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

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Abstract

We study the causal effect of mortgage rate changes on consumer spending, debt repayment, and defaults during an expansionary and a contractionary monetary policy episode in Canada. Our identification takes advantage of the fact that the interest rates of short-term fixed-rate mortgages (the dominant product in Canada's mortgage market) have to be reset according to the prevailing market interest rates at predetermined time intervals. Our empirical strategy exploits this exogenous variation in the timing of mortgage rate resets. We find asymmetric responses of consumer durable spending, deleveraging, and defaults. These results can be rationalized by the cash-flow effect in conjunction with changes in consumers' expectations about future interest rates. Our findings help to understand the responses of the household sector to changes in the interest rate, especially in countries where variable-rate, adjustable-rate, and short-term fixed-rate mortgages are prevalent.

Keywords: Mortgage Rate Reset, Monetary Policy, Consumption, Consumer Debt, Consumer Expectations.

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

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1 Introduction

During the global financial crisis, central banks worldwide cut short-term interest rates and engaged in large-scale asset purchases in an effort to boost the real economy. Although these actions can stimulate the household sector through various channels, the recent literature has emphasized that monetary policy is most effective when it operates through raising household disposable income (e.g., Kaplan et al. (2018) and Cloyne et al. (2018)). For example, lower interest rates bring down the cost of borrowing, allowing households to reduce their debt service and consume more. Since mortgage debt is the largest component of household debt in many countries, this cash-flow channel of monetary policy is expected to be important.

Several studies have attempted to evaluate the cash-flow channel using micro data from different countries.[1] These studies, however, have mostly focused on a single episode when some households experienced substantial mortgage rate declines while other households did not. As the global economy has largely recovered and interest rates are expected to rise eventually, it is increasingly urgent for policy makers to understand the consequences of higher interest rates for the household sector, especially in countries where rising policy rates are effectively passed through to both new and existing mortgage borrowers. This includes countries where variable-rate, adjustable-rate, or short-term fixed-rate mortgages are dominant such as Australia, Canada, Germany, Ireland, Japan, Korea, Spain and the U.K.[2] Even in countries where long-term fixed-rate mortgages are prevalent (e.g., the United States and Denmark), this question is still relevant, given that alternative mortgage products often account for a non-negligible market share and are subject to frequent rate resets.[3]

Notwithstanding the importance of this question, there has been little research into the cash-flow channel of monetary policy in a rising interest rate environment. We provide a detailed analysis of the causal effects of mortgage rate changes on consumer spending, debt repayment, and defaults based on a comprehensive consumer panel dataset. Our study is among the first to examine the cash-flow channel not only when interest rates decrease, but also when they increase.[4]

[1] See, e.g., Di Maggio et al. (2017), Jappelli and Scognamiglio (2018), La Cava et al. (2016), Floden et al. (2016), and Agarwal et al. (2019).

[2] For an overview of cross-country mortgage product offerings, see Lea (2010).

[3] In the United States, for example, adjustable-rate mortgages accounted for 20% of originations in 2000-2018, according to the Mortgage Market Statistical Annual 2019, Inside Mortgage Finance Publications, Inc.

[4] The only other study that examines the cash flow-channel under both expansionary and contractionary monetary policy is the work by Agarwal et al. (2019). Their strategy is to compare the responses of mortgage borrowers to monetary policy changes to the responses of homeowners without mortgages. Our empirical strategy, unlike theirs, compares mortgage borrowers who hold the same type of contract. Moreover, our data allow us to study not only credit card debt as they do, but the full scope of a consumer's debt portfolio.

Isolating the cash-flow effects is empirically challenging because of the lack of suitable data and the difficulty in establishing identification. In the United States, for example, most homeowners hold long-term fixed-rate mortgage (FRM) contracts. Mortgage payments may be lowered through refinancing, but the timing of a refinance is determined by the borrower, and the outcomes depend on the borrower's financial condition and creditworthiness. Besides, it is infeasible to study the effect of negative cash flows on borrowers holding this type of contracts, because the current rate on the mortgage can be safely locked in until the mortgage is paid off. Evidence of the cash-flow channel from the U.S. is provided by Di Maggio et al. (2017), who focus on borrowers in a specific segment of the adjustable-rate mortgage (ARM) market during a low interest rate period. These borrowers, however, need not be representative of the majority of homeowners in the country. In contrast, evidence for countries where ARMs are prevalent, due to the lack of high-frequency data for identifying the timing of rate changes, is typically based on comparing ARM borrowers to FRM borrowers, or mortgage borrowers to homeowners without mortgages. This approach, however, is prone to selection bias due to unobserved characteristics.

We address these concerns by focusing on the Canadian mortgage market and relying on a comprehensive consumer credit panel dataset. What makes Canada an interesting case to consider is that the institutional characteristics of the Canadian mortgage market permit a clean identification of mortgage rate resets. Almost 80% of mortgages in Canada are short-term fixed-rate mortgages. By design, the interest rate of these mortgages is fixed within a term (typically 2-5 years), but has to be reset for the next term according to the prevailing market rate. This occurs through a contract renewal at the end of each term, until the mortgage is paid off. If the contract is renewed with the same lender, as is the case for most mortgages, the lender does not reassess the underwriting criteria such as credit scores, loan-to-value (LTV) and debt-to-income (DTI) ratios. Moreover, due to penalties on full prepayment, most borrowers reset their mortgage rates exactly on schedule.

These institutional characteristics imply that the timing of a mortgage rate reset is predetermined by past contract choices. This feature, combined with pronounced changes in market rates over time, generates sizable mortgage rate reductions or increases upon reset, which are exogenous with respect to borrowers' spending and savings decisions, and do not depend on their financial positions or creditworthiness. Intuitively, this allows us to compare the responses of two borrowers that are similar in every aspect except that one borrower resets her mortgage rate earlier than the other borrower. Our identification strategy, therefore, exploits the variation in the predetermined timing of mortgage rate resets.

The implementation of this strategy requires high frequency mortgage loan-level data for identifying the timing of the resets. In addition, one needs measures of consumer spending and savings that can be merged to the mortgage loan-level data for each consumer. The other advantage of studying this question in the Canadian context is the availability of high-quality, high-frequency data. We use granular trade-line-level data on mortgages, credit cards, lines of credit, auto and non-auto installment loans provided by one of the two credit agencies in Canada. For each consumer, we merge mortgage loan-level information to the consumer's credit reports which we compiled ourselves from the trade-line-level data. This procedure allows us to precisely identify, for example, the incidences of auto purchases, typically considered as a proxy for durable spending. It also helps to align the timing of the reports provided by different lenders. The mortgage sample used in our analysis is large and representative, covering close to 20% of the loans in the Canadian mortgage market between 2009 and 2019. Our dataset allows us to study the change in mortgage rates and payments, as well as consumer durable spending, revolving debt repayment, and default due to automatic mortgage rate resets.

We focus on typical short-term mortgages that were scheduled to reset in two episodes: an expansionary monetary policy episode (2015m1-2017m1) and a contractionary monetary policy episode (2017m7-2019m6). These episodes correspond to the two major monetary policy shifts during our sample (see Figure 1). We start by showing that these changes were effectively passed through to consumers when they renewed their mortgage contracts. For example, borrowers on average experienced a rate reduction of 16 to 113 basis points (b.p.) in the first episode, and an increase of 32 to 85 b.p. in the second episode, depending on the term before the renewal. Changes in mortgage rates, in turn, imply substantial adjustment in interest payments, which form the source of positive and negative cash flows. We estimate that required monthly mortgage payments fall by \$14 to \$92 (rise by \$34 to \$83) per month, or \$2,907 to \$20,891 (\$7,072 to \$19,165) over the life of the loan, assuming the same future mortgage rates and the same length of time for paying off the loan.

We then examine the impact of cash flow changes driven by mortgage rate resets on consumer spending and debt repayment. Consumer spending is measured in two ways. First, we use newly-originated auto loans as a proxy for spending on automobiles. Second, we use new installment loans that are not categorized as student loans as a proxy for broader types of spending. In Canada, these loans are designed to cover large one-time expenses and are typically used for home improvements or purchases of furniture and other durable goods. Our premise is that consumers

increase their spending when mortgage payments are lower, but cut their spending when payments are higher, and that liquidity-constrained borrowers are more responsive to these cash-flow shocks, as implied by standard consumption theory with borrowing constraints (e.g., Carroll (1997), Deaton (1991), and Kaplan and Violante (2014)).

Our results for the case of mortgage payment declines associated with lower rates support the theory, and are in line with the previous literature on the cash-flow channel during expansionary monetary policy episodes. We find that, for borrowers experiencing large positive cash flows, spending financed by auto loans and installment loans increase by 16% and 18%, respectively. Further, young borrowers are more responsive to these shocks. We also find that spending by consumers having difficulty in getting access to new credit are less responsive to stimulus. When mortgage rates and payments increase, however, consumers do not cut the types of spending we measure in the data. Our results echo the recent empirical finding in Baugh et al. (2018), who show that U.S. consumers respond asymmetrically to positive and negative cash flows. In particular, consumers do not respond to negative cash flows resulting from federal income tax payments, regardless of whether such payments are expected or unexpected.

Next, we study the response of debt repayments to mortgage rate resets. We measure deleveraging in two ways: mortgage prepayments and changes in revolving debt balances (i.e., credit cards and lines of credit). Although we do not observe the entire consumer balance sheet, mortgage borrowers tend to have little liquid assets (Cloyne et al. (2018)). We therefore use changes in their debt to proxy changes in their net savings.

Our results, while showing consumers pay down their debt in the case of mortgage rate declines, reveal that they do not raise, but again, reduce their debt when mortgage rates increase. The fact that consumers deleverage in response to higher mortgage rates is new to the literature. If higher mortgage rates only affect consumers through the negative cash-flow channel, we would expect them to borrow more rather than to deleverage. One possible explanation is that consumers use debt to finance their spending not measured in our data (e.g., nondurables), and when hit by negative cash flows, they cut spending and hence appear to deleverage. If so, we would expect borrowers experiencing the largest negative cash flows to deleverage most. Our estimates, however, do not show such a pattern. We also rule out the possibility that banks force consumers to deleverage due to concerns about their repayment ability. Instead, we propose an alternative explanation based on the change in expectations about future interest rates. Since most revolving debt products have

variable rates, consumers may choose to pay down debt when expecting even higher interest rates in the future. Such a change in expectations may be triggered by mortgage rate resets. We present supporting evidence for this explanation based on data from the Canadian Survey of Consumer Expectations (CSCE).

Finally, we examine the change in delinquency rates for a wide range of consumer debt. Consistent with previous studies based on the U.S. mortgage market, we find that lower mortgage rates and payments reduce defaults and improve consumers' credit scores. In the contractionary episode, however, we do not find any increase in delinquency rates. We conclude from our analysis that mortgage rate resets in the contractionary episode do not discourage durable spending, render consumers more leveraged, or increase the likelihood of defaults, as is commonly asserted in newspapers and financial press at the time of the monetary policy actions.[5]

Given our micro-level estimates, we expect mortgage rate resets to have sizable aggregate effects on spending when interest rates are low, and to contribute to aggregate savings when rates are high. Since our estimates are based on a representative sample of Canadian mortgage borrowers, we evaluate the aggregate effect of mortgage rate resets using both micro estimates and macro data. We estimate that, between 2015 and 2017 when interest rates fell, the additional auto spending caused by mortgage rate resets amounted to $1.55-$1.93 billion, or 1.17%-1.45% of aggregate new auto spending, while additional durable expenditures financed by loans accounted for about 0.5% of aggregate durable expenditures. In the contractionary episode, the deleveraging of revolving debt caused by resets raised aggregate saving by 1.64%. Our methodology also allows us to assess the aggregate effects of resets over the entire period of 2009-2019. We find a substantially time-varying pattern consistent with the size of rate adjustment at specific points in time.

Relation to the Literature. Our paper is related to the literature on the effects of mortgage rate changes driven by monetary policy shifts on household balance sheets, consumption, and defaults (e.g., Di Maggio et al. (2017), Agarwal et al. (2019), Jappelli and Scognamiglio (2018), La Cava et al. (2016), Floden et al. (2016), Tracy and Wright (2016), Fuster and Willen (2017), Ganong and Noel (2016), Agarwal et al. (2017), Ehrlich and Perry (2017), Karamon et al. (2017), and Abel and Fuster (2018)). Relative to the most closely related work, Di Maggio et al. (2017), we make two main contributions. First, we focus on mortgage products that are representative for the Canadian market, whereas Di Maggio et al. studied a specific segment of the U.S. ARM market, namely,

[5] See, for example, Danielle Kubes, *"Bank of Canada increases interest rate to 1.75%"*, October 24, 2018, Ratehub. Another example is Andy Blatchford, *"Higher interest rates will hit younger, middle-income households the most: analysis"*, July 30, 2018, The Globe and Mail.

prime, non-agency contracts that were originated in 2005-2007 and were interest-only for the first 10 years. ARM borrowers in the U.S. before the financial crisis tended to be riskier, having lower non-housing wealth and living in areas experiencing rapid appreciation of property values (see, e.g., Chen and Stafford (2019)). When mortgage rates fell during the crisis, these borrowers likely had larger consumption responses and lower incentives to deleverage than a typical American consumer. In fact, when focusing on the representative Canadian borrowers in our data set, we find a smaller increase in auto spending and a much stronger response of mortgage prepayments than Di Maggio et al. Second, our study provides new evidence on how consumers respond to higher mortgage rates and on the importance of consumer expectations for this response.

Our paper also relates to the recent literature that emphasizes the heterogeneous transmission of monetary policy to the household sector through the disposable income channel (e.g., Kaplan et al. (2018) and Cloyne et al. (2018)), and through the home equity extraction channel (e.g., Beraja et al. (2018), Wong (2016), Greenwald (2017), Chen et al. (2018), Hurst and Stafford (2004), and Bhutta and Keys (2016)). The cash flows resulting from changes in mortgage payments are akin to the disposable income channel, but only applicable to mortgage borrowers.

Finally, our work contributes to the literature on the role of alternative mortgage features in affecting the transmission of monetary policy (see e.g., Campbell et al. (2018)). The automatic reset of short-term fixed-rate mortgages is a double-edged sword. It implies that, in economic downturns, more mortgages can be reset to lower rates than in a market where households' ability to refinance is constrained by declining house prices and tightened lending standards. Such constraints would severely weaken the transmission of monetary policy (e.g., Beraja et al. (2018) and DeFusco and Mondragon (2018)). On the other hand, automatic resets directly expose borrowers to higher rates when policy is in contraction.

