NBER WORKING PAPER SERIES

INTEREST RATE PASS-THROUGH WITH ADJUSTABLE RATE MORTGAGES

Manuel Adelino
Miguel A. Ferreira
Sujiao Zhao

Working Paper 34824
http://www.nber.org/papers/w34824

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2026

We thank seminar participants at Duke University, European Central Bank, Fordham University, Nova School of Business and Economics, University of Notre Dame, University of Wisconsin-Madison, National University of Singapore, Singapore Management University, and University of Florida. This research has been financed by Portuguese public funds through FCT - Fundação para a Ciência e a Tecnologia, I.P., in the framework of the project UID/4105/2025. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2026 by Manuel Adelino, Miguel A. Ferreira, and Sujiao Zhao. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Interest Rate Pass-Through With Adjustable Rate Mortgages
Manuel Adelino, Miguel A. Ferreira, and Sujiao Zhao
NBER Working Paper No. 34824
February 2026
JEL No. D14, E44, E52, G21

ABSTRACT

Adjustable-rate mortgages (ARMs) transmit monetary policy less directly than often assumed. We exploit quasi-experimental variation in ARM rate reset timing in Portugal—where over 92% of mortgages are indexed to Euribor—around the ECB's 2022–2023 tightening cycle to estimate responses to mortgage payment shocks. After reset dates, mortgage renegotiations increase by 10 percentage points, lender switching by 4, partial prepayments by 5, and full prepayments by 3, offsetting about 17% of the payment increase implied by policy rates. Responses occur only immediately after resets, consistent with selective inattention, and are largest among younger, more educated, and higher-balance borrowers. Supply-side factors amplify these effects: as rates rise and bank competition intensifies, households at more flexible banks renegotiate, switch lenders, and prepay more, while greater broker presence further increases lender switching. Our findings suggest that monetary policy pass-through in ARM-dominated markets depends on borrower behavior, market frictions, and sticky deposit rates.

Manuel Adelino
Duke University
Fuqua School of Business
and NBER
manuel.adelino@duke.edu

Miguel A. Ferreira
Nova School of Business and Economics
and CEPR and ECGI
miguel.ferreira@novasbe.pt

Sujiao Zhao
The University of Hong Kong (HKU)
emmasjz@hku.hk

1 Introduction

Mortgage credit is one of the largest, and most interest rate-sensitive, components of household balance sheets, making it a primary channel through which monetary policy affects consumption and housing demand. In markets dominated by fixed-rate mortgages, monetary policy pass-through is both sluggish and asymmetric: when policy rates rise, borrowers keep below-market rates contracts and postpone moving or trading up (Fonseca and Liu (2024)); when rates fall, refinancing is slow and incomplete, muting the expansionary effects of easing (e.g., Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao (2017); Beraja, Fuster, Hurst, and Vavra (2019); Zhang (2022); Berger, Milbradt, Tourre, and Vavra (2024)). In contrast, adjustable rate mortgages (ARMs) are often seen as avoiding this asymmetry, since contractual rates reset automatically to market rates over the lifetime of the loan, implying a faster and more symmetric pass-through of policy changes to household cash flows (Garriga, Kydland, and Šustek (2017)).

A critical but rarely tested assumption behind the conventional view is that mortgage terms remain fixed when rates change, so that interest rate movements pass through one-for-one to mortgage payments. In practice, however, mortgage terms may adjust through borrower- or lender-initiated actions, making pass-through incomplete or state contingent even in ARM-dominated markets. Direct evidence on such responses is limited. Existing work studies refinancing and inattention under fixed-rate mortgages (e.g., Gross and Souleles (2002); Campbell and Cocco (2003); Keys, Pope, and Pope (2016); Fuster, Plosser, Schnabl, and Vickery (2019)), the impact of switching costs and bank competition (Woodward and Hall (2012); Agarwal, Grigsby, Hortaçsu, Matvos, Seru, and Yao (2024); Allen, Clark, Houde, Li, and Trubnikova (2024)), and the sluggish adjustment of deposit rates, which shapes banks' funding costs (Drechsler,

Savov, and Schnabl (2017); Bonfim and Queiró (2024)). To the best of our knowledge, this is the one of the first papers to examine how ARM borrowers respond to large increases in inflation- and policy-driven interest rates.

We exploit the European Central Bank's (ECB) unprecedented tightening cycle between July of 2022 and September of 2023, during which the 12-month Euribor rose from -0.5% to over 4%. We focus on Portugal, which offers an unusually clean setting for three main reasons. First, ARMs make up over 92% of outstanding mortgage contracts (as of July 2022), and approximately one-quarter of these mortgages reset exactly once per year, creating a staggered, quasi-experimental timing of mortgage payment shocks.[1] We focus on contracts indexed to the 12-month Euribor, which reset annually, to isolate borrower responses to individual rate shocks and avoid overlapping event windows; the effects materialize more rapidly when reset intervals are shorter. Second, deposit-rate pass-through was muted during this period (Bonfim and Queiró (2024)), widening the gap between mortgage rates and returns on liquid savings and amplifying incentives to prepay. Third, mortgage contractual rates—the spread over the Euribor reference rate—are individually negotiated as in the United States. Borrowers can renegotiate with their current bank or switch to another, but they face significant frictions in doing so.

Using the universe of loan-level administrative data linked to contract amendments, bank transfers, prepayment flows, and short-term credit usage, we show that rate resets during the ECB's 2022–2023 tightening cycle triggered sharp changes to mortgage terms and balances. In the six months after a reset, the monthly probability of mortgage renegotiation rose by 0.74 percentage points, switching to a new lender (i.e., transfers) by 0.26, partial prepayments by 0.36, and full prepayments by 0.13.[2] By

[1] We refer to mortgages with rates that reset periodically over their lifetime as adjustable rate mortgages (ARMs). In Portugal, unlike in the United States, ARMs do not feature an initial fixed-rate "teaser" period. Instead, they are indexed from origination to the 3-, 6-, or 12-month Euribor.

[2] In the Portuguese institutional setting, switching to a new lender is typically referred to as a "transfer"

December 2023, these effects cumulated to 10.0 percentage points for renegotiations, 3.9 for transfers, 4.8 for partial prepayments, and 2.5 for full prepayments. This implies that borrowers whose mortgage rate reset during the tightening cycle were 19.8 percentage points more likely to respond than borrowers whose rate did not reset in the same calendar month-year, relative to the pre-tightening period. Most responses occur immediately after resets, consistent with rational or selective inattention (as in de Silva and Mei (2025) on durable purchases), although a subset of more educated borrowers adjusts in advance.

We find that adjustments occur across multiple margins. Lender switching delivers sizable and immediate spread reductions of roughly 65 basis points and facilitate changes in contract terms, such as switching into fixed- or mixed-rate mortgages or lowering loan-to-value (LTV) ratios through home revaluation.[3] Renegotiation yields smaller spread improvements of roughly 27 basis points but is more accessible to liquidity-constrained borrowers. Partial and full prepayments rise significantly, consistent with muted deposit-rate pass-through that lowers the opportunity cost of drawing down liquid savings. Beyond mortgages, overdraft usage rises sharply, and both credit card limits and spending increase—though limits expand faster—indicating greater reliance on high-cost credit to smooth consumption and build precautionary liquidity buffers.

The effects on mortgage renegotiation, transfer, and partial prepayment are largely driven by supply-side factors, namely lenders. We split households by lenders' observed propensity to renegotiate, accept transfers, and allow prepayments for borrowers located farther from the household—mitigating lender-borrower matching concerns—and show that this variation helps explain the magnitude of the estimated

and corresponds to refinancing with another bank.

[3]Mixed-rate mortgages in Portugal feature an initial fixed-rate period—typically 3, 5, or 10 years—followed by an adjustable rate for the remainder of the loan.

effects. Borrowers of a bank are more than three times as likely to renegotiate when that bank tends to renegotiate in other regions. Likewise, borrowers whose banks exhibit high mortgage transfer and prepayment activity in other regions are significantly more likely to switch lenders. Mortgage brokers also contribute: greater local broker presence makes borrowers more likely to switch lenders. Taken together, the evidence suggests that interest rate increases intensify bank competition, limiting the pass-through of policy rates to mortgage payments.

Borrower heterogeneity also helps explain the magnitude of the estimated effects. Renegotiations and transfers are more prevalent among younger households, who tend to have lower income and higher leverage and therefore stronger incentives to reduce mortgage payments. Prepayments, by contrast, are stronger among older households, who are more likely to hold liquid savings that facilitate deleveraging. Across margins, responses are more common among more educated borrowers, consistent with greater financial literacy that lowers search and switching costs.

Back-of-the-envelope calculations suggest that, in aggregate, contract adjustments and mortgage balance changes absorbed about 17% of the increase in scheduled mortgage payments during the tightening cycle that would have occurred under full monetary policy pass-through. In particular, transfers and renegotiations offset about 3% of the payment increase implied by policy rates. These findings show that even in an ARM-dominated market, monetary policy transmission is shaped not only by contract design but also by borrower behavior, market frictions, and sticky deposit rates.

Our findings contribute to three strands of literature. First, we add to work on the heterogeneous transmission of monetary policy through household debt portfolios by showing that, even in an ARM-dominated market, borrower responses play a central role in shaping aggregate pass-through (Garriga et al. (2017); Berger et al. (2024)). This

finding relates to existing studies examining how households respond to interest rate shocks (Abel and Fuster (2021); Berger, Milbradt, Tourre, and Vavra (2021); Berger et al. (2024); Fonseca and Liu (2024)). Abel and Fuster (2021) examine program-driven refinancing under HARP in the United States in 2009; Berger et al. (2021, 2024) study refinancing frictions and path dependence in fixed-rate markets during easing cycles; and Fonseca and Liu (2024) analyze fixed-rate mortgage lock-in effects on household mobility when interest rates rise. Boutros, Clara, and Kartashova (2025) show that the coexistence of fixed-rate, adjustable-rate, and hybrid contracts in the Canadian market is welfare-enhancing and that the dominant contract type shapes monetary transmission. Closest to our setting, Fuster, Gianinazzi, Hackethal, Schnorpfeil, and Weber (2025) examine the German market, where mortgages typically carry a 5–15 year fixed-rate period. During the 2022-2023 euro area tightening cycle, they find that borrowers are attentive to rate movements and act preemptively by locking in rates through "forward mortgage" contracts—unlike in Portugal, where we observe that responses cluster after rate resets.

Second, we extend the literature on mortgage market competition by showing how abrupt reference-rate changes interact with search frictions and switching costs (DeFusco and Paciorek (2017)). These frictions influence whether borrowers renegotiate with their existing bank or transfer to a new one. We document that competition intensifies as interest rates rise, with more flexible banks and greater broker presence amplifying renegotiation, lender switching, and prepayment activity.

Third, we contribute to the growing evidence on sluggish deposit-rate pass-through (Drechsler et al. (2017); Bonfim and Queiró (2024)) and its connection to bank profitability (Altunok, Arslan, and Ongena (2024)). Low deposit betas raise bank profitability by widening the spread between mortgage rates and returns on liquid savings. This wedge, in turn, strengthens households' incentives to deleverage.

Consistent with this mechanism, we document substantial increases in partial and full prepayments as well as in lender switching.

Our contribution is to examine borrower-initiated responses to rising mortgage payments in an ARM-dominated market where refinancing is not program-driven but arises organically from predictable mortgage rate resets. In Portugal, these adjustments occur mainly through within-bank renegotiation, lender switching, and partial prepayment, as home equity lines (HELOCs) and cash-out refinancing are rare—consistent with voluntary deleveraging under financial pressure. Rather than transmitting interest rate changes swiftly and automatically to household budgets, we show that households actively renegotiate, switch lenders, or reduce principal, thereby limiting the pass-through of monetary policy. Because these actions are tied to individual reset schedules, they alter both the timing and profile of monetary policy transmission. For policymakers, this implies that the effectiveness of rate hikes depends not only on the prevalence of ARMs but also on competitive dynamics in mortgage and deposit markets and on borrower attention to financial conditions—factors that vary widely across countries and over time.

These findings are consistent with prior evidence documenting sizable short-run consumption responses to changes in mortgage payments, particularly among highly indebted borrowers with ARMs (Di Maggio et al. (2017), Flodén, Kilström, Sigurdsson, and Vestman (2021), and Ahn, Galaasen, and Maehlum (2024)). In contrast, Elias, Gillitzer, Kaplan, La Cava, and Prasad (2025) report a muted consumption response to interest rate increases in Australia, where most mortgage contracts include redraw facilities that allow borrowers to smooth payment adjustments through voluntary repayments. Portugal differs from the U.S. fixed-rate setting, where refinancing is typically triggered by rate cuts. In Portugal, households adjust primarily to increases in mortgage payments, implying a state-contingent behavioral pass-through: sharp

responses during tightening episodes—especially at rate reset dates—and relative inertia in normal periods, consistent with rational or selective inattention (Cloyne, Ferreira, and Surico (2019)).

2 Data and Identification Strategy

2.1 The Mortgage Market in Portugal

The Portuguese mortgage market is characterized by the overwhelming dominance of adjustable-rate contracts.[4] As of July 2022, ARMs represented 92% of the outstanding stock of mortgages, a share far above the euro-area average. The bulk of contracts are indexed to the 3-, 6- or 12-month Euribor. As of July 2022, loans with 12-month reset frequencies represent 26% of all mortgages in the Portuguese Central Credit Register, while 3-month and 6-month resettable loans account for 29% and 42%, respectively. The 12-month index accounts for the largest share when measured by amounts outstanding, accounting for 40% of all mortgages, compared with 23% for 3-month resettable loans and 30% for 6-month resettable loans. Origination spreads are negotiated bilaterally and averaged about 150 basis points over Euribor in the period preceding the 2022–2023 tightening cycle, creating room for ex-post renegotiation.

Mortgages in Portugal are full-recourse contracts, allowing lenders to pursue borrowers' other assets and future income in the event of default. Contracts typically include clauses permitting renegotiation or transfer to another institution. Prepayment penalties are legally capped at 0.5% of the outstanding balance for adjustable-rate loans and 2% for fixed-rate loans.[5] Life- and fire-insurance coverage are not mandated

[4] As in Portugal, adjustable-rate contracts dominate in Finland, Greece, Ireland, Italy, and Spain. In addition, in Canada and the U.K., the typical mortgage has an initial fixed rate that later resets, similar to ARMs in the United States.

[5] To encourage transfers and prepayments during the recent rate-hike episode, the government

by law but are routinely required by banks as conditions for mortgage approval.

Since July 2018, the Bank of Portugal has imposed borrower-based restrictions on all new housing loans: (1) a loan-to-value (LTV) cap of 90% for owner-occupied purchases (lower for secondary homes and investment properties); (2) a debt-service-to-income (DSTI) ratio cap of 50%; and (3) a maximum original maturity reduced from 40 to 30 years by the end of 2022. All loans must amortize through regular principal-and-interest installments; interest-only periods and negative-amortization schedules are prohibited.

Portuguese banks fund a large share of their mortgage books with domestic retail deposits. Bonfim and Queiró (2024) document incomplete pass-through of monetary policy to deposit rates. They estimate a long-run deposit beta of 0.65 using 1997:Q4–2023:Q4 data: a 100 basis point increase in money-market rates raises new household-deposit rates by only 65 basis points after one year, compared with a euro-area average of 0.87.[6] During the 2022–2023 tightening cycle, mortgage rates on ARMs moved one-for-one with Euribor, while deposit remuneration adjusted far more slowly. The widening gap between mortgage and deposit rates increased the opportunity cost of holding large sight balances and likely triggered the wave of partial and full prepayments we document.

These institutional features jointly shape how the ECB's policy shocks reach Portuguese households. Euribor-indexed contracts ensure mechanical pass-through to scheduled payments, but low switching costs, capped (and at times waived) prepayment penalties, negotiable spreads, and muted deposit remuneration create margins for borrowers to insulate themselves once mortgage rate resets occur.

suspended prepayment penalties on ARMs for owner-occupied homes between late 2022 and December 2025, lowering pecuniary switching costs. Borrowers were also allowed to use retirement savings for mortgage prepayments without forfeiting tax benefits. In addition, targeted measures supported low-income households with debt-service-to-income ratios above 35% through incentives for lender renegotiation and mortgage payment subsidies. These distress-related renegotiations are excluded from our sample of mortgage actions.

[6] Bonfim and Queiró (2024) also report an even lower deposit beta of 0.59 for household deposits.

2.2 Data

Our data come from the Portuguese Central Credit Register, maintained by the Bank of Portugal, which records all loans to households above a reporting threshold of €50. The Credit Register provides granular loan-level information on both loan and borrower characteristics. Because of the low threshold, it captures nearly all credit relationships in Portugal. The data are reported monthly, allowing us to track household credit over time and to distinguish between actual liabilities and potential liabilities from pre-approved bank commitments.

In our main analyses, we focus on adjustable-rate mortgages (ARMs) indexed to the 12-month Euribor, which reset annually, issued for owner-occupied homes.[7] As noted above, ARMs are the dominant mortgage type in Portugal, accounting for about 92% of the stock of all contracts as of July 2022. Their share of the stock of mortgages declined during the tightening cycle—to 88% by December of 2023 and 85% by June of 2024—due to making up 76% of new contracts in July of 2022, but just 17% of new contracts in June of 2023 and 12% in December of 2024.

