The Mortgage Cash-Flow Channel: How Rising Interest Rates Impact Household Consumption*

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Abstract

How do increased debt servicing costs, resulting from monetary policy tightening, impact household consumption? Understanding this cash-flow effect is crucial for assessing the overall and disparate effects of monetary policy. By utilizing panel microdata on all mortgage holders in Israel and leveraging quasi-exogenous variation in exposure to adjustable-rate mortgages (ARMs) due to a regulatory shift, we analyze household consumption reactions. Our results indicate that the mortgage cash flow channel caused a 3.6% reduction in households consumption following a 4.65 percentage points policy hike, predominantly affecting mid to lower income households. These results underscore the significant role of the mortgage cash-flow channel in the transmission of monetary policy, with important consequences for both economic stability and inequality.

Keywords: Adjustable-rate Mortgages, monetary policy, cash-flow channel, household consumption, heterogeneity, Israel.
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"[T]he structure of mortgage contracts may matter for consumption behavior. In countries...where most mortgages have adjustable rates, changes in short-term interest rates have an almost immediate effect on household cash flows... In an economy where most mortgages carry fixed rates...that channel of effect may be more muted... [T]hese issues seem worthy of further study..."

— Bernanke (2007)

1 Introduction

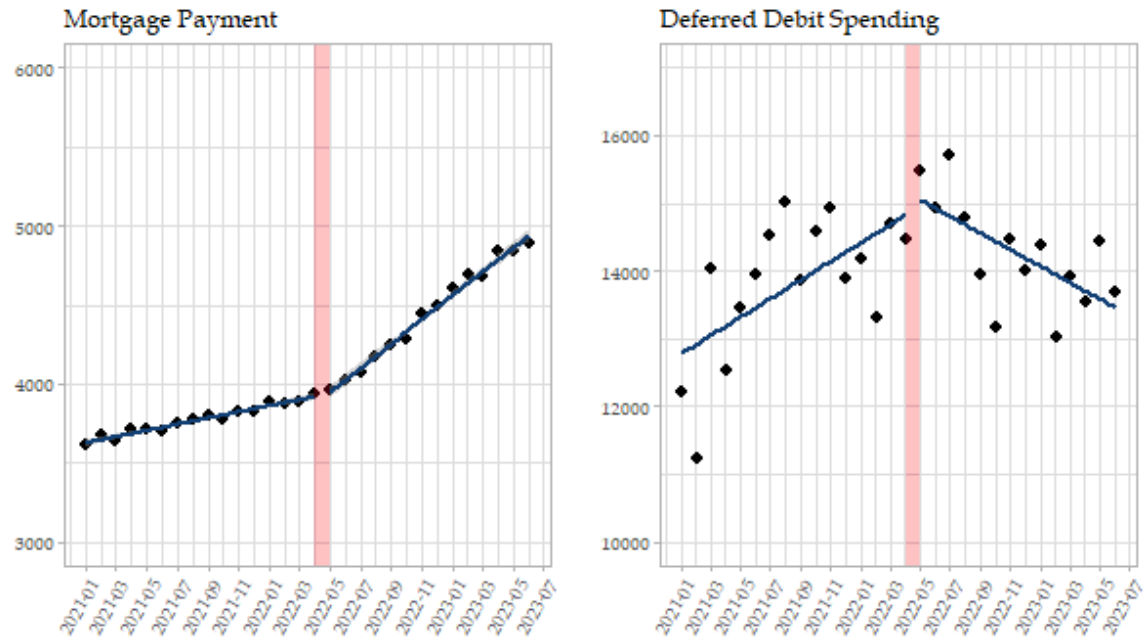
The surprising return of inflation during 2021-2023 has lead many central banks around the world to enact an aggressive tightening cycle not seen in decades. One of the key challenges for monetary policymakers is understanding the impact of policy rate changes on consumer spending, particularly in the context of adjustable-rate mortgages (ARMs). This issue is especially crucial in countries where a significant portion of mortgages are tied to fluctuating policy rates. Understanding this relationship is vital for effective economic policy, as changes in central bank rates can directly influence household expenditures, especially in economies where mortgages play a significant role in personal finance. However, analyzing this impact is challenging due to the complex interplay between policy rates, mortgage payments, and consumer spending behavior.

The motivation for our study is neatly summarized by Figure 1. The figure presents a comparative analysis of the average monthly mortgage payments and deferred debit spending for all mortgage borrowers in Israel at the household level. An upward trajectory is observed in mortgage payments, escalating from NIS 3,883 in March 2022 to NIS 4,885 by June 2023, marking a significant increase of approximately 25% within a span of fifteen months.[1] At the same time, the graph outlines a contraction in credit card spending among the same cohort of mortgage borrowers. A dip from the monthly average of NIS 14,703 to NIS 13,701 during the same timeframe is depicted, registering a reduction of roughly 9%. Our study uncovers the *causal* relationship between consumption and the exposure of households to interest changes via their exposure to variable rate mortgages. This underpins the simultaneous surge in mortgage payments and the reduction in credit card spending, as

[1] There is a general upward trend in average mortgage payments, reflecting a persistent increase in the size of new mortgages against the backdrop of rising house prices throughout the period.

shown in the figures, providing insight into a particular channel through which monetary policy operates - the Mortgage Cash-Flow Channel.

Figure 1. *Mortgage and deferred debt spending*



Notes: This figure reports the average mortgage payment (left panel) and average deferred debt spending per household from January 2021 to June 2023(right panel)

Our study establishes the causal effect of mortgage cash flow on household consumption, based on two key elements: a proprietary dataset covering the entirety of Israeli mortgages and an empirical strategy that utilizes variations in exposure to interest rate changes. This approach is further strengthened by a natural experiment stemming from a regulatory change. We uniquely leverage the characteristics of Israeli mortgages to analyze the impact of policy rate changes on consumption expenditures. Moreover, our dataset allows us to examine how households adjust their spending in response to the negative cash-flow shock resulting from the Bank of Israel's interest rate hikes during 2022-2023. Our primary focus is on the direct effects of these rate increases on mortgage payments and the subsequent deferred debit spending patterns of these households. Given that credit cards deferred debit are the primary payment method in Israel, this extensive dataset facilitates a comprehensive analysis of a major part of mortgage households consumption patterns

in the fifteen months following the policy announcement.

The empirical approach of this study employs a difference-in-differences (DiD) methodology to address potential endogeneity issues arising from the heterogeneity of treatment and control groups. The study uses a multi-stage analytical framework, initially categorizing borrowers based on the relative size of their adjustabl-rate mortgage (hereinafter referred to as the "ARM ratio"), which is directly linked to the Bank of Israel's policy rate. Additionally, we leverage a quasi-natural experimental setting, capitalizing on a regulatory change by the Bank of Israel in January 2020 that increased the ARM mortgage ratio cap from 33% to 67%. By focusing on the upper 50% of borrowers affected by this regulatory shift, we can compare borrower cohorts that are nearly identical, primarily differing in the magnitude of their ARM mortgage ratio. We argue that this comparison enables a credible assessment of the interest rate change's impact on disposable income and spending patterns. Moreover, our analysis facilitates an exploration of the heterogeneity in responses across different households, offering insights into how such financial shocks impact diverse segments of the population.

We find that a 1% increase in the adjustable-rate mortgage (ARM) ratio leads to a 3.6 basis point decrease in deferred debit spending. For a household with a typical 33% ARM ratio, this translates to an approximately 1% reduction in overall spending compared to a household with no ARM exposure. Extrapolating to the mortgage market level reveals the aggregate economic impact. Critically, our analysis demonstrates that the effect is most pronounced among mid to lower income households. This result highlights how fluctuations in mortgage rates can disproportionately exacerbate financial vulnerability for certain socioeconomic groups, with implications for inequality.

We make several important contributions: first, leveraging a comprehensive dataset and quasi-experimental variation in mortgage rate exposure, we provide empirical evidence quantifying the causal relationship between adjustable-rate mortgages and declines in household consumption during periods of rising interest rates, elucidating the mortgage cash-flow channel of monetary policy transmission. Second, by documenting substantial heterogeneity across income groups, this study highlights the distributional consequences of monetary policy changes mediated through adjustable-rate mortgages, underscoring effects on inequality. Third, we demonstrate how regulatory changes in mortgage markets can significantly impact

monetary policy transmission and financial stability, offering lessons for coordination between central banks and financial supervision agencies. More broadly, unlike previous studies which focused on specific samples, this paper's dataset and analysis provides deeper quantitative insights and robust identification strategies in examining the relationship between mortgage structures and interest rate sensitivity. Ultimately, the findings emphasize the critical role of the mortgage cash flow channel in monetary policy transmission and the need for policymakers to account for household debt dynamics.

Related Literature. Monetary policy exerts its influence on the broader economy through various channels. Traditional economic models generally view the impact of policy on the economy as being driven by changes in interest rates, a concept known as the "interest rate channel of monetary policy." These models typically operate under the assumption that prices and wages are relatively inflexible in the short term. Therefore, an increase or decrease in nominal interest rates leads to correspondingly higher or lower real interest rates. This change affects the cost of borrowing due to the intertemporal substitution effect, influencing both investment and consumer spending. However, the actual response of the economy to interest rate adjustments by the central bank is often more significant than these models suggest, indicating that there are other mechanisms at play beyond the direct influence of interest rates on the economy (Bernanke and Gertler 1995). Recent international evidence for these various channels and their relative importance can be found in Choi et al. (2024).

In light of this, extensive research has been conducted to explore additional channels through which monetary policy affects the economy. Bernanke and Gertler (1995) investigated the Credit Channel, emphasizing its influence on the adjustment of credit supply and demand. Eichenbaum and Evans (1995) highlighted the Exchange Rate Channel and its impact on trade balances, while Svensson (1997) focused on the Expectations Channel and its role in shaping economic forecasts. The Bank Lending Channel, which examines the roles of banks in policy transmission, was discussed by Kashyap and Stein (1994). Additionally, Borio and Zhu (2012) suggested that monetary transmission also occurs through variations in financial intermediaries' risk-taking behaviors. The Asset Price Channel, exploring the interaction between monetary policy and asset values, was examined by Bernanke and Kuttner (2005).

