in order to reduce the effect of outliers.

D. Additional Empirical Evidence and Robustness

Table D1: Term transition probabilities and market shares (%)

	After reset				
Before reset	FRM-2yr	FRM-3yr	FRM-4yr	FRM-5yr	Share
Panel I: Expansionary episode					
FRM-2yr	65.3	6.8	4.2	23.6	30.0
FRM-3yr	36.7	20.1	5.7	37.5	9.3
FRM-4yr	22.5	6.3	18.3	52.9	6.2
FRM-5yr	19.0	7.5	5.1	68.4	54.5
Panel II: Contractionary episode					
FRM-2yr	57.5	16.0	6.8	19.7	28.3
FRM-3yr	29.8	34.5	7.7	28.1	14.8
FRM-4yr	24.1	13.4	27.7	34.8	13.4
FRM-5yr	20.1	12.4	11.3	56.2	43.5

Source: TransUnion Canadian mortgage account-level data; authors' calculations.

Table D2: Borrowing activity following loan termination

	Expansionary episode			*Contractionary episode*		
	Share	with current lender	with other lender	Share	with current lender	with other lender
Loans terminated before scheduled renewal	28%	-	-	26%	-	-
Among terminated loans:						
1. Replaced by a cash-out-refinance loan (Balance rises by 5% or more; same postal code)	46%	86%	14%	40%	78%	22%
2. Replaced by a renewal loan (Balance rises by 0-5%; same postal code)	10%	38%	62%	13%	22%	78%
3. Replaced by a home-purchase loan (New account opened in a different postal code)	5%	66%	34%	5%	57%	43%
4. No replacement loan found	39%	-	-	43%	-	-

Notes: These estimates are obtained by linking the mortgage accounts of the same borrowers. Specifically, for each terminated loan, we search for a replacement loan originated within three months of the termination date of the original loan by the same borrower. The replacement loan may be issued by any lender in the TransUnion database. This table presents the estimates using all mortgages. The estimates by loan term are similar to those shown in this table.

Table D3: Changes in monthly debt service payments (in dollars) upon the reset

	Total	Mortgage	Non-mortgage	Revolving debt
	(1)	(2)	(3)	(4)
Panel I: Expansionary episode				
FRM-5yr				
PostRenew	-60.22***	-46.47**	-14.7***	-6.76***
	(2.14)	(0.64)	(2.00)	(0.94)
FRM-4yr				
PostRenew	-9.42***	-9.90***	0.33	-3.52
	(4.64)	(1.85)	(4.31)	(2.04)
FRM-3yr				
PostRenew	-11.15***	-2.19	-8.91***	-6.05***
	(2.68)	(1.17)	(2.43)	(1.23)
FRM-2yr				
PostRenew	-8.41***	-1.76**	-6.76***	-4.49***
	(1.74)	(0.88)	(1.51)	(0.77)
Panel II: Contractionary episode				
FRM-5yr				
PostRenew	22.92***	39.23***	-15.91***	-8.36***
	(2.52)	(0.73)	(2.41)	(1.34)
FRM-4yr				
PostRenew	32.51***	40.37***	-7.75***	-4.83***
	(2.88)	(0.77)	(2.77)	(1.53)
FRM-3yr				
PostRenew	33.29***	49.49***	-15.93***	-7.93***
	(3.80)	(1.31)	(3.58)	(2.04)
FRM-2yr				
PostRenew	75.53***	84.49***	-7.62***	-5.86***
	(1.54)	(0.85)	(1.29)	(0.77)

Notes: Each cell presents the results from estimating one regression using equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the loan level. All regressions include a set of control variables (see Section 3), month fixed effects, and loan fixed effects. Column (1) shows the responses of total monthly debt service payments, which include scheduled mortgage payments (column 2) and required non-mortgage payments (column 3). The latter consist of required payments on revolving debt (column 4) and on non-revolving debt (auto and installment loans).

