# Interest Rate Pass-Through With Adjustable-Rate Mortgages*

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October 8, 2026

**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 91% 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 2, offsetting about 21.8% of the payment increase implied by policy rates, netting out the pre-tightening baseline. Responses are concentrated after resets, consistent with selective inattention, and are largest among younger, and more educated borrowers. Supply-side factors amplify these effects: as rates rise and bank competition intensifies, households at more flexible banks renegotiate and switch lenders 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.

**JEL classification**: E52, G21, D14, E44
**Keywords**: Monetary Policy Transmission, Adjustable-Rate Mortgages, Household Finance, Bank Competition

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*The views expressed in this paper are those of the authors and do not necessarily represent those of Banco de Portugal or the Eurosystem. We thank seminar participants at American Real Estate and Urban Economics National Conference, China International Conference in Finance, Drexel University, Duke University, European Central Bank, Federal Reserve Bank of Chicago, Fordham University, Indiana University and Chicago Fed Real Estate and Urban Policy Symposium, MIT CRE Research Seminar, Nova School of Business and Economics, Philadelphia Fed Mortgage Market Research Conference, Rice University, University of Notre Dame, University of Wisconsin-Madison, National University of Singapore, Singapore Management University, University of Florida, the Chinese University of Hong Kong, and Western Finance Association for helpful comments. 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.

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# 1 Introduction

Mortgage credit is one of the largest 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 et al. (2017); Beraja et al. (2019); Zhang (2022); Berger et al. (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 et al. (2017)).

A critical 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 et al. (2016); Fuster et al. (2019)), the impact of switching costs and bank competition (Woodward and Hall (2012); Agarwal et al. (2024); Allen et al. (2024)), and the sluggish adjustment of deposit rates, which shapes banks' funding costs (Drechsler et al. (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 91% 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 rises by 0.76 percentage points, switching to a new lender (i.e., transfers) by 0.22, partial prepayments by 0.32, and full prepayments by 0.14.[2] Over the six months following a reset in the tightening cycle, these effects cumulate to 9.6 percentage points for renegotiations, 3.9 for transfers, 5.0 for partial prepayments, and 2.4 for full prepayments. This implies that borrowers whose mortgage rate reset

[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" and corresponds to refinancing with another bank.

during the tightening cycle were 19.0 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 56 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 32 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 somewhat, and both credit card limits and spending increase 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 effects. Borrowers of a bank are roughly 2.5 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

[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.

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. Across all actions, responses are more common among more educated borrowers, consistent with greater financial literacy lowering search and switching costs.

Back-of-the-envelope calculations suggest that, in aggregate, contract adjustments and mortgage balance changes absorbed about 21.8% 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 4.3% 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 et al. (2021, 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 et al. (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 et al. (2025) examine the German market, where mortgages typically carry a 5–15 year fixed-rate period. During the 2022-2023 euro area tightening cycle, borrowers in Germany act preemptively by locking in rates through "forward mortgage" contracts—unlike in Portugal, where we observe that responses cluster after rate resets. In addition, using a letter randomized control trial and a survey, the authors find that, in their setting, borrowers are also aware of rate levels and rate movements and prepare for those changes. In the Spanish setting, Agarwal et al. (2026) show that accelerated prepayment of mortgages in the same tightening cycle led to bank-specific inflows that were subsequently reallocated toward small corporate borrowers.

Second, we contribute to the literature on mortgage market competition by examining how abrupt reference-rate changes interact with search frictions and switching costs (DeFusco and Paciorek, 2017). De Jonghe et al. (2025) documents near-complete pass-through of policy rates to newly originated mortgage pricing across nine European countries in 2022–2024, consistent with strong competition at origination. We instead focus on the stock of outstanding mortgages, where reference-rate changes translate into payments only through borrowers' ability to search, renegotiate, or refinance. We show that these frictions shape both within-lender renegotiation and cross-bank refinancing (transfers). Moreover, competition intensifies as rates rise: borrowers facing more flexible lenders renegotiate, switch lenders, and prepay more, while greater broker presence further increases lender switching.

We also 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) and De Jonghe et al. (2025)). Prior work by DeFusco and Paciorek (2017) demonstrates that mortgage demand is meaningfully interest-rate elastic, with even modest pricing differences capable of shifting borrowers across lenders and contract types. More recently, De Jonghe et al. (2025) provides harmonized cross-country evidence from nine European household credit registers over 2022–2024, finding near-complete pass-through of policy rates to new mortgage rates, a pattern consistent with competitive pricing at origination. While these studies focus on the demand for and pricing of new loans, our paper shifts attention to the stock of existing mortgages. For these borrowers, the translation of reference-rate changes into actual payments is mediated by search frictions, switching costs, and institutional features of mortgage markets. We show that such frictions influence not only whether borrowers renegotiate with their current lender, but also whether they refinance by transferring their loan to a competing bank. We document that competition intensifies as interest rates rise, with more flexible banks and greater broker presence amplifying renegotiation, lender switching, and prepayment activity.

Finally, 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 et al. (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 et al. (2021), and Ahn et al. (2024)). In contrast, Elias et al. (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 et al. (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 91% 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 39% 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 by law but are routinely required by banks as conditions for mortgage approval.

[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 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.

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. 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.

## 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.[6] As noted above, ARMs are the dominant mortgage type in Portugal, accounting for about 91% of the stock of all contracts as of July 2022. Their share of the stock of mortgages declined during the tightening cycle—to 87% by December of 2023 and 84% by June of 2024—due to making up 74% of new contracts in July of 2022, but just 16% of new contracts in December of 2023 and 12% in June 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. [7] 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 municipality of residence. For mortgages with multiple household heads listed

[6]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.

[7]The reported house valuations in the data are not marked-to-market. We therefore compute LTV by taking the house value at origination and adjusting it with a national house price index, which is available from 2007. This sample therefore covers loans originated after 2007, representing about 80% of total mortgages in terms of outstanding loan balances.

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 301,595 mortgage loans for owner-occupied properties, totaling 751,070 resets and 9,012,840 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 €79,026, with a mortgage balance of €71,970 and a monthly installment of €310. The average mortgage carries an interest rate spread of 1.48%, a loan-to-value (LTV) ratio of 0.43, and a residual maturity of about 30 years. Among mortgage actions, renegotiations and partial prepayments are the most frequent, occurring at monthly rates of 1.1% and 1.0%, respectively, followed by full prepayments (0.5%) and transfers (0.3%). The average debtor is 42 years old, 69% are employed, and about 55% 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 in Abel and Fuster (2021) and Berger et al. (2021). These studies show how changes in

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

mortgage payments shape household behavior, whether through policy-induced refinancing under HARP or market-driven rate differentials.

We estimate the following regression equation:

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

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 $\beta_t$, 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.2 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 IA.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 1 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, 15.4% of mortgages were renegotiated in the 18 months after July 2022, compared with only 2.3% in the pre-tightening period (a difference of 13.1 percentage points). The corresponding differences are 4.5 percentage points for transfers, 6.7 for partial prepayments, and about 2.9 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 2 plots the $\beta_t$ 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 or shortly after the reset and remaining elevated in the following months. In the month after reset, renegotiations increase by 1.5 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 2, 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 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 2025, and the easing period corresponds to the post-tightening period of January 2024 to June 2025). Renegotiations, transfers, and partial prepayments spike at reset during the tightening period but are much weaker or disappear during easing. 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 $\beta_1$ and $\beta_2$ 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 0.76 percentage points, transfers by 0.22, partial prepayment by 0.32, and full prepayment by 0.14. In addition, the probability of households taking any action increases by 1.5 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 and full repayments, the coefficients on the interaction term $Immediate\ Pre\text{-}Reset \times Tightening$ are positive and significant at the 1% level. For transfers the pre-reset effects arestatistically 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.