However, the Cash Flow Channel, especially in the context of ARMs and household consumption, has not been as extensively examined as these other channels. This channel examines the impact of monetary policy changes on the cash flow of borrowers and consumers. Changes in interest rates can directly influence borrowers' cash flow by altering their debt servicing costs, thereby affecting their disposable income and their ability to spend and invest.[2]

In recent studies, the mortgage cash flow channel of monetary policy transmission has gained significant attention, highlighting its crucial role in influencing economic activities. Noteworthy research indicates that consumers' spending varies significantly in response to interest rate changes, emphasizing the mortgage cash flow channel's central role in mediating household consumption and investment in response to monetary policy changes (Agarwal and Qian 2014; Agarwal et al. 2021; Agarwal et al. 2022; Di Maggio et al. 2017). Additionally, there is a growing focus on how policy interest rate changes affect household spending and labor demand through mortgage payments. A key area of study is the different impacts of mortgage structures, such as fixed-rate mortgages and Adjustable Rate Mortgages (ARMs), on the transmission of monetary policy (Garriga et al. 2017; Daniel H. Cooper 2021). For example, Calza et al. (2013) find that the presence of fixed-rate mortgages can significantly dampen the impact of a monetary policy shock on both consumption and residential investment. Furthermore, the literature delves into income distribution as well as racial and regional variations in these effects, stressing the significance of local economic structures and inequality in the mechanism of monetary policy transmission (Holm et al. 2021; Cumming 2019; Gerardi et al. 2023; Tzamourani 2021).

Building on these insights, there has been a recent shift in macroeconomic research towards emphasizing the role of household heterogeneity in economic outcomes. This shift reflects a growing recognition that various monetary policy channels, including the less examined Cash Flow Channel, can have differing impacts across diverse household groups. Kaplan et al. (2014) introduced the concept of a 'hand-to-mouth' population within macroeconomic models. They demonstrated that the consumption patterns of liquidity-constrained households significantly in-

[2]More broadly, we can think of a debt service ratio (DSR) channel of monetary policy that relates to the association between debt (variable rate payments) of firms or households relative to income and macroeconomic outcomes (e.g., Hofmann and Peersman (2017), Ippolito et al. (2018), and Cloyne et al. (2020))

fluence aggregate demand responses to fiscal policy changes. Similarly, Auclert (2019) highlighted the necessity of viewing monetary policy through a distributional lens, acknowledging the substantial macroeconomic effects of income and wealth disparities.

This perspective is further supported by Krueger et al. (2016), who explored the macroeconomic consequences of disturbances in the mortgage market, and Slacalek et al. (2020), who quantified the varying impacts of monetary policy shocks on household consumption expenditures, particularly considering their liquidity constraints. Their research underscores that general equilibrium effects, particularly those related to labor income and house prices, are predominant. These findings emphasize the critical importance of accounting for household heterogeneity in economic analyses. The recognition of this heterogeneity not only deepens our understanding of economic dynamics but also guides more effective and targeted monetary policy interventions.

Outline. The remainder of the paper is organized as follows: Section 2 provides an overview of monetary policy and the mortgage market in Israel. Section 3 describes the unique dataset from Israel and presents descriptive statistics. Section 4 details the methodological approach. Section 5 discusses the empirical results and includes initial robustness checks. Section 6 describes a battery of additional robustness tests. Finally, the paper concludes with Section 7, which summarizes the findings and implications of the study.

2 Macroeconomic and Institutional Background

2.1 Monetary Policy

The Bank of Israel has three primary objectives as outlined in the 2010 Bank of Israel Law. Firstly, the Bank aims to maintain price stability, which is defined in the law as keeping the annual Consumer Price Index (CPI) inflation rate within a range of 1-3%. Secondly, the Bank seeks to support government policies that contribute to economic growth, employment, and reducing inequality, as long as such support does not undermine its price stability objectives. Lastly, the legislation mandates the Bank to preserve the stability of the financial system and ensure orderly market functioning

(Bank of Israel Law, 2010). Therefore, while price stability is the foremost goal in the central bank's hierarchy of objectives, the law also acknowledges a secondary role for counter-cyclical policies and financial oversight.

To achieve these objectives, the Bank of Israel employs various policy instruments, with the primary tool being the short-term interest rate, set by a Monetary Committee led by the Governor. This rate, known as the Bank of Israel interest rate, forms the basis for the interest the Bank pays to commercial banks on their deposits with it. The Bank operates within a "felxible inflation target" where he sets this interest rate at a level that either maintains inflation within the target range or expected brings inflation back to the target range within a period not exceeding two years. The Bank operates independently in setting the short-term interest rate and in utilizing monetary instruments to achieve its goals.

Between April 2022 and July 2023, Israel's monetary policy underwent significant shifts in response to changing inflation dynamics, reflecting domestic and global economic factors. Throughout this period, Israel experienced an elevated inflation environment, with year-over-year inflation rates consistently surpassing the upper bound of the central bank's target range. The Bank of Israel attributed this rise in inflation primarily to increased domestic demand, alongside global economic trends. In response, the Bank of Israel embarked on a path of monetary tightening, primarily through a series of interest rate hikes. From mid-2022 to early 2023, the central bank increased the interest rate from 0.10% to 3.75%, continuing the tightening process initiated in the post-COVID-19 period. This policy stance was further intensified in the first half of 2023, with the interest rate reaching 4.75% by July 2023, following which the rate was kept there until the first rate cut in January 2024.[3]

2.2 The Israeli Mortgage Market

In Israel, banks are practically the sole originators of all mortgage products.[4] A typical Israeli mortgage is characterized by various "tracks," each having its specific interest rate structure. There are primarily three common interest rate options in the Israeli mortgage market: Long Fixed rate, where the mortgage interest rate is fully fixed; Medium-Fixed, where the base rate adjusts in accordance with government

[3]Bank of Israel (2022) and Bank of Israel (2023).

[4]Although a few P2P lending platforms provide mortgages, their combined market share as of 2023 accounts for less than one percent of both new and outstanding mortgages.

bonds every five years;[5] and Variable, which includes mortgages directly tied to the Bank of Israel's interest rate.[6] In what follows, we will refer to the latter track as ARM and use it as our measure of exposure of mortgage borrowers to changes in the interest rate.[7]

As of September 2023, the total balance of mortgages in Israel is approximately NIS 540 billion. The distribution among the different tracks is quite telling: Fixed interest rates constitute 37.4 percent of the total credit, Medium-Fixed account for 23 percent, ARM account for 39 percent, and the residual (0.6 percentage) in other less common interest tracks.[8]

Mortgage borrowers in Israel have the option to tailor their mortgage structures by utilizing a mix of different financial products. Regulations stipulate that a minimum of one-third of the mortgage must be comprised of a fixed rate. Until January 2021, the proportion that could be allocated to the ARM track was capped at one-third. Figure 1 depicts the share of each mortgage type within the new mortgage balances over the previous decade, showing notable variances in mortgage structures over this period.[9] Furthermore, there is substantial diversity in mortgage configurations across various segments. For example, Figure 3 describes the distribution of the ARM ratio as of March 2022, segmented by four different origination year of the mortgages. This information underscores pronounced disparities in the direct exposure to the Bank of Israel rate via the ARM track among cohorts of mortgage borrowers with loans initiated in proximate timeframes.

In 2013, the Bank Supervision Department of the Bank of Israel implemented a regulation limiting the maximum ARM ratio of a mortgage loan to two-thirds. This regulation also restricted the permissible variation within five years to no more than one-third. Consequently, only up to one-third of each mortgage could be directly tied to the Bank of Israel's policy rate. The remainder had to be allocated to either

[5] A minor portion adjusts biannually; however, their contribution to the mortgage balance in our sample is negligible.

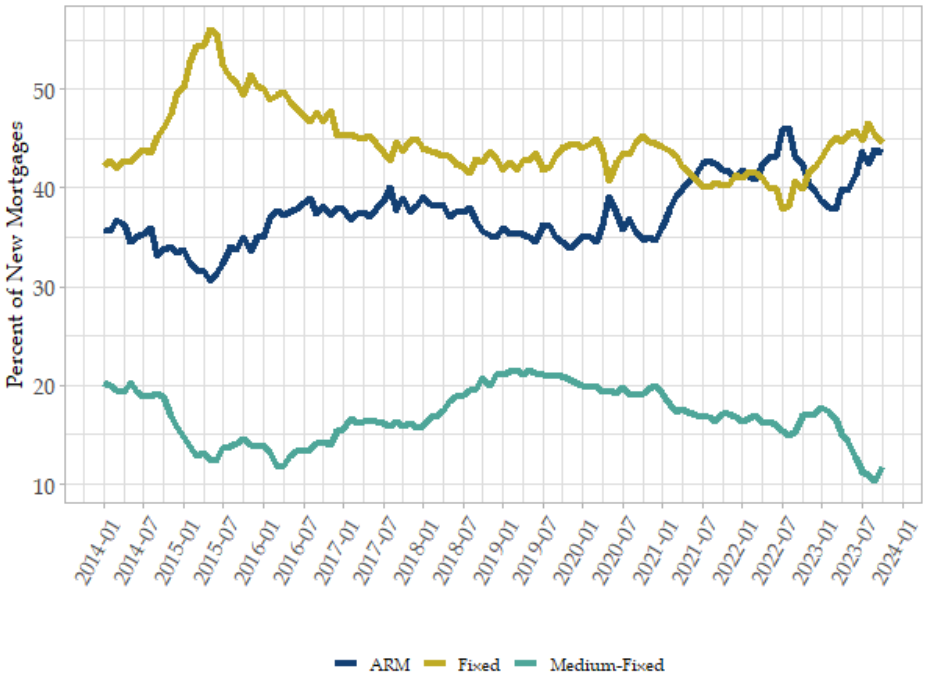
[6] In Israel the variable rate tracks are known as the "Prime rate" track. This is not to be confused with the creditworthiness of the borrower but rather to the interest rate adjusting process.

[7] Fixed and Medium-Fixed tracks in Israel may also be linked to the price index.

[8] 36% of the total credit is also linked to the price index with bulk of those in the Medium-Fixed track.

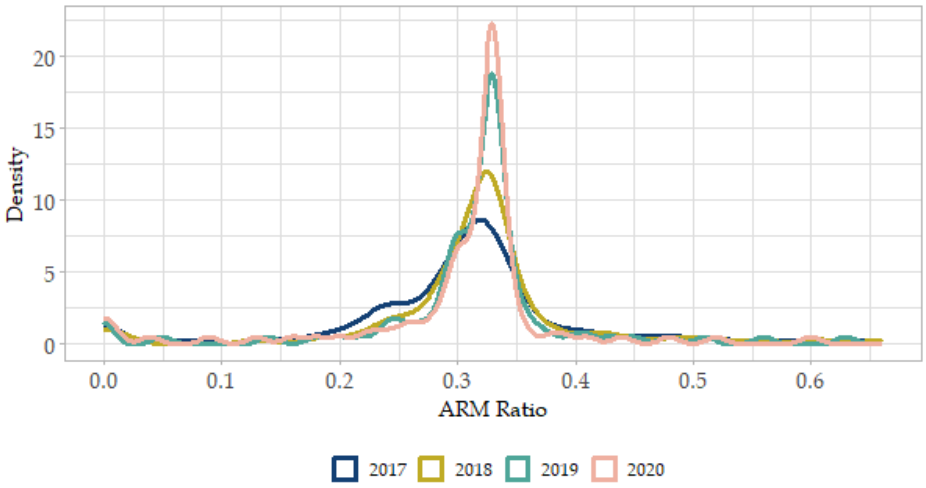
[9] It is essential to recognize that the regulation is only applicable at the inception of the mortgage. Given that various tracks within a single mortgage may have different maturity dates, and borrowers have the discretion to repay specific tracks preferentially, the proportion of the ARM track within the outstanding balance may surpass one-third, while the fixed rate's share may fall below this threshold.