Table D4: Robustness: Post-renewal observations restricted to be within four quarters

	Mortgage rate (p.p.)	Required ($/m)	Scheduled ($/m)	Amortization (months)	Auto spending ($/m)	Auto pur. prob. (%)	IL-Financed spending ($/m)	IL pur. prob. (%)	Revolving ($)	CC ($)	LOC ($)	Mortgage 60-day (‰)
Panel I: Expansionary episode												
FRM-5yr												
Renew×	-0.96***	-80.53***	-48.25***	-8.96***	27.63**	0.08***	40.59	0.18***	319.36	-146.36***	494.85**	-0.53
PostRenew	(0.008)	(1.06)	(1.52)	(0.35)	(11.44)	(0.03)	(22.88)	(0.05)	(217.83)	(51.89)	(211.04)	(0.42)
FRM-4yr												
Renew×	-0.19***	-21.26***	-5.85	-4.30***	-71.76**	-0.18	30.06	0.17	959.95	-184.71	1083.12	-0.18
PostRenew	(0.014)	(1.63)	(3.14)	(0.69)	(33.64)	(0.09)	(58.57)	(0.15)	(577.57)	(107.17)	(579.40)	(0.71)
FRM-3yr												
Renew×	-0.12***	-8.60***	0.34	-3.78***	16.46	0.03	36.07	0.04	376.14	-151.56***	590.65	0.31
PostRenew	(0.001)	(1.10)	(2.03)	(0.35)	(18.44)	(0.05)	(30.29)	(0.07)	(304.81)	(58.87)	(302.26)	(0.42)
FRM-2yr												
Renew×	-0.04***	-5.93***	0.99	-3.88***	-5.09	-0.03	36.21	0.01	349.85	-172.03***	595.67***	0.67**
PostRenew	(0.008)	(0.85)	(1.76)	(0.29)	(17.34)	(0.05)	(33.30)	(0.07)	(197.42)	(42.09)	(195.27)	(0.33)
Panel II: Contractionary episode												
FRM-5yr												
Renew×	0.31***	32.68***	38.66***	-1.84***	0.38	0.02	49.57**	0.07	-1100.00***	-289.32***	-937.53***	-0.23
PostRenew	(0.005)	(0.60)	(0.98)	(0.12)	(10.19)	(0.03)	(21.94)	(0.05)	(255.49)	(50.58)	(249.80)	(0.24)
FRM-4yr												
Renew×	0.70***	52.60***	58.32***	-2.30***	-16.92	-0.05	-8.55	0.02	-784.39	-291.53***	-510.80	0.33
PostRenew	(0.007)	(0.79)	(1.40)	(0.22)	(19.75)	(0.05)	(42.05)	(0.09)	(415.78)	(83.75)	(400.41)	(0.36)
FRM-3yr												
Renew×	0.92***	72.81***	63.95***	1.07***	11.85	0.03	52.47	0.13	-612.37	-130.91	-440.56	0.09
PostRenew	(0.011)	(1.52)	(2.13)	(0.36)	(27.53)	(0.07)	(45.49)	(0.12)	(490.10)	(94.27)	(470.46)	(0.58)
FRM-2yr												
Renew×	1.02***	101.78***	102.55***	-2.16***	9.82	0.03	78.13**	0.14**	-8.87	-210.56***	181.24	0.28
PostRenew	(0.004)	(1.14)	(1.46)	(0.16)	(15.78)	(0.04)	(32.39)	(0.06)	(206.08)	(36.57)	(201.70)	(0.21)

Notes: See notes in Tables 3 and 6 for estimation details. These estimates are obtained using the sample that restricts the post-renewal observations to be within four quarters for all loans.

Table D5: Robustness: Mortgage terms restricted to be the same before and after the reset