The specification in equation (2) treats the tightening cycle as a binary variable, which pools resets of different magnitudes. As an alternative, we replace $Tightening_{ilm}$ in equation (2) with $RateShock_{ilm}$, the percentage-point change in the contractual rate at reset implied by the 12-month Euribor, so that the interaction coefficients measure the response to a one percentage point increase in the mortgage rate rather than to the tightening regime as a whole. Table 3 reports the estimates. A one percentage point rate increase raises the monthly probability of renegotiation by 0.21 percentage points, transfer by 0.07, and partial prepayment by 0.10 in the six months after a reset, all significant at the 1% level. The immediate pre-reset interactions are again positive and significant for renegotiation and partial prepayment, and here also for transfer, indicating that anticipatory adjustment scales with the size of the expected payment increase.

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.

We also study mortgages indexed to the 6-month Euribor as a robustness check. Table IA.3 in the Internet Appendix presents the corresponding interaction coefficients. While these estimates are less precise, they are broadly consistent with the 12-month results.

**Cumulative Effects** The estimates in Figure 2 describe monthly probabilities of mortgage-related actions. As noted above, Figure 1 shows that cumulative frequencies rise substantially over time, reaching 15.4% for renegotiations, 6.7% for transfers, 11.5%

for partial prepayments, and 8.8% 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 4 reports the cumulative treatment effects of rate resets during the tightening period. Over the six months following a reset in the tightening cycle, the likelihood of renegotiation rises by 9.6 percentage points, transfer by 3.9, partial prepayment by 5.0, and full prepayment by 2.4—magnitudes that underscore the active role households play in managing payment shocks. Overall, households are 19.0 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. Specifically, , we analyze changes in (1) credit card drawdowns, (2) credit card limits (authorized limit), and (3) overdraft balances. We estimate the same specification as in equation (1), but depart from the linear probability model used in our main analysis, here the dependent variable is the raw credit amount and we

employ a Poisson pseudo-maximum likelihood estimator with high-dimensional fixed effects, which is better suited to the non-negative, count-like nature of the credit data.

Figure 3 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. Credit card usage (Panel (a)) grows by about 2 percentage points—likely to meet obligations or smooth consumption, while authorized credit limits (Panel (b)) grow by about 0.5 percentage points in the reset month (time 0). Credit card drawdowns remain elevated by two months after reset. Overdraft usage shows a positive but statistically insignificant response, though the point estimates are consistent with an upward trend. When we restrict the sample to households that did not take any mortgage-related action (e.g., renegotiation, switching, or prepayment) during the sample period, the results, shown in Figure IA.7, are even stronger: credit limits increase by about 0.8 percentage points and credit card usage by roughly 3 percentage points in the reset month, indicating that these households rely more heavily on credit cards as a liquidity buffer. This suggests that while some households adjust along the mortgage margin to absorb the payment shock, others turn to credit cards and other liquid credit lines to smooth consumption. 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.

**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.5 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

[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.

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.

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 but located in different districts, and in different age 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 4 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 more likely to renegotiate

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

mortgages, transfer, and (to a weaker extent) 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.

Figure 5, 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 6 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 7 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.6 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.

**Loan-to-Value** Figure IA.9 splits the sample at the median LTV ratio. High-LTV households respond far more strongly through renegotiation, with a post-reset effect roughly twice that of low-LTV households, consistent with larger outstanding balances making a given increase in the reference rate more salient in euro terms. The pattern reverses for prepayment: low-LTV households are substantially more likely to prepay, both partially and in full, possibly reflecting the greater equity and liquid savings that

make deleveraging feasible. Transfers, by contrast, show no meaningful difference across the two groups. Taken together with the DSTI results, this suggests that leverage shapes which margin households use rather than whether they act: households with more debt outstanding renegotiate, while those with more equity retire principal.

**Maturity** Figure IA.10 also in the Internet Appendix shows that households with longer-maturity loans are more responsive through both renegotiation and transfer. This is consistent with the present value of a spread reduction being increasing in the remaining term, so that the gains from repricing—and hence the incentive to bear the search and switching costs—are largest for borrowers with the longest horizon.

## 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, in which the event-time indicators are fully interacted with pre-tightening and tightening period dummies, yielding separate event-study coefficients for each period within a single regression:

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

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, such as the mortgage spread, LTV ratio or home value. $Event_{ilm}$ is an indicator equal to one in event month $t$ in which a mortgage renegotiation or transfer occurs, and zero otherwise. $Pre-Tightening_{ilm}$ and $Tightening_{ilm}$ are mutually exhaustive indicators for the pre- and post-July 2022 periods in which the event occurs. We omit the event month -3 and include mortgage contract fixed effects, $\zeta_l$, so that the coefficients $\alpha_t$ and $\beta_t$ trace within-contract changes in mortgage terms relative to the omitted pre-event month, separately for each period. Standard errors are clustered at the contract and month-year levels.

Figure 8 present the estimates for mortgage spreads. 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 56 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 32 basis points—but remain more accessible to liquidity-constrained borrowers. During the tightening period, spread reductions are somewhat smaller than in the pre-tightening period for both renegotiations and transfers, consistent with more limited borrower bargaining power when market rates are rising. Even so, the sizeable drop in spreads during tightening indicates that borrowers are able to partially offset the mechanical increase in Euribor-indexed mortgage rates through contract repricing.

Panels (c) and (d) decompose these spread dynamics by the borrower's initial spread level, separating loans with above- and below-median spreads at the beginning of the sample. For renegotiations (Panel (c)), high-spread borrowers obtain markedly larger spread reductions than low-spread borrowers. The same pattern holds for transfers (Panel (d)): borrowers who enter the event with above-median spreads secure substantially larger pricing improvements upon switching lenders. These findings are consistent with two complementary mechanisms. First, high-spread borrowers have more room to negotiate or shop for better terms, so the gains from action are larger. Second, the tightening cycle amplifies competition for transferees, enabling high-spread borrowers to extract particularly large concessions from receiving banks. The results also suggest that mortgage actions compress the cross-sectional dispersion of spreads by narrowing the gap between initially expensive and initially cheaper contracts.

Figure IA.13 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.

Figure IA.11 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. In contrast, transfers display a sharp, concentrated reduction in LTV ratios in the event month, reflecting the

updated appraisals required for refinancing.

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 63%), while roughly 27% move to mixed-rate contracts. By contrast, transfers are associated with a much larger shift toward other regimes—especially mixed-rate mortgages (59%)—and only about 20% 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. Spread reductions are especially large among borrowers with high initial spreads during monetary tightening, suggesting that renegotiation and transfer compress dispersion in mortgage pricing and help borrowers partially offset payment shocks during tightening.

## 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 9 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 5 quantifies how much mortgage actions reduced the increase in scheduled payments that would have occurred under full contractual pass-through of Euribor movements. Panel A presents an accounting decomposition. For each loan, we compute counterfactual payments assuming no mortgage action and mechanical Euribor-linked resets, and compare them with actual payments. The difference captures the total reduction in scheduled payments attributable to household responses. We then decompose this reduction by type of action. Categories are mutually exclusive: borrowers who undertook more than one action are classified under "Multiple Action" and excluded from individual action categories. During the tightening period (July 2022-December 2023), contract adjustments and balance changes offset about 30% of the increase in scheduled payments that would have occurred under full pass-through. Renegotiations account for 1.1 percentage points (p.p.) of the total payment shock, transfers for 3.2 p.p., and partial prepayments for about 5.6 p.p. Households undertaking multiple actions contribute 5.9 p.p., while the largest share comes from full repayments (14.1 p.p.), of which roughly three-quarter correspond to permanent market exits and one-quarter to borrowers who subsequently re-enter with a new mortgage.