Figure 2. *Mortgages Interest Rate Structure*



Notes: This figure presents the distribution of new mortgages in Israel categorized by their interest rate types.

Figure 3. *ARM Ratio Density*



Notes: This figure presents the density of the ARM track share from each mortgage current balance in March 2022, split by mortgage origination year

a fixed-rate format (at a minimum of one-third) or a five-year variable rate. This regulation resulted in a marked decrease in the availability of two-year adjustable variable rate mortgages. In a notable policy shift in December 2020, the maximum portion of the mortgage that could fluctuate with the Bank of Israel policy rate was raised to two-thirds. This directive was swiftly enacted, taking effect in January 2021. The amendment underscores the dynamic nature of the Israeli mortgage market and the pivotal role of regulatory decisions in shaping its trajectory.[10]

3 Data

In this study, we use data from the Israeli Consumer Credit Register, which includes all consumer credit data for the entire population of borrowers in Israel. The Credit Register was established as part of the "Credit Data Law" in 2016, with the proclaimed goals of enhancing competition in the retail credit market through the sharing of credit information. The Credit Register is maintained by the Bank of Israel, and two private credit bureaus use this data to supply credit reports and scores about potential borrowers. All banks and credit card companies are required to report both their new and outstanding credit data on a monthly basis.[11] The Credit Register contains information on all consumer credit facilities, both new and outstanding, such as consumer loans, credit cards, credit lines, and mortgages, updated on a monthly basis.

For our empirical analysis, we extract a panel dataset of all mortgage borrowers in Israel, a group that totals approximately 904,000 households, representing about 30% of the households in Israel. We aggregate credit information for each household on a monthly basis, which includes details on their monthly outstanding mortgage debt. Specifically, our focus is on mortgage balances that are subject to an adjustable mortgage rate (ARM), which is directly linked to the Bank of Israel's (BOI) prime rate. This means that the interest on these ARMs updates automatically and immediately following any changes in the BOI's policy rate. For each borrower, we calculate the

[10] See Section 4.2 for more details on the ARM ratio regulation change.

[11] The Bank of Israel gathers and holds all the credit data used to compute Israeli credit scores, commonly referred to as the "Credit Register." This data is then transmitted to private credit bureaus, created following the law, which compute credit scores based on this information on a case-by-case basis. The Bank of Israel provides a website where consumers can obtain their credit history. Additional information regarding the Israeli Credit Data Register is available at: https://www.creditdata.org.il/en.

'ARM ratio' by dividing the balance of the ARM by the total outstanding mortgage balance. This ratio serves as our primary explanatory variable for assessing the exposure of mortgage borrowers to interest rate changes.

We use credit card spending information to proxy for consumption patterns.[12] Generally, most credit cards issued in Israel are really *deferred debit* cards. There is no interest payments for using these cards and the full outstanding balance is automatically withdrawn from the consumer checking account once every month. While rollover credit cards such as the ones in the US where consumers choose how much to pay every month and pay interest on the balance exist, they are extremely uncommon.[13] For each consumer we aggregate separately all interest bearing credit card balances and non-interest Bering credit card balances where the latter is defined as "deferred debit" balance and is used as our main variable of interest for estimating consumption.

Our sample period spans from January 2021 through June 2023, encompassing the entirety of the recent interest rate increase period as well as a symmetric period of 15 months before the rates began to rise. For each household, we exclude months where there was no balance on any debit card.[14] Overall, our baseline sample includes roughly 20 million household-month observations. Table 1 presents descriptive statistics for the entire sample. The term "Low ARM" represents observations where the borrower's ARM ratio is below the full sample median, and "High ARM" refers to observations where the ARM ratio is equal to or above the sample median.

[12] While we can not observe cash withdrawals and cash payments, credit cards are by fare the most popular means of payment is Israel.

[13] One option of using the deferred debit for longer credit is to split a specific bill with a specific merchants over the course of several months (known in Hebrew as "Tashlumim"). This method does include, in some cases, interest payment and the split bill reduces available credit limit during the payment schedule.

[14] Out of the 904 thousands mortgage households, approximately 756 thousands (or 83%) had debit card spending in every month they were part of the sample, and 95% had no spending for up to five months.

Table 1. *Descriptive statistics - All mortgagors split by ARM exposure*

	Low ARM				High ARM			
	Mean	St. Dev	Q1	Q3	Mean	St. Dev	Q1	Q3
Age Group	7.39	2.40	6	9	6.77	2.26	5	8
Socio-Economic Index	5.73	2.09	5	7	6.09	2.22	5	8
Mortg. ARM ratio	0.17	0.13	0	0.30	0.47	0.21	0.33	0.53
Mortg. Current Balance	580,727	607,614	165,900	816,550	730,233	670,376	311,900	962,685
Mortg. Payment	3,726	10,717	1,850	4,650	4,686	8,674	2,640	5,635
Consumer Loan (%)	58	49	0	100	53	50	0	1
Consumer Loan (Balance)	136,481	566,347	35,700	158,000	160,135	698,106	38,650	167,050
Overdraft (%)	42	49	0	1	36	48	0	1
Overdraft (Balance)	8,783	42,992	0	9,750	7,972	65,599	0	6,750
Credit Card Loan (%)	34	47	0	1	27	44	0	100
Credit Card Loan (Balance)	6,491	23,832	0	1,410	5,144	41,197	0	320
Deferred Debit (balance)	13,070	32,247	4,405	16,920	15,938	53,475	5,745	20,300
Observations	10,395,246				10,395,291			

Notes: This table presents the descriptive statistics for the household with mortgages dataset. All observations are recorded at the household-month level. Columns 1 through 4 detail households with mortgages whose ARM ratio – the share of the mortgage's unpaid current balance that is directly linked to the Bank of Israel's interest rate – falls below the median of the distribution. Conversely, Columns 5 to 8 focus on borrowers with an ARM ratio above the sample median. The data covers the sample period from January 2021 to June 2023. For detailed information on the construction of the sample and the variables, refer to Section 3. The table displays the mean, standard deviation, and the 25th (Q1) and 75th (Q3) percentiles for each variable.

Age Group and Socio-Economic Index are the only non-credit related information that appear in the credit registry. Age is reported in 14 groups.[15]. The socio-economic indicator is based on the municipality where the borrower resides. The Israeli Central Bureau of Statistics provides a socioeconomic index ranging from 1 to 10 for each local council or municipality, where one represents the poorest socioeconomic conditions and ten the highest. The mortgage ARM ratio is our main explanatory variable and is defined as the share of the borrower monthly current balance that is directly linked to the BOI. Our main dependent variable is the borrower deferred debit monthly balance from all credit cards.

We also control for three additional type of consumer debt. Overdraft debt which is a credit line that banks grant their clients on their checking accounts from which they can withdraw funds up to some limit, and Consumer loans which are all other

[15]Ages 0-21 are coded as 1; ages 22-24 are coded as 2; ages 25-29 are coded as 3; ages 30-34 are coded as 4; ages 35-39 are coded as 5; ages 40-44 are coded as 6; ages 45-49 are coded as 7; ages 50-54 are coded as 8; ages 55-59 are coded as 9; ages 60-64 are coded as 10; ages 65-69 are coded as 11; ages 70-74 are coded as 12; ages 75-79 are coded as 13; and ages above 79 are coded as 14

term loans which consumer use that include car loans and other general purpose loans. Credit card loans refer to the aggregate balance from all rollover credit cards and balances that carry interest on regular cards.

Table 1 offers insightful descriptive statistics that further illuminate the financial landscape of Israeli mortgage borrowers during our study period from January 2021 to June 2023. Notably, the High ARM group, characterized by a higher ARM ratio, exhibits a greater average mortgage balance (730,223) and mortgage payment (4,686) compared to the Low ARM group (580,727 and 3,726, respectively). This suggests a more significant financial exposure in terms of housing costs among those more exposed to interest rate fluctuations. Additionally, the High ARM group has a slightly higher socio-economic index, indicating a correlation between economic status and exposure to variable interest rates. In terms of credit behavior, a larger proportion of the Low ARM group engages in consumer loans and overdrafts, yet the High ARM group shows a higher average balance in both categories. This dichotomy underscores varied financial management strategies across different borrower segments. Finally, the table reveals that credit card loans are more prevalent in the Low ARM group, although the High ARM group maintains higher balances in deferred debit.

Table 2 shows the descriptive statistics for the datset when split by observation in the period before the rise in interest rates (January 2021-March 2022) and the period after (April 2022-June 2023). The table shows that the pre and post samples are overall similar which suggests that there was no large shifts in borrower composition during the period.

For the estimation around the prime regulation change, we focus exclusively on borrowers whose mortgages were originated around the time of the regulatory shift. Specifically, we include only those borrowers with mortgages originating from August 2020 to May 2021. We further exclude borrowers whose mortgages commenced in December 2020 and January 2021 — the months when the regulation was announced and implemented, respectively. Borrowers with mortgages initiated before December 2020 (from August to November) constitute the control group, while those with mortgages starting after January 2021 (February to May) are deemed the treated group. Our examination then centers on the consumption behavior of these two groups from July 2021 through June 2023.

Table 3 presents descriptive statistics of mortgage borrowers in Israel who originated mortgages around January 2021, specifically before and after the regulatory

Table 2. *Descriptive statistics - All mortgagors split by period*

	January 2021-March 2022				April 2022-June 2023			
	Mean	St. Dev	Q1	Q3	Mean	St. Dev	Q1	Q3
Age Group	7.17	2.37	5	9	6.67	2.33	5	8
Socio-Economic Index	5.92	2.15	5	8	5.89	2.17	5	8
Mortg. ARM Ratio	0.32	0.23	0.23	0.37	0.32	0.22	0.24	0.37
Mortg. Current Balance	620,237	608,062	223,000	852,000	691,147	676,792	256,000	933,900
Mortg. Payment	3,888	10,821	2,045	4,785	4,523	8,558	2,440	5,550
Consumer Loan (%)	55	49	0	100	55	49	0	100
Consumer Loan (Balance)	142,937	602,877	36,000	155,500	152,634	661,491	38,250	169,200
Overdraft (%)	38	48	0	100	39	48	0	100
Overdraft (Balance)	8,081	63,997	0	7,750	8,695	44,609	0	8,995
Credit Card Loan (%)	30	45	0	100	31	46	0	100
Credit Card Loan (Balance)	5,139	20,229	0	780	6,503	43,181	0	1000
Differed Debit (balance)	14,144	37,510	4,945	18,100	14,869	50,028	5,090	19,16
Observations	10,457,297				10,333,240			

Notes: This table presents the descriptive statistics for the household with mortgages dataset. All observations are recorded at the household-month level. Columns 1 through 4 detail observations in the pre BOI policy hike - January 2021 through March 2022. Conversely, Columns 5 to 8 present observation the the post period - April 2022 through June 2023. For detailed information on the construction of the sample and the variables, refer to Section 3. The table displays the mean, standard deviation, and the 25th (Q1) and 75th (Q3) percentiles for each variable.

change that increased the maximum variable rate portion allowed in a mortgage. Overall,the comparison reveals that the borrowers who obtained mortgages post-regulation change share many characteristics with those who obtained them before the change. They are generally of a similar age, have comparable socio-economic statuses, and exhibit consistent borrowing and debt patterns, with only minor variations in certain financial metrics. Furthermore, the average current mortgage balances and monthly mortgage payments, while higher in the post-change group, follow a consistent trend, suggesting a stable mortgage market environment. In terms of additional debts, both groups show a propensity to hold consumer and credit card loans. Overall, the two groups seem quite similar with an important distinction in the mortgage ARM ratio where the treated group mean is four percent point higher and the 75^{th} percentile seven percent point higher relative to the control group.