The remainder of the paper is organized as follows. Section 2 discusses the institutional features of the Canadian mortgage market that facilitate our identification, and describes the credit-bureau data used in our analysis. Section 3 presents our empirical strategy. Section 4 discusses mortgage loan-level adjustment in rates and payments upon reset in each episode. Section 5 examines borrower-level responses of spending, debt repayment, expectations, and defaults. Section 6 provides estimates of the aggregate effect of mortgage rate resets on spending and saving. Section 7 discusses further evidence and establishes the robustness of the baseline results. Section 8 concludes.

2 Institutional Setting and Data

2.1 Canadian Mortgage Market

The Canadian mortgage market has several interesting institutional features. First, unlike the U.S. mortgage market which is dominated by long-term fixed-rate mortgages, the vast majority of Canadian mortgages is characterized by short terms (2-5 years) and long amortization periods (25-30 years). The amortization period is the length of time it takes to pay off a mortgage, whereas the term is the length of time the mortgage contract, and in particular, the interest rate, is in effect. Having a short-term fixed-rate mortgage requires the borrower to renew the contract by the end of each term. Upon renewal, the remaining balance is rolled over and the mortgage interest rate is reset according to the prevailing market rate for another term.[6] Typically, by the end of the amortization, a mortgage contract has been renewed several times.

Second, when renewing the mortgage contract with the current lender, as most borrowers do, the borrower's repayment ability, captured by credit scores, LTV and DTI ratios, is not reassessed. Thus, both rate decreases and increases are automatically passed on to renewing borrowers, unlike mortgage refinancing in the United States where most borrowers file applications when the interest rate falls, and are reassessed in the process.

Third, the existence of prepayment penalties ensures that borrowers renew their mortgage contracts on time. 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 current 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 latter captures all financial gains from prepaying the mortgage in full and originating a new mortgage at a lower rate. In practice, borrowers may renew the contract slightly earlier than scheduled with their current lender without having to pay a penalty. As shown in Figure 2, in our data, more than 98% of renewals occur in the six months leading up to the scheduled date, with on-time renewals accounting for 50%.[7]

These institutional features imply that the timing of a mortgage rate reset is predetermined and

[6] Mortgage rates obtained by individual borrowers may still vary slightly with their bargaining power (Allen et al. (2014, 2017)). In all of our analysis, we control for the borrower fixed effect and a set of borrower characteristics, which help to remove the sources of variation in the bargaining power.

[7] 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.

that the change in the interest rate upon reset is exogenous with respect to the borrower' spending and savings decisions, and does not depend on his or her financial position or creditworthiness.[8]

2.2 Data

We use granular trade-line (account) 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 monthly frequency.[9]

For each consumer, we merge mortgage loan-level information to consumer-level information on auto loans, installment loans (excluding student loans), credit cards, and lines of credit, which we compiled from account-level data. The main advantage of this approach over using consumer-level credit reports provided by the credit agency is the alignment of the timing across lenders' reports. Credit agencies usually produce consumer-level reports at a specific point in time by aggregating all information available at that time, ignoring the fact that the auto loan information, for example, may be provided by the lenders in a different month than the reports by credit card lenders. Our aggregation approach based on lenders' reporting time allows us to precisely identify the timing of durable purchases financed by auto loans or installment loans, as well as debt repayment associated with mortgage rate resets.

The mortgage loan-level data have static information on origination date, initial amount, insurance status, whether the loan is taken out jointly, whether the borrower is the primary holder of the loan, and other relevant characteristics. The dynamic information contains monthly updates on outstanding balances, contracted payments, contracted terms, delinquency status, and the indicator of whether the loan is closed. The information on other types of account (auto loans, installment loans, credit cards, and lines of credit) has a similar structure. The key variables we use for compiling consumer-level reports include origination date, initial balance, credit limit,

[8] Consumers may also extract home equity through cash-out refinancing at the end of a term by prepaying the mortgage in full and taking out a new mortgage with a higher balance. Our study focuses on the rate-reset channel conditional on balance rollover, rather than the cash-out refinancing channel, for several reasons. First, resets are much more prevalent than cash-out refinancing. In our data, the annual cash-out refinancing rate is about 2%, whereas the reset rate is 25%. Second, rate resets do not depend on consumers' LTV or DTI ratios, whereas cash-out refinancing requires reassessing underwriting standards, making the outcomes endogenous to borrowers' characteristics. Third, cash-out refinancing depends on house price movements, which, one one hand, are partially determined by interest rate fluctuations, and on the other hand, may confound the effect of mortgage rate changes. We leave the evaluation of this channel for future research.

[9] 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. The data we rely on have been stripped of all personal identifiers.

current outstanding balance, scheduled payment, and delinquency status. We also have consumer demographic information on age and the forward sortation area (FSA) code (first three digits in a postal code), as well as credit scores.

For our purpose, knowing the exact timing of a mortgage rate reset is crucial. However, not all mortgages in the loan-level dataset can be associated with their scheduled renewal dates, because lenders do not consistently report such information. In particular, a large fraction of these dates refers to the end of the amortization period, as opposed to the end of the current term. For this reason, we perform the analysis on mortgages issued by one of the five largest banks in Canada (the "Big Five" banks), which is the only bank among the Big Five that reports the end of the current term as the loan maturity date, thus allowing us to identify the timing of a mortgage renewal.

We show that our sample based on this bank is large and representative of the loans and the borrowers in the Canadian mortgage market. First, using our dataset and several alternative sources, we establish that this bank's share, both in mortgage origination and in the stock of debt outstanding, is close to 20% of the overall Canadian mortgage market. Second, we compare the characteristics of the loans originated by this bank and by all other federally regulated lenders using an alternative dataset (Bank of Canada-OSFI Mortgage Origination Dataset) that covers more detailed origination information on more than 80% of the mortgages originated in Canada since 2014. The upper panel of Table 1 shows that the FRMs for home purchases originated by this bank are very similar to those originated by other lenders. Since 5-year FRMs account for the majority of Canadian mortgages, the lower panel of Table 1 focuses on this subset of loans. Clearly, 5-year FRMs originated by this bank are quite similar to those originated by other lenders.[10]

2.3 Construction of Key Variables

Mortgage rates. Our analysis requires information on the type of mortgage rates (i.e., fixed or variable), and the level of mortgage rates. These pieces of information are not provided in the original dataset. To identify the mortgage rate type, we classify a loan as a FRM within a term if the contracted payment does not change within that term.[11] We take a series of steps to recover the rates associated with the FRMs in our sample. In Appendix A, we describe in detail how these rates are constructed, and how we use two alternative datasets that contain direct information on

[10] We also compared loan characteristics by origination purpose, by insurance status, and by broker's status. In all of these breakdowns, loans issued by the bank of our sample are quite similar to those by other lenders. We report the statistics for home purchase loans because this category appears to be most consistent among lenders' reporting.

[11] Although some lenders in Canada offer fixed-payment schedules for variable-rate mortgages, the lender in our sample typically does not. This helps identity variable-rate mortgages based on within-term changes in contracted payments.

actual mortgage rates to validate our procedure. We show that the distribution of the constructed rates based on this procedure closely matches that in the two alternative datasets.

Required monthly payments. Given the new mortgage rate upon reset, we construct a payment schedule that is not observed in the data but measures the automatic adjustment in monthly payments implied by a rate reset. When constructing this variable, we assume the same remaining amortization period (constructed as shown below) and the outstanding balances as in the month before the reset. Comparing the change in the required payment to the change in the scheduled (contracted) payment set by borrowers, we are able to examine the choice between mortgage prepayment and cash withdrawal due to the reset.

Remaining amortization. If a borrower schedules a higher payment than required when renewing the contract, the remaining amortization period is effectively shortened. For each renewing mortgage, we first use the pre-renewal rate, balance, and contracted payment to infer the remaining amortization, had the mortgage not been renewed. We then use the the post-renewal rate, post-renewal scheduled payment, and the pre-renewal balance to infer the amortization upon reset.

Durable spending measures. We construct two measures for durable spending. First, we use newly-originated auto loans as a proxy for spending on automobiles.[12] Since we work directly with auto loan-level data, we can precisely identify the timing and the amount of an auto purchase, rather than picking up discrete jumps based on ad hoc thresholds from the consumer-level reports that are commonly employed in the literature. Second, we use newly-originated installment loans (excluding student loans) as a proxy for 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 and other durable goods. Like auto loans, we use the timing and the amount of new origination to construct the likelihood of making such spending, and the amount spent.

Delinquency measures. Given loan-level information on delinquency status, we create consumer-level measures of delinquency on each type of debt (mortgage, auto loans, installment loans, credit cards, and lines of credit) 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 certain level of delinquency (60 or 90 days). We then add the number of newly delinquent accounts under each type of debt.

[12] 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 of motor vehicles in Canada is close to 100%.

Third, we convert the resulting number of delinquent accounts under a debt type into a dummy variable that captures the likelihood of being newly delinquent on at least one account under this type of debt.

2.4 Summary Statistics

Table 2 shows the summary statistics of key variables at the mortgage loan level and the consumer level used in our analysis. For the expansionary episode, we perform the analysis on loans renewed in 2015m1-2017m1, and for the contractionary episode, we focus on loans renewed in 2017m7-2019m6. For tractability, we restrict our analysis to FRMs that have terms of 2, 3, 4, and 5 years before the reset (which jointly account for 95% of the loan-level data), and present summary statistics for each term separately.[13] We perform the analysis on primary mortgage accounts. We also exclude consumers that have more than one mortgage at the same time. In total, we have 88,328 loans reset during the expansionary episode and 85,376 loans reset 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 short, 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.[14] Our analysis is carried out separately for each mortgage term in each episode, so we can focus on borrowers with similar contracts, and avoid potential endogeneity concerns due to selection into different terms.

The rich panel structure of the data allows us to include a set of borrower-level characteristics, individual fixed effects, and time fixed effects that may confound the effect of mortgage rate changes on consumer behavior. Our baseline specification is

$$y_{j,t} = \alpha_0 + \alpha_1 PostRenew_{j,t} + \alpha_2 \mathbf{x}_{j,t} + \gamma_j + \delta_t + \varepsilon_{j,t}, \tag{1}$$

where j denotes the consumer and t denotes the month. $y_{j,t}$ is either a loan-level outcome variable

[13] In the contractionary episode, some mortgages renewed early experienced small rate declines, especially 5-year FRMs. This is because the reversal of the market rates at the beginning of the episode had not been large enough to offset the earlier declines. Since we are interested in the behavior of consumers who experience rate increases in this episode, we focus on the sample period when the majority (70%) of the mortgages for each type were renewed to higher rates. We set 2017m7, 2017m10, 2017m11, and 2018m2 as the starting month for 2, 3, 4, and 5 -year FRMs, respectively, and the end month being 2019m6 for all types. We also show that the results are similar when we choose the surrounding months as the starting points.

[14] A similar strategy is used in Fuster and Willen (2017) and Di Maggio et al. (2017), both exploiting the timing of automatic rate resets of ARMs in the U.S. to study borrowers' responses to lower mortgage payments.

(analyzed in Section 4) or a borrower-level outcome variable (analyzed in Section 5). $PostRenew_{j,t}$ is an indicator for the months after the renewal. $\mathbf{x}_{j,t}$ is a vector of borrower-level characteristics, including the previous-month credit score, age, and the previous-quarter LTV ratio of the borrowers' FSA. γ_j is the individual fixed effect that absorbs all time-invariant unobserved heterogeneity correlated with the consumer's choices. δ_t is the monthly fixed effect designed to capture the trend in the macro economy and to control for the confounding effects of aggregate shocks. α_1 is the key parameter of interest that captures the effect of a mortgage rate reset. The standard errors are clustered at the consumer level.[15]

Both the theoretical and the empirical literature has shown that consumers respond differently to positive income shocks, depending on their wealth status and access to the credit market. Motivated by this literature, we consider three empirical measures for studying these heterogeneous responses. First, we use the average credit score over the preceding 12 months as a proxy for access to new credit. Second, we use the combined utilization rate of credit (credit cards and lines of credit) averaged over the preceding 12 months as proxy for constraints on existing available credit. Third, we use age under 45 as a proxy for low wealth. For estimating the heterogeneous responses, we interact the post-renewal indicator with each of these empirical measures.

Borrowers may change consumption or savings even before the reset in anticipation of a change in the mortgage rate. To evaluate the anticipation effect, we estimate a dynamic version of specification (1) that, instead of a single post-renewal indicator, includes a set of quarterly dummies. Specifically, we estimate α_1^q's from

$$y_{j,t} = \alpha_0 + \sum_{q \in Q} \alpha_1^q \mathbf{1}_j(t \in q) + \alpha_2 \mathbf{x}_{j,t} + \gamma_j + \delta_t + \varepsilon_{j,t}, \tag{2}$$

where q denotes the quarter since the mortgage renewal, and $\mathbf{1}_j(t \in q)$ is a dummy that takes the value of 1 if month t is in the qth quarter since the mortgage renewal. We set the quarter before the renewal as quarter 0, and estimate the responses in the two quarters before, and in the five quarters after the renewal.

One potential concern with the baseline strategy is that it may be unable to account for the mortgage-age effect that drives consumption and savings decisions. For example, consumers tend to expand their consumption several years after a home purchase. This timing may overlap with

[15] Our results are robust to controlling for the region-time fixed effect or the cohort-time fixed effect, where region is defined as the province, and cohort is defined as the quarter of the previous reset. The first set of fixed effects allows 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 (2018)). The second set of fixed effects allows for unobserved heterogeneity across cohorts.

their mortgage resets. In this case, consumption increases for reasons related to preferences or life-cycle needs, rather than mortgage rate changes. Given that the mortgage-age effect would be collinear with the post-renewal indicator, we cannot control for it.

We implement two alternative strategies as robustness checks. First, we consider a difference-in-difference design that introduces as the control group longer-term mortgages (7 and 10-year term FRMs). These mortgages have previously reset at the same time as the mortgages in our sample. Intuitively, we compare two mortgages, both originated in, say, 2010m1, but one reset in 2015m1 and the other had to wait until two years later.

While this approach is able to control for the mortgage-age effect, the precision of the estimates is limited by the small size of the control group, since not many Canadian borrowers take longer-term mortgages. In addition, one might be concerned about the endogenous selection into these mortgages. For these reasons, we also consider a second difference-in-difference design that introduces mortgages of the same term but not renewed in the period of interest as the control group. For example, in the expansionary episode, we use 5-year FRMs previously reset in 2012m1-2013m1 (hence not reset in this episode) as the control group for 5-year FRMs reset in this episode.