For each mortgage, we observe the amount outstanding (balance), installment amount, interest rate spread, reset frequency (3-, 6-, or 12-month), maturity, and LTV. The data also track households' overall credit positions, including total exposure and the use of consumer credit instruments such as credit cards, overdrafts, and auto loans, as well as loan performance (nonperforming status and arrears). We can identify mortgage actions such as renegotiations, transfers, and partial or full prepayments. Property location is available at the ZIP code level for about 78% of loans. At the borrower level, we observe age, gender, education, employment status, and

[7] As a robustness check, we analyze mortgages with 6-month reset periods. Despite differences in average borrower and loan characteristics relative to 12-month resets (see Table IA.1 in the Internet Appendix), the results are broadly consistent. Importantly, these differences diminish substantially after netting out bank–origination time fixed effects, indicating that bank-side supply factors are their primary driver.

municipality of residence. For mortgages with multiple household heads listed separately in the Credit Register, we collapse the records into a single mortgage with the combined outstanding balance. Household characteristics are defined as follows: household type (single male, single female, or joint mortgage), age (based on the average age of the household heads), maximum education level within the household, and employment status (all employed, single employed, or non-employed).

Our final sample consists of 365,143 mortgage loans for owner-occupied properties, totaling 978,140 resets and 10,695,429 loan-month observations in the 2021-2023 period. Table 1 reports descriptive statistics for the variables used in our baseline analysis at reset (12-month Euribor contracts).[8] The typical household holds total credit of €82,603, with a mortgage balance of €76,261 and a monthly installment of €314. The average mortgage carries an interest rate spread of 1.44%, a loan-to-value (LTV) ratio of 0.61, and a residual maturity of about 30 years. Among mortgage actions, renegotiations and partial prepayments are the most frequent, occurring at monthly rates of 0.8% and 0.9%, respectively, followed by full prepayments (0.4%) and transfers (0.3%). The average debtor is 41 years old, 78% are employed, and about 50% have a college degree, compared with only 30% in the Portuguese population in 2023.

2.3 Empirical Specification

We estimate event-study regressions around ARM rate reset dates to track how households adjust their mortgage—renegotiations, transfers across banks, and full or partial prepayments—over a symmetric 12-month window from six months before to six months after the reset.

Our empirical strategy relies on localized event-time regressions that trace dynamic household behavior relative to an omitted baseline event month, similar to the designs

[8]Variable definitions are provided in Table A.1 in the Appendix.

in Abel and Fuster (2021) and Berger et al. (2021). These studies show how changes in mortgage payments shape household behavior, whether through policy-induced refinancing under HARP or market-driven rate differentials.

We estimate the following regression equation:

$$Y_{ilmt} = \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\alpha_t} Reset_{ilmt} + \boldsymbol{\gamma} Tightening_{ilm} + \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\beta_t} (Reset_{ilmt} \times Tightening_{ilm}) + \boldsymbol{\eta} DebtorCharacteristics_{im} + \boldsymbol{\lambda} LoanCharacteristics_{lm} + \boldsymbol{\zeta} MonthYear_t + \epsilon_{ilmt}, \tag{1}$$

where i indexes households, l mortgages, m the reset month, and t the number of months before or after the reset. Y_{ilmt} is a dummy variable capturing mortgage actions: renegotiation, transfer, partial prepayment, and full prepayment. $Reset_{ilmt}$ are event-time dummies centered on the mortgage rate reset date ($t = 0$ is the reset month; the figures below generally omit $t = -3$). $Tightening_{ilm}$ is a dummy variable that takes the value of one if the reset occurs during the monetary policy tightening period (July 2022–December 2023), and zero otherwise.

The regressions control for household characteristics ($DebtorCharacteristics_{im}$), including household type, age group (18-34, 35-44, 45-54, and 55+), education level, employment status, and municipality of residence. We also control for loan characteristics ($LoanCharacteristics_{lm}$), including mortgage balance outstanding, residual maturity, and the LTV ratio. Finally, the regressions include calendar-time (month-by-year) fixed effects ($MonthYear_t$) to absorb any unobserved macroeconomic fluctuations.

The coefficients on the interaction term $Reset_{ilmt} \times Tightening_{ilm}$, denoted β_t, capture household responses to mortgage rate resets during the tightening period, relative both

to the same event month in the pre-tightening period (January 2021–June 2022) and to households whose mortgages did not reset in the same calendar month-year. These coefficients allow us to isolate changes in household responses under a contractionary monetary policy regime.

This approach enables us to examine how households respond to predictable mortgage rate resets and whether their responsiveness is amplified or muted during periods of monetary tightening. It also isolates anticipatory and reactive behavior before and after rate resets, particularly amid interest rate shocks. Our empirical strategy echoes Abel and Fuster (2021), who identify the causal effect of refinancing opportunities on household debt and spending using HARP eligibility. In contrast, we exploit scheduled rate resets and compare households both to themselves before the rise in interest rates and to contemporaneous households that do not reset. Importantly, reset dates are distributed relatively evenly throughout the calendar year (Figure IA.1 in the Internet Appendix), alleviating concerns that our results are driven by seasonal selection or idiosyncratic clustering in specific months.

We focus on mortgages with 12-month reset frequencies, as more frequent resets weaken the quasi-experimental clarity of a single event by creating overlapping windows; our analysis uses a 12-month event window centered on the reset. With 3- or 6-month ARMs, contract terms may change more often than households can realistically respond, and each adjustment is typically smaller, often falling below behavioral thresholds for action. Flodén et al. (2021) show that with 3-month ARMs, consumption responses arise mainly when borrowers face meaningful changes in disposable income over a predictable horizon, not at every reset. Moreover, households often display rational inattention or inertia in response to small, transient, or non-salient interest rate changes (see Fuster and Willen (2017); Keys et al. (2016)). By contrast, 12-month ARMs produce larger cumulative rate adjustments and more

salient mortgage payment changes, making household reactions easier to detect within a defined window and providing a stronger setting for identifying causal responses to rate changes.

3 Interest Rate Shocks and Household Responses

In this section, we examine household responses to interest rate shocks triggered by rising inflation and the ECB's tightening that began in July 2022. Figure 1 plots monthly changes in mortgage contract interest rates (in blue) alongside changes in the volume of mortgages undergoing three actions (in red): renegotiation (Panel A), transfer to another bank (Panel B), and partial prepayment (Panel C). The figure shows that, in aggregate, a sizable volume of mortgages undergo changes in contract terms and balances during the tightening cycle, with a lag relative to contract rates.

Figure 2 presents the monthly frequency of household responses (Panel A) and their cumulative frequency (Panel B) in the 18 months before and after the tightening that began in July 2022. The red bars show that all mortgage actions became significantly more likely after July 2022. In total, 15.8% of mortgages were renegotiated in the 18 months after July 2022, compared with only 2.3% in the pre-tightening period (a difference of 13.5 percentage points). The corresponding differences are 4.4 percentage points for transfers, 6.7 for partial prepayments, and about 2.8 for full prepayments.

3.1 Monthly and Cumulative Estimates

We show a rich set of household responses to interest rate shocks, shedding light on the micro-foundations of monetary policy transmission. We identify the effects using the staggered reset schedule of 12-month ARMs. We estimate equation (1) to track behavior within a 12-month window centered on each mortgage's reset date. Figure 3

plots the β_t coefficients of the interaction terms $Reset_{ilmt} \times Tightening_{ilm}$. The figure shows that households cope with higher rates by either renegotiating mortgage terms, transferring the mortgage to another bank (i.e., switching lender), or partially and fully prepaying mortgage balances to lower future interest payments.

The probability that a household takes action rises sharply around reset dates during periods of monetary tightening, peaking at the reset and remaining elevated in the following months. In the month after reset, renegotiations increase by 1.7 percentage points (Panel (a)), transfers by 0.4 (Panel (b)), partial prepayments by 0.6 (Panel (c)), and full prepayments by 0.2 (Panel (d)). These effects taper in later months but, given the low baseline frequencies of such actions, represent substantial relative increases. Rate resets thus serve as a powerful determinant of financial decision-making, and the magnitude of the responses highlights the economic importance of household balance-sheet adjustments in shaping monetary policy transmission during tightening cycles. Overall, the probability of taking any mortgage action increases by roughly 3 percentage points (Panel (e)) in the month after reset.

We also find some evidence of preemptive action. As shown in Figure 3, some actions (i.e., renegotiation and partial prepayment) begin to rise before rate resets, but adjustments typically peak afterward and remain elevated, suggesting that households either do not fully anticipate the payment increase or deliberately wait until higher payments are realized. This delayed response indicates that, even in an environment of rising interest rates and broad media coverage of policy changes, household financial decisions are closely tied to the immediate experience of higher repayment obligations. Such behavior is consistent with rational inattention models (e.g., Sims (2003); Mackowiak and Wiederholt (2009)), in which households optimally allocate limited attention to complex financial choices, as well as with the staggered and non-salient structure of ARM resets, which obscure the timing and magnitude of

payment changes. Limited salience and perceived complexity (Keys et al. (2016)) can thus delay adjustment and mute the speed of interest rate pass-through despite the mechanical link between ARMs and market rates.

We also study mortgages indexed to the 6-month Euribor as a robustness check. Figure IA.2 in the Internet Appendix plots the corresponding interaction coefficients. While these estimates are less precise, they are broadly consistent with the 12-month results. We further consider an alternative definition of the tightening cycle. Figure IA.3 shows that dating the start of tightening to January 2022—the initial increase in the 12-month Euribor—yields qualitatively similar estimates.

Finally, Figure IA.4 tests for asymmetries in household responses between monetary policy tightening and easing. To increase power for easing, we extend the sample through December 2024, so the easing period corresponds to the post-tightening period (January 2024-December 2024). Renegotiation and prepayment spike during tightening but are much weaker during easing. Transfers display the opposite pattern, plausibly reflecting stronger competition—particularly higher mortgage-broker activity—that lowers switching costs during the easing period. Overall, the evidence points to state-contingent pass-through in ARM markets: households respond strongly to salient payment increases but are comparatively inert when rates fall, consistent with loss aversion, selective inattention, and cyclical liquidity constraints.

Average Treatment Effect around the Rate Reset To complement the dynamic event-study results, we estimate a specification that groups event time more coarsely to capture average household behavior before and after the rate reset. We partition the window into three mutually exclusive periods: (1) event months –6 to –3 (omitted baseline); (2) event months –2 to –1 ("Immediate pre-reset"); and (3) event months 0 to

+5 (“Post-reset”). The regression equation is:

$$
\begin{aligned}
Y_{ilmt} = {} & \boldsymbol{\alpha_1}\, Immediate\ Pre\text{-}Reset_{ilmt} + \boldsymbol{\alpha_2}\, Post\text{-}Reset_{ilmt} + \boldsymbol{\gamma}\, Tightening_{ilm} \\
& + \boldsymbol{\beta_1}\big(Immediate\ Pre\text{-}Reset_{ilmt} \times Tightening_{ilm}\big) \\
& + \boldsymbol{\beta_2}\big(Post\text{-}Reset_{ilmt} \times Tightening_{ilm}\big) \\
& + \boldsymbol{\eta}\, DebtorCharacteristics_{im} + \boldsymbol{\lambda}\, LoanCharacteristics_{lm} + \boldsymbol{\zeta}\, MonthYear_t + \epsilon_{ilmt}\,.
\end{aligned}
\tag{2}
$$

The interactions coefficients β_1 and β_2 capture how the tightening cycle impacts household responses in the immediate pre-reset and post-reset periods, respectively, relative to the same event periods before the tightening period and relative to households that do not reset in the same calendar month-year.

Table 2 reports the estimates. During the tightening cycle, the post-reset interaction effects, $Post\text{-}reset \times Tightening$, are large and statistically significant at the 1% level: the likelihood of renegotiation increases by 0.74 percentage points, transfers by 0.26, partial prepayment by 0.36, and full prepayment by 0.13. In addition, the probability of households taking any action increases by 1.6 percentage points during the tightening period relative to the pre-tightening period. These effects confirm that households actively adjust their mortgages when facing with higher payments.

In the two months preceding resets, we also observe some increases in household responses—particularly in renegotiations and partial prepayments—indicating some anticipatory behavior. For renegotiations and partial repayments, the coefficients on the interaction term $Immediate\ Pre\text{-}Reset \times Tightening$ are positive and significant at the 1% level. For transfers and full prepayments the pre-reset effects are either negative or statistically insignificant, consistent with an absence of anticipatory behavior in

response to rising mortgage rates. In fact, transfers are likely to take more time and therefore we do not observe any significant action before rate reset.

Taken together, these results reinforce our core finding: households do not absorb mortgage payment shocks passively. While most adjustments occur after resets, some borrowers respond in advance—often by renegotiating or deleveraging—showing that both reactive and anticipatory behaviors shape monetary policy pass-through in ARM-dominated mortgage markets.

Cumulative Effects The estimates in Figure 3 describe monthly probabilities of mortgage-related actions. As noted above, Figure 2 shows that cumulative frequencies rise substantially over time, reaching 15.8% for renegotiations, 6.4% for transfers, 11.5% for partial prepayments, and 8.6% for full prepayments in the 18 months after July 2022. These patterns motivate an alternative specification that estimates cumulative rather than monthly effects.

We collapse the data at the contract–reset window–tightening period level and estimate a modified version of equation (2), where the dependent variable indicates whether a household undertook a given action in any reset period within one of three windows relative to the reset: pre-reset (–6 to –3 months; omitted baseline), immediate pre-reset (–2 to –1 months), and post-reset (0 to +5 months). We then examine the post-tightening period—starting in July 2022 and cumulative through December 2023—relative to the pre-tightening period (January 2021-June 2022) to track how responses evolve over time.

Table 3 reports the cumulative treatment effects of rate resets during the tightening period. By December 2023, the likelihood of renegotiation rises by 10.0 percentage points, transfer by 3.9, partial prepayment by 4.8, and full prepayment by 2.5—magnitudes that underscore the active role households play in managing

payment shocks. Overall, households are 19.8 percentage points more likely to take any mortgage action in the post-tightening period relative to the control group.

Credit Card and Personal Loan Actions To complement our analysis of mortgage-related actions, we examine how households adjust short-term debt in response to mortgage rate resets, using credit card and overdraft balances as proxies for liquidity management. Using the same specification as equation (1), we analyze changes in (1) credit card drawdowns, (2) credit card limits (authorized limit), and (3) overdraft balances. Figure 4 presents the event-time estimates for these outcomes, tracing the timing and magnitude of spending-related adjustments around mortgage rate resets.

We find clear evidence of liquidity adjustments following rate resets during the tightening cycle. Authorized credit limits (Panel (a)) grow by about 11 percentage points in the reset month (time 0), while actual credit card usage (Panel (b)) grows by about 6 percentage points, indicating that households expand credit access—likely to meet obligations or smooth consumption. Credit card limits and drawdowns remain elevated by at least three months after reset. In addition, overdraft usage increases significantly by 2 percentage points in month after the reset (time 1), and remains elevated in subsequent months. These patterns are consistent with the cash-flow channel of monetary policy: higher mortgage rates reduce disposable income for indebted households, prompting greater reliance on high-cost credit instruments (see Di Maggio et al. (2017); Flodén et al. (2021)).

The increased reliance on short-term credit suggests that, although renegotiations, transfers, and prepayments partially mitigate payment shocks, they do not fully insulate household balance sheets. A greater dependence on short-term consumer credit may heighten fragility and future default risk.

Mobility Figure IA.5 in the Internet Appendix studies mobility responses to interest rate shocks by decomposing full prepayments into sell-and-buy (a new mortgage within one year) in Panel (a) and sell-and-rent (no subsequent mortgage) in Panel (b). Sell-and-buy remains sizable, but a meaningful share of households fully prepay and transition to renting after a reset. We further split sell-and-buy into repurchases with a smaller mortgage (Panel (c)) and with a larger mortgage (Panel (d)). Among repurchasers, most take a smaller subsequent mortgage, consistent with home and mortgage downsizing. Overall, rising mortgage payments induce not only balance-sheet adjustment but also real housing re-optimization—exiting owner-occupation or purchasing a smaller/cheaper home—adding a mobility margin to monetary policy transmission in ARM markets. The pattern is consistent with liquidity-constrained households relieving cash-flow pressure and with equity-rich households extracting home equity or lowering housing costs in response to mortgage payment shocks.

Heterogeneous Treatment Timing A potential concern with our estimates is that the baseline specification may be biased under heterogeneous treatment timing if earlier-reset mortgages implicitly serve as controls for later-reset mortgages. We address this using a staggered difference-in-differences (DiD) estimator in the spirit of Callaway and Sant'Anna (2021).

Our setting is not a canonical staggered DiD because rate resets are recurring, non-absorbing events rather than one-time treatments. We therefore estimate separate models for resets in the pre-tightening period (July 2021–June 2022) and the tightening period (July 2022–June 2023), ensuring that each mortgage enters the estimation only once per reset. To reduce overlap across reset cycles, we restrict the event window to months $[-11, 11]$ around each reset. This approach retains the key advantages of

staggered DiD—addressing heterogeneous treatment timing and avoiding comparisons that use earlier-treated units as controls for later-treated ones—while accommodating the recurring nature of rate resets.

Figure IA.6 in the Internet Appendix closely matches the baseline event study: renegotiation, transfers, and partial prepayment rise sharply around resets, with much larger effects during tightening than pre-tightening.[9] This agreement across designs increases confidence that the results are not driven by differential trends or non-parallel dynamics between reset and non-reset mortgages.

3.2 The Role of the Supply-Side

Our analysis has so far given limited attention to the relative importance of household (demand-side) behavior versus bank (supply-side) behavior. We now examine how supply-side factors—specifically differences across banks and intermediation channels—affect household responses to mortgage rate resets. The key question is whether heterogeneity in bank competition or mortgage broker presence amplifies or dampens the mortgage-level adjustments we document.