	Mortgage rate (p.p.)	Required ($/m)	Scheduled ($/m)	Amortization (months)	Auto spending ($/m)	Auto pur. prob. (%)	IL-Financed spending ($/m)	IL pur. prob. (%)	Revolving ($)	CC ($)	LOC ($)	Mortgage 60-day (‰)
Panel I: Expansionary episode												
FRM-5yr												
PostRenew	-1.14***	-96.77***	-43.39***	-15.79***	13.89	0.07***	47.20***	0.12***	168.42	-188.58***	363.54**	-0.10
	(0.004)	(0.61)	(1.00)	(0.25)	(7.92)	(0.02)	(14.82)	(0.04)	(156.66)	(41.46)	(152.02)	(0.15)
FRM-4yr												
PostRenew	-0.36***	-32.88***	-7.53	-5.41***	-55.75	-0.03	40.58	0.22	-2.16	-77.58	-55.94	-0.08
	(0.012)	(1.75)	(5.01)	(0.89)	(58.83)	(0.14)	(74.33)	(0.20)	(667.80)	(166.23)	(668.86)	(0.21)
FRM-3yr												
PostRenew	-0.21***	-19.45***	3.68	-5.78***	26.14	0.07	39.15	0.14	-583.03	-255.18***	-195.81	0.01
	(0.007)	(0.77)	(2.46)	(0.50)	(25.61)	(0.07)	(42.54)	(0.11)	(476.96)	(92.17)	(469.25)	(0.30)
FRM-2yr												
PostRenew	-0.35***	-31.92***	-16.44**	-4.72***	2.69	0.00	12.65	0.06	149.94	-162.33***	348.74**	-0.02
	(0.003)	(0.33)	(1.12)	(0.23)	(13.81)	(0.04)	(25.31)	(0.06)	(165.54)	(33.05)	(163.30)	(0.09)
Panel II: Contractionary episode												
FRM-5yr												
PostRenew	0.30***	30.01***	38.91***	-1.77***	10.62	0.02	12.50	0.04	-436.33	-218.36***	-319.07	-0.04
	(0.004)	(0.51)	(1.01)	(0.15)	(12.39)	(0.03)	(21.69)	(0.05)	(289.25)	(57.33)	(286.15)	(0.08)
FRM-4yr												
PostRenew	0.47***	32.66***	39.34***	-0.99***	33.67	0.09	-6.15	0.14	-222.16	-338.29***	213.29	0.11
	(0.004)	(0.50)	(1.19)	(0.22)	(22.81)	(0.07)	(61.22)	(0.11)	(439.61)	(104.23)	(430.48)	(0.09)
FRM-3yr												
PostRenew	0.64***	51.81***	48.00***	1.11**	-24.91	-0.08	75.56	0.01	-632.62	-325.58***	-290.63	-0.11
	(0.009)	(1.39)	(2.48)	(0.43)	(31.28)	(0.09)	(54.46)	(0.13)	(583.98)	(121.31)	(565.55)	(0.11)
FRM-2yr												
PostRenew	0.68***	66.37***	65.43***	-0.07	4.10	0.05	23.78	0.07	-142.25	-171.09***	77.62	-0.00
	(0.003)	(0.81)	(1.15)	(0.17)	(15.89)	(0.04)	(35.93)	(0.06)	(195.73)	(35.16)	(194.98)	(0.09)

Notes: See notes in Tables 3 and 6 for estimation details. These estimates are obtained using the sample that restricts the mortgage term to be the same before and after the reset.

Table D6: Robustness: DID estimates (Control group: longer-term FRMs not yet renewed)

	Mortgage rate (p.p.)	Required ($/m)	Scheduled ($/m)	Amortization (months)	Auto spending ($/m)	Auto pur. prob. (%)	IL-Financed spending ($/m)	IL pur. prob. (%)	Revolving ($)	CC ($)	LOC ($)	Mortgage 60-day (‰)
Panel I: Expansionary episode												
FRM-5yr												
Renew×	-1.13***	-92.04***	-46.50***	-13.95***	19.46***	0.07***	45.54***	0.14***	101.74	-162.31***	254.23**	-1.09***
PostRenew	(0.004)	(0.54)	(0.81)	(0.20)	(6.09)	(0.02)	(11.98)	(0.03)	(124.83)	(32.46)	(121.02)	(0.20)
FRM-4yr												
Renew×	-0.36***	-32.28***	-9.14***	-5.75***	-6.06	-0.00	3.92	0.07	-1000***	-314.57***	-708.86	-0.15
PostRenew	(0.006)	(0.76)	(1.72)	(0.34)	(16.34)	(0.04)	(26.51)	(0.07)	(373.70)	(72.04)	(370.44)	(0.30)
FRM-3yr												
Renew×	-0.19***	-15.05***	-3.40***	-4.35***	9.49	0.03	18.48	0.05	-964.16***	-287.54***	-630.19***	-0.11
PostRenew	(0.004)	(0.50)	(1.13)	(0.21)	(8.38)	(0.02)	(14.57)	(0.03)	(195.76)	(38.88)	(192.36)	(0.16)
FRM-2yr												
Renew×	-0.18***	-15.23***	-2.55**	-4.88***	4.55	0.02	25.79	0.08***	-384.78**	-154.17***	-206.23	0.33**
PostRenew	(0.003)	(0.38)	(0.87)	(0.18)	(7.99)	(0.02)	(15.89)	(0.03)	(159.76)	(31.87)	(156.69)	(0.13)
Panel II: Contractionary episode												
FRM-5yr												
Renew×	0.31***	33.87***	38.88***	-1.54***	3.08	0.02	15.19	-0.01	-795.41***	-214.97***	-666.28***	-0.19
PostRenew	(0.003)	(0.44)	(0.72)	(0.11)	(7.65)	(0.02)	(14.46)	(0.03)	(217.86)	(41.18)	(212.79)	(0.17)
FRM-4yr												
Renew×	0.49***	36.32***	40.35***	-1.07***	-3.23	-0.03	-0.40	0.06	86.23	-141.74***	232.61	0.43
PostRenew	(0.003)	(0.34)	(0.77)	(0.13)	(12.97)	(0.03)	(23.63)	(0.06)	(269.87)	(53.34)	(261.11)	(0.45)
FRM-3yr												
Renew×	0.70***	55.32***	49.68***	0.72***	16.64	0.04	48.70	0.12	-826.07**	-272.99***	-498.50	0.93
PostRenew	(0.006)	(0.77)	(1.31)	(0.24)	(18.57)	(0.05)	(27.72)	(0.07)	(329.19)	(65.25)	(318.38)	(0.72)
FRM-2yr												
Renew×	0.85***	83.31***	84.43***	-1.36***	17.68	0.06**	41.53	0.07	-304.88**	-216.37***	-75.70	-0.03
PostRenew	(0.003)	(0.66)	(0.85)	(0.12)	(10.50)	(0.03)	(23.29)	(0.04)	(136.37)	(24.91)	(134.54)	(1.00)