Both empirical designs can be implemented by the following specification,

$$y_{j,t} = \beta_0 + \beta_1 Renew_j \times PostRenew_{j,t} + \beta_2 \mathbf{x}_{j,t} + \gamma_j + \delta_t + \varepsilon_{j,t}, \tag{3}$$

where $Renew_j$ is an indicator for loans renewed in an episode. All other variables are similarly defined as in (1). The parameter of interest is β_1, which captures the difference-in-difference effect. In Section 7, we show that the estimates based on the baseline specification are robust to the two alternative empirical designs.

4 Mortgage Loan-Level Adjustment

We start by estimating the change in mortgage rates and the resulting change in monthly payments upon reset assuming the same amortization. We then examine the change in scheduled monthly payments set by borrowers, which helps infer the decision on mortgage prepayment. We also estimate directly the change in amortization. We conclude this section by assessing the heterogeneity in the choice of scheduled payments relative to the change in required payments and linking it to predictions from standard consumption theory.

4.1 Change in Mortgage Rate and Required Payment

Column (1) in Table 3 shows the change in the mortgage rate upon reset by term. In the expansionary episode, renewing mortgages experienced substantial downward adjustment in rates. The degree of adjustment, however, varies with the previous mortgage term. Having a longer term before the reset results in a larger rate reduction. For example, 5-year FRMs on average experienced a 113 b.p. rate decline, followed by 4-year FRMs with a 38 b.p. reduction, whereas 2 and 3-year FRMs experienced moderate rate declines of 16 b.p. and 18 b.p., respectively. The difference across terms is expected, since the prevailing market rates had already been trending down prior to 2015, so longer-term mortgages experienced larger rate reductions when they were renewed in this episode.

Lower mortgage rates imply savings on interest payments. Assuming the same amortization, we use the new rate upon reset to compute the new required monthly payment. Column (2) shows the change in the required payment. When the mortgage rate declines, it measures the maximum reduction in the monthly payment borrowers can cash out. Our estimates show that borrowers with 5-year FRMs may lower their payments by $92 per month upon reset, $1,104 per year, or $20,891 for the remaining life of the loan (see Table 4). Although interest savings are relatively smaller for other borrowers, the total savings can still be as large as $8,500 for 4-year FRM borrowers, and about $3,000 for 2 and 3-year FRM borrowers. Since 5-year FRMs are the most common product in the Canadian mortgage market, our analysis suggests that most borrowers renewing their mortgage contracts in this episode experienced sizable positive cash flows.

In the contractionary episode, all renewing mortgages experienced rate increases. The degree of adjustment, however, decreases with the term prior to the reset. The 2-year FRMs, for example, experienced the largest rate increase with 85 b.p., followed by 3-year FRMs with 70 b.p., whereas the rate of 4 and 5-year FRMs experienced a 49 b.p. and 32 b.p. upward adjustment, respectively. This pattern, again, is consistent with the trend in the prevailing market rates, which started to rise only after the monetary policy tightening in mid 2017, resulting in smaller rate changes for mortgages with longer terms.

Higher mortgage rates cause higher interest payments. According to our estimates, the monthly required payments increase by $83, $55, $36, and $34 per month for 2, 3, 4, and 5-year term mortgages, respectively. Taking into account the remaining amortization, borrowers of 2-year FRMs have to pay $19,165 more in total in response to the higher mortgage rate. Even 5-year

FRM borrowers still have to pay $7,072 more than before. For a straightforward visualization of the change in mortgage rates and payments across terms in each episode, see Figures 3 and 4.

4.2 Change in Contracted Payment and Amortization

Unlike in the case of ARM resets in the United States, where both mortgage rates and payments are adjusted automatically, Canadian borrowers, given the new rate, can choose the new monthly fixed payments when renewing their mortgage contracts. Scheduling higher payments than required, for example, allows borrowers to pay down the principal faster and to accelerate the amortization. By comparing the change in required payments with the change in scheduled payments, we are able to infer the choice between mortgage prepayment and liquidity withdrawal.

For the expansionary episode, the results in column (3) of Table 3 show that borrowers do not lower their payments fully to the required level. For example, borrowers of 5-year FRMs on average only lower their monthly payments by $46, compared to the maximum possible reduction of $92 per month. A similar pattern is found in other types of renewing mortgages in this episode (also see Figure 4). This implies that only part of interest savings are cashed out, and the rest are used to repay the principal faster. How much faster? We estimate the change in the remaining amortization based on the new rate and scheduled payment. Column (4) shows that, depending on the term, the amortization period is shortened by 4 to 14 months. The acceleration in amortization leads to further interest savings. As shown in Table 4, mortgage rate resets in the expansionary episode on average result in total savings of about $5,000 to $24,000 for renewing mortgages, after adjusting for the change in amortization.[16]

In the contractionary episode, our estimates show that borrowers' new monthly payments increase almost as much as the required payments, leaving amortization largely unchanged. The asymmetric responses of scheduled payments in the two episodes are not surprising, since borrowers face supply-side constraints when the mortgage rate increases. Lenders in general do not allow borrowers to schedule payments lower than required, or to extend amortization to smooth the higher payments for the purpose of renewal.

4.3 Heterogeneity in Mortgage Payment Choices

Our previous results show that, in the expansionary episode, borrowers use part of their interest savings from the reset to repay the mortgage principal faster. There are reasons to believe that this

[16] In principle, borrowers may also prepay their mortgages through ad hoc out-of-pocket payments on top of scheduled monthly payments. We estimate the change in this type of prepayment, and find economically very small effects. This means mortgage prepayment is mostly done by scheduling higher monthly payments at contract renewal.

pattern may vary across borrowers. Standard consumption theory implies that liquidity-constrained borrowers will cash out more of the interest savings for spending, and leave less for prepaying the mortgage. We now focus on borrowers who experience large payment declines (i.e., 4 and 5-year FRM borrowers), and examine how liquidity-constrained borrowers, characterized by the three empirical measures (described in Section 3), differ from other borrowers.

Table 5 confirms the theoretical prediction. We compute the ratio of the change in contracted payment to the change in required payment as a measure for liquidity cashed out. First, consider two groups of borrowers, having high and low credit scores, who renew their 5-year FRMs. Our estimates show that the cash out rate 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, the cash out rates for borrowers with low and high credit utilization are 37% and 68%. Likewise, this rate is 47% for middle aged borrowers, but 57% and 58% for young and old borrowers. Turning to borrowers renewing 4-year FRMs, we find a similar pattern that liquidity-constrained borrowers convert more of the interest savings to immediate liquidity than other borrowers.

We also examined heterogeneity in payment choices for the contractionary episode (not shown to conserve space). Unlike in the expansionary episode, we find no heterogeneity in the ratio of the change in contracted payment to the change in required payment. Borrowers set their scheduled payments close to the required levels, and leave amortization unchanged, regardless of the measure of liquidity constraints. The lack of heterogeneity here, again, can be explained by lenders' policy that scheduled payments in general cannot fall short of required payments, even though liquidity-constrained borrowers may have strong incentives to do so.

5 Mortgage Rate Resets and Consumer-Level Responses

We now examine the response of consumer spending, debt repayment, and defaults to mortgage rate resets. Our findings for the expansionary episode are consistent with standard consumption theory, and are in line with previous studies, whereas the patterns we find for the contractionary episode are new to the literature, and do not appear to be symmetric in the expansionary episode. Most interestingly, we find consumers pay down, rather than raise, their debt when mortgage rates increase, which is inconsistent with the interpretation that mortgage rate shocks only affect consumer behavior through the cash-flow channel. We evaluate several alternative explanations, and find supportive evidence for the role of interest rate expectations in reconciling this fact.

5.1 Consumer Spending

In the expansionary episode, we find that consumers having the largest mortgage rate reductions, i.e., 5-year FRM borrowers, increase their durable spending. On average, monthly spending financed by auto loans and installment loans increases by $19 and $44, respectively, corresponding to a 16% and 18% increase relative to the sample mean (Table 6, columns 1 and 3). Our results also show that mortgage rate resets cause some consumers who otherwise would not have been able to do so to spend on these goods. For example, columns (2) and (4) show that the likelihood of purchasing an auto increases by 0.07 percentage points in a month (19% higher relative to the mean), and the likelihood of taking a new installment loan increases by 0.14 percentage points (15% higher relative to the mean).[17]

We also address the question of whether these borrowers have already raised their spending before the reset, and of whether their spending is completely reversed after the initial increase. The estimates from the dynamic-version of the specification (Figure 5) show that the sharp increase in spending on both automobiles and purchases financed by new installment loans occurs in the quarter of the reset. Moreover, spending on these items remains high for the next few quarters. In five quarters after the reset, total spending on automobiles and spending financed by new installment loans amount to $400 and $500, respectively. This implies that increased durable spending driven by lower mortgage rates and payments is not reversed.

Before we turn to the contractionary episode, we examine heterogeneity in spending across borrowers. We focus on 5-year FRM borrowers. Standard consumption theory predicts that liquidity-constrained borrowers will be more responsive to positive income shocks. On the other hand, since payment reductions are realized over the course of several years, the difficulty in obtaining new credit may create a hurdle for some consumers who could have used debt to finance their current spending. Our findings can be summarized into three points (see Table 7). First, while all borrowers increase their spending on automobiles and purchases financed by new installment loans, low credit-score borrowers display relatively smaller responses than high credit-score borrowers. This finding suggests that these borrowers may have limited access to new credit, or face high borrowing costs. Second, young borrowers are more responsive in spending than other age groups, consistent with life-cycle consumption theory. Third, there is no significant

[17] We do not find significant responses of spending by borrowers renewing other terms of mortgages. This is not surprising, given that the size of mortgage rate and payment reduction is small for these borrowers. The patterns of heterogeneity across borrowers within each term, however, are similar to those of 5-year FRM borrower.

heterogeneity across credit utilization rates, which may be explained by the inability of high-usage borrowers to obtain more credit.

In the contractionary episode, surprisingly, we do not find spending decreases. In fact, with only one exception, spending measures for borrowers renewing any type of mortgage do not change significantly. The only exception is the likelihood of auto purchases for 2-year FRM borrowers, which turns out to be positive, not negative, and significant at the 5% level. Nor does spending appear to decrease at longer horizons when we examine the estimates from the dynamic version of the specification. Across borrowers, the only noticeable heterogeneity is that those having low credit scores tend to lower their spending relative to higher credit-score borrowers, confirming the role of credit market access for explaining spending divergence.

The lack of spending responses in the contractionary episode raises the question of whether our measures of spending are insufficient to capture consumption responses to negative cash flows. This is possible, given that our data can only measure durable spending financed by auto loans and new installment loans. However, there are reasons to believe that consumers do not cut their spending materially when experiencing negative cash flows. First, similar asymmetries have been documented in different contexts. Baugh et al. (2018), using detailed transaction-level data that include both banking (checking, savings, and debit) and credit card transactions to measure consumption, finds that consumers respond asymmetrically to positive and negative cash flows. In particular, consumers do not cut their spending when making federal income tax payments whether or not such payments are unexpected. Second, it is unlikely that the insignificant estimates are due to the lack of power of our test. Recall that our spending estimates for 5-year FRM borrowers in the expansionary episode have the expected signs, are highly statistically significant (all below 1%), and are in line with the previous studies solely focusing on expansionary episodes. For the contractionary episode, we apply exactly the same estimation strategy.

5.2 Revolving Debt Repayment

The recent empirical literature has documented that, apart from raising consumption, households pay down their debt in response to positive income and wealth shocks (e.g., Di Maggio et al. (2017), Bhutta and Keys (2016), and Baugh et al. (2018)). Although deleveraging attenuates the effect on spending, improved household balance sheets can provide a buffer against unexpected negative shocks in the future. Our analysis in Section 4.2 shows that consumers pay down their mortgages faster when experiencing lower mortgage rates and payments, while leaving amortization

unchanged when mortgage payments are higher. We now examine the response of revolving debt (credit cards and lines of credit), our second measure of deleveraging, to mortgage rate resets.

In the expansionary episode, we find that consumers on average pay down their credit card debt by about $130 to $250 (3-6% relative to the average balance) upon reset, as shown in column (6) of Table 6. The deleveraging in credit card debt, however, is completely reversed by raising lines of credit debt (column 7), leaving the total revolving debt balances almost unchanged (column 5). In terms of timing, Figure 6 illustrates for 2-year and 5-year FRM borrowers that the balance on credit cards falls sharply in the quarter of the reset and stays roughly the same for the next few quarters, whereas the balance on lines of credit gradually increases and becomes significantly higher after two quarters.

Although revolving debt does not respond on average, closer scrutiny reveals stark heterogeneity across borrowers. Panel I in Table 8 focuses on the results for 5-year FRM borrowers. The patterns are very similar for borrowers having other types of mortgage. Overall, high credit-score, low credit-usage, and old borrowers deleverage more than other borrowers. The fact that low credit-score and high credit-usage borrowers deleverage less, and sometimes even raise their leverage, suggests that they rely on existing, rather than new credit for smoothing consumption in response to income shocks. This is consistent with the interpretation that these borrowers face difficulties in obtaining new credit. To see this point, we also estimate the change in the combined credit utilization rate. Although these borrowers increase their utilization rates upon reset relative to other borrowers, the changes are too small to push the overall utilization rates above unity.[18]

Our most interesting finding is the response of revolving debt repayment to higher mortgage rates in the contractionary episode, which has not been examined in the literature. We find that consumers pay down their credit card debt by about $210 to $270 (5-6% of the average balance), but unlike in the expansionary episode, credit card deleveraging is not offset by higher debt on lines of credit (Panel II in Table 6). Even at longer horizons, we do not find that the balance on lines of credit increases (Figure 6, lower panel). Consumers, therefore, reduce their total revolving debt by $260 to $900 when resetting their mortgage rates to higher levels, except for 4 -year FRM

[18]The only complication is heterogeneity in revolving debt repayment across age. First, we find that old borrowers deleverage more than young and middle-aged borrowers on both credit cards and lines of credit, consistent with the incentive to pay down debt at the end of the life cycle. Second, young borrowers deleverage less on credit card debt than other borrowers, consistent with life-cycle consumption theory. What surprises us, is that young borrowers deleverage more on lines of credit than middle-aged borrowers. One possible explanation is that young borrowers are closer to the credit limit on their lines of credit. This is true in the data. The utilization rate of lines of credit is 90% for young borrowers, compared to 59% for middle-aged borrowers. The utilization rate of credit cards, on the other hand, is 55% for young and 40% for middle-aged borrowers.

borrowers who display no change. At the cross-sectional level, heterogeneity in deleveraging exhibits similar patterns as in the expansionary episode (Table 8). High credit-score, low credit-usage, and old borrowers deleverage more than other borrowers, although in some cases the heterogeneous responses are not precisely estimated.