We construct a measure of each bank's propensity for renegotiations, transfers, and prepayments; the prepayment propensity serves as an indicator of competitiveness in deposit-rate setting. Specifically, we calculate the rate at which borrowers from the same bank—but geographically distant from the focal household, as well as in a different age group, and different mortgage balance group—undertake these actions. While borrower selection into banks may partly reflect similarities in observable characteristics, we mitigate this concern by focusing on borrowers who differ by region, age, and loan balance.

[9] Full-prepayment estimates are noisier because we report period-specific effects here, whereas the baseline identifies the differential via an interaction. Differencing the two period estimates (tightening minus pre-tightening) yields a differential that closely matches the baseline interaction.

Specifically, we define geographically distant borrowers as those residing in another district ("distrito").[10] Age groups are defined as <35, 36–45, 46–55, and >55 years old. Balance groups are defined according to the median at rate reset. For each household in a given district, we compute the rate at which borrowers of the same bank—located in different districts, age groups, and mortgage balance groups—renegotiate, transfer, or prepay their mortgages in the prior six months. These supply-side measures proxy for the bank's overall policy toward each mortgage action, as well as for the competitiveness of its deposit rates as reflected in prepayment behavior. We estimate equation (1) for each mortgage action separately for households with ARMs whose banks are above and below the median for each action.

Figure 5 shows how household responses vary with our supply-side measures. The results indicate pronounced differences across banks. At high-shift banks—those actively adjusting contracts elsewhere—households are substantially more likely to renegotiate mortgages, transfer, and make partial prepayments after a rate reset. The difference is most pronounced for renegotiation, where responsiveness rises immediately and persists in the post-reset period. These findings highlight the central role of supply-side factors in enabling household adjustment, echoing evidence in Keys et al. (2016) and Berger et al. (2024) on the influence of lender competition and refinancing frictions. Even in an ARM-dominated market, contractual flexibility is not purely mechanical but depends critically on lender behavior.

Mortgage Brokers We next examine the role of mortgage brokers, who facilitate borrower–lender matching and mitigate search and information frictions. We split the sample by mortgage broker availability in the household's municipality ("concelho") and re-estimate equation (1) for above- versus below-median number of brokers.

[10] Portugal has 18 districts, ranging from about 100,000 residents to just over 2 million. Districts are larger than U.S. counties.

Figure 6, Panel (b), shows that households in municipalities with higher broker presence are more likely to transfer the mortgage (i.e., switch lender) following rate resets. This highlights the role of brokers in lowering switching costs and enhancing competition in the mortgage market. In contrast, broker presence does not influence mortgage renegotiations with the existing lender (Panel (a)). In this case, brokers are not compensated, and outcomes are instead shaped by established bank–client relationships and customer retention policies. While brokers do not increase renegotiation, they intensify competition by easing transfers, consistent with prior evidence on intermediation reducing search frictions (e.g., Woodward and Hall (2012)) and market structure and borrower–broker interactions in shaping monetary policy transmission (Berger et al. (2021, 2024)).

3.3 Heterogeneity

While prior analyses have focused on average effects, heterogeneity in households' financial constraints, education, and costs of (in)action likely shapes both the magnitude and the nature of household responses. In this subsection, we examine how responses to mortgage rate resets vary across borrower profiles. Specifically, we re-estimate the specifications from Table 2 for subgroups defined by age, education, and DSTI ratios. This allows us to assess whether certain households are more responsive—or more constrained—when facing higher mortgage payments.

Age Figure 7 shows significant heterogeneity in responses by borrower age groups. Younger households are substantially more responsive to rate resets, particularly through renegotiation and transfers. This likely reflects higher leverage and lower income, which increase both the salience and potential gains from adjusting mortgage terms. By contrast, households over 55 years old exhibit much smaller, or even muted,

responses through renegotiation and transfer, consistent with lower financial exposure and reduced perceived benefits from adjustment. Households aged 55 and older exhibit stronger responses in the form of partial—and especially full-prepayments—likely reflecting higher liquid savings.

Education Figure 8 shows a strong positive relationship between educational attainment—primary, secondary, tertiary (higher)—and household responsiveness to policy shocks. Households with college degrees are far more likely to take active steps after a reset, whereas those with primary (or no formal education) exhibit only modest adjustments. Furthermore, anticipation effects prior to mortgage rate resets are strongest among highly educated households, as shown in Figure IA.7 in the Internet Appendix (red solid lines). This heterogeneity is consistent with differences in financial literacy/sophistication, information-processing capacity, confidence in explaining complex financial decisions such as the response to mortgage rate increases, as well as a more forward-looking approach to mortgage management.

Debt Service-to-Income Ratio Figure IA.8 in the Internet Appendix examines heterogeneity by household DSTI ratio, using the median to split the sample. Unlike the sharp variation by age or education, differences across DSTI groups are smaller. High-DSTI households are somewhat more likely to renegotiate but far less likely to make partial prepayments. This pattern is consistent with financially constrained borrowers adjusting through low-cost channels while struggling to undertake balance-sheet improvements that require liquidity outflows (Beraja et al. (2019)). Renegotiation typically requires little or no upfront cash and may even be initiated by lenders to limit delinquency risk, whereas partial prepayment depends on cash buffers—resources that high-DSTI households often lack despite strong incentives to

deleverage when rates rise. In addition, we find no difference in transfer responses between high- and low-DSTI households, consistent with high-DSTI borrowers having stronger incentives to switch lenders but limited bargaining power to do so. By contrast, low-DSTI households are more likely to prepay, consistent with greater liquidity buffers.

3.4 Contract Terms around Renegotiation and Transfer

In this subsection, we examine how contract characteristics evolve around mortgage renegotiation and transfer. To shed light on the mechanisms behind mortgage actions, we track changes in the six months before and after these events, conditional on their occurrence. Our empirical design is an event study centered on the month of renegotiation or transfer:

$$\begin{aligned} Y_{ilmt} = & \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\alpha_t} Event_{ilmt} + \boldsymbol{\gamma} Tightening_{ilm} + \\ & \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\beta_t} Event_{ilmt} \times Tightening_{ilm} + \boldsymbol{\zeta} Loan_l + \epsilon_{ilmt}, \end{aligned} \tag{3}$$

where i indexes households, l mortgages, m the event month, and t the number of months relative to the event (month of renegotiation or transfer is zero). The dependent variable Y_{ilmt} is a monthly household-level outcome: mortgage spread, LTV ratio or home value. We omit the event month -3 and include mortgage contract fixed effects to isolate within-contract changes. $Event_{ilm}$ is an indicator equal to one in months in which a mortgage renegotiation or transfer occurs, and zero otherwise. $Tightening_{ilm}$ is defined as in equation (1). The interaction $Event_{ilm} \times Tightening_{ilm}$ captures how the tightening cycle changes the evolution of mortgage terms around the

adjustment event (renegotiation or transfer).

Figure 9 present the estimates. Panels (a) and (b) show that mortgage spreads fall sharply in the event month for both renegotiations and transfers. The sample for this test is restricted to renegotiations and transfers that retain 12-month adjustable rates, ensuring comparability before and after the adjustment. This pattern indicates that borrowers secure better pricing either through within-bank renegotiation (Panel (a)) or by switching to more competitive lenders (Panel (b)). Transfers deliver sizable and immediate spread reductions of roughly 65 basis points and often involve changes in contract terms, such as switching into fixed- or mixed-rate mortgages (see Table IA.2 in the Internet Appendix) or lowering LTV ratios through home revaluation. Renegotiations yield smaller spread improvements—about 27 basis points—but remain more accessible to liquidity-constrained borrowers. Finally, the coefficient on the interaction term with the tightening indicator is slightly positive for both renegotiations and transfers, suggesting limited borrower bargaining power when interest rates are rising.

Figure IA.9 in the Internet Appendix plots inbound and outbound transfer volumes alongside conditional offered rates—measured relative to a reference lender—for different mortgage types. We find that lenders offering lower rates consistently attract greater inbound transfers, particularly for mixed-rate mortgages. This pattern suggests that lender switching is highly sensitive to cross-bank price differentials and that competitive pricing is a key mechanism reallocating mortgage flows during monetary tightening. Overall, the results highlight the role of supply-side forces in pass-through: even in an ARM-dominated market, heterogeneity in lenders' pricing strategies shapes both the magnitude and direction of mortgage transfers.

Panels (c) and (d) show that LTV ratios decline around renegotiations and transfers, but with different dynamics. Renegotiations exhibit a gradual and sustained drop in LTV

ratios, consistent with faster deleveraging and home revaluations as shown in Panel (e). In contrast, transfers display a sharp, concentrated reduction in LTV ratios in the event month, reflecting the updated appraisals required for refinancing as shown in Panel (f).

Table IA.2 summarizes transitions across interest-rate regimes for 12-month ARMs after renegotiations and transfers. After renegotiation, most loans remain 12-month ARMs (about 71%), while roughly 20% move to mixed-rate contracts. By contrast, transfers are associated with a much larger shift toward other regimes—especially mixed-rate mortgages (43%)—and only about 25% remain 12-month ARMs, consistent with borrowers seeking greater insulation from interest-rate risk.

In short, mortgage actions—renegotiations and transfers—extend beyond repricing to also include changes in leverage, collateral valuation, and interest-rate regime. In addition, these adjustments broaden and intensify during monetary tightening, with across-bank transfers enabling larger and more structural modifications than (within-bank) renegotiations.

3.5 Back-of-the-Envelope Calculation of the Effects Across the Borrower Population

Up to this point, we have analyzed household behavior at the micro level. We now turn to the aggregate consequences, focusing on how mortgage-related actions shape the transmission of monetary policy through the mortgage market. Specifically, we compare the path of mortgage payments absent any adjustment with the actual path once actions are taken.

Figure 10 plots the trajectories of monthly payments for ARM borrowers, normalized to an index value of one in July 2022. The figure distinguishes six groups of households: those that renegotiate, transfer, partially prepay, fully prepay, take

multiple actions, or take no action. While payments rise sharply for all groups due to the automatic Euribor-linked reset, trajectories diverge once borrower responses are considered. The "No Action" group experience the steepest and most sustained increase, reflecting near-complete mechanical monetary policy pass-through. By contrast, households that act—especially through prepayment, transfer, or multiple adjustments—face smaller increases in mortgage payments, indicating that deleveraging and contract modifications significantly reduce their exposure to interest rate shocks.

To assess aggregate effects, Table 4 compares actual payments with counterfactual payments under mechanical Euribor-linked resets—i.e., assuming no mortgage action and full contractual pass-through—for several subperiods. During the tightening period (July 2022–December 2023; column (4)), contract adjustments and balance changes offset about 17% of the increase in scheduled payments that would have occurred under full pass-through. We then decompose this reduction by household response (columns sum to 100%). Renegotiations account for 2.3%, transfers for 13.8%, and partial prepayments for about 14%. Notably, households undertaking multiple actions contribute a sizable 23.3%, while the largest share of the total reduction comes from full repayments (46.5%).

4 Conclusion

This paper provides new evidence on how mortgage contract adjustment and prepayment shape monetary policy transmission in an ARM-dominated market. Exploiting the ECB's 2022–2023 tightening cycle and the staggered reset schedule of 12-month Euribor-linked mortgages in Portugal, we show that rate resets trigger substantial mortgage adjustment and deleveraging. Cumulative responses include

increases of 10 percentage points in renegotiations, 4 in lender switching, 5 in partial prepayments, and 3 in full prepayments, with transfers and renegotiations delivering significant reductions in spread and LTV ratio. Together, these actions absorbed about 17% of the payment increase during the tightening cycle that would have occurred under no mortgage action (i.e., under full contractual interest rate pass-through).

Household responses are concentrated after rate resets, consistent with selective inattention, and vary systematically with borrower profiles, loan characteristics, and supply-side factors. Younger and more educated borrowers are the most responsive. Lenders offering greater flexibility in renegotiation, transfers, and prepayments, together with higher mortgage-broker presence, significantly increase transfers and prepayments, highlighting how higher interest rates intensify lender competition. Sluggish deposit-rate pass-through further strengthens deleveraging incentives by lowering the opportunity cost of using liquid savings to repay mortgage balances.

For policymakers, these findings imply that while ARMs can deliver faster and more symmetric monetary policy transmission than fixed-rate mortgages, they do not ensure full pass-through. The magnitude and timing of transmission depend on borrower characteristics, market frictions, and competitive conditions in mortgage and deposit markets. Policies that strengthen competition, reduce switching costs, improve financial literacy, and limit deposit-rate stickiness would increase household adjustment to payment shocks. At the same time, by facilitating renegotiation, lender switching, and prepayment, such measures would attenuate and delay the pass-through of monetary tightening while improving household resilience during tightening cycles. More broadly, our results show that pass-through in ARM markets is not mechanically pinned down by contract design: it is state-contingent and behavior-driven, shaped jointly by household choices and market institutions.

References

Abel, J. and A. Fuster (2021). How do mortgage refinances affect debt, default, and spending? Evidence from HARP. *American Economic Journal: Macroeconomics 13*(2), 254–291.

Agarwal, S., J. Grigsby, A. Hortaçsu, G. Matvos, A. Seru, and V. Yao (2024). Searching for approval. *Econometrica 92*(4), 1195–1231.

Ahn, S., S. Galaasen, and M. Maehlum (2024). The cash-flow channel of monetary policy - Evidence from billions of transactions. Norges Bank Working Paper.

Allen, J., R. Clark, J.-F. Houde, S. Li, and A. Trubnikova (2024). The role of intermediaries in selection markets: Evidence from mortgage lending. *Review of Financial Studies*, hhae075.

Altunok, F., Y. Arslan, and S. Ongena (2024). Monetary policy transmission with adjustable and fixed-rate mortgages: The role of credit supply. *Swiss Finance Institute Research Paper* (24-65).

Beraja, M., A. Fuster, E. Hurst, and J. Vavra (2019). Regional heterogeneity and the refinancing channel of monetary policy. *Quarterly Journal of Economics 134*(1), 109–183.

Berger, D. W., K. Milbradt, F. Tourre, and J. S. Vavra (2021). Mortgage prepayment and path-dependent effects of monetary policy. *American Economic Review 111*(9), 2829–2879.

Berger, D. W., K. Milbradt, F. Tourre, and J. S. Vavra (2024). Refinancing frictions, mortgage pricing and redistribution. National Bureau of Economic Research Working Paper 32022.

Bonfim, D. and L. Queiró (2024). Deposit interest rates and monetary policy transmission. *Banco de Portugal Economic Studies 10*(4), 35–48.

Boutros, M., N. Clara, and K. Kartashova (2025). The value of mortgage choice: Payment structure and contract length.

Callaway, B. and P. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230.

Campbell, J. and J. Cocco (2003). Household risk management and optimal mortgage choice. *Quarterly Journal of Economics 118*(4), 1449–1494.

Cloyne, J., C. Ferreira, and P. Surico (2019). Monetary policy when households have debt: New evidence on the transmission mechanism. *Review of Economic Studies 87*(1), 102–129.

de Silva, T. and P. Mei (2025). Selective inattention to interest rates. Stanford University Working Paper.

DeFusco, A. A. and A. Paciorek (2017). The interest rate elasticity of mortgage demand: Evidence from bunching at the conforming loan limit. *American Economic Journal: Economic Policy 9*(1), 210–240.

Di Maggio, M., A. Kermani, B. J. Keys, T. Piskorski, R. Ramcharan, A. Seru, and V. Yao (2017). Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging. *American Economic Review 107*(11), 3550–3588.

Drechsler, I., A. Savov, and P. Schnabl (2017). The deposits channel of monetary policy. *Quarterly Journal of Economics 132*(4), 1819–1876.

Elias, M., C. Gillitzer, G. Kaplan, G. La Cava, and N. Prasad (2025). The mortgage debt channel of monetary policy when mortgages are liquid. National Bureau of Economic Research Working Paper 34461.

Flodén, M., M. Kilström, J. Sigurdsson, and R. Vestman (2021). Household debt and monetary policy: Revealing the cash-flow channel. *Economic Journal 131*(636), 1742–1771.

Fonseca, J. and L. Liu (2024). Mortgage lock-in, mobility, and labor reallocation. *Journal of Finance 79*(6), 3729–3772.

Fuster, A., V. Gianinazzi, A. Hackethal, P. Schnorpfeil, and M. Weber (2025). The response of debtors to rate changes. Working Paper.

Fuster, A., M. Plosser, P. Schnabl, and J. Vickery (2019). The role of technology in mortgage lending. *Review of Financial Studies 32*(5), 1854–1899.

Fuster, A. and P. Willen (2017). Payment size, negative equity, and mortgage default. *American Economic Journal: Economic Policy 9*(4), 167–191.

Garriga, C., F. Kydland, and R. Šustek (2017). Mortgages and monetary policy. *Review of Financial Studies 30*(10), 3337–3375.

Gross, D. and N. Souleles (2002). Do liquidity constraints and interest rates matter for consumer behavior? evidence from credit card data. *Quarterly Journal of Economics 117*(1), 149–185.

Keys, B., D. Pope, and J. Pope (2016). Failure to refinance. *Journal of Financial Economics 122*(3), 482–499.

Mackowiak, B. and M. Wiederholt (2009). Optimal sticky prices under rational inattention. *American Economic Review 99*(3), 769–803.

Sims, C. (2003). Implications of rational inattention. *Journal of Monetary Economics 50*(3), 665–690.

Woodward, S. and R. Hall (2012). Diagnosing consumer confusion and sub-optimal shopping effort: Theory and mortgage-market evidence. *American Economic Review 102*(7), 3249–3276.

Zhang, D. (2022). Closing costs, refinancing, and inefficiencies in the mortgage market. Rice University Working paper.