This accounting exercise, however, captures all mortgage actions observed during

the period, including those that would have occurred even in the absence of monetary tightening, for instance, borrowers who prepay because of an inheritance or a home sale. To isolate the causal effect of the payment shock, we estimate a difference-in-differences specification (equation 4) that compares borrowers whose rate resets during the tightening period (tightening group) with borrowers whose rate resets outside this window (control group). The dependent variable is the deviation of scheduled payments from the actual payment. The coefficient of interest, $\hat{\beta}$, captures the average monthly differential change in scheduled payments for tightening relative to control borrowers in the post-reset period (event months 0-5, where month 0 is the reset month). To express the causal effect as a share of the total payment shock absorbed, we normalize by the average mechanical payment increase: $\hat{\theta} = \frac{\hat{\beta}}{\overline{\Delta P}}$.

$$
\begin{aligned}
Y_{ilmt} = {} & \boldsymbol{\alpha}\, Post\text{-}Reset_{ilmt} + \boldsymbol{\gamma}\, Tightening_{ilm} \\
& + \boldsymbol{\beta}\big(Post\text{-}Reset_{ilmt} \times Tightening_{ilm}\big) \\
& + \boldsymbol{\eta}\, DebtorCharacteristics_{im} + \boldsymbol{\lambda}\, LoanCharacteristics_{lm} + \boldsymbol{\zeta}\, MonthYear_{t} + \epsilon_{ilmt}\,.
\end{aligned}
\tag{4}
$$

Panel B reports the causal estimates. Mortgage actions causally offset about 22% of the payment shock ($\hat{\theta} = 0.22$), compared with the 30% implied by the accounting decomposition in Panel A. The gap of roughly 8 percentage points reflects mortgage actions that would have taken place regardless of the tightening, i.e., the baseline activity captured by the control group. Put differently, about three-quarters of the observed reduction in scheduled payments is causally attributable to the monetary policy tightening, while the remainder reflects normal household behaviour unrelated to the rate cycle.

**Mortgage Re-Entry** As shown in Panel A of Table 5, household responses offset about 30% of the increase in scheduled payments that would have occurred under full pass-through. The largest contributor is full prepayment (14.1 p.p.), which we further decompose into two components: *exits* (i.e., households that sell their home and do not originate a new mortgage within the sample window) and *re-entries* (i.e., households that fully prepay and subsequently take out a new mortgage). Exits account for 10.4 p.p. of the total offset, while re-entries account for 3.7 p.p. The dominance of exits is consistent with households relieving cash-flow pressure through home sales or other forms of deleveraging. Re-entry, by contrast, reflects refinancing via a brief market exit and is economically similar to a transfer. Both components are heavily concentrated among highly educated borrowers: re-entry in particular is almost entirely driven by those with tertiary education (2.8 of 3.7 p.p.), consistent with the financial-literacy gradient documented earlier.

Figure IA.12 examines spread dynamics around mortgage re-entry. Panel (a) shows that borrowers who fully prepay and subsequently originate a new mortgage obtain spread reductions of roughly 50 to 60 basis points, comparable in magnitude to those achieved through formal transfers, shown in Figure 8. Panels (b) and (c) decompose re-entry by the size of the new mortgage relative to the original. Spread reductions are present for both downsizers (Panel (b)) and upsizers (Panel (c)), suggesting that the gains reflect competitive repricing rather than simple deleveraging. Table IA.2 further shows that re-entering borrowers frequently shift into mixed-rate mortgages (about 43%), insulating themselves from future interest-rate risk.

# 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 (over the six months following a reset) include increases of 10 percentage points in renegotiations, 4 in lender switching, 5 in partial prepayments, and 2 in full prepayments, with transfers and renegotiations delivering significant reductions in spread and LTV ratio. Together, these actions absorbed about 21.8% 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 significantly increase transfers and prepayments, while higher mortgage-broker presence is associated with more transfers, 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.

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Table 1: Summary statistics

| | (1) Mean | (2) Std. Dev. | (3) P10 | (4) Median | (5) P90 |
|---|---|---|---|---|---|
| **Mortgage Characteristics** | | | | | |
| Balance Outstanding (€) | 71,970 | 66,316 | 20,413 | 57,903 | 132,513 |
| Installment (€) | 310 | 496 | 100 | 238 | 569 |
| Spread (%) | 1.476 | 0.586 | 1.000 | 1.300 | 2.050 |
| Maturity (month) | 355 | 111 | 191 | 382 | 462 |
| LTV | 43.132 | 19.103 | 15.694 | 44.337 | 67.209 |
| Renegotiation (%) | 1.100 | 10.432 | 0.000 | 0.000 | 0.000 |
| Transfer (%) | 0.317 | 5.623 | 0.000 | 0.000 | 0.000 |
| Partial Prepayment (%) | 1.015 | 10.024 | 0.000 | 0.000 | 0.000 |
| Full Prepayment (%) | 0.459 | 6.762 | 0.000 | 0.000 | 0.000 |
| Any Action (%) | 2.917 | 16.827 | 0.000 | 0.000 | 0.000 |
| **Household Credit Positions** | | | | | |
| Total Credit (€) | 79,026 | 74,207 | 24,005 | 63,733 | 143,069 |
| Credit Card Drawdown (€) | 668 | 1,782 | 0 | 19 | 1,732 |
| Credit Card Limit (€) | 2,696 | 3,712 | 0 | 1,500 | 6,871 |
| Overdrafts (€) | 31 | 721 | 0 | 0 | 0 |
| Overdue Credit (€) | 132 | 3,055 | 0 | 0 | 0 |
| **Household Characteristics** | | | | | |
| Single Male | 0.181 | 0.385 | 0.000 | 0.000 | 1.000 |
| Single Female | 0.188 | 0.391 | 0.000 | 0.000 | 1.000 |
| Joint | 0.631 | 0.483 | 0.000 | 1.000 | 1.000 |
| Age (years) | 41.74 | 9.24 | 31.00 | 41.00 | 54.00 |
| Higher Education | 0.550 | 0.497 | 0.000 | 1.000 | 1.000 |
| Employed | 0.689 | 0.463 | 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 301,595 mortgage loans for owner-occupied properties, totaling 751,070 resets and 9,012,840 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 |
|---|---|---|---|---|---|
| $Immediate\ Pre-reset$ | 0.051*** | -0.024 | 0.039*** | -0.042*** | 0.027 |
| | (0.011) | (0.028) | (0.011) | (0.011) | (0.021) |
| $Post-reset$ | 0.114*** | 0.015 | 0.080*** | -0.013 | 0.196*** |
| | (0.017) | (0.014) | (0.009) | (0.009) | (0.020) |
| $Tightening$ | -0.027 | -0.045** | -0.032** | -0.052*** | -0.157*** |
| | (0.023) | (0.019) | (0.013) | (0.010) | (0.041) |
| $Immediate\ Pre-reset \times Tightening$ | 0.192*** | 0.052 | 0.167*** | 0.095*** | 0.510*** |
| | (0.041) | (0.031) | (0.032) | (0.017) | (0.084) |
| $Post-reset \times Tightening$ | 0.759*** | 0.222*** | 0.320*** | 0.136*** | 1.451*** |
| | (0.096) | (0.031) | (0.043) | (0.019) | (0.156) |
| Observations | 9,012,840 | 9,012,840 | 9,012,840 | 9,012,840 | 9,012,840 |
| Adjusted $R^2$ | 0.007 | 0.003 | 0.006 | 0.001 | 0.012 |

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 12-month resettable ARMs originated after 2007 and 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: Interest Rate Shocks and Household Responses

| | (1) Renegotiation | (2) Transfer | (3) Partial Repayment | (4) Full Repayment | (5) Any Action |
|---|---|---|---|---|---|
| $Immediate\ Pre-reset$ | 0.071*** | -0.025 | 0.048*** | -0.037*** | 0.060** |
| | (0.013) | (0.027) | (0.012) | (0.010) | (0.023) |
| $Post-reset$ | 0.162*** | 0.034** | 0.089*** | -0.008 | 0.280*** |
| | (0.025) | (0.015) | (0.013) | (0.009) | (0.034) |
| $Rate\ Shock$ | -0.009 | 0.002 | -0.023 | -0.010** | -0.042 |
| | (0.029) | (0.008) | (0.016) | (0.005) | (0.050) |
| $Immediate\ Pre-reset \times Rate\ Shock$ | 0.055*** | 0.024** | 0.051*** | 0.033*** | 0.164*** |
| | (0.012) | (0.010) | (0.011) | (0.006) | (0.027) |
| $Post-reset \times Rate\ Shock$ | 0.213*** | 0.071*** | 0.095*** | 0.047*** | 0.430*** |
| | (0.034) | (0.009) | (0.020) | (0.007) | (0.060) |
| Observations | 9,012,840 | 9,012,840 | 9,012,840 | 9,012,840 | 9,012,840 |
| Adjusted $R^2$ | 0.007 | 0.003 | 0.006 | 0.001 | 0.011 |