These patterns suggest that the change in cash flows is not the only channel through which higher mortgage rates can affect consumer savings. If it were, consumers would increase, not decrease, their leverage in response to higher mortgage payments. Put differently, consumers would lower their net savings in order to smooth consumption when they face negative income shocks.

One argument in favor of the cash-flow channel is that, consumers use debt to finance their spending not measured by our data (e.g., nondurables), and since they reduce their debt, they must cut their spending. This simple argument, however, is difficult to reconcile with two additional facts. First, it cannot explain why consumers who experience the largest negative income shocks (i.e., 2-year FRM borrowers) do not deleverage more than borrowers who experience much smaller negative income shocks (e.g., 5-year FRM borrowers). Second, it implies that liquidity-constrained borrowers will cut their spending more, and hence deleverage more than other borrowers, which is the opposite of what we find in the data.

Another explanation is that banks force consumers to deleverage, because they are concerned about the repayment ability of those who experience higher mortgage payments. Since we observe the credit limit of each account, we can evaluate this argument by estimating the response of credit-supply measures. First, we estimate the change in the likelihood of extending credit limits by at least $1,000 in a month. Columns (1) and (2) in Table 9 show a higher, rather than lower, likelihood of obtaining more credit. Second, we estimate the change in the total credit limit for each type of revolving debt. The results in columns (3) and (4) show that the credit limits increase for lines of credit and do not change for credit cards.[19] Third, we estimate the response of the required payment to previous balance ratio. A higher payment (relative to the balance) required by banks reflects tightening credit. We do not observe any change in this ratio (columns 5 and 6). To summarize, we find no evidence that deleveraging in the contractionary episode is driven by banks tightening the lending policy.

[19]It is possible that borrowers may voluntarily reduce their credit limits by closing their accounts, by contacting the lenders to downsize the available credit, or by opening fewer accounts than otherwise. If we were to find declines in credit limits, it would be hard to determine whether such a fall is driven by supply or demand side factors. However, our finding that borrowers' credit limits do not fall but rather rise rules out the explanation that lenders force borrowers to deleverage.

A more plausible explanation is the change in consumer expectations about future interest rates upon reset. As revolving credit products often have variable rates, consumers may choose to pay down their debt if they expect higher interest rates in the future. Since our credit-agency data do not have information on consumer expectations, in Section 5.3 we turn to data from consumer expectation surveys to investigate this explanation.

5.3 Consumer Expectations

We postulate that when the current interest rate increases, consumers expect future interest rates to be higher, which causes them to pay down debt. The change in expectations about future interest rates may be triggered by mortgage rate resets. Given the well-known inattention problem documented in the household finance literature (e.g., Keys et al. (2016) and Andersen et al. (2019)), it is reasonable to believe that the mandatory mortgage renewal process in Canada forces consumers to pay attention to mortgage rate changes around the time of resets, and to revise their beliefs about future interest rates.

We use the Canadian Survey of Consumer Expectations (CSCE) to establish three facts that together support this explanation.[20] First, consumers who are aware that interest rates have risen tend to expect the rates to be even higher in the future. Second, in response to their expectations about higher future rates, consumers are more likely to pay down debt, cut back spending and save more. Third, in the contractionary episode, mortgage borrowers that experience frequent or recent rate resets are more likely to be aware that interest rates have risen. Since measures for expectations in the survey data are qualitative, we view our evidence based on the CSCE as suggestive of the expectations channel.

To establish the first fact, we estimate the following logistic model that helps control for consumer characteristics that may confound the relationship between the perceptions of the current interest rates and the expectations about future rates,

$$Pr(ExpectH_{i,t} = 1 | CurrentH_{i,t}, \mathbf{x}_{i,t}, \delta_t) = \mathbf{F}\left(\theta_0 + \theta_1 CurrentH_{i,t} + \mathbf{x}_{i,t}\theta_2 + \delta_t\right), \tag{4}$$

where $\mathbf{F}$ is the cdf of the logistic distribution. $ExpectH_{i,t}$ is a dummy variable that takes the value of 1 if consumer i at time t expects interest rates (on mortgages, bank loans and savings) to be

[20] The Canadian Survey of Consumer Expectations (CSCE), launched by the Bank of Canada in 2014q4, provides comprehensive information about consumer expectations for inflation, interest rates, labor markets, credit markets and housing markets. The survey also collects information on demographics and income. The survey data are collected from a nationally representative sample of 1,000-2,000 household heads every quarter. The methodology and design used for the survey largely follow those of the Federal Reserve Bank of New York's Survey of Consumer Expectations. See Gosselin and Khan (2015) for a detailed description of the CSCE.

higher in certain number of years from now with a probability greater than 0.5. $CurrentH_{i,t}$ is a dummy variable equal to 1 if the consumer expresses that interest rates have risen over the past 12 months. $\mathbf{x}_{i,t}$ is a vector of consumer characteristics (age, gender, marital status and education). δ_t is the time fixed effect. The standard errors are clustered at the consumer level. The estimated coefficients of the logistic regression are transformed to marginal effects. Table 10 shows that consumers who are aware that interest rates have risen are more likely to expect rates to be higher in the next 12 months (column 1), even higher 2 years from now (column 2), and continuously rising over 5 years (column 3).

To establish the second fact, we take advantage of a survey question that explicitly asks consumers about the actions they are taking or plan to take (pay down debt, cut spending/save more, postpone major purchases, bring forward major purchases) in response to their expectations about future interest rates. Since consumers can choose multiple actions, we estimate a series of logistic regressions with each action replaced at a time, similar to model (4). Columns (4) to (7) in Table 10 show that consumers who perceive rising interest rates tend to pay down debt, cut spending, and save more. Since this fact links consumers' perceptions of the current rates, their expectations about future rates, and the corresponding actions, it provides direct support for our findings of debt repayment in response to higher interest rates.

Finally, we show that mortgage borrowers who experience frequent rate resets or recent resets when the overall interest rates are rising are more likely to be aware of this trend. Since the survey data do not provide information on mortgage contract renewals, we use the indicator of having a variable-rate mortgage ($VRM_{i,t}$) as a proxy for frequent resets, and the indicator of having taken a new mortgage less than a year before ($New_{i,t}$) as a proxy for recent resets, to predict the likelihood of perceiving the interest rates to have risen in the contractionary episode. The omitted group is fixed-rate mortgage borrowers who have had the loan for at least a year. The logistic model is

$$Pr(CurrentH_{i,t} = 1|VRM_{i,t}, New_{i,t}, \mathbf{x}_{i,t}, \delta_t) = \mathbf{F}\left(\eta_0 + \eta_1 VRM_{i,t} + \eta_2 New_{i,t} + \mathbf{x}_{i,t}\eta_3 + \delta_t\right). \quad (5)$$

The estimates, $\hat{\eta}_1 = 0.11$ and $\hat{\eta}_2 = 0.08$, with $t-$statistics of 5.74 and 3.32, imply that in the contractionary episode variable-rate borrowers and borrowers who have recently taken out a loan are 11% and 8%, respectively, more likely to be aware that interest rates have risen than fixed-rate mortgage borrowers. This supports the view that consumers may not continuously pay attention to interest rate movements unless the nature of their mortgage contracts forces them to do so.[21]

[21] One question is why we do not observe significant debt accumulation in the expansionary episode, as the expectations channel should work symmetrically when the interest rate declines. We find that such asymmetry may

5.4 Delinquency

Based on evidence from the U.S. mortgage market, the previous literature has found that positive cash flows resulting from lower mortgage rates help lower mortgage default rates[22]. This finding is important for designing policies to reduce defaults and for regulating the mortgage market in the aftermath of the U.S. foreclosure crisis.

There has not been a study, however, that systematically examines the effect of higher mortgage rates on default. One challenge is that, before the crisis, ARM resets in the U.S. almost always led borrowers to increase their monthly payments, and many borrowers responded by refinancing. These refinances introduce a selection bias because less creditworthy borrowers are less likely to refinance. Thus, comparing borrowers who reset to higher rates (but not refinance) with borrowers who do not reset tends to overestimate the effect on defaults (see Fuster and Willen (2017)). In fact, this selection problem poses an identification challenge not only for estimating the effect of ARM resets on defaults, but also on other consumer behavior such as spending and savings when interest rates are rising. Focusing on the Canadian mortgage market allows us to circumvent this selection problem and to cleanly identify the causal effect. We are particularly interested in whether higher mortgage rates cause higher defaults, not only on mortgages, but also on a wide range of consumer debt.

The results are shown in Table 11. First, we find that lower mortgage rates and payments in the expansionary episode reduce the likelihood of defaulting on mortgages, especially for 5-year FRM borrowers. This finding is consistent with the previous literature based on the U.S. mortgage market. We also find that delinquency on other types of debt falls for these borrowers, especially on installment loans. For other borrowers, we do not find that delinquency rates have changed. All borrowers, regardless of their contract type, on average experience increases in credit scores, which may be explained by deleveraging on mortgages and credit card debt.

In the contractionary episode, we do not find that delinquencies increase for any type of debt. The fact that higher required mortgage payments do not drive consumers to default on their mortgages may be explained by the stringent underwriting standards in the Canadian mortgage

be explained by the composition of expectations conditional on current perceptions. For example, when consumers are aware that interest rates haven risen, as an empirical matter, they are also very likely to expect higher rates in the future (80%), leading them to deleverage, but when they are aware that interest rates have declined, they are still more likely to expect interest rates to be higher in the future (53%). This means, expectations alone in the expansionary episode will not result in debt accumulation as much as the deleveraging in the contractionary episode.

[22]See e.g., Tracy and Wright (2016), Fuster and Willen (2017), Ehrlich and Perry (2017), Agarwal et al. (2017), Ganong and Noel (2016), Karamon et al. (2017), and Abel and Fuster (2018).

market, and the prevalence of recourse provisions, that guarantee extraordinarily low default rates (Crawford et al. (2018)). In our data, the delinquency rate on mortgages is about 0.1%. Aggregate data from the Canadian Bankers Association show that the residential mortgage default rate historically has never exceeded 0.5% since 2005, even during the global financial crisis. The fact that higher mortgage rates do not cause consumers to default on non-mortgage debt is also consistent with our previous finding that consumers tend to deleverage during the contractionary episode. Thus, higher mortgage rates and payments do not appear to pose a concern for financial stability in the household sector.[23]

6 The Aggregate Effect of Mortgage Rate Resets

Given our micro-level estimates, we expect mortgage rate resets to have an impact on aggregate spending when borrowers reset their rates to lower levels, and to contribute to higher aggregate savings by driving consumers to deleverage in the contractionary episode. Since our estimates are based on a representative sample of Canadian mortgage borrowers, in this section, we calculate the aggregate effect of mortgage rate resets using both micro estimates and macro data.

To begin with, the effect of resets on aggregate spending or saving at time t can be computed by integrating the effects across all terms, that is,

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

where D denotes the mortgage term before the reset, $\triangle R_t^D$ is the average rate adjustment, ϵ_t^D is the interest rate semi-elasticity (of spending or saving), and $\phi_t(D)$ is the number of borrowers who reset their term-D mortgages at t. $\triangle R_t^D$ is estimated using our microdata. $\phi_t(D)$ is estimated using census data on the total number of mortgages and our micro estimates on the share of each type of mortgages. We use the estimates in Table 6 suitably scaled for interest rate elasticities.[24]

Effect on aggregate auto spending. We estimate that the total increase in auto spending caused by mortgage rate resets between 2015m1 and 2017m1 amounted to \$1.55-\$1.93 billion, or 1.17%-1.45% of Canadian aggregate new auto sales. These estimates are obtained as follows. For the lower bound, we set \$1,380 as the auto spending elasticity for a 100 b.p. reduction in the

[23] We also find interesting heterogeneity across borrowers. A robust pattern showing up in all mortgage types and in both episodes is that the decline in mortgage defaults in response to a mortgage rate change is smaller for low credit-score borrowers. In contrast, the decline in credit-card defaults is larger for these borrowers.

[24] For assessing the aggregate effects, we obtain data on monthly seasonally adjusted aggregate new motor vehicle sales (scaled by the non-commercial share, 87%), quarterly seasonally adjusted aggregate durable expenditures, and quarterly seasonally adjusted aggregate household saving from Statistics Canada.

mortgage rate upon reset for 5-year FRM borrowers, and zero for other borrowers.[25] The average rate adjustment for 5-year FRM borrowers is 113 b.p. (Table 3). We also estimate that 991,104 consumers reset their 5-year FRMs over this period. Thus, resets caused $1.55 billion dollars to be spent on automobiles that would otherwise not have been spent. The aggregate new auto sales in Canada during this period was $132 billion. For the upper bound, we apply $1,380 as the auto spending elasticity for all types of borrowers, and use their corresponding rate changes and the number of resets to compute the total effect across terms.

Effect on aggregate durable consumption. We use the sum of auto spending and spending financed by new installment loans as a proxy for durable consumption, and assess the effect of resets on aggregate durable expenditures. Using a similar methodology, we estimate that between 2015m1 and 2017m1, increased expenditures on durable goods due to resets reached $1.5-$1.86 billion, or 0.46%-0.57% of overall durable expenditures.[26]

Time-varying spending effects. It is clear from expression (6) that the effect on aggregate spending can vary substantially over time due to the degree of rate adjustment, $\triangle R_t^D$, even though the spending elasticity and the number of resets are stable over time. There are other periods when mortgage borrowers experience large changes in rates when renewing their contracts. We now extend the analysis from the specific episodes to the entire period for which microdata are available, and adapt our calculation method to gauge the historical effects of mortgage rate resets.[27]

Figure 7 shows the time-varying effect of mortgage rate resets. Although resets generated large stimulus between 2015 and 2017, consistent with our earlier calculations, these effects are dwarfed by other historical episodes, notably, around 2013. Additional auto spending caused by resets accounted for almost 6% of aggregate new auto sales, and increased durable consumption reached 1.6% of aggregate durable expenditures.

How can we explain this large variation? Figure 8 provides the answer by illustrating the change in mortgage rates upon reset for 5-year FRMs. Borrowers who renewed their mortgages in 2013 were able to lower their rates by almost 250 b.p. As can be seen in Figure 1, when these borrowers previously reset in 2008, the policy rate was high, but plummeted in the subsequent global financial

[25] This elasticity is computed based on monthly auto spending of $18.56, which is precisely estimated for 5-year FRM borrowers. We then multiply this number by 84 to reflect the fact that auto loans usually last for 7 years, and divide it by 1.13 to obtain the interest rate semi-elasticity.