Table 1: Summary statistics

	(1) Mean	(2) Std. Dev.	(3) P10	(4) Median	(5) P90
Mortgage Characteristics					
Balance Outstanding (€)	76,261	69,626	22,377	60,934	140,024
Installment (€)	314	502	99	241	578
Spread (%)	1.441	0.586	1.000	1.250	2.000
Maturity (month)	353	112	186	384	468
LTV	60.874	21.849	25.641	67.514	82.806
Renegotiation (%)	0.827	9.054	0.000	0.000	0.000
Transfer (%)	0.301	5.480	0.000	0.000	0.000
Partial Prepayment (%)	0.874	9.306	0.000	0.000	0.000
Full Prepayment (%)	0.449	6.682	0.000	0.000	0.000
Any Action (%)	2.628	15.997	0.000	0.000	0.000
Household Credit Positions					
Total Credit (€)	82,603	77,917	24,292	66,500	149,835
Credit Card Drawdown (€)	708	1,831	0	32	1,858
Credit Card Limit (€)	3,596	5,090	0	1,904	9,475
Overdrafts (€)	32	723	0	0	0
Overdue Credit (€)	122	2,979	0	0	0
Household Characteristics					
Single Male	0.190	0.392	0.000	0.000	1.000
Single Female	0.190	0.392	0.000	0.000	1.000
Joint	0.620	0.485	0.000	1.000	1.000
Age (years)	41.48	9.26	30.00	40.00	54.00
Higher Education	0.493	0.500	0.000	0.000	1.000
Employed	0.781	0.414	0.000	1.000	1.000

This table presents mean, standard deviation, 10th percentile (P10), median, and 90th percentile (P90) for the variables used in the analysis. All summary statistics are calculated at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Our final sample consists of 365,143 mortgage loans for owner-occupied properties, totaling 978,140 resets and 10,695,429 loan-month observations. Variable definitions are provided in Table A.1 in the Appendix.

Table 2: Mortgage Rate Reset and Household Responses

	(1) Renegotiation	(2) Transfer	(3) Partial Repayment	(4) Full Repayment	(5) Any Action
$Immediate\ Pre-reset$	0.042***	-0.007**	0.016*	-0.007*	0.046***
	(0.009)	(0.003)	(0.008)	(0.004)	(0.014)
$Post-reset$	0.053***	0.102***	0.013*	0.310***	0.486***
	(0.011)	(0.005)	(0.007)	(0.014)	(0.015)
$Tightening$	-0.051*	-0.067***	-0.044***	-0.073***	-0.236***
	(0.027)	(0.013)	(0.013)	(0.019)	(0.059)
$Immediate\ Pre-reset \times Tightening$	0.225***	-0.036**	0.192***	-0.015	0.374***
	(0.051)	(0.018)	(0.038)	(0.010)	(0.090)
$Post-reset \times Tightening$	0.743***	0.260***	0.362***	0.133***	1.566***
	(0.103)	(0.039)	(0.048)	(0.027)	(0.197)
Observations	10,695,429	10,695,429	10,695,429	10,695,429	10,695,429
Adjusted R^2	0.009	0.004	0.009	0.003	0.016

This table reports event-time regression estimates based on equation (2). The dependent variable in each column is a mortgage action in each event (reset) month: a dummy variable for renegotiation, a dummy variable for transfer, a dummy variable for partial prepayment, a dummy variable for full prepayment or a dummy variable for any action. The explanatory variables of interest are a dummy variable for the *Immediate Pre-reset* window (months –2 to –1), a dummy variable for the *Post-reset* window (months 0 to +5), and the omitted *Pre-reset* window (months -6 to -3); month 0 corresponds to the reset month. *Tightening* is a dummy variable that takes the value of one between July 2022 and December 2023. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

Table 3: Mortgage Rate Reset and Household Responses: Cumulative Effects

	(1) Renegotiation	(2) Transfer	(3) Partial Prepayment	(4) Full Prepayment	(5) Any Action
$Immediate\ Pre-reset \times Tightening$	0.771***	-0.253***	0.582***	-0.992***	0.188**
	(0.049)	(0.023)	(0.062)	(0.044)	(0.084)
$Post-reset \times Tightening$	9.991***	3.866***	4.794***	2.516***	19.818***
	(0.155)	(0.102)	(0.240)	(0.098)	(0.315)
Observations	1,795,164	1,795,164	1,795,164	1,795,164	1,795,164
Adjusted R^2	0.060	0.032	0.027	0.025	0.115

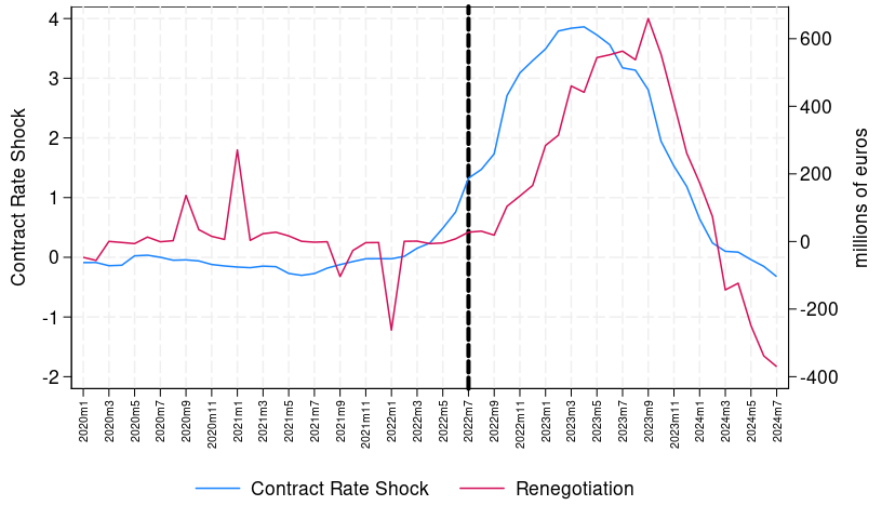
This table reports event-time regression estimates using data collapsed at the contract–reset window–tightening period level. The dependent variable in each column is a mortgage action in each event (reset) window: a dummy variable for renegotiation, a dummy variable for transfer, a dummy variable for partial prepayment, a dummy variable for full prepayment or a dummy variable for any action. The explanatory variables of interest are a dummy variable for the *Immediate pre-Reset* window (months –2 to –1), a dummy variable for the *Post-reset* window (months 0 to +5), and the omitted *Pre-reset* window (months -6 to -3); month 0 corresponds to the reset month. *Tightening* is a dummy variable that takes the value of one between June 2023 and December 2024. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality level.

Table 4: Aggregate Effects

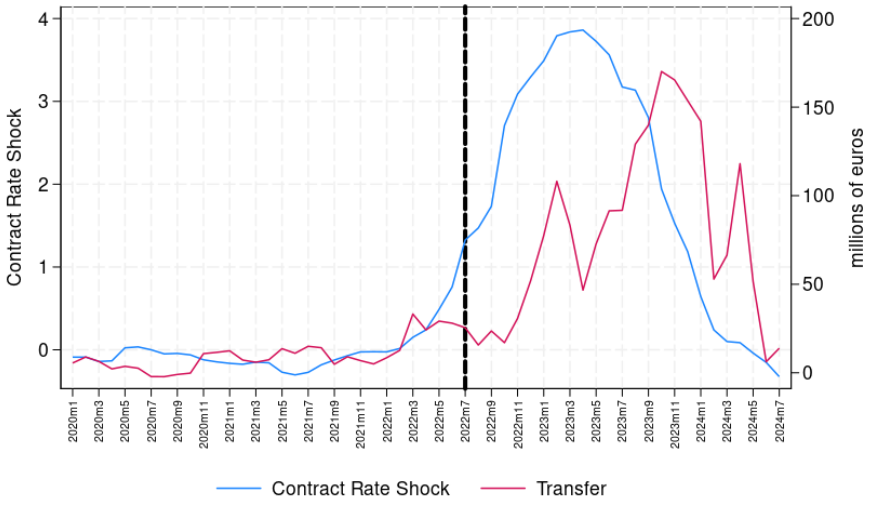
	(1)	(2)	(3)	(4)
Period	Jul - Dec 2022	Jan - Jun 2023	Jul - Dec 2023	Jul 2022 - Dec 2023
	Payment Shock Absorbed(%)			
Action	7.22	15.49	25.41	17.31
	Contribution of Payment Shock Absorbed(%)			
Renegotiation	2.74	2.26	2.3	2.34
Transfer	10.06	13.33	14.72	13.79
Partial Repayment	15.27	13.75	13.93	14.02
Full Repayment	48.48	48.86	44.97	46.52
Multiple Actions	23.44	21.8	24.08	23.33

This table presents aggregate estimates (in percentage) of how much mortgage actions reduce the increase in scheduled mortgage payments that would have occurred in their absence between July 2022 and December 2023 (column (4) and subperiods (column (1)-(3)). The table also shows the relative contribution (in percent) of each action: renegotiation, transfer, partial prepayment, full prepayment and multiple actions. The contribution of each action is calculated as the difference between scheduled payments and actual payments divided by total reduction in mortgage payments. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.

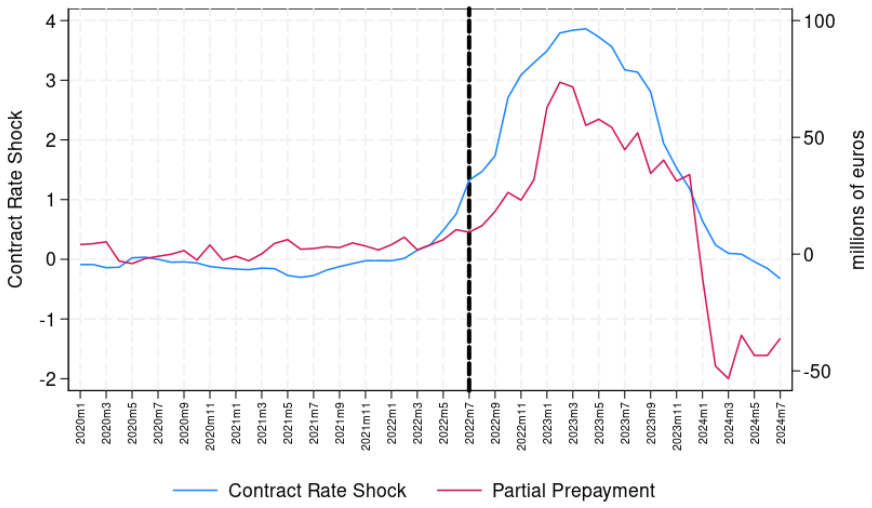
Figure 1: Interest Rate Shocks and Household Responses



(a) Renegotiation



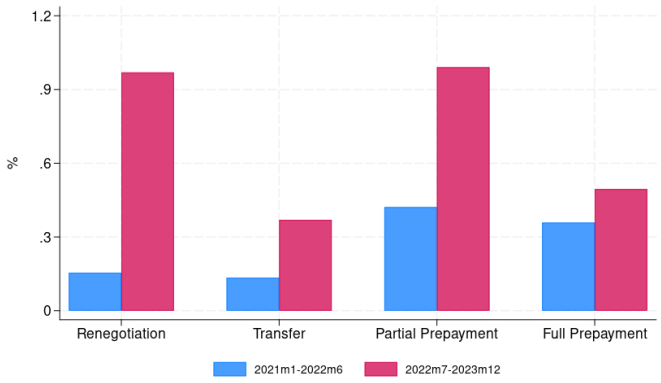
(b) Transfer



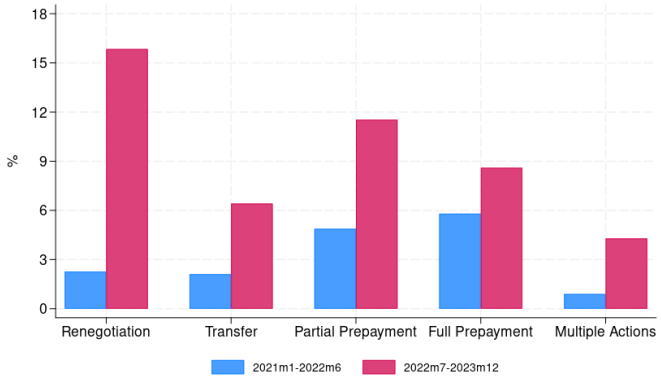
(c) Partial Prepayment

This figure shows the mean change in the mortgage rate for 12-month resettable ARMs that reset in each calendar month over the period between January 2020 and July 2024. It also shows the yearly change in the total amount (in millions of euro) of mortgage loans that undergo each action: renegotiation with the current bank (Panel A), transfer to another bank (Panel B), and partial prepayment (Panel C). The black dashed line marks the beginning of the tightening cycle in July 2022, when the ECB raised its key policy rates for the first time in 11 years. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.

Figure 2: Interest Rate Shocks and Household Responses: Monthly and Cumulative Effects



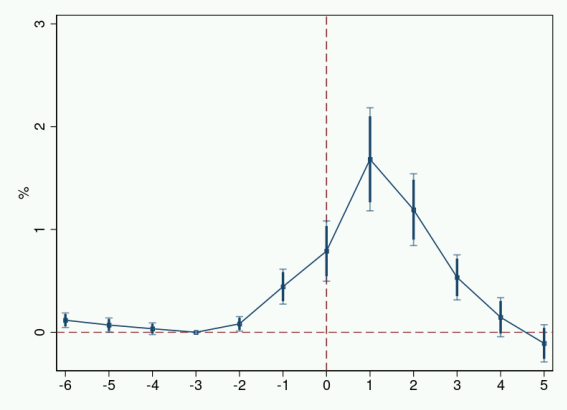
(a) Monthly Frequency



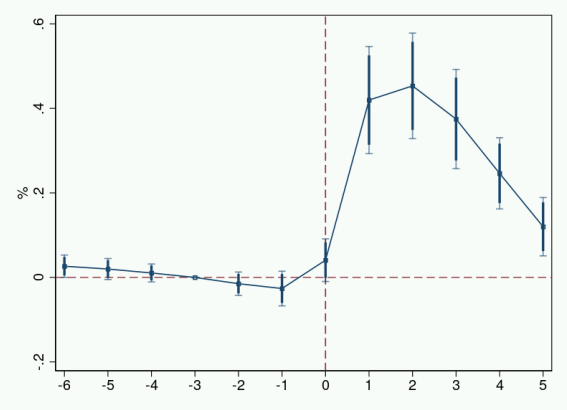
(b) Cumulative Frequency

This figure shows, separately for the January 2021–June 2022 (pre-tightening period) and July 2022–December 2023 (tightening period), both the monthly and cumulative frequencies of mortgage actions, including renegotiations, transfers, partial prepayments, full prepayments, and multiple actions. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.

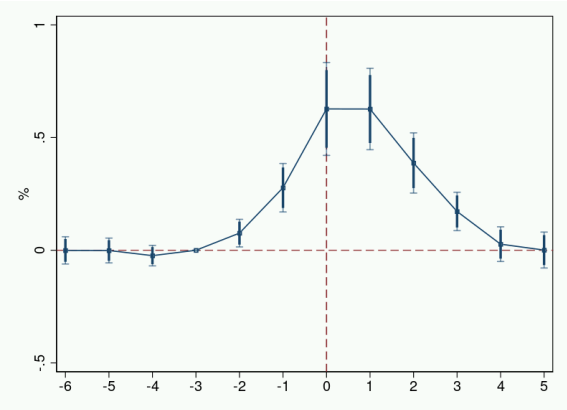
Figure 3: Household Responses Around Mortgage Rate Resets



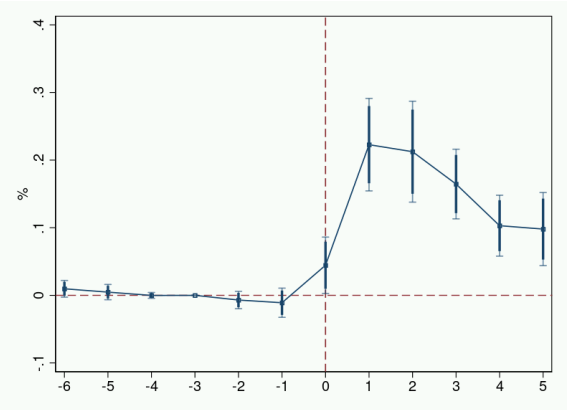
(a) Renegotiation



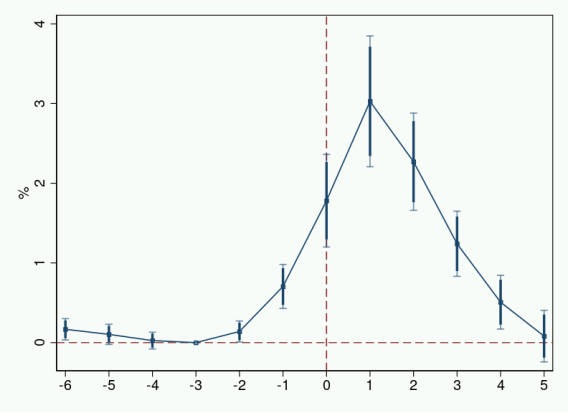
(b) Transfer



(c) Partial Prepayment



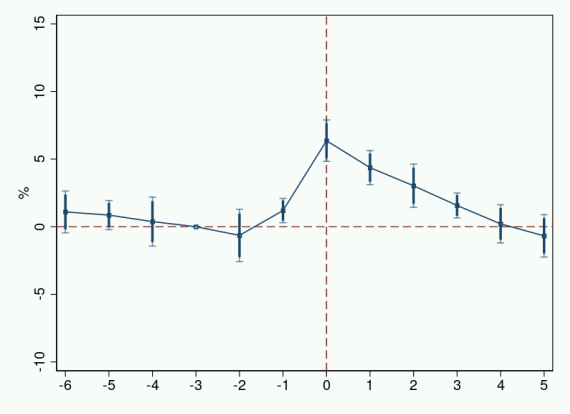
(d) Full Prepayment



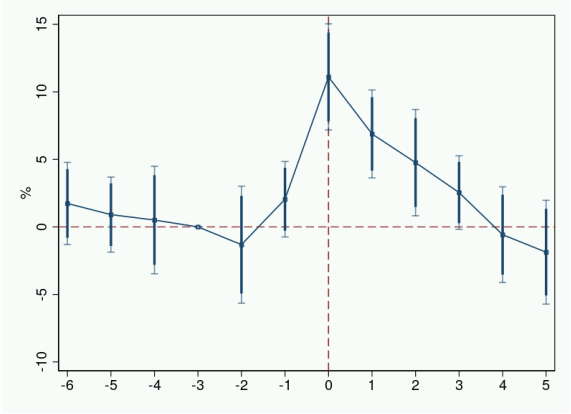
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