This table reports event-time regression estimates based on equation (2), which capture household responses to a 1 percentage point increase in the mortgage rate. 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. *Rate Shock* is defined as the percentage-point change in the interest rate at mortgage reset, as implied by the reference rate (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 12-month resettable ARMs originated after 2007 and 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 4: Mortgage Rate Reset and Household Responses: Cumulative Effects

| | (1) Renegotiation | (2) Transfer | (3) Partial Prepayment | (4) Full Prepayment | (5) Any Action |
|---|---|---|---|---|---|
| $Immediate\ Pre-reset \times Tightening$ | 0.675*** | -0.258*** | 0.653*** | -0.973*** | 0.156* |
| | (0.051) | (0.027) | (0.060) | (0.039) | (0.083) |
| $Post-reset \times Tightening$ | 9.619*** | 3.868*** | 4.977*** | 2.399*** | 18.981*** |
| | (0.167) | (0.124) | (0.239) | (0.086) | (0.337) |
| Observations | 1,536,640 | 1,536,640 | 1,536,640 | 1,536,640 | 1,536,640 |
| Adjusted $R^2$ | 0.057 | 0.032 | 0.026 | 0.023 | 0.108 |

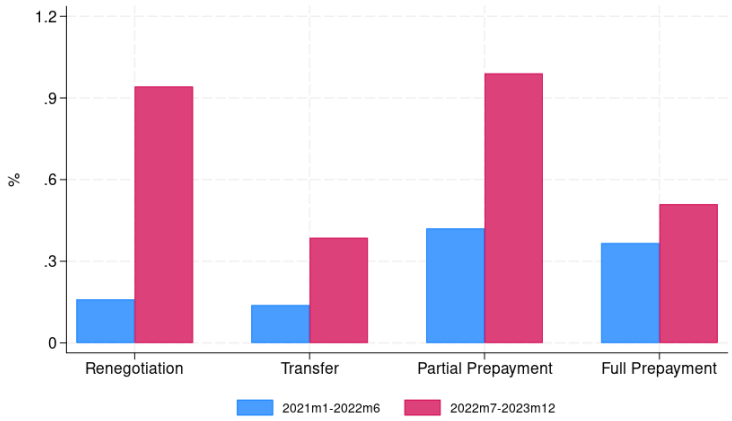
This table reports event-time regression estimates using data collapsed at the contract–reset window–tightening period level. The dependent variable in each column is a mortgage action in each event (reset) window: a dummy variable for renegotiation, a dummy variable for transfer, a dummy variable for 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 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 12-month resettable ARMs originated after 2007 and 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 5: Aggregate Effects

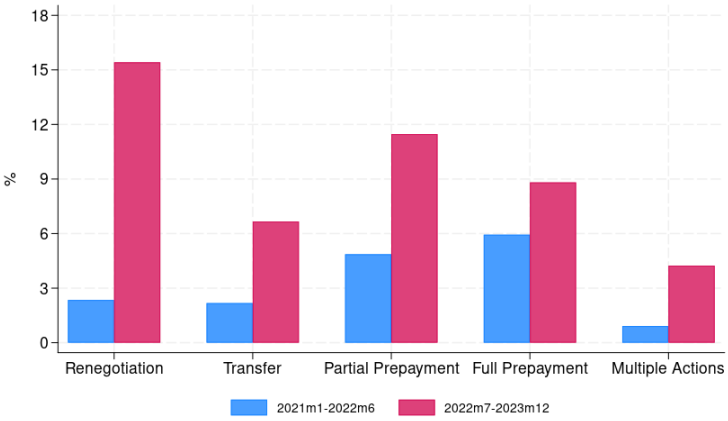
| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | | *Panel A: p.p. of Total Payment Shock* | | |
| | | Education | | |
| | All | Basic | Secondary | High |
| **Total** | 29.8 | 0.9 | 6.0 | 22.9 |
| Renegotiation | 1.1 | 0.0 | 0.1 | 0.9 |
| Transfer | 3.2 | 0.0 | 0.6 | 2.6 |
| Partial Repayment | 5.6 | 0.2 | 0.8 | 4.7 |
| Full Prepayment | 14.1 | 0.6 | 3.8 | 9.7 |
| Multiple Action | 5.9 | 0.1 | 0.8 | 5.0 |
| | *Panel B: Tightening-Induced Payment Reduction* | | | |
| | $\hat{\theta}$ (%) | Avg. Monthly $\hat{\beta}$ (€) | Std. Err. (€) | Avg. $\Delta P$ (€) |
| Any Action | 21.8 | 18.1 | 1.8 | 83.1 |

This table presents estimates 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. Panel A reports the contribution of each action (renegotiation, transfer, partial prepayment, full prepayment, and multiple actions) expressed in percentage points of the total payment shock, overall and by borrower education. The total payment shock is the total increase in scheduled payments due to monetary tightening relative to its pre-tightening level (June 2022). Categories are mutually exclusive: borrowers who took more than one action are classified under "Multiple Action" and excluded from individual action categories. Panel B reports the tightening-induced payment reduction from a difference-in-differences specification (Equation 4) comparing borrowers whose rate resets during the tightening period with borrowers whose rate resets outside this window. The dependent variable is the deviation of actual payments from scheduled payments. $\hat{\beta}$ is the coefficient on the interaction between a post-reset indicator and the tightening indicator, capturing the average monthly differential change for tightening relative to control borrowers in the post-reset period (event months 0–5, where month 0 is the reset month). To express the effect as a share of the total payment shock absorbed, we normalize by the average mechanical payment increase: $\hat{\theta} = \frac{\hat{\beta}}{\Delta P}$. The difference between the Panel A total (29.8 p.p.) and $\hat{\theta}$ (21.8 p.p.) reflects mortgage actions that would have occurred even absent the tightening. Standard errors are clustered by municipality and date. The sample consists of 12-month resettable ARMs originated after 2007 and issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023. Components may not sum exactly to totals due to rounding.

Figure 1: Interest Rate Shocks and Household Responses: Monthly and Cumulative Effects