4 Empirical Framework

4.1 All Mortgages

Our study employs a unique aspect of Israeli mortgages to understand the impact of policy rate changes on consumption expenditures. We focus on the variation

Table 3. *Descriptive statistics - Mortgages originated around January 2021*

	Before				After			
	Mean	St. Dev	Q1	Q3	Mean	St. Dev	Q1	Q3
Age Group	5.72	2.22	4	7	5.76	2.19	4	7
Socio-Economic Index	5.61	2.26	7	7	5.72	2.24	5	7
Mortg. ARM Ratio	0.32	0.12	0.30	0.33	0.36	0.16	0.31	0.40
Mortg. Current Balance	920,905	633,912	571,300	1,224,700	961,553	650,273	587,550	1,180,000
Mortg. Payment	4,766	9,462	3,040	5,650	4,839	10,800	3,010	5,830
Consumer Loan (Dummy)	0.54	0.49	0	1	0.54	0.49	0	1
Consumer Loan (Balance)	145,744	425,850	43,950	1,690,000	150,214	690,789	44,500	1,686,000
Overdraft (Dummy)	0.38	0.48	0	1	0.37	0.48	0	1
Overdraft (Balance)	7,980	37,738	0	8,500	7,642	61,603	0	7,350
Credit Card Loan (Dummy)	0.27	0.44	0	1	0.27	0.44	0	1
Credit Card Loan (Balance)	7,980	37,738	0	690	5,500	21,911	0	600
Arrears (Dummy)	0.01	0.11	0	0	0.01	0.10	0	0
Differed Debit (balance)	13,930	45,333	4,495	17,655	13,966	25,047	4,610	18,135
Observations	1,224,286				1,426,814			

Notes: This table presents the descriptive statistics of mortgage borrowers in Israel. All observations are at the individual borrower-month observation level. Columns 1 through 4 present borrowers with mortgages originated before the regulatory change increasing the maximum variable rate portion of a mortgage (November 2020 - January 2021). Columns 5-8 present borrowers with mortgages originated after the regulatory change (February 2021 - April 2021). The sample period is January 2021 to June 2023. For details on the construction of the sample and the variables, see Section 3. Mean, standard deviation, 25th and 75th percentile are presented for each variable.

in mortgage borrowers' direct exposure to changes in the Bank of Israel rate. This approach, inspired by the methodology of Agarwal et al. (2022), enables us to explore the relationship between mortgage structure and the variation in deferred debit spending following these policy changes.

The context of our research is crucial: a significant proportion of Israeli loans are ARMs, intrinsically linked to the Bank of Israel interest rate. Our analysis contrasts periods of relatively stable interest rates with a period marked by a rapid and largely unforeseen increase in these rates. We hypothesize that, had the interest rates consistently remained low, the differences in expenditure between mortgage borrowers with high and low interest rate exposure would have remained largely unchanged. This assumption is key to isolating the impact of fluctuating interest rates on household spending, thus providing clearer insights into economic behaviors under variable interest rate conditions.

To empirically test our hypothesis, we apply a regression model that accounts for individual and time fixed effects, the presence of a mortgage, and various other controls. Our baseline model, which incorporates these elements, is designed to estimate the relationship between spending, mortgage status, and other relevant

variables:

$$\log(\text{DeferredDebit})_{i,t} = \beta\left(\text{ARMRatio}_i \times \text{Post}_t\right) + \sum_{k=1}^{K} \theta_k X_{i,t-1}^{(k)} + \sum_{k=1}^{K} \delta_k \left(X_{i,t-1}^{(k)} \times \text{Post}_t\right) + \alpha_i + \gamma_t + \epsilon_{it} \quad (1)$$

where $\log(\text{DeferredDebit})_{i,t}$ represents the natural logarithm of the end-of-the-month total deferred debit spending by household i during month t, ARMRatio_i denotes the average ratio of the unpaid current balance that is directly linked to the prime rate from the total outstanding mortgage balance, in the pre period. The equation incorporates α_i and γ_t to represent individual and time fixed effects, respectively. The dummy variable Post_t takes the value of one for the period from April 2022 through June 2023, a time when the policy rate was continuously increasing. $X_{i,t-1}^{(k)}$ refers to a vector of k time-varying individual controls, capturing various forms of non-mortgage debt such as consumer loans, overdrafts, and credit card loans.

This specification enables a direct estimation of the relationship between mortgage borrowers' exposure to the Bank of Israel interest rate and their spending habits. Here, our main variable of interest is β which captures the change in spending behavior during the period of escalating interest rates, from April 2022 to June 2023.

On the one hand, when facing a rapid increase in mortgage payments, borrowers may attempt to mitigate the impact on their disposable income by depleting savings and/or incurring additional debt. This approach could potentially buffer the liquidity shock. On the other hand, exposure to other types of debt and changes in their monthly payments can affect disposable income and, consequently, household consumption. To account for this, we include controls in our model and interactions with other types of mortgage borrower debt. Specifically, a mortgagor without consumer loans, overdrafts, or credit card debt might have more options to smooth out the liquidity shock, at least in the short term, compared to borrowers who have already utilized all other debt avenues. In our baseline specification, we use a dummy variable to indicate whether the individual possesses any of these debt instruments at the end of the previous month (i.e., at the beginning of month t). The robustness of our results is further verified in the appendix, where we substitute the dummy

variable with the total unpaid balances of these debts.

We also examine the dynamic relationship between ARMRatio and borrower-level dependent variables by replacing Post with a series of dummy variables. These variables span 15 months before and 15 months after the start of the interest rate increase. This dynamic specification allows us to investigate whether borrowers with different ARMRatio values were experiencing distinct pre-existing trends in deferred credit card spending prior to the period when the rate increased.

One might question whether using the actual change in mortgage payment would be more appropriate than using the pre period average ARM ratio. However, since the actual change in payment is endogenously determined, employing it as the main independent variable could yield biased results. For instance, a borrower with a high ARMRatio might, when faced with a significant increase in the policy rate, attempt to mitigate the payment increase through several methods. These could include cutting spending or using savings to pay down parts of the mortgage, potentially resulting in an actual *reduction* in the mortgage payment alongside a decrease in debit card spending. Therefore, we use the ARM ratio of the mortgage borrower in the pre period, as it represents a predetermined *exposure* to interest rate hikes, i.e., the potential decrease in disposable income. In Section 6.1, we demonstrate that our results are also robust when using the actual amount of the mortgage payment for a subset of borrowers who did not change the structure of their mortgage, such as by paying down parts of it or refinancing, during the sample period. Additionally, in Section 6.1, we confirm that our main findings are consistent across a wide array of additional robustness tests.

It is also important to note why we use only the ARM track to proxy for borrowers' exposure to interest rates. As mentioned in Section 2.2, borrowers' mortgage payment may also be impacted by the inflation rate though the CPI-linked tracks and interest rates through the 5-year variable (Medium-Fixed) rate track. First, CPI-linked tracks do not have a large immediate impact on mortgage payment. For example, a 25-year, 100,000 NIS mortgage track that is fixed rate at 3% and linked to the CPI will pay 474 NIS in the first month. A two percent annual inflation rate (within the BOI inflation target range) will then increase the monthly payment every month, on average, by one NIS. Thus, even an increase of inflation to 5.2% (the peak point in 2022 and over the last two decades in Israel) will still imply a very modest immediate monthly payment increase. It is of course crucial to note that the increase

in payments in the CPI-linked track could have a very substantial impact on the overall cost of the mortgage due to the compounding effect of inflation; however, the impact in terms of borrowers' liquidity (cash flow) is relatively small.[16] Second, the 5-year variable rate tracks are relatively less popular (see Figure 2) and account for only 23% of the total balance. Thus, during our sample period (30 months), only a small share of the mortgage payments adjustments will be due to this track.[17]

4.2 ARM Regulation Change

Thus far, our empirical evidence is predicated on the assumption that the ARM ratio of each mortgage borrower is largely exogenous to time-varying factors that could influence the relationship between policy rate changes and borrower consumption. This means that the factors determining the variation across borrowers are not the same factors driving the results; hence, there is no additional selection or omitted variable bias causing some borrowers to have mortgages with more prime exposure while also being more sensitive to high inflation or rising interest rates. If this assumption is incorrect, our results might be biased due to an obvious selection bias of consumers opting for variable rates over fixed-rate mortgages.

To address this potential selection bias, we employ a difference-in-differences (DiD) regression methodology, taking advantage of an unanticipated regulatory change that affected mortgage borrowers' exposure to interest rates. As detailed in Section 2.2, in December 2020, the Bank of Israel's Banking Supervision Department increased the maximum limit of the prime track from 33 percent to 66 percent, effective from January 15, 2021. This regulatory amendment was unexpected and garnered significant media and public attention. At the time, the combination of high housing demand and the expectation that the "Low for long" interest rate environment would persist induced a strong demand for ARM tracks due to their low current cost. Consequently, the regulation, which was binding for many borrowers, led to an almost immediate jump in the average prime rate for new mortgages.