[26] An illustrative example of the difference from the auto spending calculation is that when computing the lower bound, we use $1,336 as durable expenditure semi-elasticity, which is the sum of monthly spending on auto and new installment loans multiplied by 24 to reflect the duration of the period, and further divided by 1.13.

[27] We set the spending elasticities to zero when borrowers experience upward adjustment in rates, consistent with our micro estimates.

crisis, leading to substantial downward rate adjustment, and hence spending stimulus, when these borrowers reset later. Although our micro data only start in 2009, preventing us from studying that crisis episode in detail, our micro estimates based on later episodes help us recover the aggregate effects of these resets.

Effect on aggregate saving. Unlike the episode of 2015-2017, the period between mid 2017 and mid 2019 is the only episode in our data when most mortgages experienced upward rate resets. Our micro-level estimates show that most borrowers deleverage on revolving debt in response to the rate change. We now focus on this episode and modify our calculations accordingly to assess the effect of resets on aggregate savings.[28] Our method suggests that over this period, consumer deleveraging in response to higher mortgage rates generated approximately $658 million of net savings (or 1.64% of aggregate saving). Figure 9 illustrates this effect by quarter, and shows that it reaches the maximum around 2018q3 (2% of aggregate saving) when consumers experienced the largest mortgage rate increases.

7 Further Evidence and Robustness Analysis

In this section, we provide further analysis and robustness checks that support the main findings in Sections 4 and 5. This analysis helps to address a number of potential concerns arising from the coverage of data, the identification strategy, the institutional features, and the anticipatory effects.

Transition to other Financial Institutions (FIs). Since mortgages in our sample are issued by one bank, a potential concern is that our estimates may not capture the effects of mortgage rate resets when borrowers switch to other FIs for contract renewal. We now assess whether switching for renewal is quantitatively important in the data. For this purpose, we follow the borrowers who were scheduled to renew their contracts in the two episodes, but closed their mortgage accounts before the renewal. We focus on the two months in the neighborhood of the closure date, and examine whether the borrower opens another mortgage account with any financial institutions. The patterns are similar when we consider longer horizons.

We classify the purpose of closing one account and opening another one into three categories: (1) cash-out refinance, if the new account has an initial balance at least $5,000 higher than the balance on the previously closed account, and the borrower keeps the same postal code; (2) renewal, if similar to (1), but the change in the balance is less than $5,000; and (3) purchase, if the borrower

[28] We use the estimates in column (5), panel II of Table 6 for constructing interest rate semi-elasticities. This effect is precisely estimated for all borrowers except for 4-year FRM borrowers, for whom we set it to zero in the calculation.

opens another account in a different postal code. We find that most borrowers closed their current accounts for the purpose of cash-out refinancing, rather than renewal. Specifically, among all borrowers who were scheduled to renew their mortgages in the two episodes, only 0.35% switched to another FI for renewal.[29] Therefore, the fraction of switching borrowers is likely to be too small to matter quantitatively for our main results.[30]

The Term-Spread Effect. In the baseline analysis, we do not restrict the mortgage term after the reset to be the same as before the reset. Thus, our estimates capture the average responses across all terms after the reset. One concern is that, if borrowers with shorter-term mortgages tend to switch to longer-term mortgages at renewal or the other way around, our estimates may be confounded by the spread between the longer and shorter-term mortgage rates. As shown in Table 2, the mortgage rate is increasing in the mortgage term. To address this concern, we first estimate term transition probabilities, and then examine to what extent the main results in Sections 4 and 5 are affected if we restrict the mortgages to have the same term before and after the reset.

Table B1 shows that the choice of term is persistent for borrowers with relatively short (2-year) and long (5-year) term mortgages. For example, 65% of 2-year and 68% of 5-year FRM borrowers choose the same terms upon reset in the expansionary episode, and these numbers, despite smaller in the contractionary episode, are still close to 60%. Borrowers with 3 and 4-year FRMs tend to switch to other terms. Given the dominance of 2 and 5-year FRMs in the market, however, it is fair to say that the majority of borrowers do not switch to other terms.

Table B2 examines loan-level adjustment and borrower-level responses to resets using the restricted sample. As expected, the rate reduction for 2-year FRMs is larger in the expansionary episode, and the rate increase is smaller for them in the contractionaty episode. The change in rates for other mortgages is similar to the baseline estimates. In terms of the responses to mortgage rate changes, the patterns in the baseline analysis are largely maintained. For example, borrowers use part of interest savings to pay down mortgage debt faster in the expansionary episode, whereas they adjust monthly payments as required in the contractionary episode without

[29] This number is computed as follows. First, only 2.3% of borrowers who were scheduled to renew closed their accounts before the scheduled month and opened a new account within two months. Second, only 18% of these borrowers opened the new account for the purpose of renewal. Third, conditional on renewal, 85% borrowers switch to different FIs. Thus, the fraction of switching for renewal is 2.3%$\times$ 18%$\times$ 85%=0.35%

[30] We find some evidence that borrowers who switched to other financial institutions for mortgage renewal appear to obtain lower rates than borrowers who stay with this bank. However, we are cautious with this result, because the sample for switching renewal is quite small, especially in the contractionary episode, making it difficult to estimate precisely the rate differential. Moreover, we do not observe the full cost of switching, which could offset the gains from a lower mortgage rate.

changing amortization. At the consumer level, 5-year FRMs borrowers increase their spending when mortgage rates decrease, whereas spending does not change when mortgage rates increase. Moreover, borrowers deleverage on revolving debt in the contractionary episode. We also find no evidence of increased delinquency.

Mortgages Reset in Both Episodes. When assessing the asymmetry in the response to mortgage rate changes, it would be ideal to focus on the renewal of the same mortgages in both episodes. In the data, we only observe a subset of 2 and 3-year FRM borrowers that experience at least two resets, one in each episode. By the selection of the two episodes, we are unable to study the behavior of the same 4 and 5-year FRM borrowers who experience rate decreases and increases. Nevertheless, we perform a robustness check that focuses on the responses of 2 and 3-year FRM borrowers who experienced two resets, one in each episode. In unreported results, we show that the loan-level adjustment and borrower-level responses are very similar to those in Table B2.

Difference-in-Difference Estimates. As described in Section 3, one concern with our baseline strategy is the inability to account for the mortgage-age effects that could drive consumption and borrowing decisions. To address this problem, we use a difference-in-difference design that introduces longer-term mortgages as the control group. Specifically, for the mortgages in the treatment group, we use the mortgages previously reset at the same time but having a 7 or 10 year term as the control group.

Table C1 shows mortgage loan-level adjustment and borrower-level responses using this approach. At the loan-level, it confirms that mortgages reset in the two episodes experienced substantial adjustment in rates and payments, the degree of which depends on the term before the reset. It also shows the asymmetric mortgage prepayment pattern as in Section 4.2. At the borrower level, we find quantitatively similar estimates as in the baseline results. The only noticeable difference is that, in the expansionary episode, the deleveraging on credit card debt is reinforced by the deleveraging on lines of credit.

The main reason why we do not use this alternative specification as the baseline is that the size of the control group is small, as not many Canadian borrowers take longer-term mortgages. 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 longer-term mortgages. For these reasons, we estimate a second difference-in-difference specification that introduces the loans not reset in the two episodes but having the same terms as the loans in the treatment group as the control group.

As shown in Table C2, these estimates are similar to the baseline estimates and to the first set of difference-in-difference estimates. One caveat of the second 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.

Anticipatory Effect. An interesting question is whether the borrower-level responses presented in Section 5 should be interpreted as the responses to unanticipated mortgage rate changes. According to the economic theory of rational expectations, the responses to unanticipated positive income shocks, for example, will be larger than those when such shocks are anticipated, assuming the fraction of liquidity constrained households is small in the population. In the context of the mortgage contract renewal, it is possible that some consumers may have already anticipated the change in their mortgage rate based on the evolution of prevailing market rates. If so, we would underestimate the true effect of mortgage rate resets.

One way to assess the importance of this anticipatory effect is to compare consumers' responses in a short period of time, when mortgage rate changes are unexpected, with a period when mortgage 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.[31] We therefore estimate borrower-level responses for those who renewed their mortgages in 2015q1, and compare them with borrowers renewing their mortgages in 2015q2. The premise is that, if the anticipatory effect is important, borrowers in the former group should have larger responses than the latter group. We do not find significant heterogeneity across the two groups of borrowers. This pattern holds even when we compare consumers who reset the rates in February 2015 with those who reset in March 2015. This suggests that anticipatory effects, if existent, are weak and are unlikely to alter our results.[32]

Timing of Renewal. As shown in Figure 2, despite 50% of borrowers renewing their mortgages on time, some do it earlier with current lenders without having to pay penalties. This observation leads to the question of whether our baseline estimates are mostly driven by borrowers renewing earlier than scheduled. There are two reasons that mainly explain early renewals. First, from a

[31] 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.

[32] This finding may be explained by inattention to the movement in interest rates, or because uncertainty about mortgage rate changes makes consumer delay their spending until the changes are realized.

behavioral point of view, some people take actions fast, responding to early offers immediately, while others tend to delay.[33] If so, we would not expect earlier renewals to mostly drive our results because borrower fixed effects are included in the estimation to take care of unobserved heterogeneity. Second, by renewing earlier when the rates are declining, borrowers can cash out interest savings earlier. If this is the case, we expect borrowers who renew early in the expansionary episode (or close to schedule in the contractionary episode) to be liquidity constrained and to have larger responses than other borrowers.

We perform two additional analysis to address this question. First, we restrict the sample to borrowers who renew their contracts on time and estimate their responses to mortgage 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 scheduled renewal. Again, we do not find borrowers who renew early respond differently from other borrowers. We do find, however, the mortgage rates obtained from early renewals are slightly lower than later renewals, but the difference is small compared to the overall rate adjustment. The fact that borrowers who renewed early in the expansionary episode do not spend more than other borrowers suggests that liquidity constraints are not likely to be the reason for early renewals.

8 Conclusion

Ten years after the global financial crisis, the expectation is that interest rates will eventually rise in many advanced economies. This rise will affect the household sector by raising the cost of new borrowing, but its impact on existing mortgage borrowers is likely to be more important, because this population is much larger than the population of new borrowers. This issue is particularly relevant for policy makers in countries dominated by variable-rate, adjustable-rate, and short-term fixed rate mortgages, where changes in the policy rate will be effectively passed through to mortgage rates, raising mortgage payments and lowering consumer spending.

We study the effect of mortgage rate resets on consumer spending, debt repayment, and defaults in Canada, taking advantage of the institutional features of the Canadian mortgage market. This allows us to design a clean identification strategy for causal inference. Moreover, the detailed trade-line-level data on consumer credit accounts permit us to examine the adjustment in the entire credit portfolio of consumers. Most importantly, we are able to provide a detailed analysis of

[33] The incentive to lock in the rate offered early should not explain renewals ahead of schedule, because borrowers can always lock in the rate by responding to the offer letter, but still renew on schedule.

how consumers respond not only to mortgage rate decreases, but also to mortgage rate increases.

Our findings for the expansionary episode are broadly in line with those based on other countries. Consumers raise their durable spending, accumulate net savings by paying down mortgage debt faster, and reduced their probability of default. From the cross-sectional point of view, liquidity-constrained borrowers are more aggressively cashing out interest savings, but their ability to use debt to finance durable consumption is limited by their access to new credit. Since interest savings resulting from lower mortgage payments are realized over the course of several years, the difficulty in accessing credit markets and the failure of bringing forward future purchases dampens the immediate effect of such stimulus on consumer spending.

Our findings for the contractionary episode are new to the literature. Specifically, we do not find that durable spending falls when mortgage rates and payments increase. This implies that either consumers dissave to maintain their consumption, or they cut their other spending (e.g., non-durables). We document a robust pattern that consumers lower, rather than increase, their revolving debt level, which cannot be reconciled with the income interpretation of mortgage rate changes, but is consistent with a change in their expectations about future interest rates. Again, this suggests that either they cut their spending or run down other types of savings. Finally, we do not see potential concerns posed for financial stability, given that delinquency did not rise, and that banks did not tighten credit to these consumers.

We conclude from our analysis for the contractionary episode that mortgage rate resets do not appear to discourage durable spending, render consumers more leveraged, or increase the chance of defaults, as is commonly asserted in newspapers and financial press. Of course, our analysis examines only one aspect of interest rate changes, namely, the adjustment in mortgage rates and payments. There are other channels that may affect consumer spending but are not investigated in our analysis. For example, the wealth effect driven by changes in asset prices, in particular house prices, may affect Canadian homeowners' spending and saving. Nor is our analysis designed to capture the extensive margin of adjustment through, for example, cash-out refinancing or home equity loans. We leave these issues for future research.

The short-term fixed-rate mortgages we focus on in our study are quite common in OECD countries. Previous studies on the relationship between mortgage payments and consumer behavior largely relied on evidence from the United States. Whether these conclusions can be generalized to other developed countries is unclear, because the United States is unique in having an unusually

high share of long-term FRMs, in the common use of securitization in housing finance, and in the absence of prepayment penalties (see Lea (2010)). Although our estimates may depend on the specific episodes studied and on Canada's socio-economic conditions, our qualitative insights should apply more broadly to other countries.