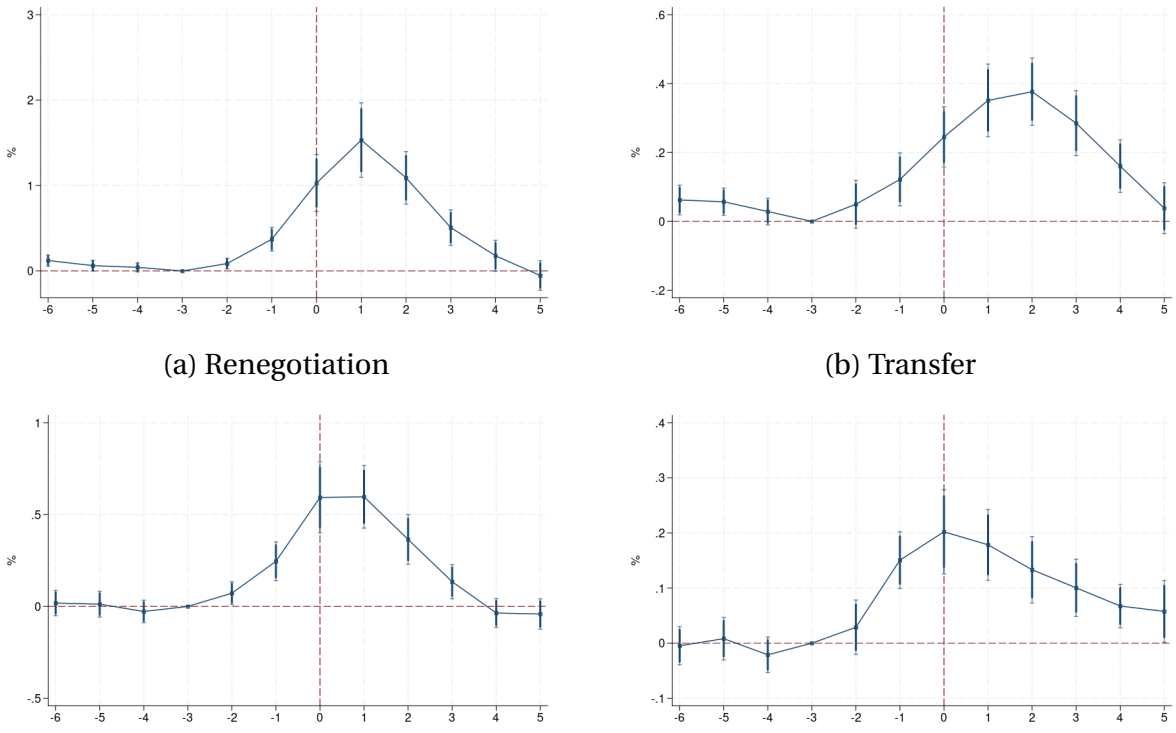

(a) Monthly Frequency




(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 12-month resettable ARMs originated after 2007 and issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2023.

Figure 2: Household Responses Around Mortgage Rate Resets




(a) Renegotiation

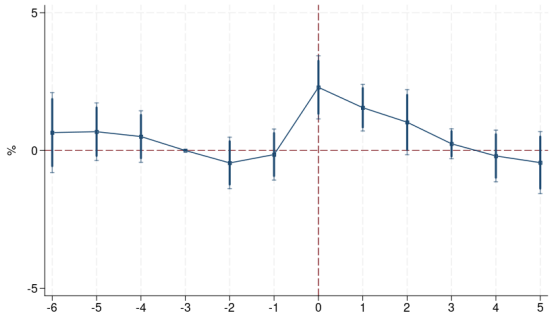
(b) Transfer

(c) Partial Prepayment

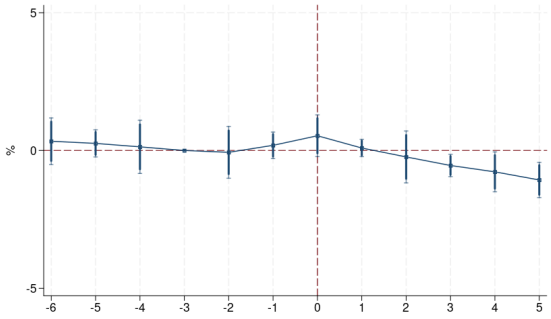
(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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.

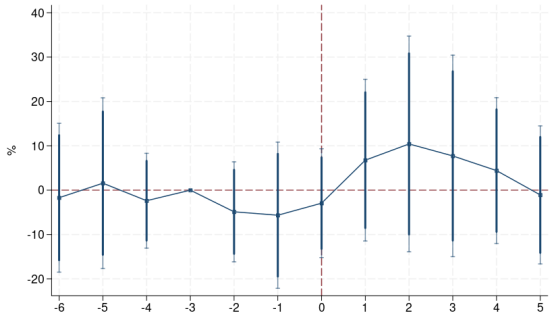
Figure 3: Short-Term Consumer Credit Around Mortgage Rate Resets




(a) Credit-Card Drawndown



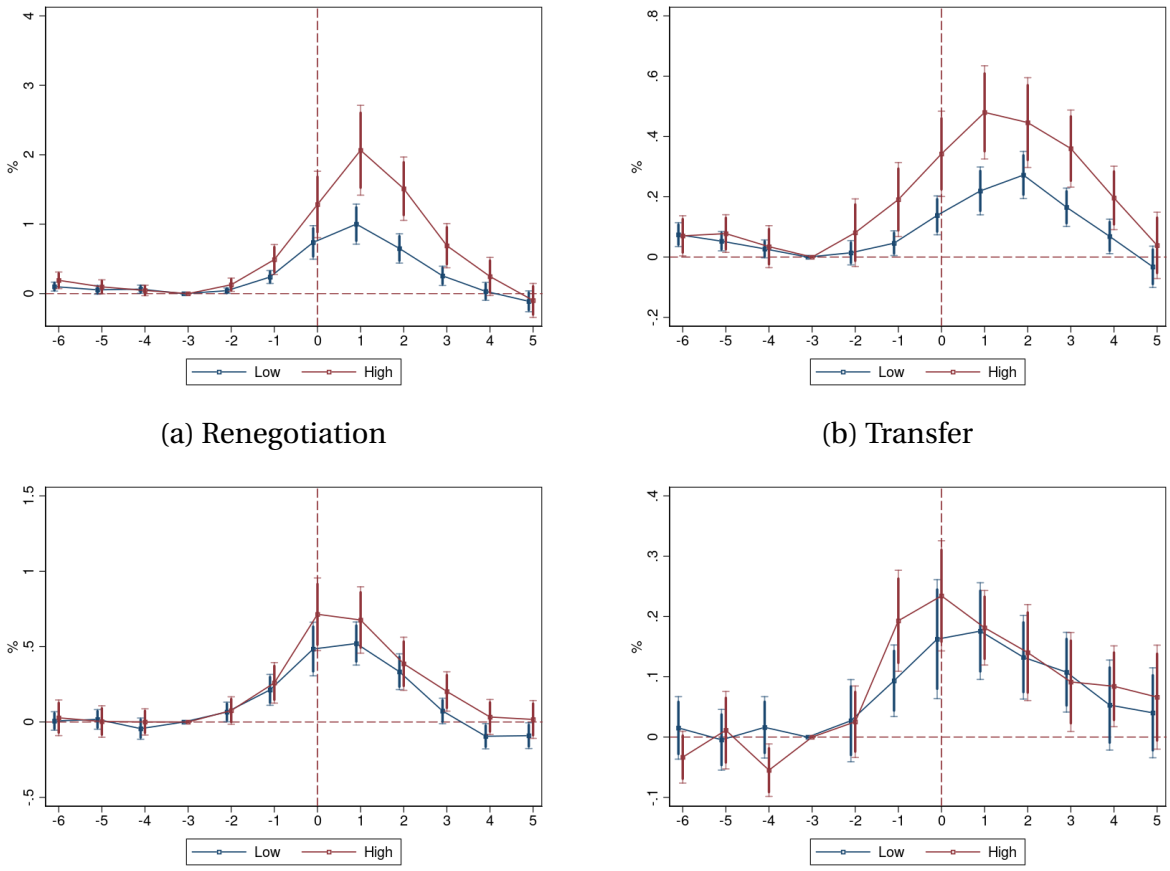

(b) Credit-Card Limit




(c) Overdrafts

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ coefficients from the Poisson pseudo-likelihood regression 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 amount of credit card drawdown (Panel (a)), the amount of credit card limit (Panel (b)), and the 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 12-month resettable ARMs originated after 2007 and 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: Household Responses Around Mortgage Rate Resets: The Role of Banks