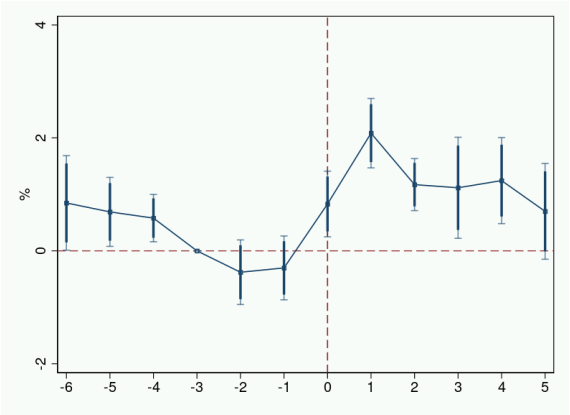
Figure 4: Short-Term Consumer Credit Around Mortgage Rate Resets



(a) Credit-Card Drawndown



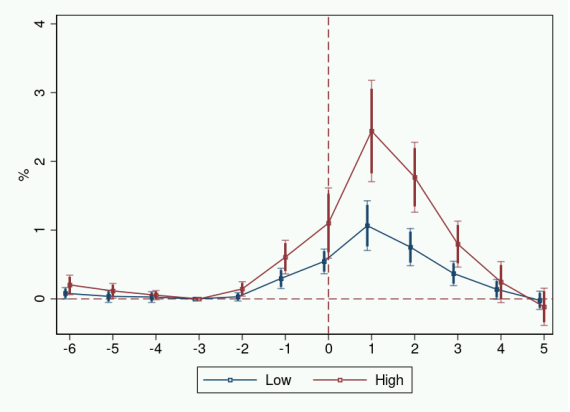
(b) Credit-Card Limit



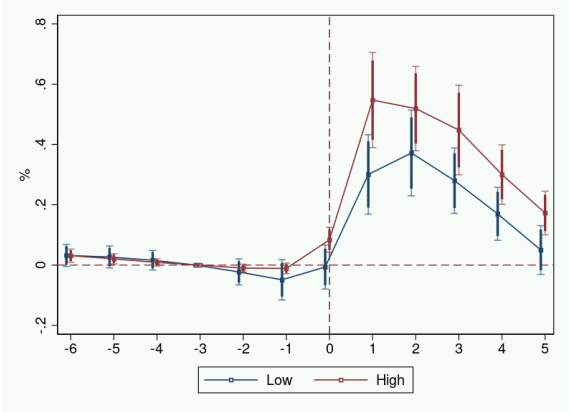
(c) Overdrafts

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The dependent variable corresponds to the log amount of credit card drawdown (Panel (a)), the log amount of credit card limit (Panel (b)), and the log amount of used overdrafts (Panel (c)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

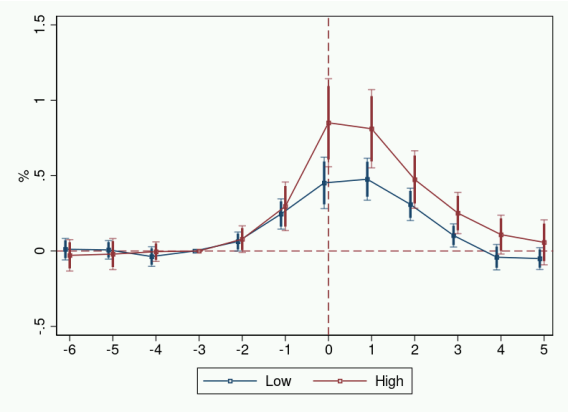
Figure 5: Household Responses Around Mortgage Rate Resets: The Role of Banks



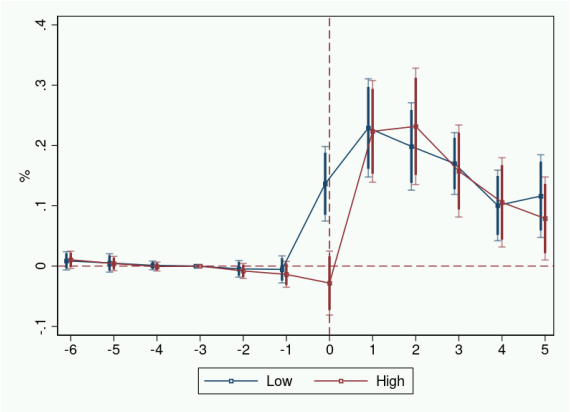
(a) Renegotiation



(b) Transfer



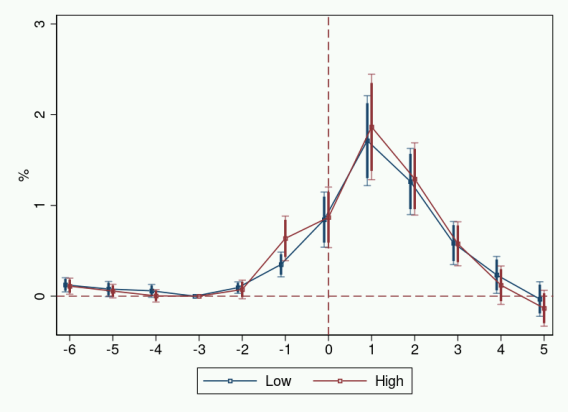
(c) Partial Prepayment



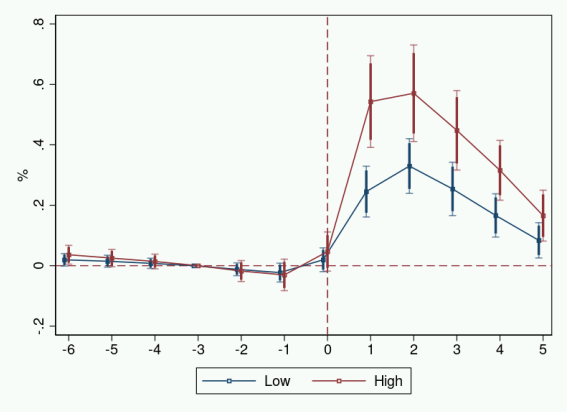
(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for subsamples of mortgages associated with below-median (low) and above-median (high) bank-level shift values. The bank-level shift is the rate at which the household's bank is acting with households located outside of the focal household's region (district) and from different age-mortgage balance groups. The rate is calculated as the number of mortgage contracts that were renegotiated, transferred (inbound), partially prepaid, or fully prepaid, divided by the total number of contracts for each bank. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.Standard errors are clustered at the municipality and month-year levels.

Figure 6: Household Responses Around Mortgage Rate Resets: The Role of Mortgage Brokers



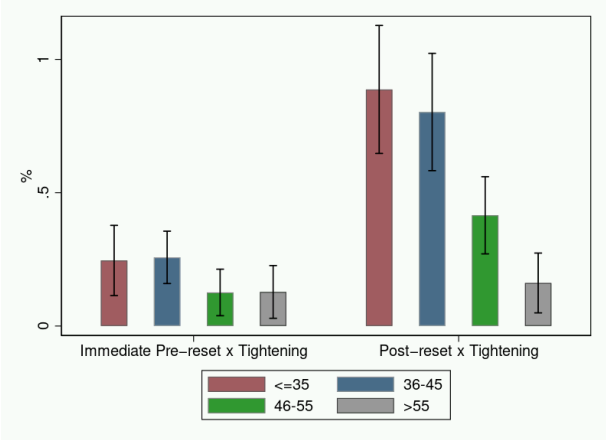
(a) Renegotiation



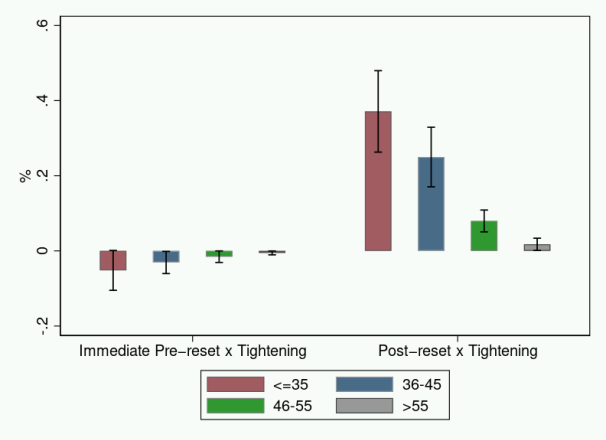
(b) Transfer

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for subsamples of mortgages held by households residing in municipalities with below-median (low) and above-median (high) numbers of mortgage brokers. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)) or a dummy variable for transfer (Panel (b)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

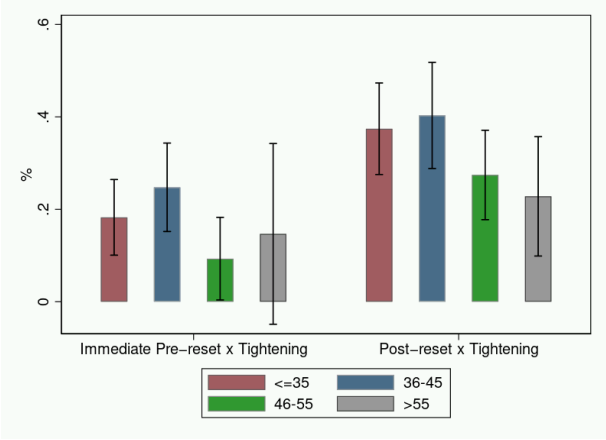
Figure 7: Household Responses Around Mortgage Rate Resets: The Role of Age



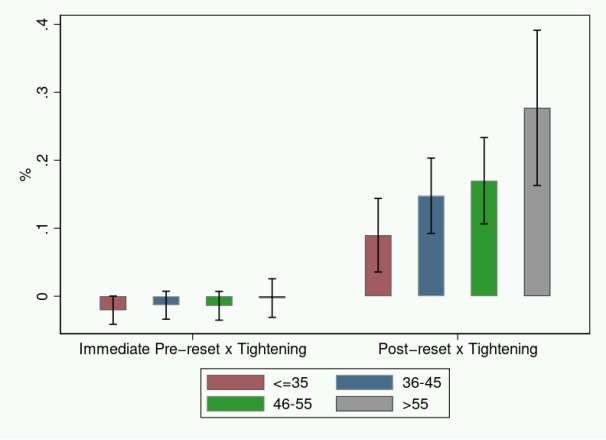
(a) Renegotiation



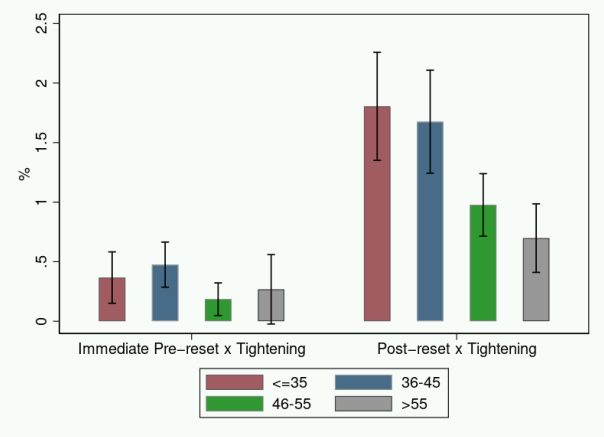
(b) Transfer



(c) Partial Prepayment



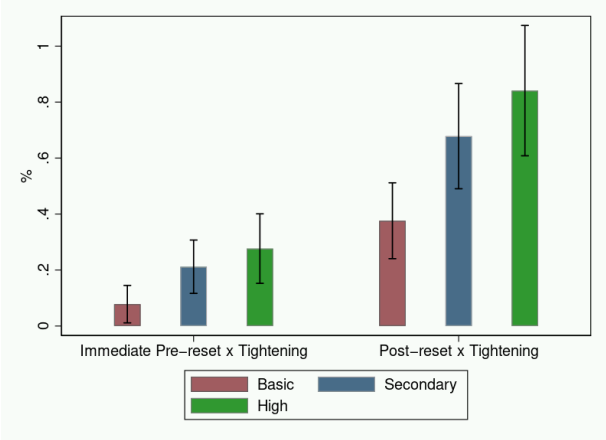
(d) Full Prepayment



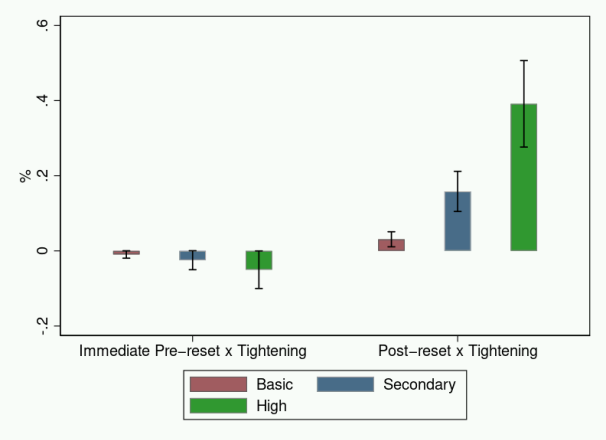
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for subsamples of households aged 35 or younger, 36-45, 46-55, and above 55. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.Standard errors are clustered at the municipality and month-year levels.

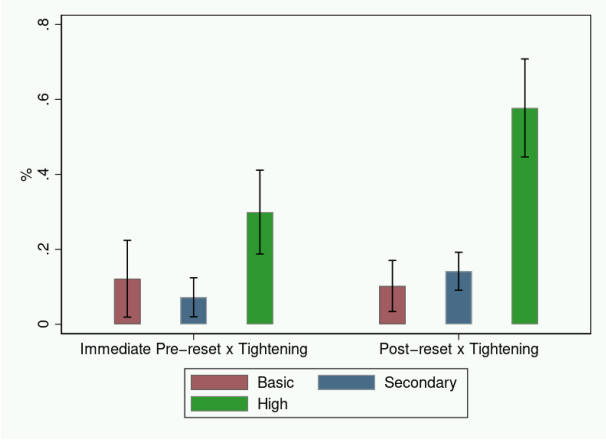
Figure 8: Household Responses Around Mortgage Rate Resets: The Role of Education



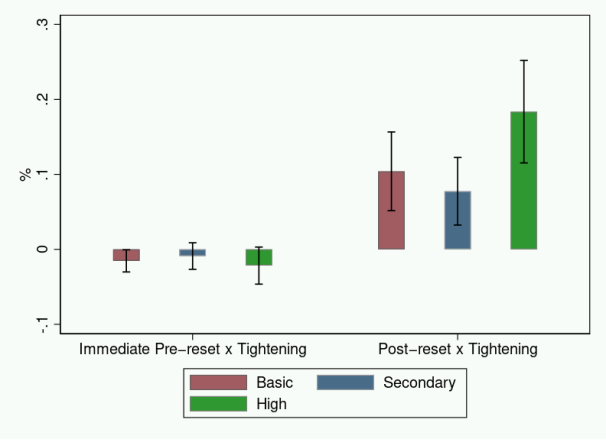
(a) Renegotiation



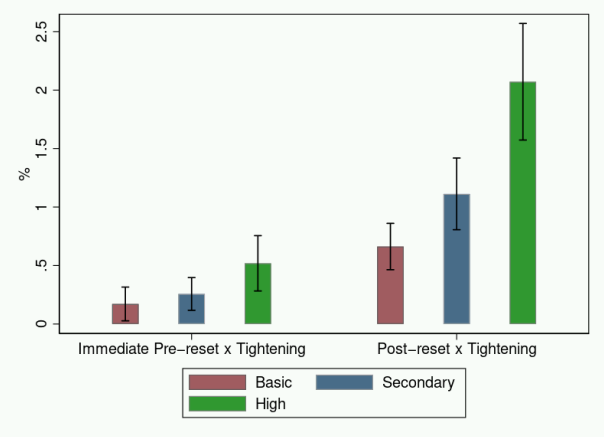
(b) Transfer



(c) Partial Prepayment



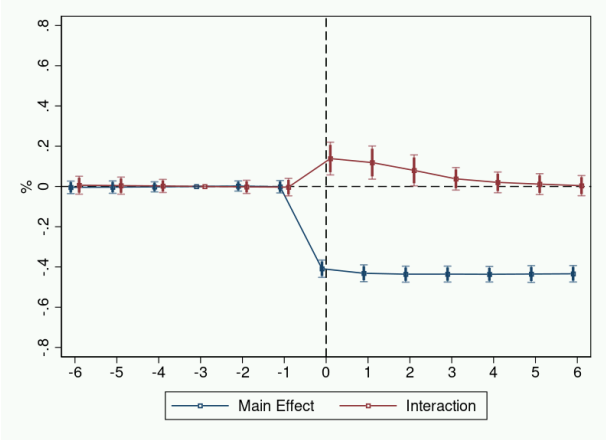
(d) Full Prepayment



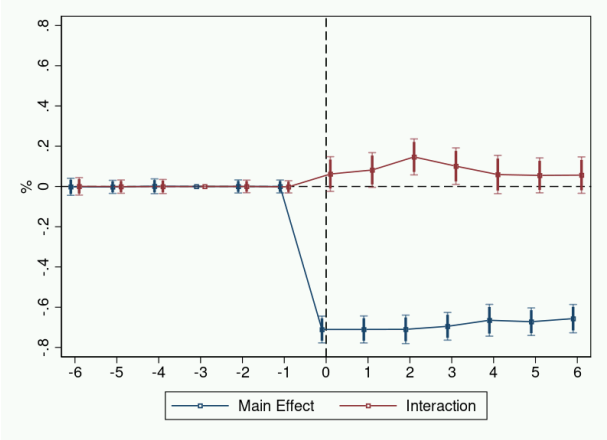
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for subsamples of households with no education or primary education (Primary), secondary education (Secondary), and tertiary education (High). The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