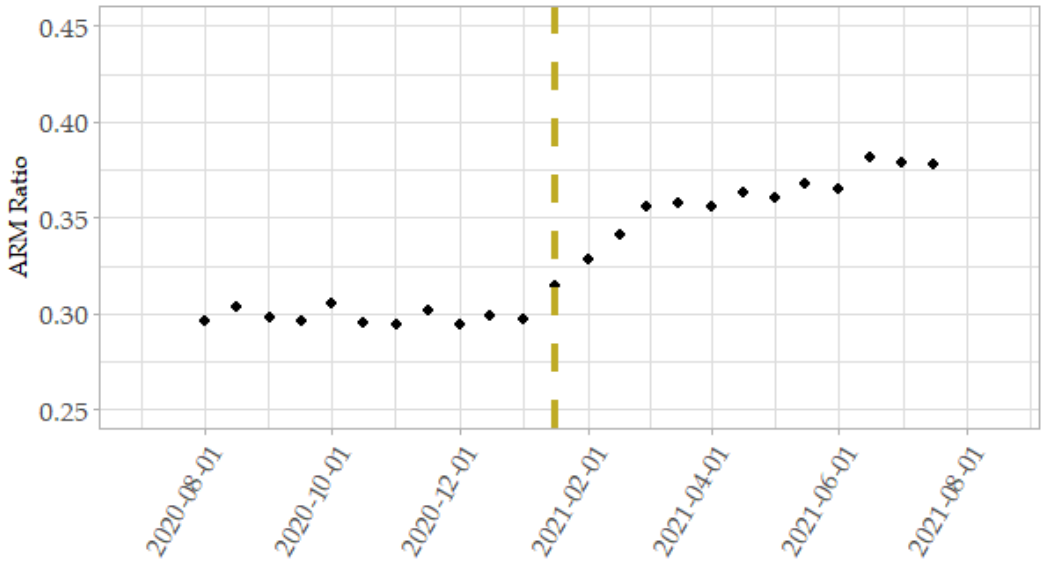
Figure 4 illustrates the average ARM ratio by mortgage origination date. We observe a distinct increase from an average ARM ratio of 29.9% before the regulatory

[16] For comparison, a 50 basis point increase in the policy rate will, on average, increase the monthly payment on a 100,000 NIS mortgage in the prime track by around 30 NIS.

[17] Of the Medium-Fixed tracks, approximately half will have their anchor interest rate updated once during the sample period, and of those, half will be in the period before the interest rate hikes.

change to 35.7% afterwards. It is noteworthy that while the regulation was binding, the new limit was not fully utilized; that is, the ratio did not increase all the way up to 66%. This suggests that while borrowers adjusted to the new regulation, they did not do so to the full extent allowed.

Figure 4. *ARM Ratio and the ARM Regulation Change*

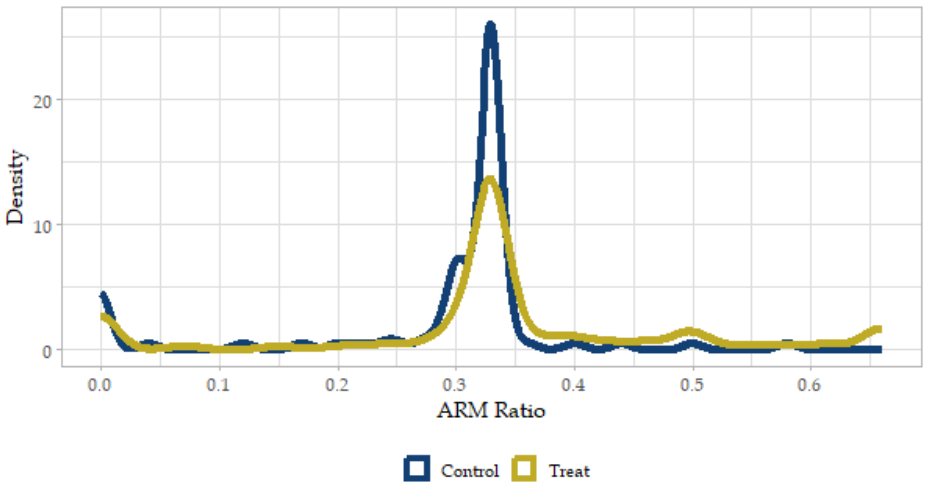


Notes: This figure illustrates the average ARM ratio of mortgages, categorized by the biweekly origination date of the mortgage. The ARM ratio is defined as the proportion of the unpaid current balance directly linked to the prime rate in relation to the total mortgage balance.

Figure 5 presents the distribution of mortgage borrowers' ARM ratios for those whose mortgages were originated around the time of the regulatory change indicates a notable pattern. Mortgages that originated just before January 2021 are highly concentrated at the regulatory limit. Specifically, 45% of borrowers whose mortgages were initiated between August 2020 and November 2020 had, as of February 2022, a ARM ratio of exactly 33% (with 60% of these borrowers' ARM ratios ranging between 32-34%). In contrast, borrowers with mortgages originating in the four months following the regulatory change show a more dispersed distribution with a lower proportion at the 33% ARM ratio, although this rate remained the most common. This pattern indicates a possible shift in borrower behavior or financial institution strategies following the regulatory amendment.

Building on these observations, we employ the following DiD design. The treat-

Figure 5. *ARM Ratio Density Around Regulation Change*



Notes: This figure presents the density of the ARM ratio from each mortgage current balance for mortgages that originated between August 2020 to November 2020 (control) and from February 2021 to May 2021 (treatment).

ment group consists of households whose mortgages originated in the four months following the regulatory change. The control group comprises borrowers with mortgages from the four months preceding the change:

$$\log(\text{DeferredDebit})_{i,t} = \beta\,(\text{Post}_t \times treat_i) + \sum_{k=1}^{K} \theta_k X_{i,t-1}^{(k)} + \sum_{k=1}^{K} \delta_k X_{i,t-1}^{(k)} \times \text{Post}_t + \alpha_i + \gamma_t + \epsilon_i \quad (2)$$

where $treat_i$ is an indicator set to one for the treatment group, and all other variables are as defined in Equation (1).[18]

Since for some borrowers, both in the control and the treatment groups, a 33% ARM ratio limit was not necessarily a binding constraint, we also estimate the DiD specification after restricting both samples to those borrowers whose average ARM ratio in the period before interest rates began to rise (January 2022 through March 2022) was above the median for the group. This approach effectively narrows our

[18]For the DiD specification, we begin the sample period in July 2021 to ensure that all mortgages in the sample have been fully drawn down.

focus to borrowers in the control group who likely would have chosen a higher ARM ratio had the opportunity been available to them.

5 Main Results

In this section we present a comprehensive analysis of the impact of interest rate changes on borrower consumption in Israel, with a specific focus on mortgage holders. Utilizing a robust dataset, we apply Equation (1) to explore how adjustments in mortgage interest rates, particularly those linked to the prime rate, influence the spending behaviors of consumers as observed through their deferred debit spending. Our approach is rooted in a detailed examination of the the proportion of a mortgage balance tied to the prime rate (ARM ratio) and its interaction with the period following the Bank of Israel's initiation of a rate hike campaign in April 2022, identified as "Post" in our study.

5.1 All Mortgages

Table 4 shows our baseline estimates for the effect of interest rate changes on the consumption of borrowers, based on applying Equation (1) to the log of deferred debit card spending as the dependent variable. "ARM ratio" is the fraction of the unpaid mortgage balance that is pegged to the prime rate compared to the total balance of the mortgage. "Post" is a binary dummy variable that takes the value of 1 for the period from April 2022 onward, the month following which the Bank of Israel started its rate hike campaign. The coefficient on the interaction between ARM ratio and Post is our main focus as it measures the effect of the change in the effect of a higher adjustable mortgage rate on the (log) level of deferred debit (our measure of consumption) as a function of the mortgagor's ARM ratio.

The interaction effect in the regression we run is given in basis points per the total change in the interest rate during the hiking period that is captured by "Post" (April 2022 - July 2023.) The first column of the table includes "ARM ratio" and its interaction with "Post." The additional variables that appear in the 2nd and 3rd columns control for other financial characteristics of mortgagors - Consumer Loans, Overdraft, and Credit Card, as well as the interaction between these variables and the dummy variable, Post. All regressions include two-way fixed effects at the level

of the borrower-month.

The interaction between ARMRatio and Post shows that during the period of rising interest rates, mortgagors with higher ARM ratios reduced their consumption more relative to those with lower ARM ratios. The implication of the coefficient is that for every 1 percentage point increase in the ARM ratio, consumption decreased by an additional 3-4 basis points during this period. In other words, in the post period, a household with a fully variable mortgage would have reduced consumption spending on average by an additional 3.6 percent points relative to a household with fully fixed rate mortgage. As this is the average response during the post period, and the policy rate averaged 2.68% during the same time span, these results imply that for every one percent point higher policy rate the mortgage cash flow channel induces households with fully variable rate mortgages to reduce spending by 1.34 percent point more relative to households with fully fixed rate mortgages.

The coefficients for the interaction of additional control variables with "Post" in columns (2) and (3) are uniformly negative and statistically significant. This indicates that consumer loans, overdrafts, and credit cards follow the trends observed in a higher interest rate environment. It's important to note, however, that while our primary focus in this paper is on mortgage payments, the evidence presented for other financial variables related to the "cash-flow channel" suggests a broad cash-flow channel that affects consumption through various paths, not just through mortgage payments. Our emphasis on mortgage payments in this study is mainly due to the data's capacity to leverage exogenous variation, allowing us to establish a credible causal link between interest rates and consumption.[19]

In order to gain some perspective on the economic significance of these results we provide a simple back-of-the-envelope estimation of the impact of these results on total consumption and economic activity. Note that the the total impact of the mortgage cash flow depends on three main factors: (i) the typical mortgage structure; (ii) the share of households with mortgages; (iii) the ratio of private consumption to GDP. For example, in Israel, the typical mortgage has a 32% ARM ratio and roughly 30% of households have a mortgage. Therefore, assuming mortgage households consumption roughly coincides with their share of the population, the estimation

[19]To converge space we present in the rest of this paper only the results of the ARM ratio. The results for the other debt controls and interactions are in line with the baseline estimations and are available upon request.

Table 4. *Baseline estimations*

	Log(Deferred debit)		
	(1)	(2)	(3)
ARM ratio×Post	−0.028***	−0.028***	−0.036***
	(0.003)	(0.003)	(0.003)
Consumer loans		0.035***	0.044***
		(0.002)	(0.002)
Overdraft		−0.016***	−0.008***
		(0.001)	(0.001)
Credit card		0.049***	0.071***
		(0.001)	(0.001)
Consumer loans×Post			−0.018***
			(0.001)
Overdraft×Post			−0.016***
			(0.001)
Credit card×Post			−0.042***
			(0.001)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	20,790,537	20,790,537	20,790,537
R^2	0.750	0.750	0.751
Adjusted R^2	0.740	0.741	0.741

Notes: This table reports the coefficient estimates of Equation 1. The estimation includes all the households with mortgages borrowers in Israel from January 2021 through June 2023. Columns represent different combinations of other borrower credit related controls. Standard errors clustered by borrower are reported in parentheses. *p<0.1; **p<0.05; ***p<0.01

from Table 4 imply that at the peak of the monetary contraction, when interest rates reached 4.75, the mortgage cash flow accounted for a 0.6% reduction in private consumption.[20] Since private consumption accounts for around 50% of GDP in Israel, this estimations imply that the mortgage cash flow channel contributed a 0.3% reduction in GDP to the recent monetary contraction.