(a) Renegotiation

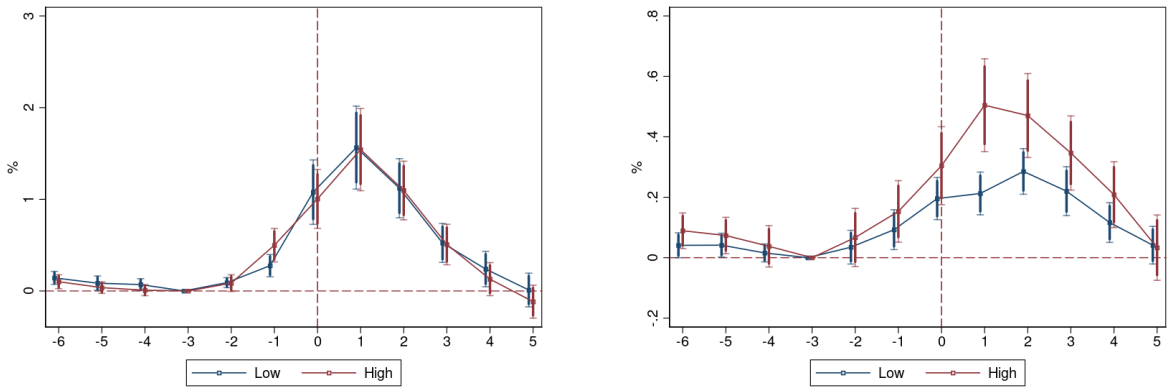
(b) Transfer

(c) Partial Prepayment

(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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 Mortgage Brokers

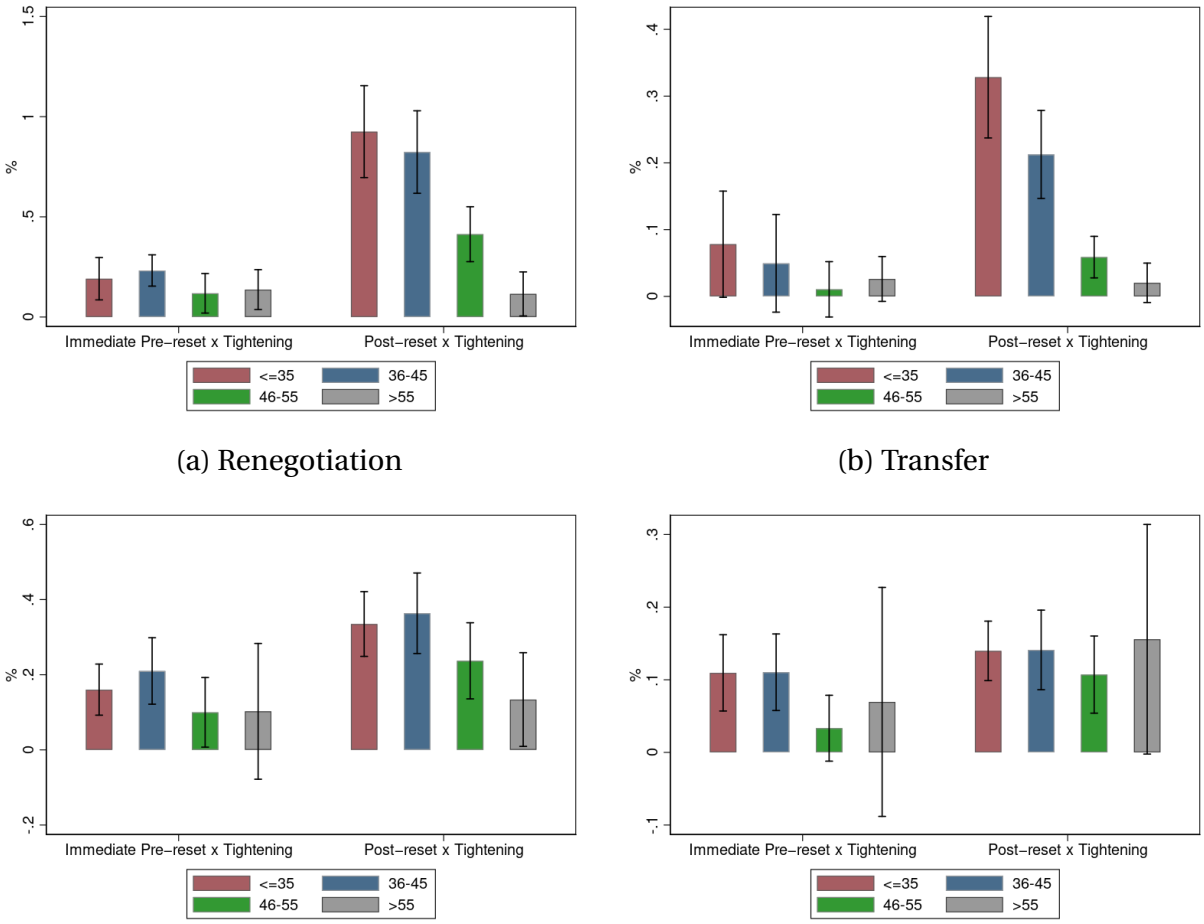



(a) Renegotiation

(b) Transfer

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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 Age




(a) Renegotiation

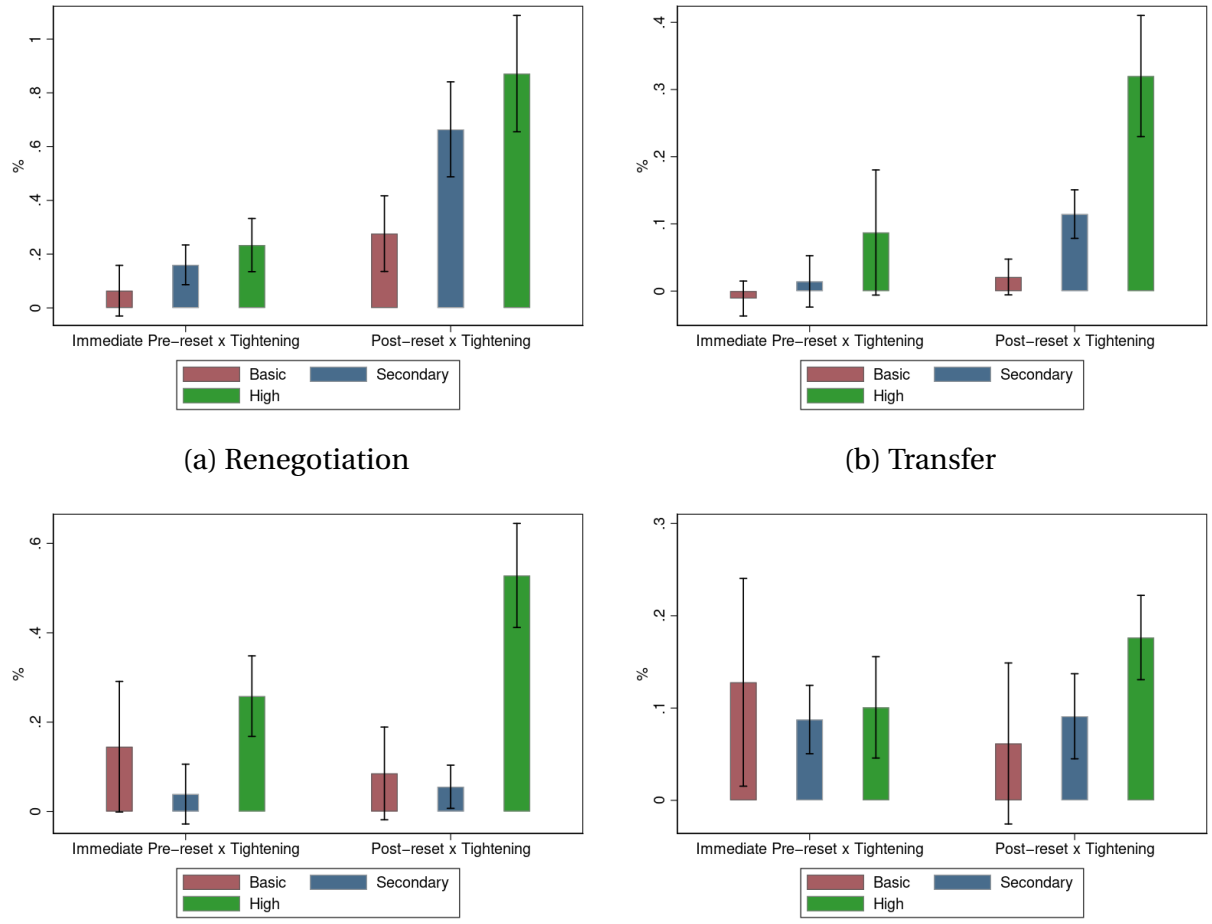
(b) Transfer

(c) Partial Prepayment

(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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 Education