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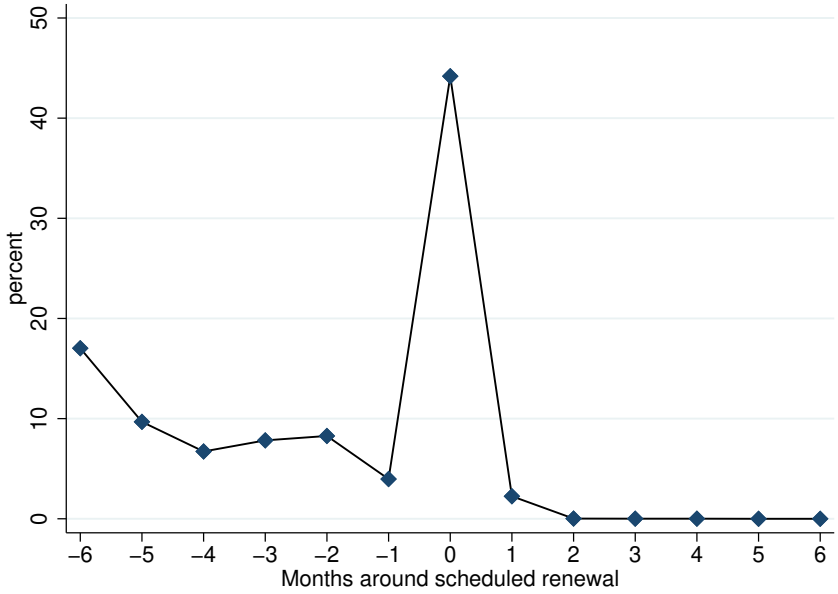
Figure 1: Bank of Canada policy interest rate (overnight target rate)

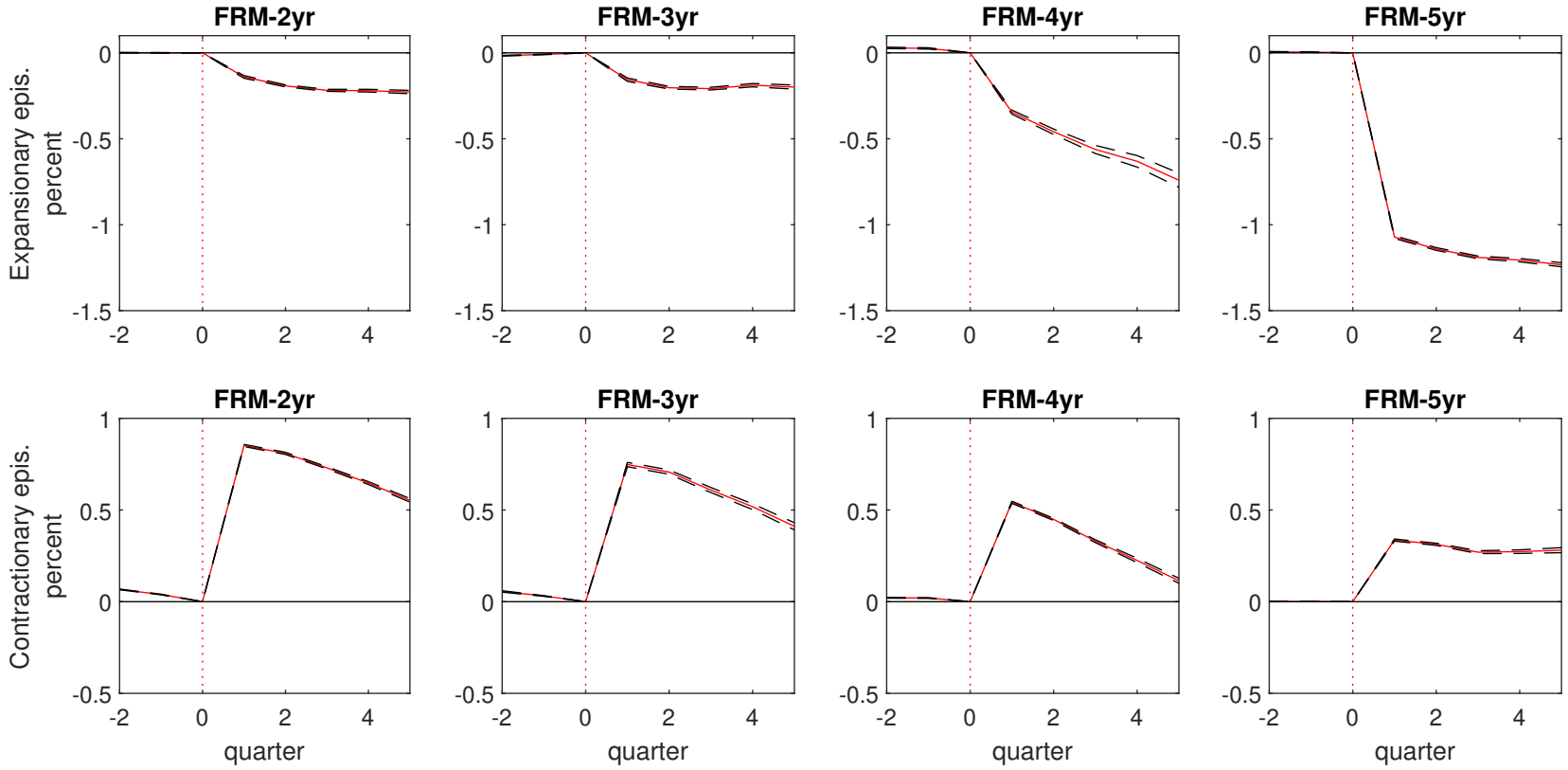
Source: Bank of Canada. The overnight rate is the interest rate at which major financial institutions borrow and lend one-day (or "overnight") funds among themselves. The Bank of Canada sets a target level for that rate, often referred to as the Bank's policy interest rate. The first vertical line indicates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

Figure 2: Timing of mortgage renewal



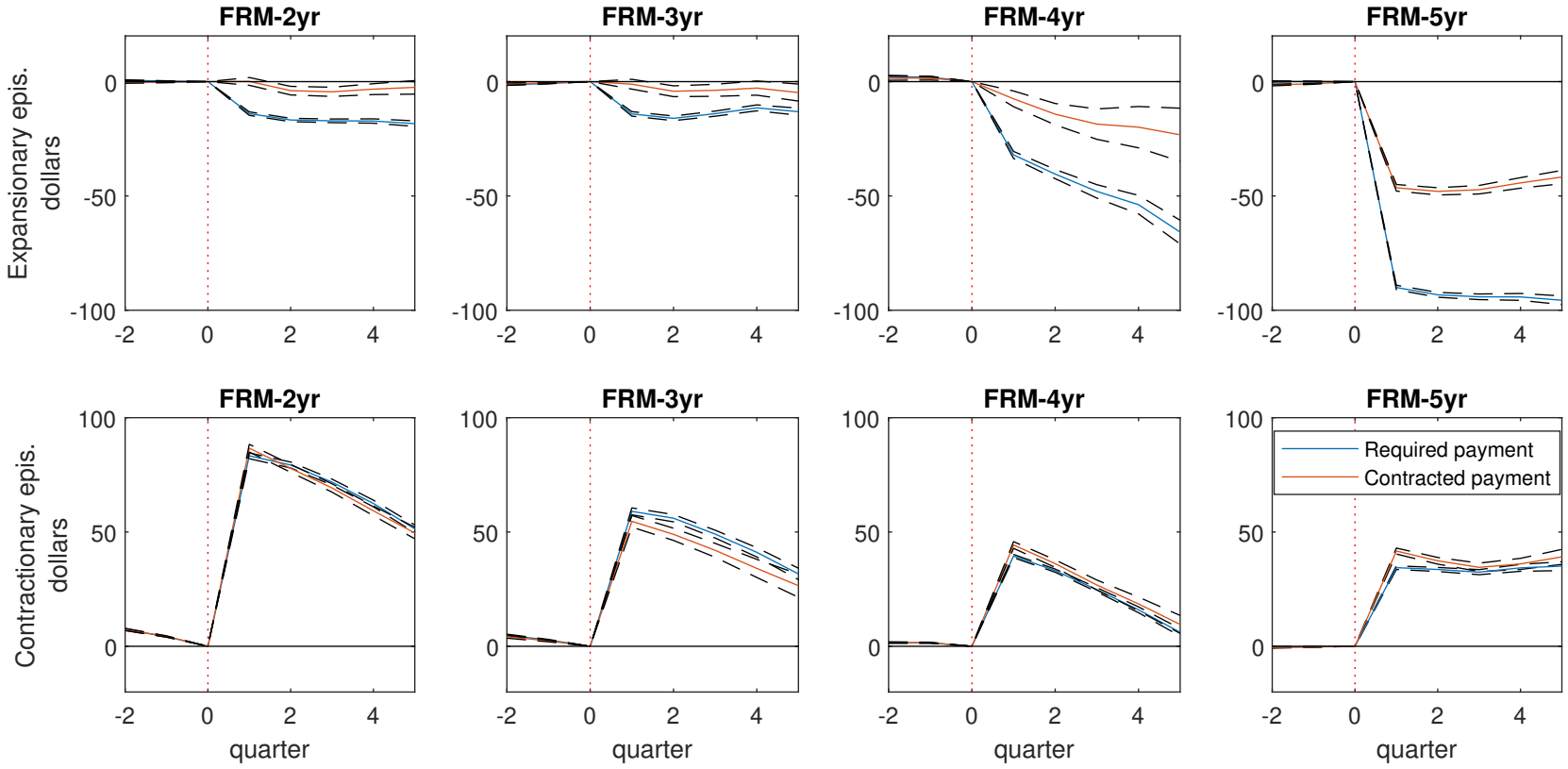
Notes: This figure plots the percent of borrowers in our sample who renew their mortgages within x months of the scheduled renewal month, where x is a value on the x-axis. "0" refers to on-time renewal.

Figure 3: Mortgage rate adjustment around the reset



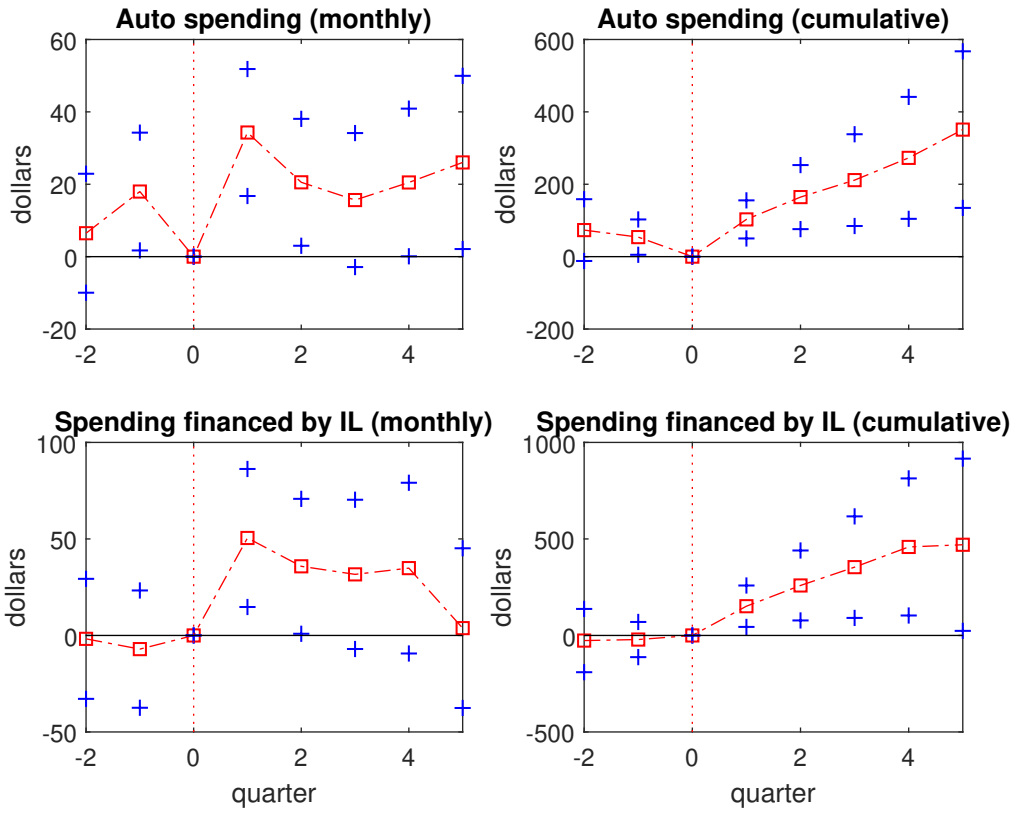
Notes: Point estimates are obtained by estimating specification (2). 95% confidence intervals are in dashed lines.

Figure 4: Change in mortgage payments around the reset



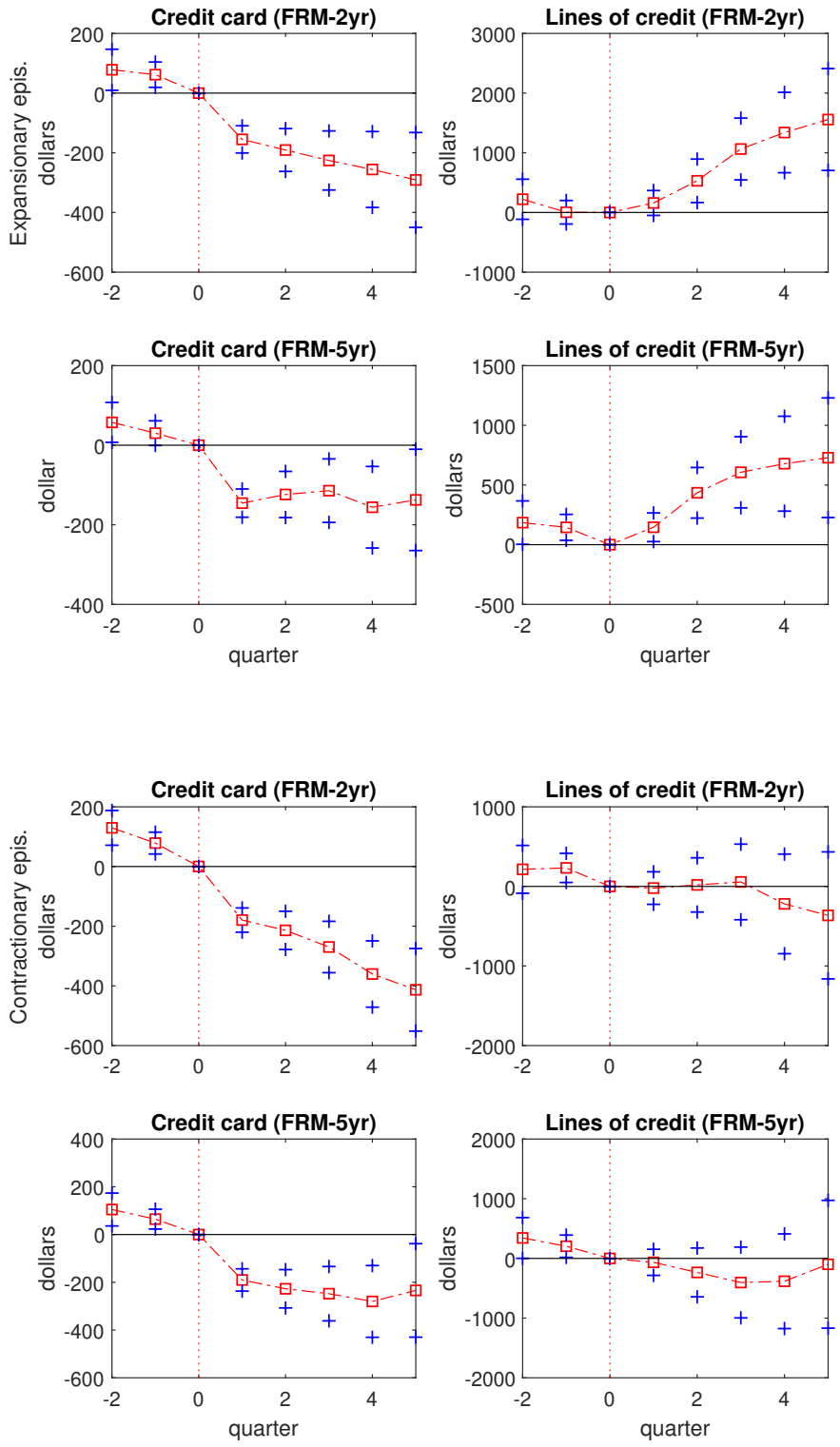
Notes: Point estimates are obtained by estimating specification (2). 95% confidence intervals are in dashed lines.