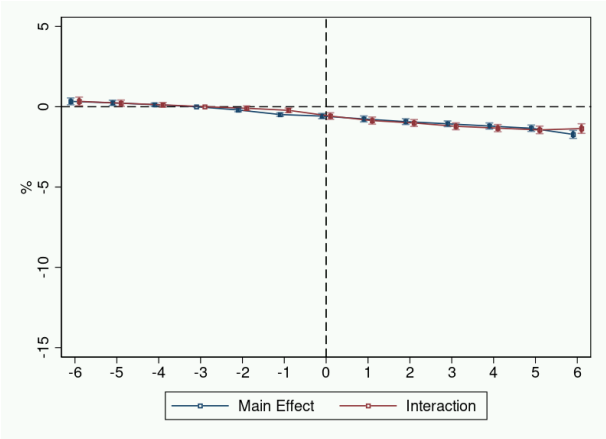
Figure 9: Change in Spread, LTV and Home Value around Renegotiation and Transfer



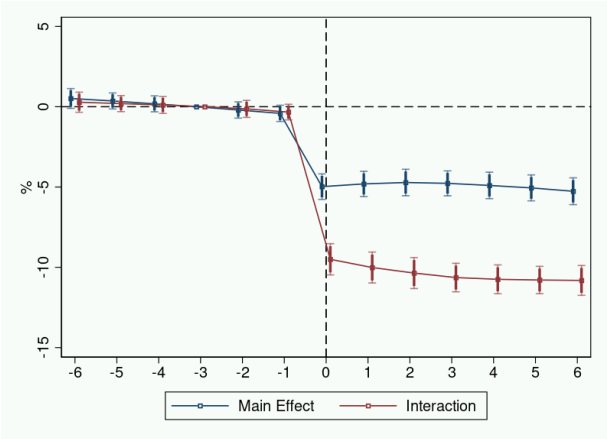
(a) Spread: Renegotiation



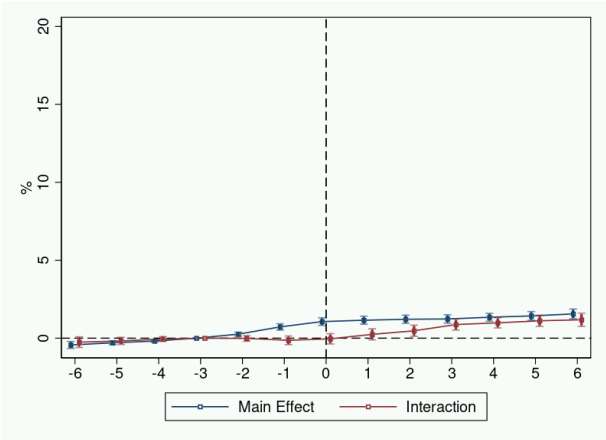
(b) Spread: Transfer



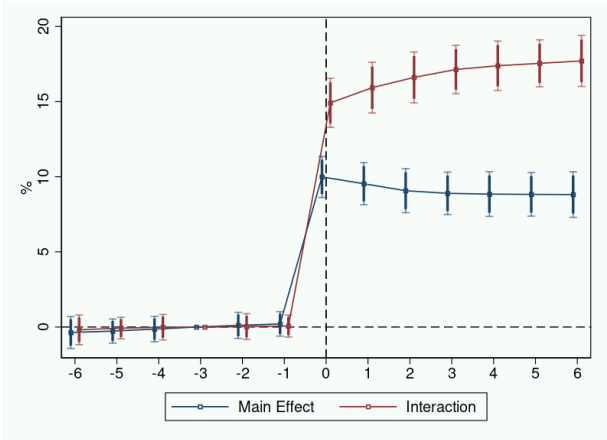
(c) LTV: Renegotiation



(d) LTV: Transfer



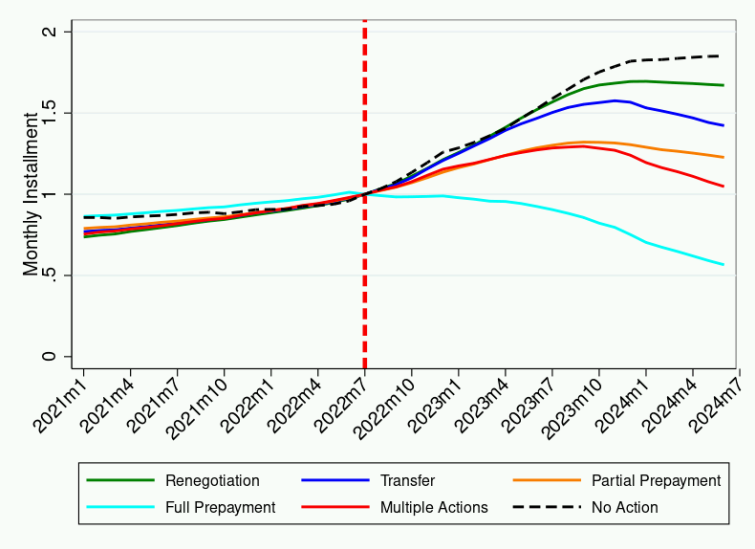
(e) Home Value: Renegotiation



(f) Home Value: Transfer

This figure presents the point estimates along with the 90% and 95% confidence intervals of γ_t in equation (3) based on two samples: mortgage that are renegotiated with the current lender and mortgages that are transferred to a new lender with the same interest rate regime (i.e., 12-month resettable). The dependent variable in Panels (a) and (b) is the mortgage spread. The dependent variable in Panels (c) and (d) is the loan-to-value ratio (LTV). The dependent variable in Panels (e) and (f) is the home value. All regressions control for loan fixed effects. The sample consists of 12-month resettable ARM issued for an owner-occupied property in Portugal with renegotiation or transfer to a new lender between January 2021 and December 2023. Standard errors are clustered at the contract and month-year levels.

Figure 10: Household Responses and Mortgage Installment Trajectories



This figure shows the mortgage installment payment trajectories (indexed to one in July 2022) for households that have renegotiated, transferred, partially prepaid, fully prepaid, taken multiple actions, or taken no action on their mortgages during the period from July 2022 to June 2024. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.

Appendix

Table A.1: Variable definitions

Mortgage Characteristics	
Balance outstanding	Mortgage amount outstanding (in euros).
Installment	Mortgage installment payment (in euros).
Spread	Mortgage loan spread (in percentage).
Maturity	Term-to-maturity of a mortgage loan (in months).
LTV	Loan-to-value, calculated as mortgage loan amount divided by the value of the mortgaged property.
DSTI	Debt-service-to-income ratio, calculated as household's total monthly debt payments divided by by monthly income.
Renegotiation	Dummy variable that takes the value one if there is a renegotiation of a mortgage with the current lender and zero otherwise (excluding renegotiations in case of noncompliance or distress).
Transfer	Dummy variable that takes the value one if a mortgage is transferred to a new lender and zero otherwise.
Partial prepayment	Dummy variable that takes the value one if there is a partial prepayment of a mortgage and zero otherwise.
Full prepayment	Dummy variable that takes the value one is there is a full prepayments of a mortgage and zero otherwise.
Household Credit Positions	
Total credit	Total credit outstanding of the household (in euros).
Overdraft	Amount of overdrafts of the household (in euros).
Credit card drawdown	Amount of credit card drawdown of the household (in euros).
Credit card limit	Amount of credit card limit of the household (in euros).
Household Characteristics	
Household type	A set of indicators that identify the type of household: single male, single female, or joint mortgage.
Age	Average age (in years); age groups are further created based on the following categories: $<=$35 years; 35-45 years; 45-55 years: $>$ 55 years).
Education	A set of dummy variables that identify the maximum educational background attained by any household member (no schooling/primary, secondary, and tertiary).
High education	Dummy variable that takes the value of one if the highest education level attained by any household member is tertiary education, and zero otherwise.
Employment status	A set of indicators that identify the employment status: all employed, single employed, or non-employed.
Employed	Dummy variable that takes the value of one if the employment status is all employed, and zero otherwise.

Internet Appendix to

"Interest Rate Pass-Through With Adjustable Rate Mortgages"

Table IA.1: 6-month versus 12-month Mortgage Contracts

	(1) 6-month	(2) 12-month	(3) dif.	(4) p-value	(5) Cond. dif.	(6) Cond. p-value
Mortgage Characteristics						
Balance Outstanding (€)	45,896	79,122	-33,226	0.000	-912	0.000
Installment (€)	276	357	-81	0.000	0	0.765
Spread (%)	1.244	1.492	-0.249	0.000	-0.009	0.000
Maturity (month)	203	339	-137	0.000	-6	0.000
LTV	32.483	56.596	-24.113	0.000	-0.882	0.000
Renegotiation (%)	0.133	0.758	-0.625	0.000	0.006	0.444
Transfer (%)	0.050	0.189	-0.139	0.000	-0.008	0.055
Partial Prepayment (%)	0.680	0.903	-0.223	0.000	-0.002	0.797
Full Prepayment (%)	0.519	0.510	0.009	0.193	-0.005	0.510
Any Action (%)	1.379	2.337	-0.959	0.000	-0.010	0.501
Household Credit Positions						
Total Credit (€)	52,988	87,252	-34,264	0.000	-1,010	0.000
Credit Card Drawdown (€)	793	748	45	0.000	0	0.841
Credit Card Limit (€)	536,640	492,115	44,525	0.000	11,826	0.000
Overdrafts (€)	50	48	2	0.698	-4	0.556
Overdue Credit (€)	304	156	148	0.000	-28	0.000
Household Characteristics						
Single Male	0.176	0.194	-0.019	0.000	-0.001	0.147
Single Female	0.197	0.187	0.010	0.000	0.002	0.000
Joint	0.627	0.619	0.009	0.000	-0.001	0.061
Age (years)	50.53	42.56	7.97	0.000	0.23	0.000
Higher Education	0.345	0.487	-0.142	0.000	0.006	0.000
Employed	0.650	0.773	-0.123	0.000	-0.004	0.000

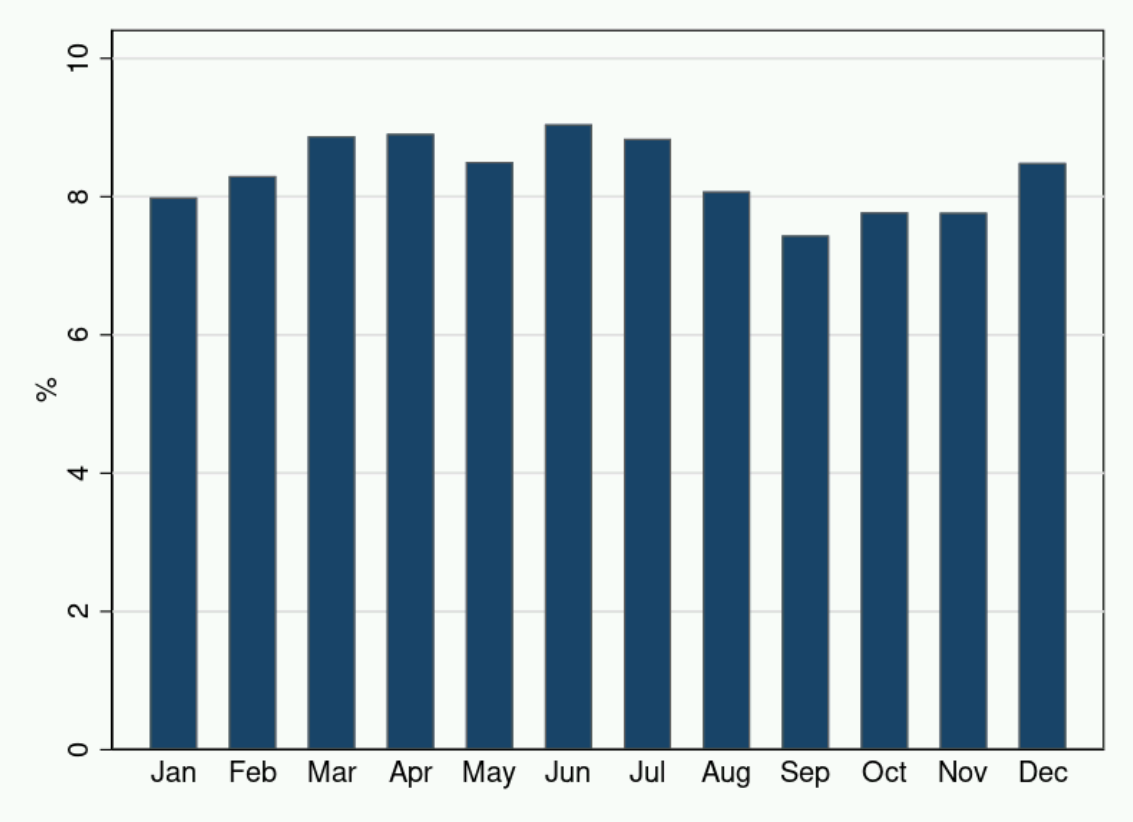
This table compares the mean and the conditional mean characteristics of 6-month and 12-month resettable ARMs issued for owner-occupied properties in Portugal between January 2021 and December 2023. The conditional mean is adjusted for bank-by-origination time fixed effects. The table also reports the difference in mean and the corresponding p-value. The sample consists of all 6-month resettable ARMs issued for owner-occupied properties in Portugal between January 2021 and December 2023. Variable definitions are provided in Table A.1 in the Appendix.

Table IA.2: Changes in Mortgage Rate Regime around Renegotiation and Transfer

	Renegotiation		Transfer	
	Obs	%	Obs	%
Fixed-rate mortgage	22	0.04	958	4.45
Mixed-rate mortgage	10,469	17.89	9,204	42.73
3-month ARMs	1,509	2.58	980	4.55
6-month ARMs	4,797	8.20	4,776	22.17
12-month ARMs	41,340	70.64	5,571	25.86
Other	388	0.66	52	0.24

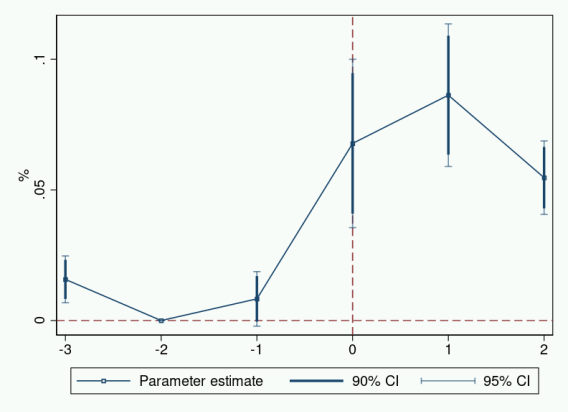
This table shows the frequency distribution of interest rate regime changes — fixed-rate mortgage, mixed-rate mortgage, and adjustable-rate mortgage (ARM) — around the time of the mortgage renegotiation and transfer. The sample consists of 12-month resettable ARM issued for an owner-occupied property in Portugal with a transfer to a new lender between January 2021 and December 2023.

Figure IA.1: 12-Month ARMs by Reset Month

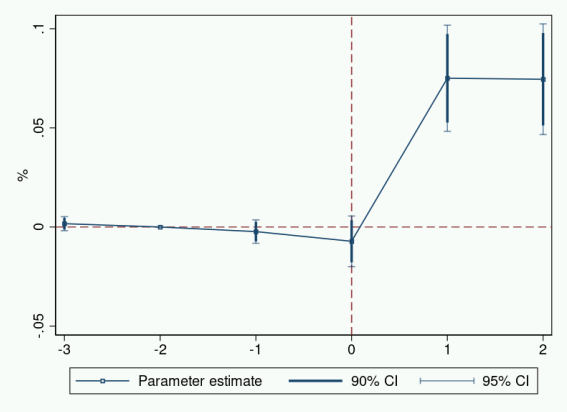


This figure presents the distribution of mortgage rate reset dates for 12-month adjustable-rate mortgages (ARMs). Each bar reports the share (in percent) of 12-month ARMs whose mortgage rate resets in a given calendar month (January through December).