(a) Renegotiation

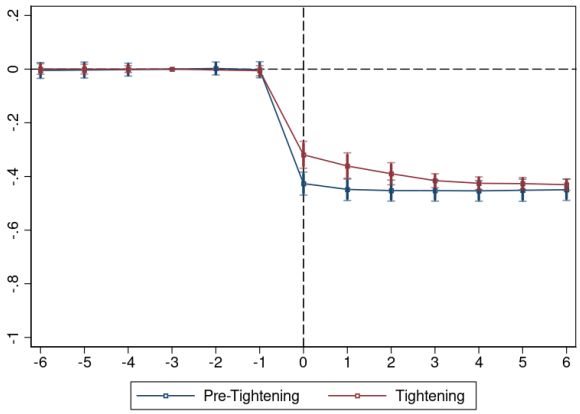
(b) Transfer

(c) Partial Prepayment

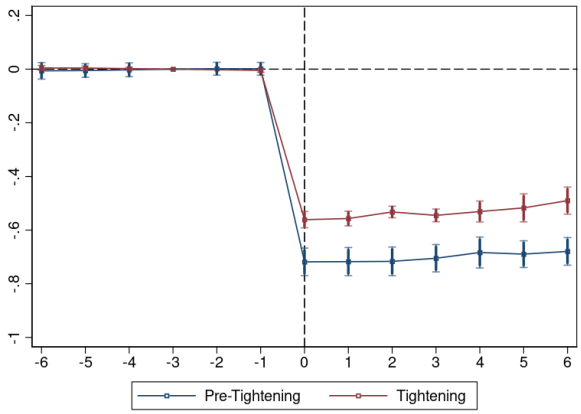
(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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.

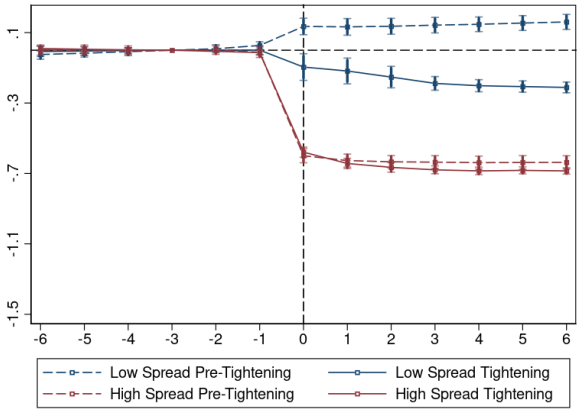
Figure 8: Change in Spread around Renegotiation and Transfer



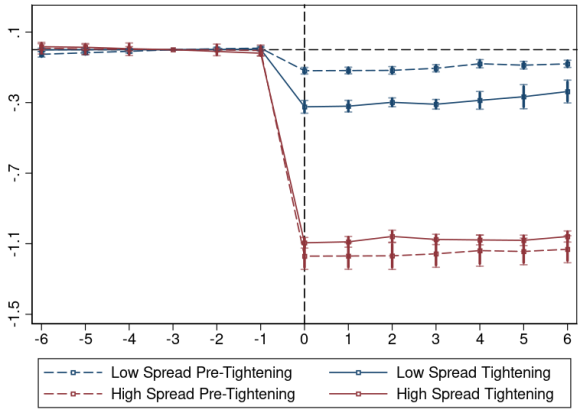

(a) Renegotiation




(b) Transfer



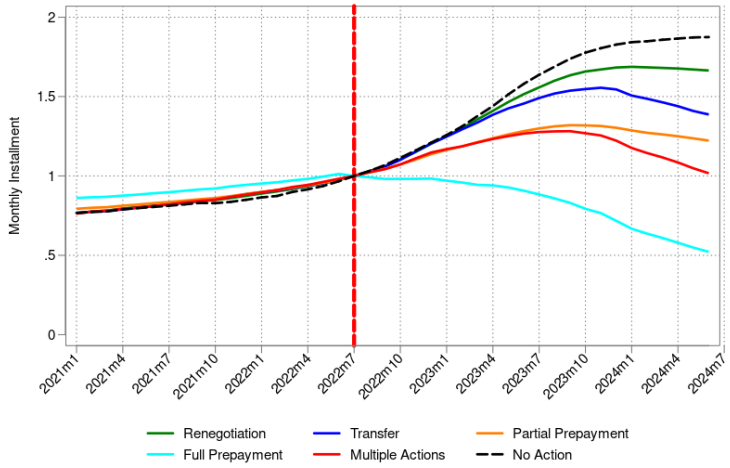

(c) Renegotiation: By Initial Spread




(d) Transfer: By Initial Spread

This figure presents the point estimates along with the 90% and 95% confidence intervals of $\gamma_t$ 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 is the mortgage spread. All regressions control for loan fixed effects. The sample consists of 12-month resettable ARM originated after 2007 and 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 9: 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 12-month resettable ARMs originated after 2007 and 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 (€) | 44,644 | 71,970 | -27,326 | 0.000 | -607 | 0.000 |
| Installment (€) | 255 | 310 | -55 | 0.000 | -2 | 0.000 |
| Spread (%) | 1.201 | 1.476 | -0.275 | 0.000 | -0.004 | 0.001 |
| Maturity (month) | 213 | 355 | -143 | 0.000 | -4 | 0.000 |
| LTV | 25.394 | 43.132 | -17.738 | 0.000 | -0.240 | 0.000 |
| Renegotiation (%) | 0.166 | 1.100 | -0.934 | 0.000 | -0.009 | 0.439 |
| Transfer (%) | 0.065 | 0.317 | -0.252 | 0.000 | -0.026 | 0.000 |
| Partial Prepayment (%) | 0.689 | 1.015 | -0.326 | 0.000 | -0.021 | 0.093 |
| Full Prepayment (%) | 0.426 | 0.459 | -0.033 | 0.000 | -0.023 | 0.009 |
| Any Action (%) | 1.349 | 2.917 | -1.567 | 0.000 | -0.082 | 0.000 |
| **Household Credit Positions** | | | | | | |
| Total Credit (€) | 51,099 | 79,026 | -27,927 | 0.000 | -763 | 0.000 |
| Credit Card Drawdown (€) | 697 | 668 | 29 | 0.000 | -10 | 0.000 |
| Credit Card Limit (€) | 2,785 | 2,696 | 89 | 0.000 | 7 | 0.131 |
| Overdrafts (€) | 45 | 31 | 13 | 0.000 | -2 | 0.102 |
| Overdue Credit (€) | 219 | 132 | 86 | 0.000 | -22 | 0.000 |
| **Household Characteristics** | | | | | | |
| Single Male | 0.166 | 0.181 | -0.014 | 0.000 | -0.002 | 0.000 |
| Single Female | 0.197 | 0.188 | 0.009 | 0.000 | 0.000 | 0.487 |
| Joint | 0.637 | 0.631 | 0.006 | 0.000 | 0.002 | 0.003 |
| Age (years) | 49.56 | 41.74 | 7.82 | 0.000 | 0.09 | 0.000 |
| Higher Education | 0.405 | 0.550 | -0.145 | 0.000 | -0.001 | 0.292 |
| Employed | 0.556 | 0.689 | -0.133 | 0.000 | -0.001 | 0.394 |

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 6-month resettable ARMs originated after 2007 and 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, Transfer, and Re-entry

| | Renegotiation | | Transfer | | Re-entry | |
|---|---|---|---|---|---|---|
| | Obs | % | Obs | % | Obs | % |
| Fixed-rate mortgage | 558 | 0.65 | 1,166 | 3.35 | 1,181 | 6.40 |
| Mixed-rate mortgage | 22,921 | 26.67 | 20,429 | 58.65 | 7,901 | 42.84 |
| 3-month ARMs | 1,634 | 1.90 | 935 | 2.68 | 415 | 2.25 |
| 6-month ARMs | 6,326 | 7.36 | 5,024 | 14.42 | 4,881 | 26.47 |
| 12-month ARMs | 53,920 | 62.73 | 6,980 | 20.04 | 3,817 | 20.70 |
| Other | 597 | 0.69 | 298 | 0.86 | 248 | 1.34 |