Figure 5: The response of monthly and cumulative spending around the reset



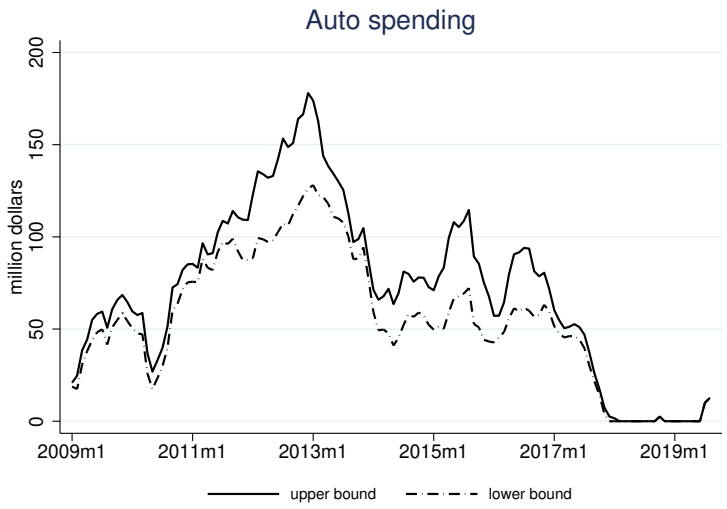
Notes: Point estimates are obtained by estimating specification (2). 95% confidence intervals are marked as plus. The upper panel shows the responses of auto spending. The lower panel shows the responses of spending financed by new installment loans (IL).

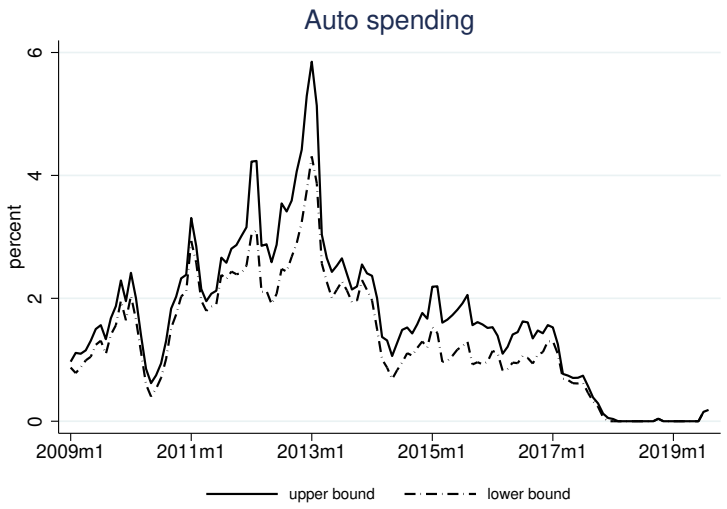
Figure 6: The response of revolving debt balances around the reset

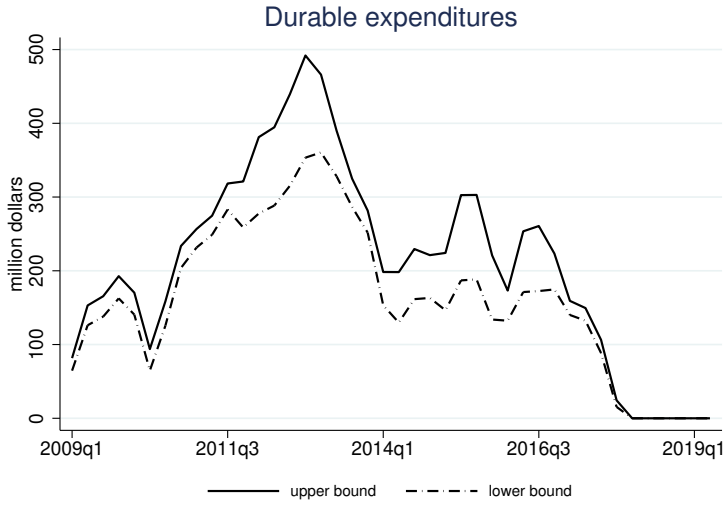


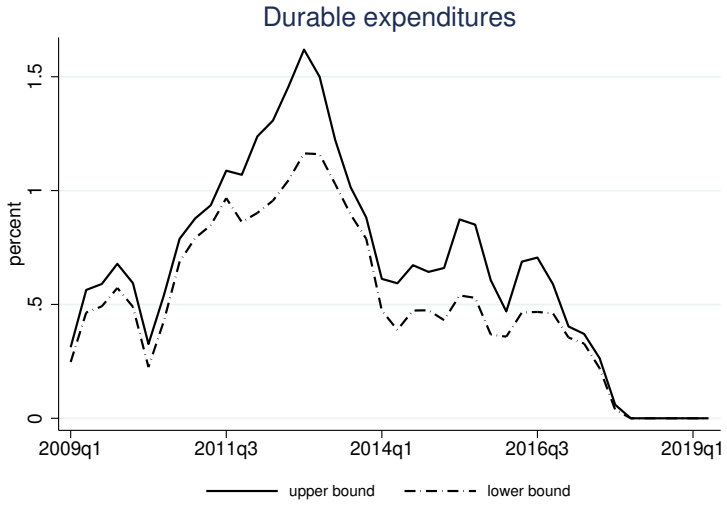
Notes: Point estimates are obtained by estimating specification (2). 95% confidence intervals are marked as plus.

Figure 7: The effect of mortgage rate resets on aggregate auto spending and durable consumption



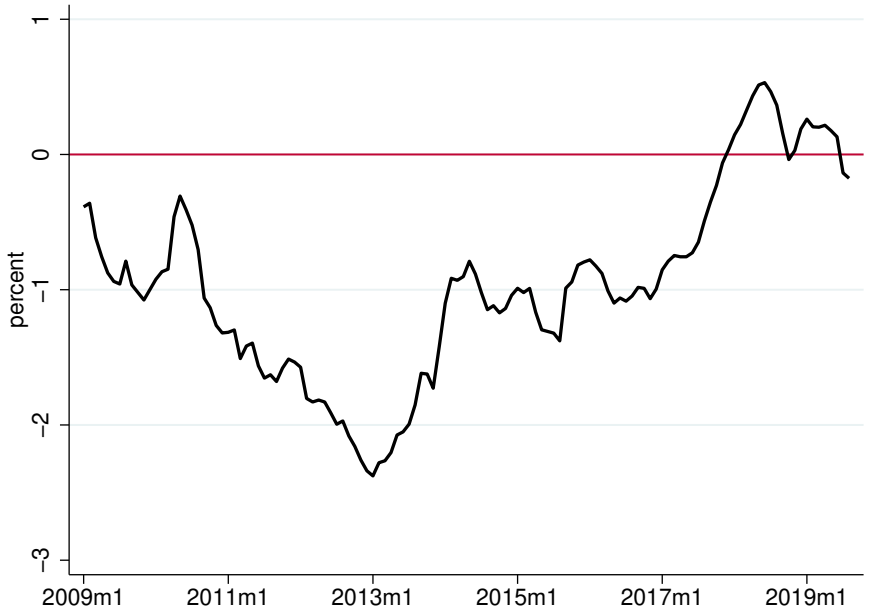






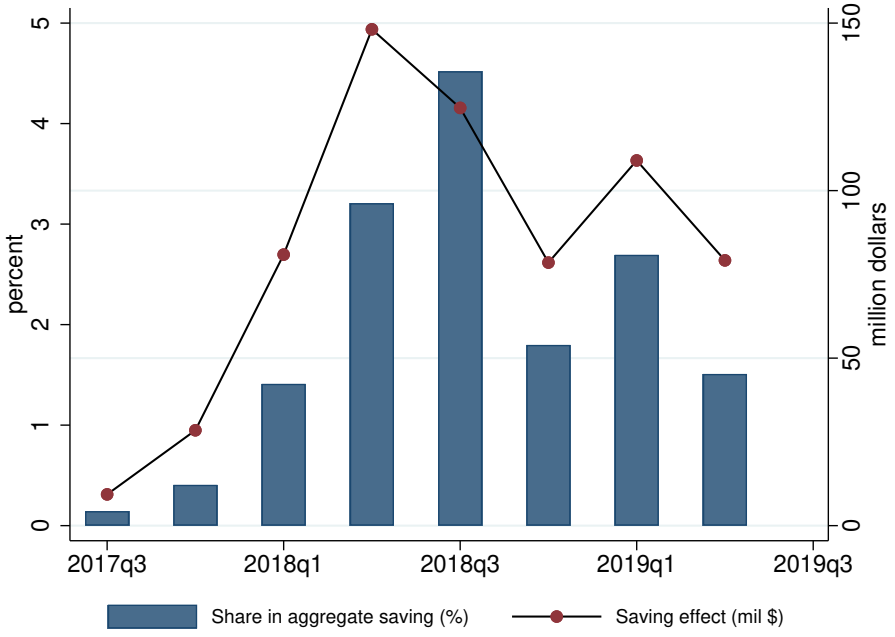
Notes: The left column shows the estimates of total spending (million dollars) caused by mortgage rate resets. The right column shows the percent of aggregate spending accounted for by the spending caused by mortgage rate resets. See Section 6 for the calculation method.

Figure 8: Mortgage rate adjustment upon reset (5-year FRMs)



Notes: This figure shows the estimated change in the mortgage rate upon reset for 5-year FRMs.

Figure 9: The effect of mortgage rate resets on aggregate saving



Notes: This figure shows the estimates of total revolving debt repayment upon reset (in million dollars), and the percent of aggregate saving accounted for by deleveraging on revolving debt.

Table 1: Mortgage loan characteristics at origination

	Sample bank		Other lenders	
	Mean	Median	Mean	Median
All FRMs				
Share of total market (%)	18	-	82	-
Contract rate (%)	2.89	2.84	2.90	2.79
Outstanding balance ($)	289,766	248,541	302,050	255,745
LTV ratio (%)	78.6	80.0	77.9	80.0
DTI ratio (%)	329.0	302.1	334.8	296.8
Credit score	768	771	756	763
Borrower age	42.5	41.0	41.9	40.0
Fraction of insured (%)	33.1	-	35.9	-
Fraction of FRM-5yr (%)	64.1	-	58.0	-
FRM-5yr				
Share of total market (%)	19	-	81	-
Contract rate (%)	2.90	2.82	2.88	2.79
Outstanding balance ($)	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 (%)	38.5	-	45.4	-

Source: Bank of Canada-OSFI mortgage originations dataset. This table shows the characteristics of the mortgages originated by the sample bank 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 ($)	160,192	131,466	166,744	128,491	181,191	125,649	169,687	119,397
Mortgage rate (%)	2.55	0.34	2.66	0.33	2.79	0.34	3.58	0.69
Contracted payment ($/month)	950	626	987	610	1,070	604	995	585
Number of loans	23,023		17,105		7,251		40,949	
Corresponding consumers								
Age								
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 ($/month)	121	2,186	123	2,179	127	2,227	114	2,078
Prob. of auto purchase (%)	0.38	6.15	0.40	6.28	0.41	6.37	0.38	6.15
New installment loan amount ($/month)	237	3,797	222	3,650	212	3,320	240	3,486
Prob. of 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 ($)	195,534	209,237	162,626	117,453	155,373	104,203	199,594	132,347
Mortgage rate (%)	2.51	0.49	2.66	0.42	2.83	0.32	3.12	0.38
Contracted payment ($/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								
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 ($/month)	152	2,592	131	2,352	122	2,335	121	2,268
Prob. of auto purchase (%)	0.44	6.65	0.39	6.26	0.36	6.01	0.37	6.07
New installment loan amount ($/month)	300	5,775	265	4,128	277	4,116	277	4,442
Prob. of 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 tradeline (account) data.

Table 3: Mortgage loan-level adjustment

	Mortgage rate (p.p.) (1)	Required ($/month) (2)	Contracted ($/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)
Controls	Y	Y	Y	Y
Loan fixed effects	Y	Y	Y	Y
Month fixed effects	Y	Y	Y	Y

Notes: Each cell presents the result from estimating one regression as in equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the loan level. Controls include a set of borrower-level characteristics: age, previous-month credit score, previous-quarter FSA-level LTV ratio. Column (1) shows the change in mortgage rate upon reset. Column (2) shows the change in required payment implied by the change in rate assuming the same amortization. Column (3) shows the change in contracted payment. Column (4) shows the change in remaining amortization.

Table 4: Interest savings upon rate reset

	Panel I: Expansionary episode				*Panel II: Contractionary episode*			
	Prev. amort. (months)	Prev. payment ($/month)	Interest savings ($)	Adj. interest savings ($)	Prev. amort. (months)	Prev. payment ($/month)	Interest savings ($)	Adj. interest savings ($)
FRM-5yr	227	1,041	+20,891	+23,925	208	1,130	-7,072	-6,242
FRM-4yr	208	1,004	+7,107	+8,485	197	936	-7,149	-6,889
FRM-3yr	209	1,072	+2,907	+4,830	205	959	-11,271	-11,904
FRM-2yr	219	987	+3,228	+4,998	230	1,041	-19,165	-17,880

Notes: *Prev. amort.* refers to the time for paying off the remaining balance, computed based on pre-reset rate and monthly payment. *Prev. payment* is the pre-reset monthly payment. *Interest savings* is computed by multiplying the change in required payment by the previous amortization. *Adjusted interest savings* is computed by taking the change in amortization into account.

Table 5: Heterogeneity in mortgage loan-level adjustment (expansionary episode)

	Required ($/month)	Contracted ($/month)	Cash out rate (%)	Required ($/month)	Contracted ($/month)	Cash out rate (%)	Required ($/month)	Contracted ($/month)	Cash out 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 previous 12-month average credit scores are below the median of the distribution. HighUse refers to the borrowers whose previous 12-month average combined rates of credit utilization are greater than 0.5. Young and old borrowers refer to age below 45 and greater than 65, respectively.