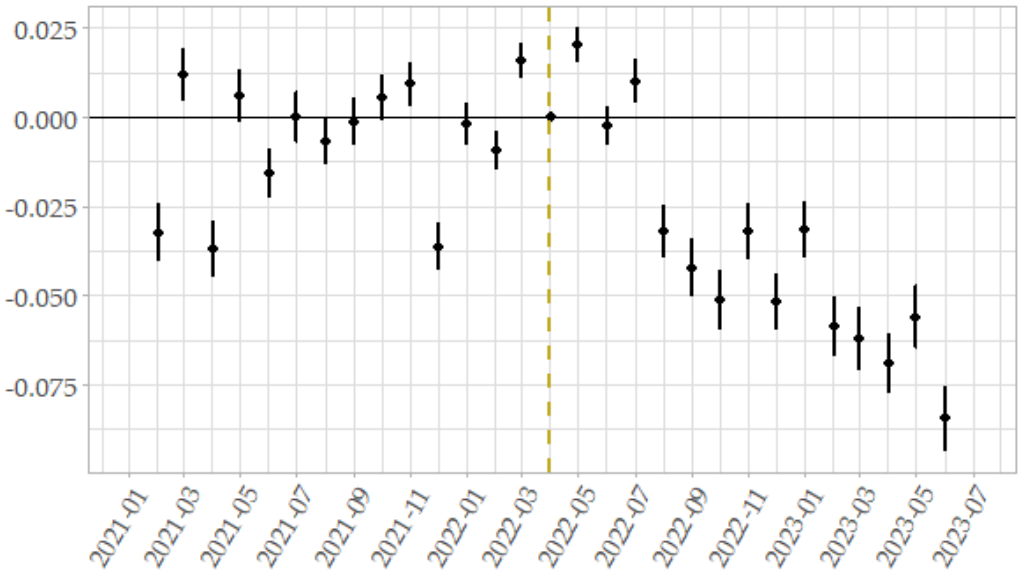
The temporal dynamics of how mortgage borrowers' ARM ratio impacts deferred debit card spending appear in Figure 6. This figure plots the month-by-month coefficients of Equation (1) from February 2021 to June 2023, revealing a negative trajectory. This trajectory highlights the ongoing effect of the policy rate's rise on the patterns of deferred debit card spending. The figure shows estimates derived from the in-

[20]The back-of-the-envelope estimation is received by multiplying the average ARM ratio (32%) with the estimated impact of one percent point higher policy rate on consumption (1.34%), the pick policy rate (4.75%) and the share of mortgage households in the Israeli population (30%).

teractions between ARM ratio and monthly dummies in Equation (1)'s estimation, presented with 90% confidence bands. The benchmark for these estimates is April 2022's coefficient, normalized to zero. This coincides with the Bank of Israel starting its interest rate hike campaign.

The dynamic specification reveals that before April 2022, the date of the Bank of Israel's first rate hike, there was no clear and significant pattern in the interaction coefficient between "ARM Rate" and the period dummy. However, after the first rate hike, a significant drop in the interaction coefficient becomes evident, especially from August 2022 onwards. This suggests a persistent and long-lasting effect of the new, higher interest rate environment on spending patterns. Most importantly, the results of the dynamic specification do not enforce a specific cutoff date, as we do with "Post" in the static specification, and nonetheless, show that our selection of the cutoff date as the date on which the Bank of Israel began raising rates is justified.

Figure 6. *Dynamic Impact of Mortgage Borrowers' Prime Rate on Monthly Deferred Debit Card Spending*



Notes: This figure reports the dynamic relationship between mortgage borrowers' ARM rate and the logarithm of monthly deferred debit card spending. The coefficient estimates presented come from the estimation of Equation (1), which includes interactions between "ARM ratio" and monthly dummies for each month from February 2021 to June 2023, displayed with 90% confidence bands. The coefficient for April 2022, the month when the Bank of Israel started hiking rates, is normalized to zero.

5.2 ARM Regulation Change

The results in Table 5 take advantage of the quasi-experimental research design leveraging the regulatory change in maximum ARM rate exposure that went into effect in January 2021. By restricting the sample to mortgages originated just before and after this change, we can examine the causal impact of higher ARM rate exposure holding other factors constant. In line with the baseline results, the interaction effect between the treatment group and the post interest rate hike period indicates that mortgagors more exposed to the fluctuating ARM interest rates substantially reduced their consumption during this period.

Specifically, the treatment group reduced consumption by an additional 2.8-3.0 basis points compared to the control group with lower prime rate exposure on their mortgage. To put this in perspective, this effect is similar in magnitude to the estimated effect from the baseline model in Table 4 which found a 3-4 basis point reduction. By utilizing a quasi-experimental approach, we increase confidence that this effect represents the causal impact of prime rate exposure on consumption. The fact that both methodologies result in similar quantitative effects further validates the significance of the channel through which adjustable-rate mortgages negatively influence spending during periods of rising interest rates.

Table 5. *Baseline estimation - ARM regulation change*

	Log(Deferred debit)		
	(1)	(2)	(3)
$treat \times$Post	-0.028^{***}	-0.028^{***}	-0.029^{***}
	(0.004)	(0.004)	(0.004)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	2,477,080	2,477,080	2,477,080
R^2	0.739	0.739	0.740
Adjusted R^2	0.727	0.727	0.727

Notes: This table reports the coefficient estimates of Equation 1 restricting the sample to only borrowers who's mortgage originated between September 2020 through May 2021 (dropping December 2020 and January 2021). Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period for the regression estimation is July 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

5.3 Borrower Heterogeneity

We investigate household income as a possible source of heterogeneity among mortgage borrowers in their consumption response to rising interest rates. Specifically, we split our sample by the socio-economic index of the household's town and re-estimate Equation (1) separately for each group.[21] We use four subsamples, with households from municipalities that are ranked 9-10 defined as 'High,' 7-8 as 'Medium-High,' 5-6 as 'Medium-Low,' and 3-4 as 'Low.' We exclude from the heterogeneity estimations municipalities ranked 1 and 2, since there is only a small share of very low-income households with mortgages.[22]

Table 6 present the results for estimating Equation (1) for different subsamples based on the socio-economic index. As we can see there is a negative and significant relation between the ARM ratio and reducing consumption in the post period for the Low to Medium income municipalities. However, for households from the High income municipalities the relation is insignificant. This suggests that High income households consumption was not impacted by the increase in mortgage payments. This result is consistent with the hypothesis that high income households have can smooth the negative liquidity shock by reducing saving without changing their consumption and standard of living. On the other hand, low and mid income household who's net monthly saving is much smaller are much more likely to cut spending.

[21] For the estimations in this section, we use all controls and interactions for the estimation of each group.

[22] While mortgages are reported from the lowest-ranking municipalities, there is a greater likelihood that the municipality ranking does not accurately represent the actual income of mortgage-holding households in these areas. Jerusalem, for instance, the largest city in Israel, is ranked two on the socio-economic index. This city is highly diverse, suggesting that wealthier households likely hold a disproportionately larger share of mortgages compared to their prevalence in the overall city population. Heterogeneity within a municipality is a concern across all socio-economic rankings, but it is especially pronounced in those with the lowest rankings.

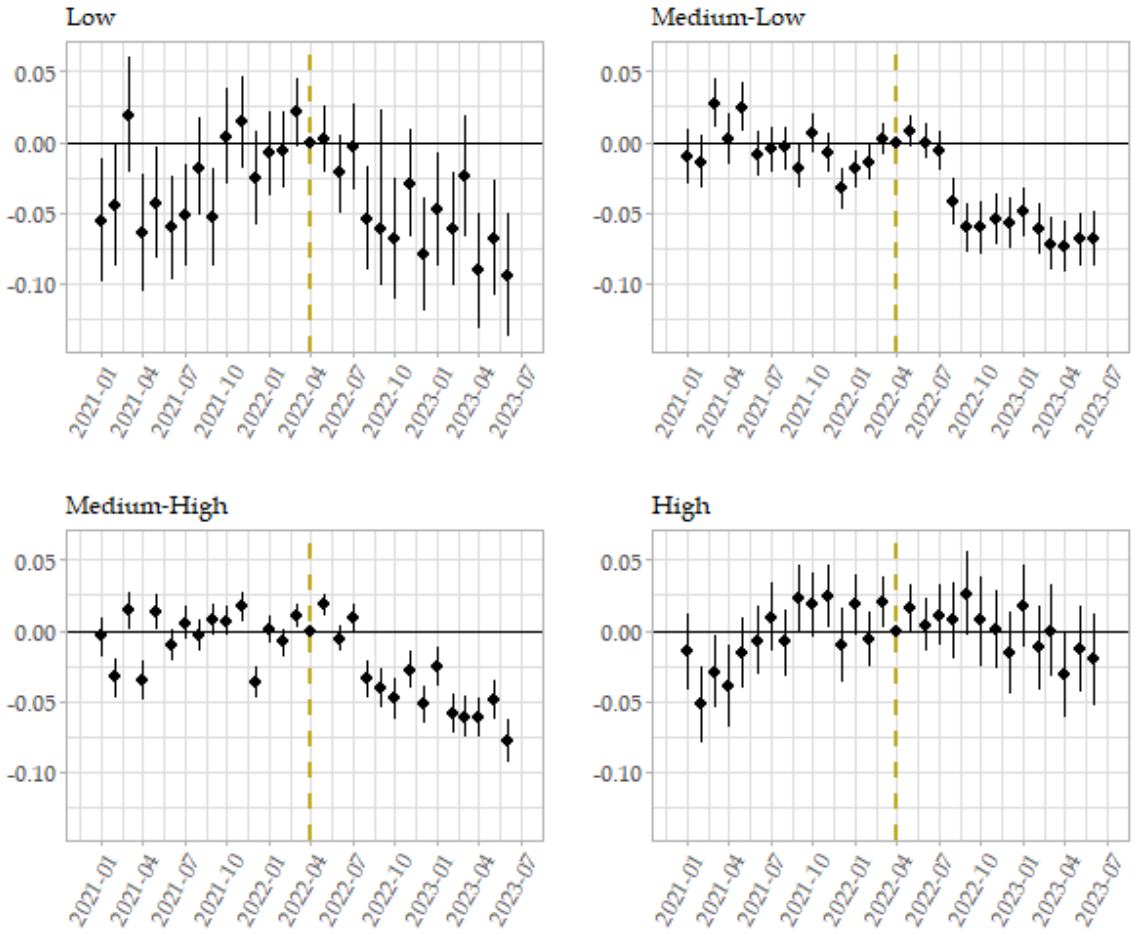
Table 6. *Heterogeneous impact by households' municipality socio-economic index*

	Log(Deferred debit)			
	Low	Medium-Low	Medium-High	High
	(1)	(2)	(3)	(4)
ARM ratio×Post	−0.032***	−0.039***	−0.035***	−0.007
	(0.014)	(0.006)	(0.005)	(0.010)
Controls	Y	Y	Y	Y
Interacted Controls	Y	Y	Y	Y
Borrower f.e	Y	Y	Y	Y
Time f.e	Y	Y	Y	Y
Observations	1,373,792	5,405,674	8,181,459	1,435,250
R^2	0.732	0.743	0.741	0.723
Adjusted R^2	0.721	0.732	0.731	0.713

Notes: This table reports the coefficient estimates of Equation 1 splitting the sample by the socio-economic index of the households' municipality. Standard errors clustered by borrower are reported in parentheses. Time period for the regression estimation is July 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

This results are further confirmed by Figure 7 which shows the dynamic estimation for each group.