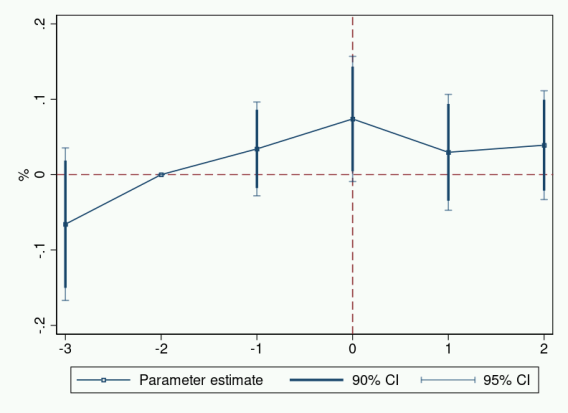
Figure IA.2: Household Responses Around Mortgage Rate Resets: ARMs with 6-month Rate Resets



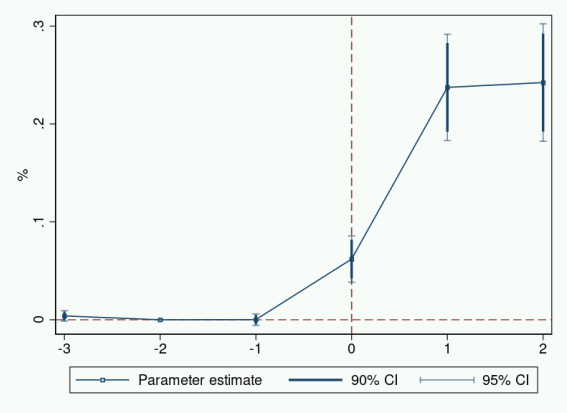
(a) Renegotiation



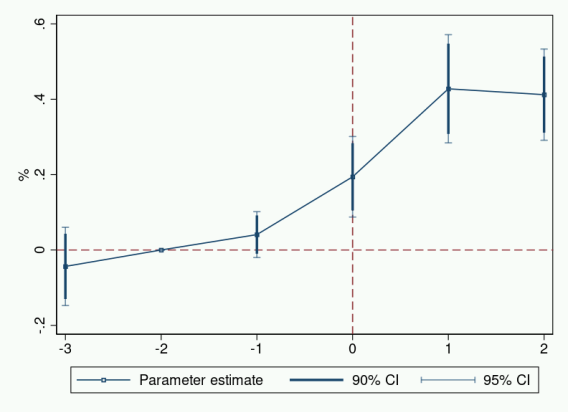
(b) Transfer



(c) Partial Prepayment



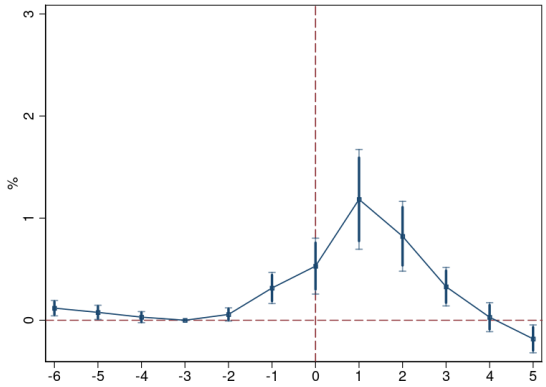
(d) Full Prepayment



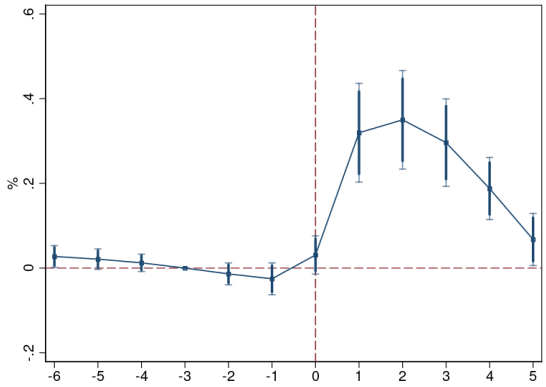
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 6-month resettable ARMs issued for owner-occupied properties in Portugal between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

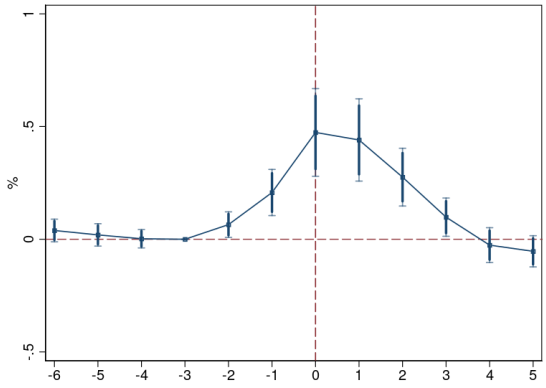
Figure IA.3: Household Responses Around Mortgage Rate Resets: Alternative Tightening Cycle



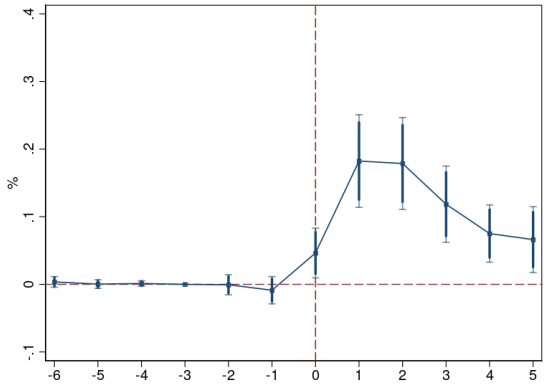
(a) Renegotiation



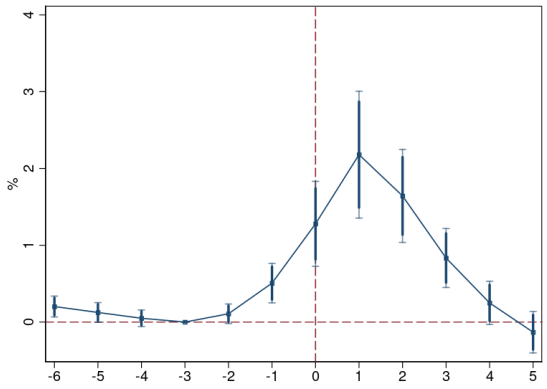
(b) Transfer



(c) Partial Prepayment



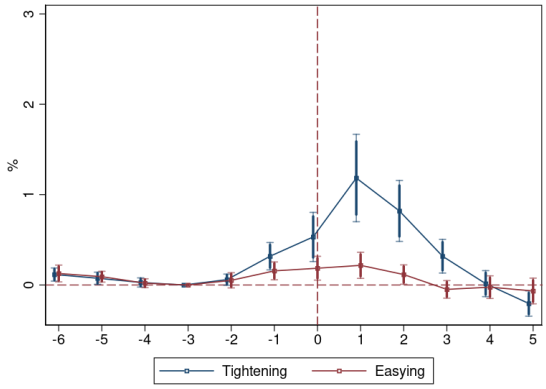
(d) Full Prepayment



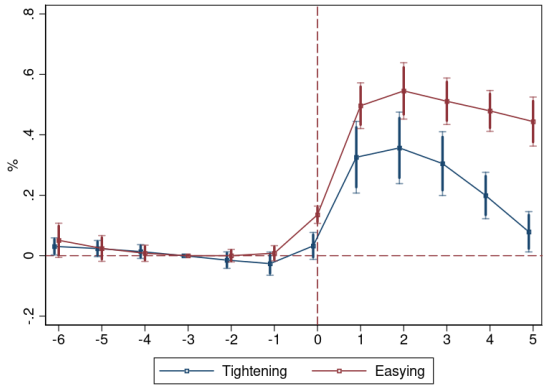
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-December 2021) and to households whose mortgages did not reset in the same calendar month–year. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). The tightening period is defined as January 2022 to December 2023, with the start date corresponding to the initial increase in the 12-month Euribor. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

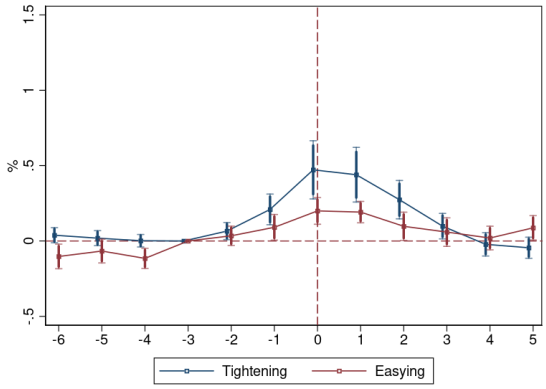
Figure IA.4: Household Responses Around Mortgage Rate Resets: Tightening versus Easing Cycles



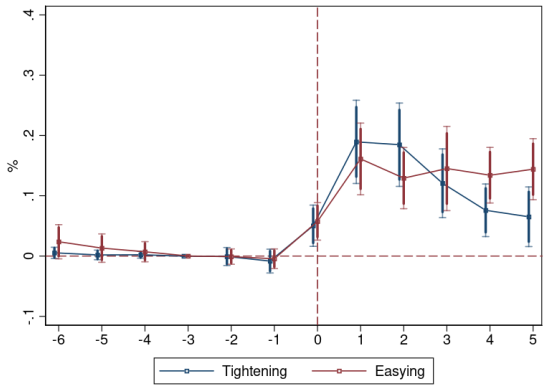
(a) Renegotiation



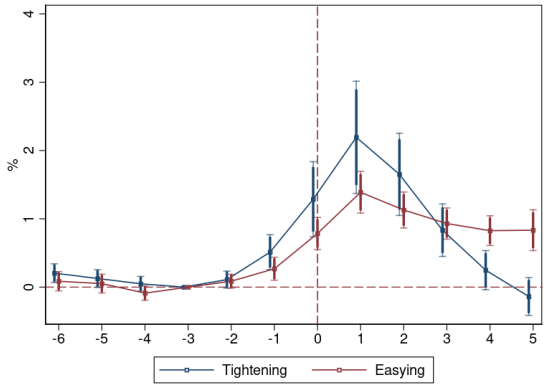
(b) Transfer



(c) Partial Prepayment



(d) Full Prepayment



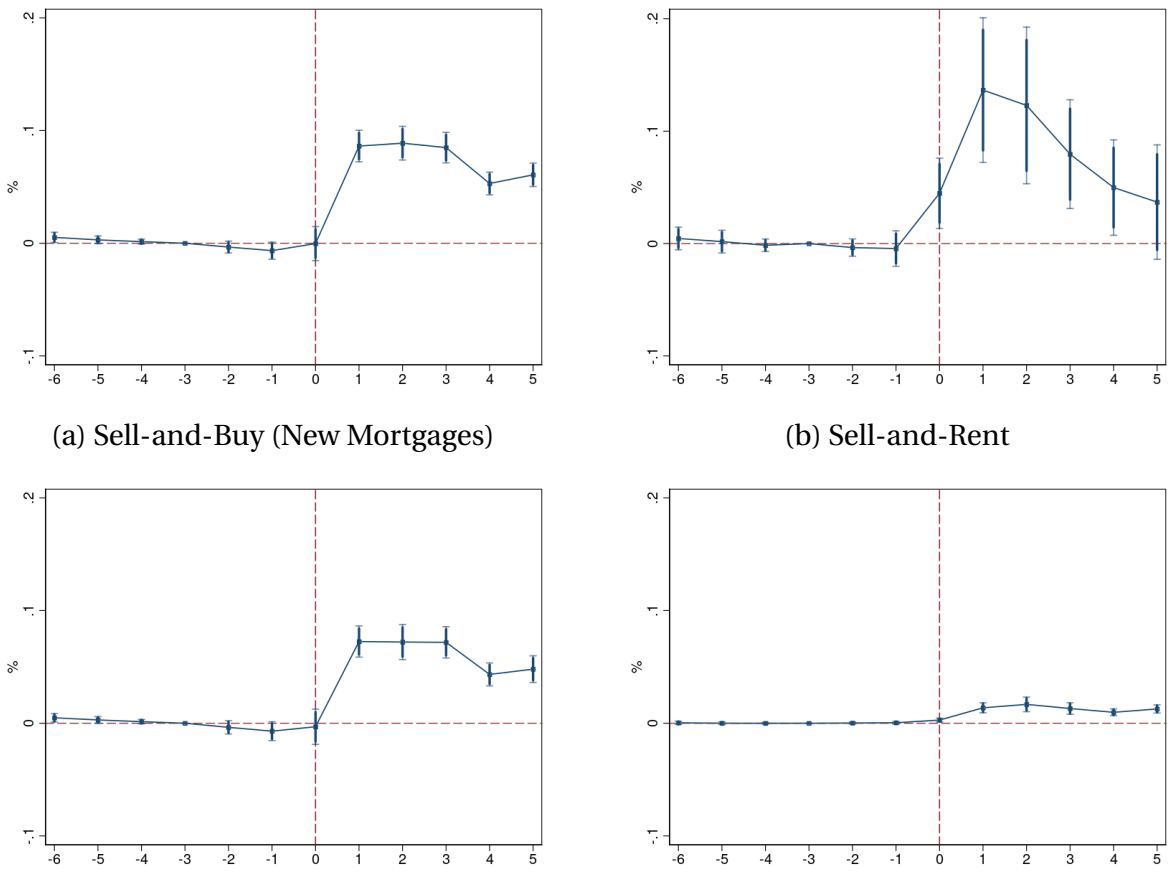
(e) Any Action

This figure presents the point estimates along with the 90% and 95% confidence intervals of β_{1t} and β_{2t} in the following equation:

$$
\begin{aligned}
Y_{ilmt} = & \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\alpha_t} Reset_{ilmt} + \boldsymbol{\gamma_1} Tightening_{ilm} + \boldsymbol{\gamma_2} Easying_{ilm} \\
& + \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\beta_{1t}} (Reset_{ilmt} \times Tightening_{ilm}) \\
& + \sum_{t=-6, t\neq -3}^{5} \boldsymbol{\beta_{2t}} (Reset_{ilmt} \times Easying_{ilm}) \\
& + \boldsymbol{\eta} DebtorCharacteristics_{im} + \boldsymbol{\lambda} LoanCharacteristics_{lm} \\
& + \boldsymbol{\zeta} MonthYear_t + \epsilon_{ilmt},
\end{aligned}
\tag{5}
$$

The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). $Tightening_{ilm}$ is a dummy variable that takes the value of one if the reset occurs between July 2022 and December 2023, and zero otherwise. $Easing_{ilm}$ is a dummy variable that takes the value of one if the reset occurs between January 2024 and December 2024, and zero otherwise. The omitted period is January 2021 to June 2022. Each variable takes a value of one for resets within its respective period and zero otherwise. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2024. Standard errors are clustered at the municipality and month-year levels.

Figure IA.5: Mobility Around Mortgage Rate Resets



(a) Sell-and-Buy (New Mortgages)

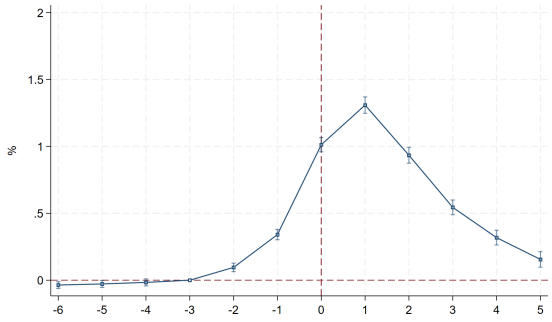
(b) Sell-and-Rent

(c) Sell-and-Buy (Small Mortgages)

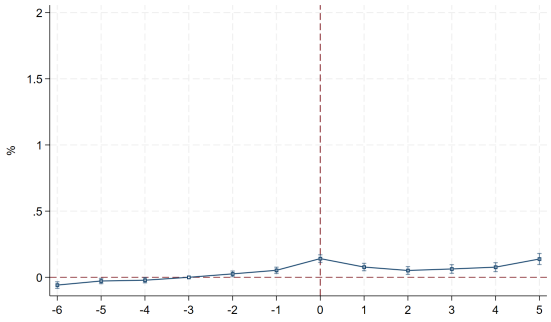
(d) Sell-and-Buy (Large Mortgages)

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The dependent variable in each panel is a dummy variable indicating a specific type of full prepayment action observed in the reset month. Panel (a) Sell-and-Buy for prepayment followed by a new mortgage within one year. Panel (b) Sell-and-Rent for prepayment not followed by a new mortgage within one year. Panel (c) Sell-and-Buy (Small Mortgages) for prepayment followed by a smaller mortgage within one year. Panel (d) Sell-and-Buy (Large Mortgages) for prepayment followed by a larger mortgage within one year. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

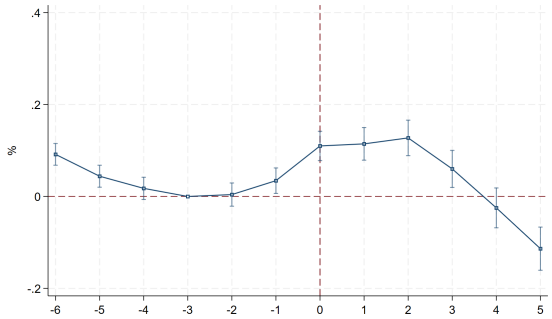
Figure IA.6: Household Responses Around Mortgage Rate Resets: Staggered Difference-in-Differences