Table 6: The response of spending and revolving debt repayment

	Auto spending ($/month) (1)	Auto purchase prob. (%) (2)	New IL ($/month) (3)	New IL prob. (%) (4)	Total rev. debt ($) (5)	Credit cards debt ($) (6)	Lines of credit debt ($) (7)
Panel I: Expansionary episode							
FRM-5yr							
PostRenew	18.56***	0.073***	44.36***	0.141***	101.31	-160.90***	251.98**
	(6.09)	(0.017)	(12.03)	(0.029)	(124.59)	(32.54)	(120.79)
FRM-4yr							
PostRenew	-21.53	-0.053	19.83	0.111	193.69	-133.00**	247.81
	(19.61)	(0.054)	(30.63)	(0.084)	(352.90)	(65.79)	(353.62)
FRM-3yr							
PostRenew	13.81	0.036	30.25	0.051	-329.1	-247.60***	3.22
	(10.29)	(0.029)	(17.55)	(0.043)	(191.67)	(38.99)	(188.11)
FRM-2yr							
PostRenew	-4.24	-0.008	33.88	0.088**	49.02	-167.40***	246.69**
	(10.30)	(0.029)	(20.20)	(0.044)	(124.86)	(25.78)	(123.34)
Panel II: Contractionary episode							
FRM-5yr							
PostRenew	7.09	0.024	22.36	0.036	-438.20**	-246.90***	-278.80
	(8.34)	(0.022)	(15.55)	(0.035)	(213.42)	(40.73)	(210.50)
FRM-4yr							
PostRenew	6.34	-0.002	11.77	0.079	167.26	-247.60***	428.15
	(12.57)	(0.033)	(23.68)	(0.056)	(226.53)	(48.94)	(220.17)
FRM-3yr							
PostRenew	16.90	0.048	41.46	0.087	-900.70***	-273.90***	-596.50
	(18.57)	(0.049)	(28.89)	(0.075)	(323.86)	(64.12)	(312.23)
FRM-2yr							
PostRenew	20.52	0.066**	44.59	0.068	-261.60**	-213.30***	-44.50
	(10.73)	(0.027)	(23.73)	(0.040)	(133.72)	(24.36)	(131.97)
Controls	Y	Y	Y	Y	Y	Y	Y
Borrower fixed effects	Y	Y	Y	Y	Y	Y	Y
Month fixed effects	Y	Y	Y	Y	Y	Y	Y

Notes: Each cell presents the result from estimating one regression as in equation (1). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the borrower level. Controls include a set of borrower-level characteristics: age, previous-month credit score, previous-quarter FSA-level LTV ratio. Column (1) is the change in auto spending identified from new originations in the trade-line-level data. Column (2) is the change in the probability of taking a new auto loan. Columns (3)-(4) are the estimates for new installment loans (IL), similar to the auto spending case. Columns (5)-(7) are the changes in the balances of total revolving debt, credit card, and lines of credit debt.

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

	Auto spending ($/month)	New IL ($/month)	Auto spending ($/month)	New IL ($/month)	Auto spending ($/month)	New IL ($/month)
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 previous 12-month average credit scores are below the median of the distribution. HighUse refers to the borrowers whose previous 12-month average combined rates of credit utilization are greater than 0.5. Young and old borrowers refer to age below 45 and greater than 65, respectively.

Table 8: Heterogeneity in revolving debt repayment

	Tot rev.($)	Cc ($)	LoC ($)	Utilization	Tot rev.($)	Cc ($)	LoC ($)	Utilization	Tot rev.($)	Cc ($)	LoC ($)	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	1080***	409.52***	724.74***	0.023***								
×LowScore	(202.65)	(46.63)	(197.75)	(0.002)								
PostRenew					6878***	759.84***	6244***	0.051***				
×HighUse					(210.24)	(51.25)	(205.04)	(0.002)				
PostRenew									-1100***	254.92***	-1500***	0.000
×Young									(207.00)	(48.43)	(200.84)	(0.002)
PostRenew									-2100***	-140.09**	-2100***	0.007**
×Old									(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	490.53	85.09	461.19	0.006***								
×LowScore	(288.80)	(49.93)	(282.29)	(0.002)								
PostRenew					469.92	156.48**	310.75	-0.018***				
×HighUse					(314.78)	(64.17)	(305.56)	(0.002)				
PostRenew									-497.17	141.08***	-638.29***	0.005
×Young									(305.52)	(53.98)	(299.28)	(0.002)
PostRenew									-2100***	-192.69***	-1900***	-0.006**
×Old									(389.55)	(64.43)	(380.15)	(0.003)

Notes: LowScore refers to borrowers whose previous 12-month average credit scores are below the median of the distribution. HighUse refers to the borrowers whose previous 12-month average combined rates of credit utilization are greater than 0.5. Young and old borrowers refer to age below 45 and greater than 65, respectively.

Table 9: The response of credit supply measures (contractionary episode)

	Prob. new cc credit (1)	Prob. new loc credit (2)	Cc limit($) (3)	Loc limit($) (4)	Cc Pay/Bal ratio (5)	Loc Pay/Bal 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 the change in the likelihood of obtaining a credit limit increase of at least $1,000 in a month. Columns (3)-(4) show the change in the credit limit. Columns (5)-(6) show the change in the payment to previous balance ratio.

Table 10: Evidence from consumer expectations surveys

	Higher in 1 Yr (1)	Higher in 1&2 Yr (2)	Higher in 1,2,5 Yr (3)	Pay down debt (4)	Cut spending save more (5)	Postpone purchases (6)	Bring fwd purchases (7)
Panel I: All sample							
Currently high	0.21***	0.22***	0.17***	0.11***	0.08***	0.03***	-0.008
	(0.011)	(0.012)	(0.012)	(0.014)	(0.013)	(0.011)	(0.007)
Panel II: Contractionary episode							
Currently high	0.20***	0.26***	0.21***	0.17***	0.07***	-0.01	-0.02**
	(0.012)	(0.015)	(0.017)	(0.016)	(0.017)	(0.014)	(0.009)
Controls	Y	Y	Y	Y	Y	Y	Y
Quarter fixed effects	Y	Y	Y	Y	Y	Y	Y

Notes: Each cell presents the result from estimating one logistic regression as in equation (4). Data are from the Canadian Survey of Consumer Expectations (CSCE). ** and *** denote significance levels at 5% and 1%. Standard errors are clustered at the consumer level. Controls include age, gender, marital status and education. Columns (1)-(3) show the estimates of the change in the likelihood of expecting future interest rates to higher in 1 year, in 1 and 2 years, an in 1, 2, and 5 years. Columns (4)-(7) show the estimates of the change in the likelihood of taking certain action in response to interest rate expectations.

Table 11: The response of delinquency (‰) 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: ** and*** denote significance levels at 5% and 1%. Standard errors are clustered at the borrower level. Delinquencies are measured by the probability of approaching certain number of days (60 or 90) of delinquency on at least one account under certain type of debt.

Not-for-Publication Appendix

A. Data: Construct 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 contracted payments, the outstanding balances and contracted 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 the prepayment above the amortization schedule) or too high (most likely due to the 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% cutoffs at the bottom and the top of the distribution. A minor caveat of this procedure is that we are unable to recover the rates for a small fraction of loans that are characterized by systematic prepayment in addition to the required amortization or by the frequent delays in contracted payments.

To validate our imputation procedure, we compare the distribution of the recovered mortgage rates in our data to two alternative data sources, one is the 5-year FRM rates quoted by national mortgage brokers, and the other is the contracted rates reported in the Bank of Canada-OSFI mortgage originations dataset. Both datasets report the actual mortgage rates received by borrowers. The broker data series spans a long time period, but is only available for the average rate across all 5-year FRMs. The OSFI dataset allows us to further break down the mortgages by insurance status and purpose, but is available only from 2014. Since mortgages in both sources are newly originated, we compare their rate distributions with those of the newly originated mortgages in our sample.

Figure A1 shows that the imputed mortgage rates track the brokers' rates quite closely over time. Classifying mortgages by their insurance status, Figure A2 shows that the imputed rates are similar to the rates in the mortgage originations dataset, and that the rate differentials for insured and uninsured mortgages are small. Although our sample does not allow us to distinguish between loan purposes, the originations dataset suggests that the rates for home purchases do not differ much from other purposes such as cash-out refinancing, especially for uninsured mortgages. We also compare the standard deviations of our recovered rates with those from the originations dataset by insurance status. The results are quite close, both varying between 20 and 30 basis points since 2014.

Figure A1: Imputed 5-year FRM rates and the 5-year FRM rate among national mortgage brokers

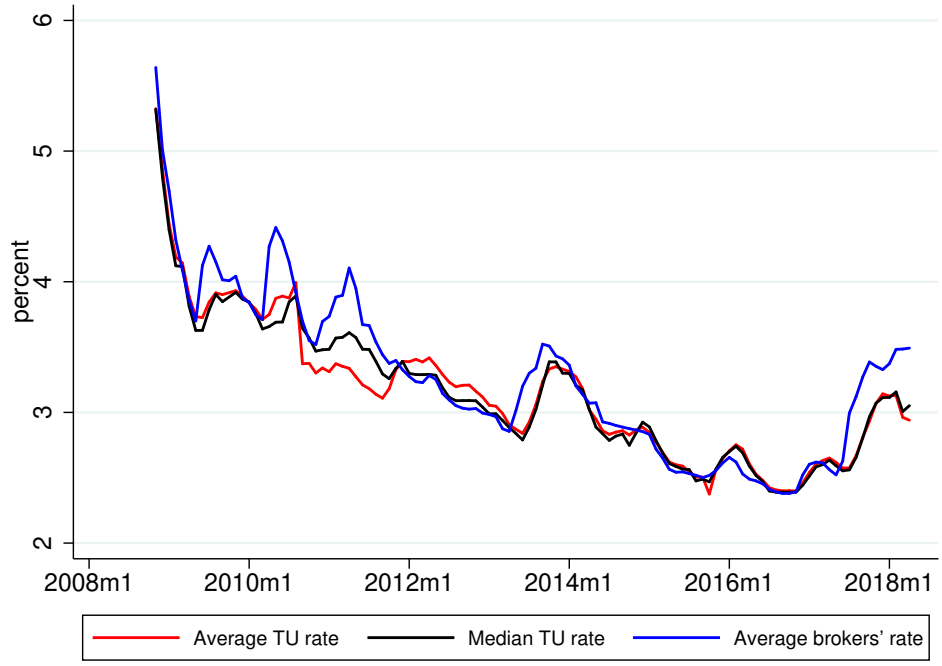
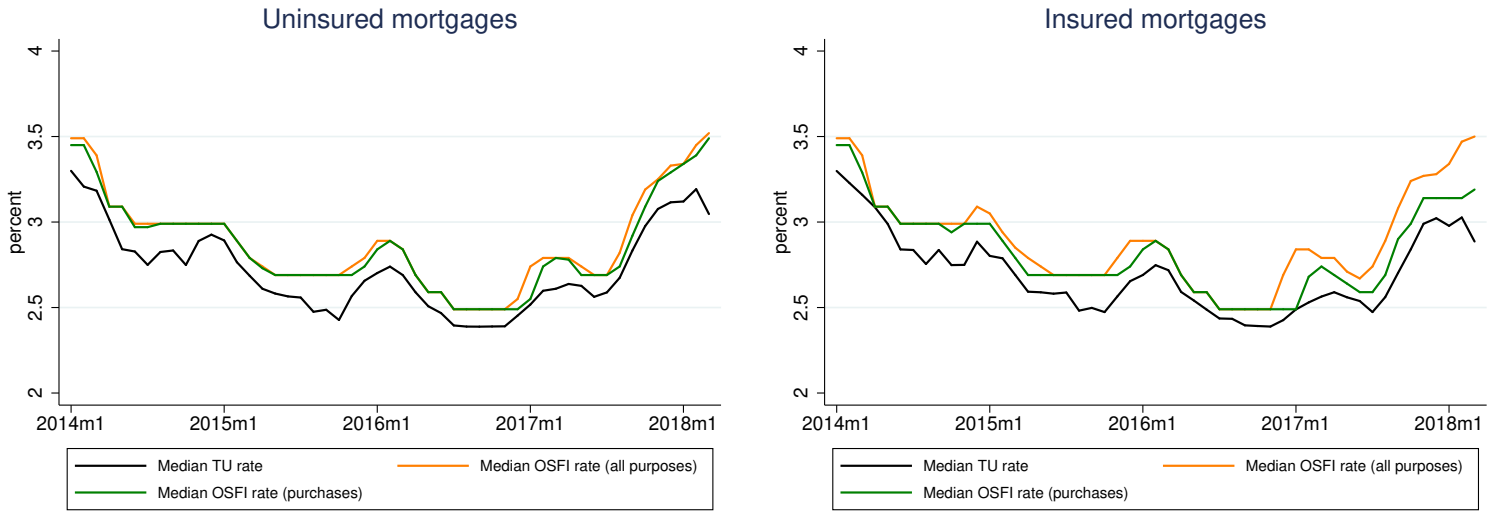


Figure A2: Imputed rates and OSFI mortgage origination rates



Notes: OSFI rates are constructed based on the Bank of Canada-OSFI mortgage originations dataset.

B. Remove Term-Spread Effect

Table B1: 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

Table B2: Estimates based on mortgages with the same term before and after the reset

	Mortgage rate (p.p.)	Required ($/month)	Contracted ($/month)	Amortization (months)	Auto spending ($/month)	Auto pur. prob. (%)	New IL ($/month)	New IL prob. (%)	Tot rev. ($)	Cc ($) ($)	LoC ($) ($)	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)

C. Difference-In-Difference Estimates

Table C1: Diff-in-diff estimates
(Control group: longer-term mortgages)

	Mortgage rate (p.p.)	Required ($/month)	Contracted ($/month)	Amortization (months)	Auto spending ($/month)	Auto pur. prob. (%)	New IL ($/month)	New IL prob. (%)	Tot rev. ($)	Cc ($) ($)	LoC ($) ($)	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)

Table C2: Diff-in-diff estimates
(Control group: same-term mortgages)

	Mortgage rate (p.p.)	Required ($/month)	Contracted ($/month)	Amortization (months)	Auto spending ($/month)	Auto pur. prob. (%)	New IL ($/month)	New IL prob. (%)	Tot rev. ($)	Cc ($) ($)	LoC ($) ($)	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)