Figure 7. *Dynamic Impact of Mortgage Borrowers' ARM Ratio on Monthly Deferred Debit Card Spending, Split by Households' Socio-Economic Index in Their Municipality*



Notes: This figure illustrates the dynamic relationship between the ARM ratio for mortgage borrowers and the logarithm of monthly deferred debit card spending across socio-economic groups. The coefficient estimates are derived from the estimation of Equation (1), incorporating interactions between the ARM ratio and monthly indicators for each month from February 2021 to June 2023. These are displayed alongside 90% confidence intervals. Notably, the coefficient for April 2022—the month when the Bank of Israel commenced its rate hikes—is set as the baseline and normalized to zero.

6 Robustness

6.1 All Mortgages

Selection and survival bias Our baseline specification faces several identification concerns. First, our sample may include new mortgage borrowers who react differently

to the changing interest rate environment. Specifically, borrowers who obtained mortgages in the post-period might fundamentally differ from those in the pre-period. This difference could affect the sample's structure in the post versus the pre-period, potentially leading to selection bias.[23]

To tackle this issue, we first narrow our sample to include only those mortgage borrowers whose mortgages originated before January 2021, i.e., before the sample period (and before the prime regulation change). Table 7 displays the results for this restricted sample. Our findings reinforce the robustness of our results even after addressing potential selection bias by restricting the sample to mortgages originating before the sample period. Notably, the interaction term $ARMRatio \times Post$ shows a significant negative coefficient of similar magnitude, consistent with a clear shift in spending behavior after the interest rate hikes. As before, this negative effect also persists when controlling for other forms of credit.

Table 7. *Robustness - Sample restricted to mortgages that originated before the sample period (selection bias)*

	Log(Deferred debit)		
	(1)	(2)	(3)
ARM ratio×Post	-0.025^{***}	-0.025^{***}	-0.035^{***}
	(0.003)	(0.003)	(0.003)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	18,141,447	18,141,447	18,141,447
R^2	0.757	0.757	0.757
Adjusted R^2	0.747	0.747	0.747

Notes: This table reports the coefficient estimates of Equation 1. The estimation includes mortgage borrowers who's mortgage originated before January 2021. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is January 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

An additional concern is that our results could be affected by people reacting to the interest rate increase by altering their mortgage structure through refinancing or

[23]Consider, for example, in a high interest rate environment, a specific group of borrowers might be over or under-represented in new mortgages. For instance, the share of new homeowners might increase relative to switchers (people upgrading their homes). If these two groups have distinct consumption patterns, it could influence the results.

paying down a portion of the mortgage[24]. Moreover, it is common for a mortgage in Israel to be sanctioned with an initial lump sum followed by a series of payment facilities that are 'drawn' over a period, usually not exceeding two years, based on the house's payment schedule. Therefore, even after restricting our sample to mortgages initiated before January 2021, our sample may still include incomplete mortgages and/or changes in monthly mortgage payments due to either planned increases in the mortgage balance or borrowers' strategic reactions to the rising interest rates.

To address these issues, we further restrict our sample to borrowers whose mortgage structure and principal amount did not change by more or less than 5% during the sample period. Table 8 displays the results for this more narrowly defined sample. Overall, the table offers stronger evidence for the stability of our results against survival bias. Comparing the coefficient estimates from Table 8 with those in earlier tables, the interaction term "ARM ratio × Post" consistently shows a significant negative coefficient. This confirms that the spending adjustment downward is distinct among borrowers whose mortgage principals did not change after the interest rate hikes, albeit slightly less than previously observed. These findings emphasize the need to consider mortgage structure changes when evaluating the impact of interest rates on consumer spending, thereby enhancing the credibility of our assessment of the effect of higher interest rates on deferred debit card spending.

Empirical specification Using the $Post$ dummy in our baseline estimation effectively implies that we are estimating the average response of mortgage borrowers' consumption during the period of rising interest rates. We believe this specification is appropriate as it captures both the accumulating increase in the policy rate as well as the expectations and overall environment during this period.

Alternatively, one can use the actual monthly policy rate, namely MP, instead of $Post$. Table 9 presents the results. The interpretation of the coefficients is that a one percentage point increase in the BOI policy rate is associated with a reduction between 1.4 to 1.6 basis points for every one percentage point higher ARM ratio. This result is exactly in line with the our interpretation of the results in Section (5.1).

Additionally, we test the robustness of the results for using the log of the actual monthly mortgage payments of each households instead of the ARM ratio. The focus now is on estimating the impact of higher mortgage payments, in percent, on

[24]See Bank of Israel Annual Report 2023 (forthcoming), Chapter 4.

Table 8. *Robustness - Sample restricted to mortgages that did not change during the sample period (survival bias)*

	Log(Deferred debit)		
	(1)	(2)	(3)
ARM ratio×Post	−0.025***	−0.025***	−0.032***
	(0.004)	(0.004)	(0.004)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	12,476,978	12,476,978	12,476,978
R^2	0.760	0.760	0.760
Adjusted R^2	0.750	0.750	0.750

Notes: This table reports the coefficient estimates of Equation 1. The estimation includes mortgage borrowers who's mortgage originated before January 2021 and did not change the structure of the mortgage during the estimation period. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is January 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

Table 9. *Estimating the impact of the monetary policy rate*

	Log(Deferred debit)		
	(1)	(2)	(3)
ARM ratio×MP	−0.014***	−0.014***	−0.016***
	(0.001)	(0.001)	(0.001)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	20,790,537	20,790,537	20,790,537
R^2	0.750	0.750	0.750
Adjusted R^2	0.740	0.741	0.741

Notes: This table reports the coefficient estimates of Equation 1 using the the monthly level of the BOI policy rate (MP) instead of the *post* indicator. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is January 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

the consumption of borrowers, again in terms of deferred debit card spending. As explained in section 4, for this specification we only use households which did not pay down or increased their mortgage principle during the sample period as those would cause large changes in mortgage payments that are unrelated to changes in

policy rate.

The findings from this analysis are detailed in Table 10. The table reports the coefficients from the estimation of a modified version of Equation (1), using the contemporaneous log of the monthly mortgage payments instead of the ARM ratio.

Note that in this specification the coefficient on the $log(Mortgage\ Payment)$ without the interaction does not drop since the monthly mortgage payments changes over time and is thus not observed by the household fixed effect. The coefficients in the first row indicate that in the pre period changes in mortage payments were unrelated to changes in households consumption. This is unsurprising since by design we only examine households whose payment was stable during that period as we only take fully fully drawn down mortgages that did not refinance and there were no changes in the policy rate during that time. However, In the post period the results indicate that a 1% increase in mortgage payments leads to 1.5-1.7 basis points decrease in deferred debit spending. Therefore, for a 25% increase in mortgage payments in the post period the results imply a reduction of around 0.4%. Recall that for the baseline results we found that the mortgage cash flow accounted for a 1% reduction in consumption in the post period for a typical 33% ARM ratio mortgage. Thus the results from this estimation is somewhat weaker in magnitude but largely consistent with the baseline results, reinforcing the negative relationship between increased mortgage payments during the rate hike period and deferred spending.

6.2 Prime Regulation Change

Table 11 presents our first robustness result for the DiD specification, using a restricted sample of borrowers who did not change their mortgage structure during the sample period. As shown in the table, and similar to the previous section, restricting the sample to borrowers who did not change their mortgages does not alter our conclusions. The coefficient on the interaction term remains in the vicinity of 3 basis points, and its magnitude is slightly lower once we include our set of control variables.

Although the ARM regulation was generally binding, the large cross-sectional differences between borrowers imply that even before the regulation change, some borrowers had an ARM ratio that was below the regulation limit. That is, in both the treated and control samples, there are likely borrowers who were not directly

Table 10. *Estimating the impact of the mortgage payment*

	Log(Deferred debit)		
	(1)	(2)	(3)
log(*Mortgage Payment*)	0.002	0.002	0.006
	(0.0004)	(0.0004)	(0.0004)
log(*Mortgage Payment*)×Post	-0.017^{***}	-0.017^{***}	-0.015^{***}
	(0.033)	(0.033)	(0.033)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	12,403,001	12,403,001	12,403,001
R^2	0.760	0.760	0.760
Adjusted R^2	0.750	0.750	0.750

Notes: This table reports the coefficient estimates of Equation 1 using the log of th contemporaneous monthly mortgage payment instead of the ARM ratio. The estimation includes mortgage borrowers who's mortgage originated before January 2021 and did not change the structure of the mortgage during the estimation period. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time estimation period is January 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

impacted by the regulation. We thus test the sensitivity of the results to restricting both the control and treated groups to "high ARM" borrowers. "High ARM" borrowers are defined as those whose average ARM ratio in the first quarter of 2022, right before the increase in interest rates, was above each group's median.

Table 12 presents the results for the high ARM borrowers. As can be seen, our main conclusion is also robust to restricting the sample to 'high ARM' borrowers. In particular, the coefficient on the interaction effect equals roughly 3.3 basis points after we add our set of control variables to the regression.

To address potential concerns about spurious findings in our Difference-in-Differences (DiD) analysis, we additionally conducted a standard placebo test. This test involved running the same DiD specification but with an arbitrary cutoff date set to January of four previous years (2017-2020), during which there were no changes in regulation. Specifically, in each panel estimation is performed only for borrowers whose mortgage originated between August 2016/2017/2018/2019 through May 2017/2018/2019/2020. For each group of mortgage borrowers, we keep only borrowers whose average ARM ratio is above each group's median.