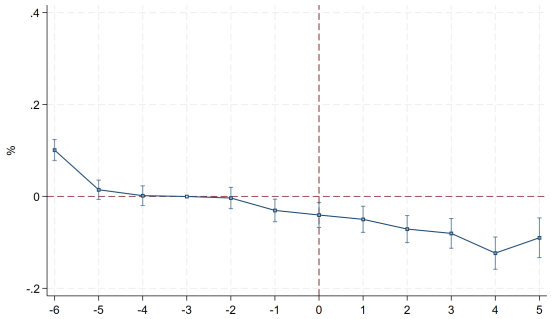
(a) Renegotiation: Tightening



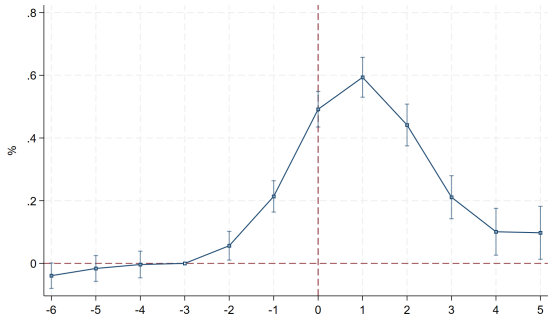
(b) Renegotiation: Pre-Tightening



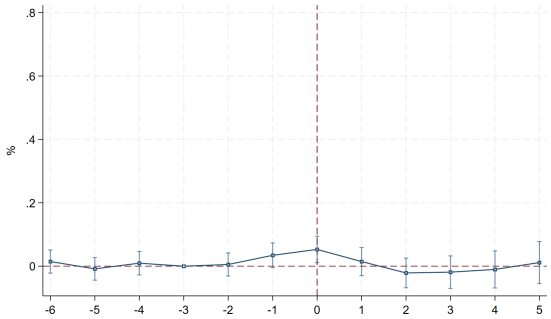
(c) Transfer: Tightening



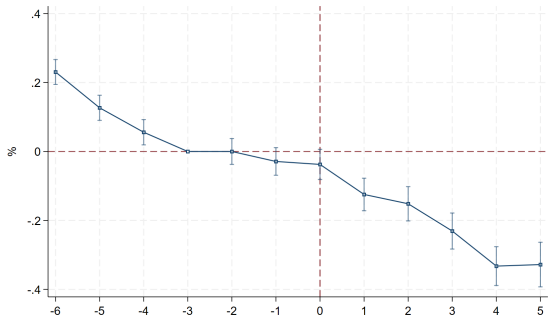
(d) Transfer: Pre-Tightening



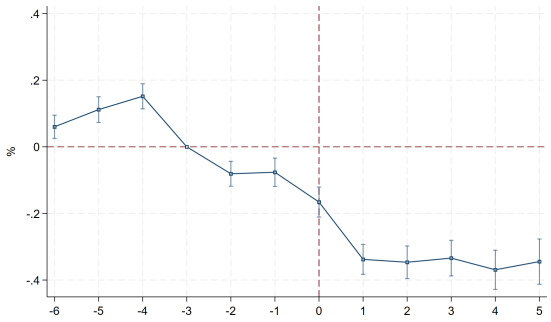
(e) Partial Prepayment: Tightening



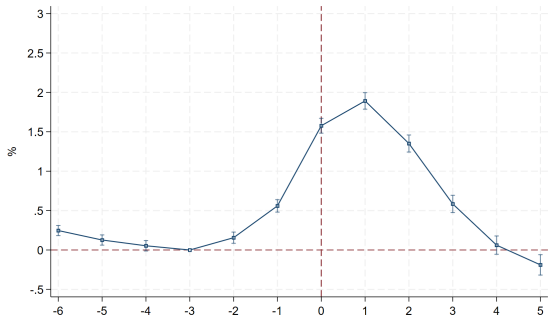
(f) Partial Prepayment: Pre-Tightening



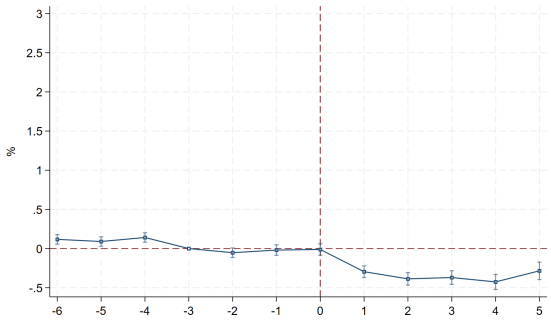
(g) Full Prepayment: Tightening



(h) Full Prepayment: Pre-Tightening



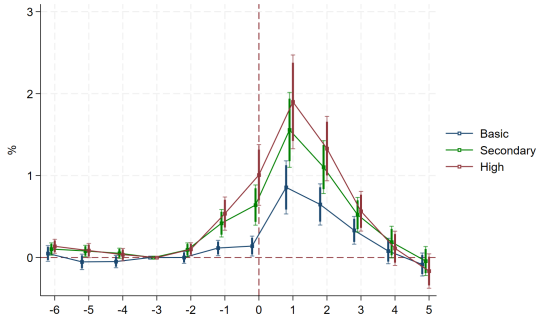
(i) Any Action: Tightening



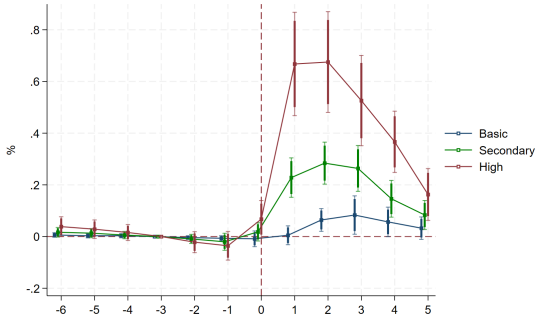
(j) Any Action: Pre-Tightening

This figure presents point estimates and 95% confidence intervals from a staggered difference-in-differences analysis of household responses to interest rate shocks in the spirit of Callaway and Sant'Anna (2021). The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panels (a) & (b)), a dummy variable for transfer (Panels (c) & (d)), a dummy variable for partial prepayment (Panels (e) & (f)), a dummy variable for full prepayment (Panels (g) & (h)) or a dummy variable for any action (Panels (i) & (j)). To avoid overlap with adjacent reset cycles, observations beyond the [-11,11] cycle are excluded. The analysis excludes observations beyond the [-11,11] event window to prevent overlap between adjacent reset cycles. All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring in the pre-tightening period (July 2021 to June 2022) or the tightening period (July 2022 to June 2023). We estimate separate regressions for the pre-tightening and tightening periods. Standard errors are clustered at the municipality and month-year levels.

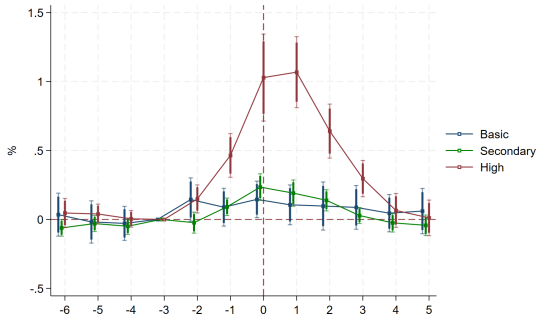
Figure IA.7: Household Responses Around Mortgage Rate Resets: Anticipation Effects and Education



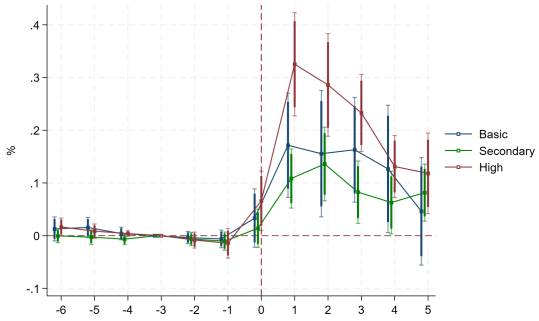
(a) Renegotiation



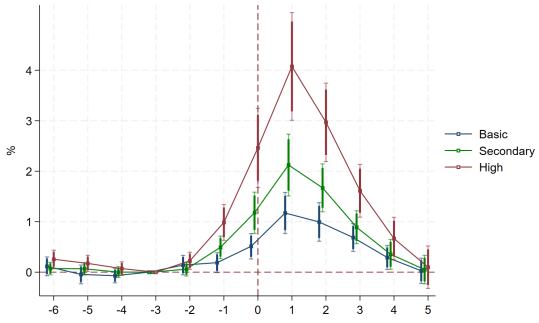
(b) Transfer



(c) Partial Prepayment



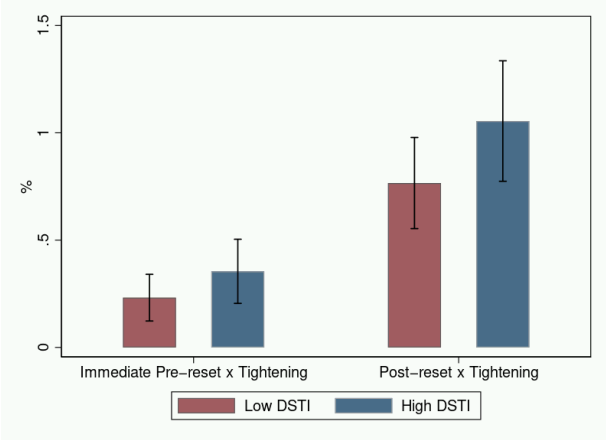
(d) Full Prepayment



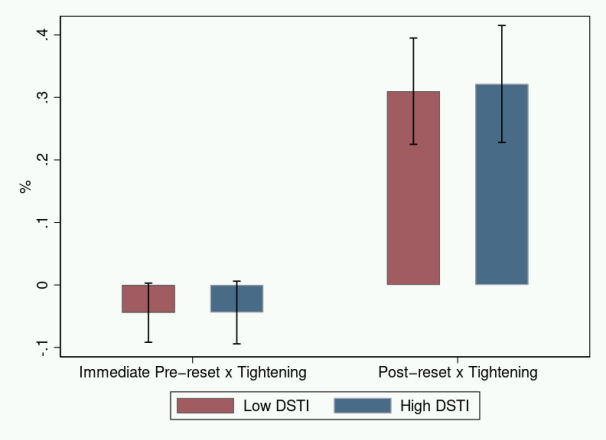
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for subsamples of households with no education or primary education (Primary), secondary education (Secondary), and tertiary education (High). The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Standard errors are clustered at the municipality and month-year levels.

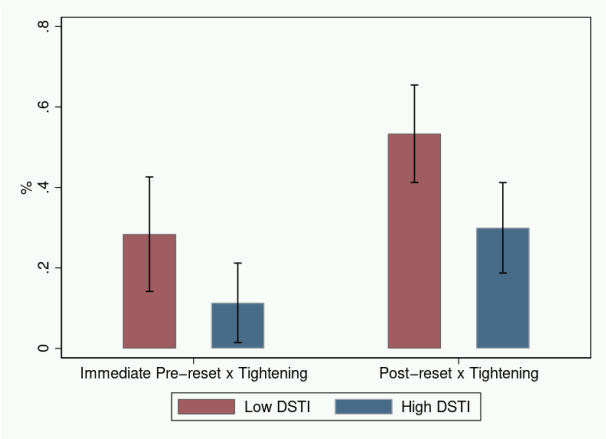
Figure IA.8: Household Responses Around Mortgage Rate Resets: The Role of Debt Service-to-Income



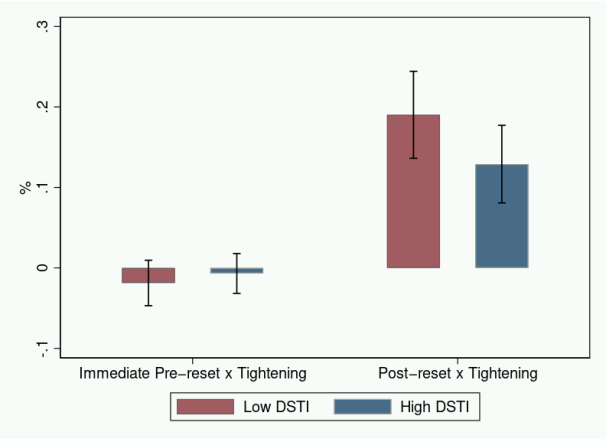
(a) Renegotiation



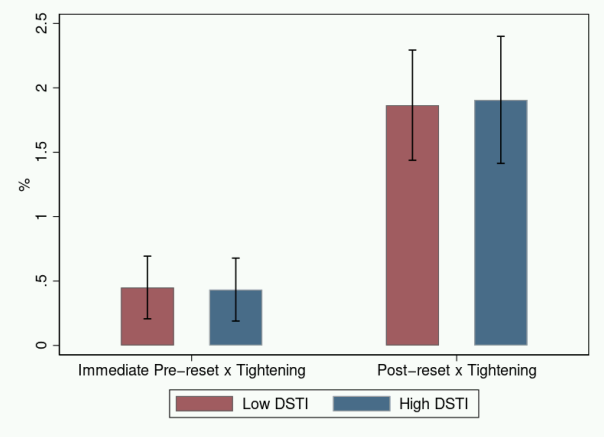
(b) Transfer



(c) Partial Prepayment



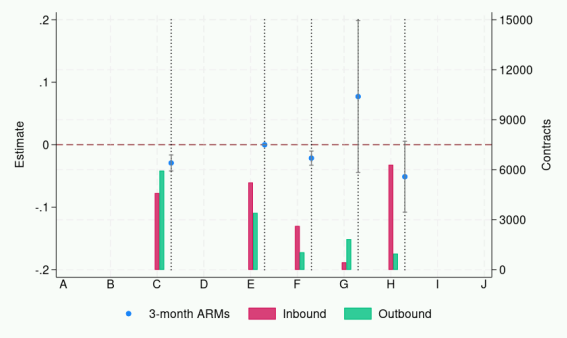
(d) Full Prepayment



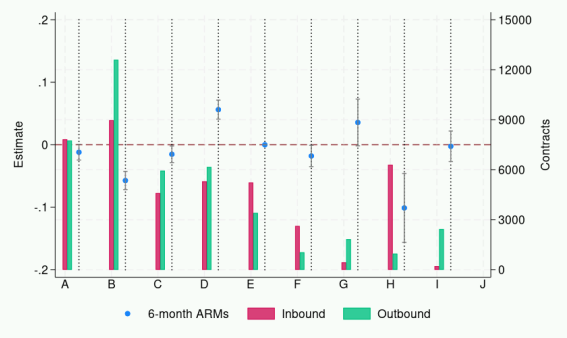
(e) Any Action

This figure reports point estimates and 90% and 95% confidence intervals for the β_t coefficients in equation (1), which capture household responses to mortgage rate resets during the tightening period, relative both to the same event month in the pre-tightening period (January 2021-June 2022) and to households whose mortgages did not reset in the same calendar month–year. The estimation is conducted separately for households with below-median (low) and above-median (high) debt service-to-income (DSTI) ratio. The dependent variable in each panel is a mortgage action in each event (reset) month: a dummy variable for renegotiation (Panel (a)), a dummy variable for transfer (Panel (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panel (e)). All regressions control for loan characteristics (residual maturity, balance outstanding, LTV ratio), household characteristics (household type, age, education level, employment status, and municipality of residence), and calendar month-year fixed effects. Loan characteristics and household characteristics are measured at the time of the mortgage rate reset. The sample consists of all 12-month resettable ARMs issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.Standard errors are clustered at the municipality and month-year levels.

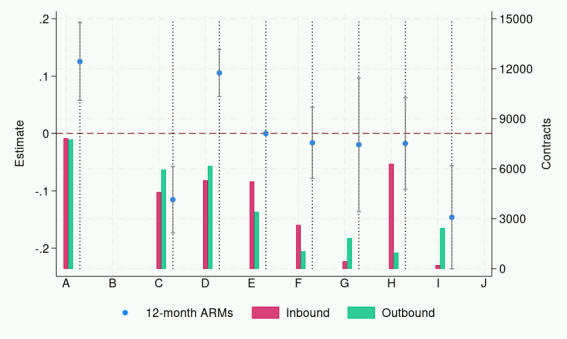
Figure IA.9: Winners and Losers: Mortgage Transfer Flows and Offered Rate



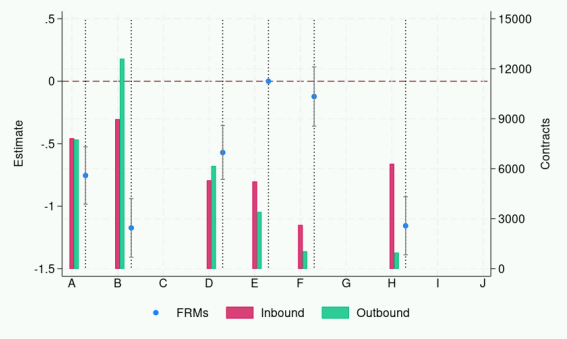
(a) Rates Offered on 3-Month ARMs



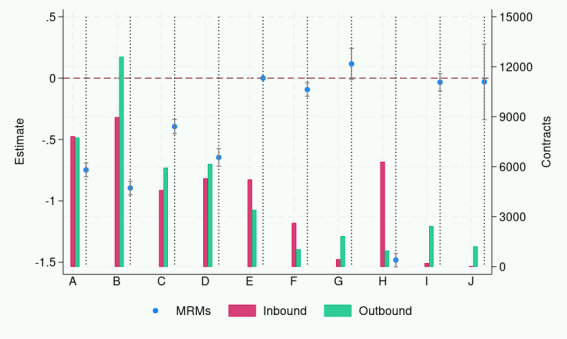
(b) Rates Offered on 6-Month ARMs



(c) Rates Offered on 12-Month ARMs



(d) Rates Offered on FRMs



(e) Rates Offered on MRMs

This figure presents the relationship between lender's mortgage inflows/outflows around the time of the mortgage transfer and their quoted interest rates, identifying competitive winners and losers in the market. It shows inbound (red bars) and outbound (green bars) mortgage transfer flows by bank (right axis), along with point estimates (blue dots) and 95% confidence intervals (vertical lines) of the conditional offered rate by bank, reported relative to the reference bank E. Estimates control for loan characteristics (term-to-maturity, amount outstanding, loan-to-value ratio), borrower characteristics (age group, household type, max education level, employment status, municipality of residence), and transfer year–month fixed effects. Results are presented separately for inbound 3-month ARMs, 6-month ARMs, 12-month ARMs, fixed-rate mortgages, and mixed-rate mortgages. Negative coefficients indicate lower offered rates than the reference bank for otherwise comparable loans and borrowers. Rate estimates use inbound transfers only.