Notes: Each cell presents the results from estimating one regression using equation (3). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the loan (consumer) level. All regressions include a set of control variables (see Section 3), month fixed effects, and loan (consumer) fixed effects. The control group consists of 7- and 10-year FRMs that previously reset the rates at the same time as the treatment group but were not scheduled to be renewed in the episode.

Table D7: Robustness: DID estimates (Control group: FRMs having the same term as the treated group but not yet renewed)

	Mortgage rate (p.p.)	Required ($/m)	Scheduled ($/m)	Amortization (months)	Auto spending ($/m)	Auto pur. prob. (%)	IL-Financed spending ($/m)	IL pur. prob. (%)	Revolving ($)	CC ($)	LOC ($)	Mortgage 60-day (‰)
Panel I: Expansionary episode												
FRM-5yr												
Renew×	-1.15***	-93.87***	-49.62***	-13.39***	11.00**	0.04***	19.20**	0.08***	-1600***	-384.37***	-1200***	-1.17***
PostRenew	(0.003)	(0.51)	(0.76)	(0.18)	(4.33)	(0.01)	(8.28)	(0.02)	(110.54)	(26.04)	(108.03)	(0.12)
FRM-4yr												
Renew×	-0.34***	-29.61***	-7.88***	-5.54***	7.37	0.03	29.58	0.11**	-2000***	-416.09***	-1600***	-0.17
PostRenew	(0.006)	(0.71)	(1.61)	(0.31)	(11.13)	(0.03)	(17.99)	(0.05)	(270.02)	(53.06)	(266.82)	(0.23)
FRM-3yr												
Renew×	-0.19***	-15.17***	-3.38***	-4.43***	12.82	0.03	20.63	0.03	-557.48***	-202.41	-288.73***	-0.27
PostRenew	(0.004)	(0.49)	(1.12)	(0.21)	(9.18)	(0.03)	(15.85)	(0.04)	(177.70)	(35.32)	(174.11)	(0.16)
Panel II: Contractionary episode												
FRM-5yr												
Renew×	0.31***	33.09***	37.63***	-1.53***	6.42	0.01	20.83	0.04	-2000***	-451.93***	-1600***	-0.54***
PostRenew	(0.003)	(0.41)	(0.67)	(0.10)	(5.53)	(0.01)	(12.89)	(0.03)	(163.02)	(31.41)	(160.10)	(0.13)
FRM-4yr												
Renew×	0.52***	38.70***	42.13***	-1.11***	8.11	0.00	7.25	0.07	19.10	-278.76***	305.32	-0.03
PostRenew	(0.003)	(0.34)	(0.71)	(0.12)	(12.29)	(0.03)	(23.14)	(0.05)	(223.93)	(47.87)	(217.88)	(0.14)
FRM-3yr												
Renew×	0.73***	58.87***	52.42***	0.83***	-1.10	0.00	57.72**	0.13**	-1500***	-330.88***	-1100***	-0.23
PostRenew	(0.005)	(0.79)	(1.29)	(0.23)	(14.06)	(0.04)	(25.06)	(0.06)	(262.03)	(52.24)	(254.71)	(0.31)

Notes: Each cell presents the results from estimating one regression using equation (3). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the loan (consumer) level. All regressions include a set of control variables (see Section 3), month fixed effects, and loan (consumer) fixed effects. The control group consists of mortgages that had the same terms as the treatment group but were not scheduled to be renewed in the episode.