Table 11. *Robustness - ARM regulation change - Sample restricted to mortgages that did not change during the sample period (survival bias)*

	Log(Deferred debit)		
	(1)	(2)	(3)
treat×Post	−0.025***	−0.025***	−0.025***
	(0.005)	(0.005)	(0.005)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	1,629,527	1,629,527	1,629,527
R^2	0.741	0.741	0.741
Adjusted R^2	0.729	0.729	0.729

Notes: This table reports the coefficient estimates of Equation 1 restricting the sample to only borrowers who's mortgage originated between between September 2020 through May 2021 (dropping December 2020 and January 2021) and the mortgage structure did not change during the estimation period. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is July 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

Table 12. *Robustness - ARM regulation change - high ARM borrowers*

	Log(Deferred debit)		
	(1)	(2)	(3)
treat×Post	−0.033***	−0.033***	−0.033***
	(0.005)	(0.005)	(0.005)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	1,244,122	1,244,122	1,244,122
R^2	0.736	0.736	0.736
Adjusted R^2	0.724	0.724	0.724

Notes: This table reports the coefficient estimates of Equation 1 restricting the sample to only borrowers who's mortgage originated between between September 2020 through May 2021 (dropping December 2020 and January 2021). For each group of mortgage borrowers, those with mortgages that originated in the period prior to the prime regulatory change, we keep only borrowers who's average ARM ratio is above each group median. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is July 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01

The results of our placebo test are documented in Table 13. Significantly, the results revealed that all four interaction terms, corresponding to each of the four years, were of smaller magnitude and, crucially, none were statistically significant. This lack of significance in the placebo test provides additional confidence in the reliability of our DiD methodology and its estimations, bolstering the credibility of our findings.

7 Conclusions

This paper provides empirical evidence for the mortgage cash-flow channel of monetary policy transmission. Leveraging detailed household-level data and quasi-experimental variation in adjustable-rate mortgage exposure, we demonstrate that higher debt servicing costs resulting from interest rate hikes lead to significant declines in consumption expenditures.

Our analysis reveals that mortgagors more exposed to fluctuating rates via adjustable-rate mortgages reduced consumption spending by an additional 3.6% following a 465 basis points increase in policy rates. This effect is most pronounced among mid to lower income households, indicating distributional consequences of the mortgage cash-flow channel.

These results have several key implications. First, they quantify a mechanism of monetary policy transmission that has received less empirical scrutiny compared to other channels. By establishing a causal relationship between adjustable-rate mortgage exposure and consumption responses, we deepen understanding of how interest rates influence economic activity. Second, our findings demonstrate significant heterogeneity in transmission effects, with low and middle income groups exhibiting greater sensitivity. This suggests monetary policy changes mediated through consumer debt and cash flows may exacerbate inequality. Accounting for distributional impacts should be an important consideration for central banks. Finally, the results highlight how regulatory choices in mortgage markets can dramatically affect policy transmission. The shift allowing a higher share of adjustable-rate mortgages meaningfully intensified the consumption effect of rate hikes. Greater coordination between central banks and financial supervision agencies is warranted.

In general, our paper underscores the necessity of viewing monetary policy

Table 13. *Robustness - prime regulation change placebo test*

	Log(Deferred debit)		
	(1)	(2)	(3)
Panel A: January 2020			
treat×Post	−0.001	−0.001	−0.003
	(0.008)	(0.008)	(0.008)
Observations	555,057	555,057	555,057
R^2	0.738	0.738	0.738
Adjusted R^2	0.726	0.726	0.726
Panel B: January 2019			
treat×Post	−0.015	−0.014*	−0.015*
	(0.008)	(0.008)	(0.008)
Observations	442,482	442,482	442,482
R^2	0.739	0.739	0.739
Adjusted R^2	0.727	0.727	0.727
Panel C: January 2018			
treat×Post	−0.010	−0.011	−0.011
	(0.009)	(0.009)	(0.009)
Observations	365,307	365,307	365,307
R^2	0.745	0.746	0.746
Adjusted R^2	0.733	0.733	0.733
Panel D: January 2017			
treat×Post	−0.010	−0.010	−0.010
	(0.010)	(0.010)	(0.010)
Observations	310,253	310,253	310,253
R^2	0.747	0.747	0.747
Adjusted R^2	0.735	0.735	0.735
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y

Notes: This table reports the coefficient estimates of the placebo test for the prime regulation that happened in January 2021. Estimation is exactly as described in Section 4.2 but with different dates for determining the treatment and control. Specifically, in each panel estimation is performed only for borrowers whose mortgage originated between August 2016/2017/2018/2019 through May 2017/2018/2019/2020 (dropping the corresponding December and January). For each group of mortgage borrowers, we keep only borrowers whose average ARM ratio is above each group's median. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is July 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01.

decisions through the lens of household balance sheets. Fluctuations in mortgage rates have profound influence on borrowers' demand. As debt service burdens rise globally, accounting for these dynamics in policy setting will be vital for both stabilizing output and inflation and safeguarding financial resilience.

References

Agarwal, Sumit, Chomsisengphet, Souphala, Yildirim, Yildiray, and Zhang, Jian (2021). "Interest rate pass-through and consumption response: The deposit channel". In: *Review of Economics and Statistics* 103.5, pp. 922–938.

Agarwal, Sumit, Deng, Yongheng, Gu, Quanlin, He, Jia, Qian, Wenlan, and Ren, Yuan (2022). "Mortgage debt, hand-to-mouth households, and monetary policy transmission". In: *Review of Finance* 26.3, pp. 487–520.

Agarwal, Sumit and Qian, Wenlan (2014). "Consumption and debt response to unanticipated income shocks: Evidence from a natural experiment in Singapore". In: *American Economic Review* 104.12, pp. 4205–4230.

Auclert, Adrien (2019). "Monetary policy and the redistribution channel". In: *American Economic Review* 109.6, pp. 2333–2367.

Bank of Israel (2022). *Monetary Policy Report Second Half of 2022*.

— (2023). *Monetary Policy Report for the first half of 2023*.

Bernanke, Ben S. (June 2007). *The Financial Accelerator and the Credit Channel*. Federal Reserve Board. URL: https://www.federalreserve.gov/newsevents/speech/bernanke20070615a.htm.

Bernanke, Ben S and Gertler, Mark (1995). "Inside the black box: the credit channel of monetary policy transmission". In: *Journal of Economic perspectives* 9.4, pp. 27–48.

Bernanke, Ben S and Kuttner, Kenneth N (2005). "What explains the stock market's reaction to Federal Reserve policy?" In: *The Journal of finance* 60.3, pp. 1221–1257.

Borio, Claudio and Zhu, Haibin (2012). "Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?" In: *Journal of Financial stability* 8.4, pp. 236–251.

Calza, Alessandro, Monacelli, Tommaso, and Stracca, Livio (2013). "Housing finance and monetary policy". In: *Journal of the European Economic Association* 11.suppl_1, pp. 101–122.

Choi, Sangyup, Willems, Tim, and Yoo, Seung Yong (2024). "Revisiting the monetary transmission mechanism through an industry-level differential approach". In: *Journal of Monetary Economics*, p. 103556.

Cloyne, James, Ferreira, Clodomiro, and Surico, Paolo (2020). "Monetary policy when households have debt: new evidence on the transmission mechanism". In: *The Review of Economic Studies* 87.1, pp. 102–129.

Cumming, Fergus (2019). "Mortgage cash-flows and employment". In: *European Economic Review*. DOI: 10.1016/j.euroecorev.2021.104019. URL: https://consensus.app/papers/mortgage-cashflows-employment-cumming/0895471bdbad5b459d7f09471832fc05/?utm_source=chatgpt.

Daniel H. Cooper Vaishali Garga, María J. Luengo-Prado (2021). "The Mortgage Cash Flow Channel of Monetary Policy Transmission: A Tale of Two Countries". In: *Federal Reserve Bank of Boston Research Department Working Papers*.

Di Maggio, Marco, Kermani, Amir, Keys, Benjamin J, Piskorski, Tomasz, Ramcharan, Rodney, Seru, Amit, and Yao, Vincent (2017). "Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging". In: *American Economic Review* 107.11, pp. 3550–3588.

Eichenbaum, Martin and Evans, Charles L (1995). "Some empirical evidence on the effects of shocks to monetary policy on exchange rates". In: *The Quarterly Journal of Economics* 110.4, pp. 975–1009.

Garriga, Carlos, Kydland, Finn E, and Šustek, Roman (2017). "Mortgages and monetary policy". In: *The Review of Financial Studies* 30.10, pp. 3337–3375.

Gerardi, Kristopher, Willen, Paul S, and Zhang, David Hao (2023). "Mortgage prepayment, race, and monetary policy". In: *Journal of Financial Economics* 147.3, pp. 498–524.

Hofmann, Boris and Peersman, Gert (2017). "Is there a debt service channel of monetary transmission?" In: *BIS Quarterly Review, December*.

Holm, Martin Blomhoff, Paul, Pascal, and Tischbirek, Andreas (2021). "The transmission of monetary policy under the microscope". In: *Journal of Political Economy* 129.10, pp. 2861–2904.

Ippolito, Filippo, Ozdagli, Ali K, and Perez-Orive, Ander (2018). "The transmission of monetary policy through bank lending: The floating rate channel". In: *Journal of Monetary Economics* 95, pp. 49–71.

Kaplan, Greg, Violante, Giovanni L, and Weidner, Justin (2014). *The wealthy hand-to-mouth*. Tech. rep. National Bureau of Economic Research.

Kashyap, Anil K and Stein, Jeremy C (1994). "Monetary policy and bank lending". In: *Monetary policy*. The University of Chicago Press, pp. 221–261.

Krueger, Dirk, Mitman, Kurt, and Perri, Fabrizio (2016). "Macroeconomics and household heterogeneity". In: *Handbook of macroeconomics*. Vol. 2. Elsevier, pp. 843–921.

Slacalek, Jiri, Tristani, Oreste, and Violante, Giovanni L (2020). "Household balance sheet channels of monetary policy: A back of the envelope calculation for the euro area". In: *Journal of Economic Dynamics and Control* 115, p. 103879.

Svensson, Lars EO (1997). "Inflation forecast targeting: Implementing and monitoring inflation targets". In: *European economic review* 41.6, pp. 1111–1146.

Tzamourani, Panagiota (2021). "The interest rate exposure of euro area households". In: *European Economic Review* 132, p. 103643.

A Online Appendix (not for publication)

A.1 Additional results

Table 14. *Robustness - alternative controls*

	Log(Deferred debit)		
	(1)	(2)	(3)
ARM ratio×Post	−0.028***	−0.028***	−0.029***
	(0.003)	(0.003)	(0.003)
Consumer loans		0.00004***	0.0001***
		(0.000)	(0.000)
Overdraft		0.00002	0.0001***
		(0.000)	(0.000)
Credit card		0.0001***	0.001***
		(0.000)	(0.000)
Consumer loans×Post			−0.00001***
			(0.0000)
Overdraft×Post			−0.0002***
			(0.00002)
Credit card×Post			−0.001***
			(0.00004)
Controls	N	Y	Y
Interacted Controls	N	N	Y
Borrower f.e	Y	Y	Y
Time f.e	Y	Y	Y
Observations	20,790,537	20,790,537	20,790,537
R^2	0.750	0.750	0.750
Adjusted R^2	0.740	0.740	0.740

Notes: This table reports the coefficient estimates of Equation 1, using continuous control variables (balances in thousands) instead of dummy variables. Columns represent different borrower other credit related controls. Standard errors clustered by borrower are reported in parentheses. Time period is January 2021 through June 2023. *p<0.1; **p<0.05; ***p<0.01