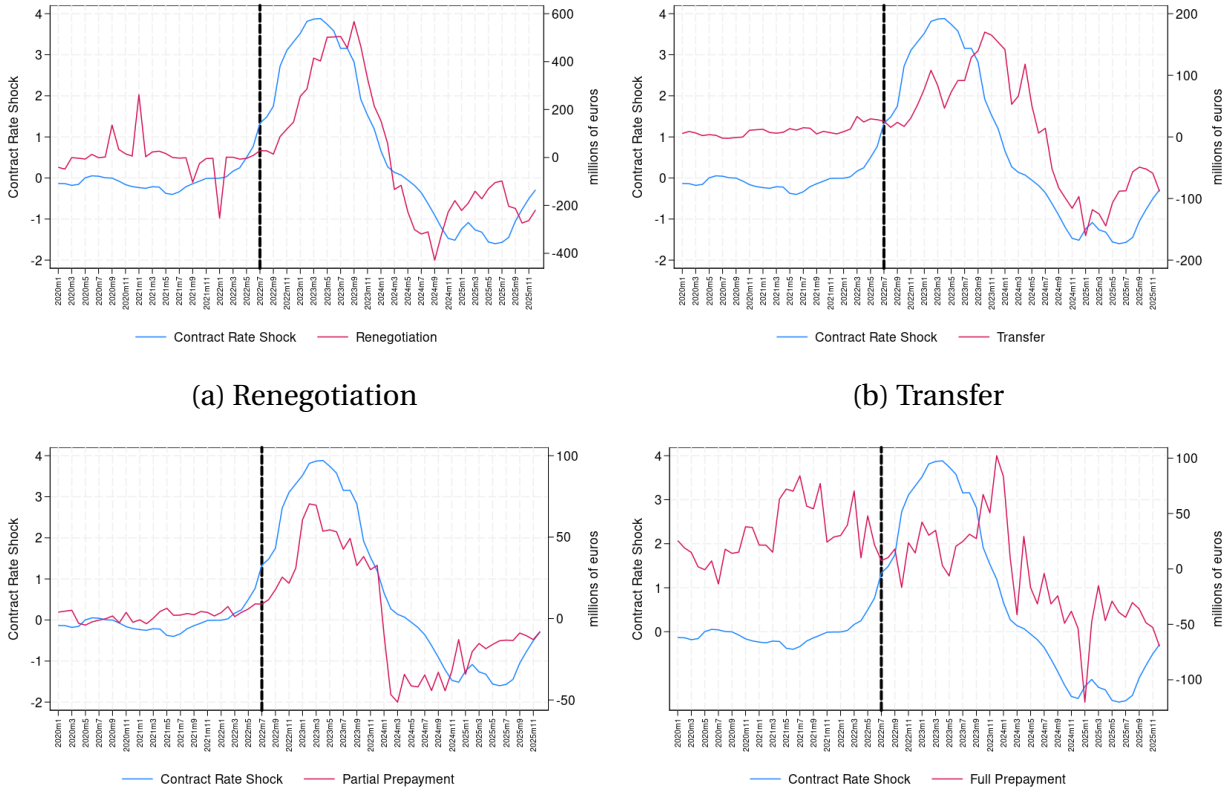
This table shows the frequency distribution of interest rate regime changes — fixed-rate mortgage, mixed-rate mortgage, and adjustable-rate mortgage (ARM) — around the time of the mortgage renegotiation and transfer. The sample consists of 12-month resettable ARM originated after 2007 and issued for an owner-occupied property in Portugal with a transfer to a new lender between January 2021 and December 2023.

Table IA.3: Household Responses Around Mortgage Rate Resets: ARMs with 6-month Rate Resets

| | (1) Renegotiation | (2) Transfer | (3) Partial Repayment | (4) Full Repayment | (5) Any Action |
|---|---|---|---|---|---|
| $Immediate\ Pre-reset$ | 0.000 | -0.004 | -0.030 | -0.041*** | -0.075*** |
| | (0.001) | (0.004) | (0.022) | (0.015) | (0.022) |
| $Post-reset$ | 0.014*** | -0.002 | 0.006 | -0.007 | 0.012 |
| | (0.003) | (0.003) | (0.016) | (0.007) | (0.017) |
| $Tightening$ | -0.004 | -0.009* | 0.047 | -0.031** | 0.001 |
| | (0.005) | (0.005) | (0.042) | (0.013) | (0.035) |
| $Immediate\ Pre-reset \times Tightening$ | 0.001 | -0.003 | 0.059* | 0.027 | 0.084** |
| | (0.006) | (0.005) | (0.030) | (0.019) | (0.036) |
| $Post-reset \times Tightening$ | 0.085*** | 0.008* | 0.058** | 0.040*** | 0.191*** |
| | (0.013) | (0.004) | (0.022) | (0.013) | (0.036) |
| Observations | 14,570,540 | 14,570,540 | 14,570,540 | 14,570,540 | 14,570,540 |
| Adjusted $R^2$ | 0.001 | 0.002 | 0.003 | 0.002 | 0.004 |

This table reports event-time regression estimates based on equation (2) for ARMs with 6-month Rate Resets. 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 6-month resettable ARMs originated after 2007 and 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.1: Interest Rate Shocks and Household Responses




(a) Renegotiation

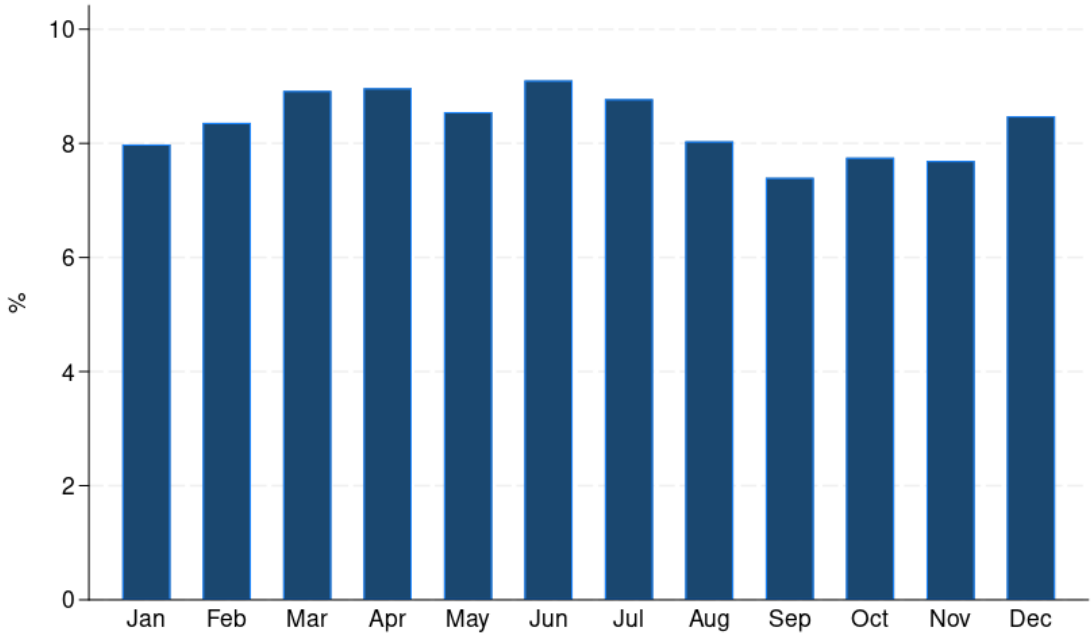
(b) Transfer

(c) Partial Prepayment

(d) Full Prepayment

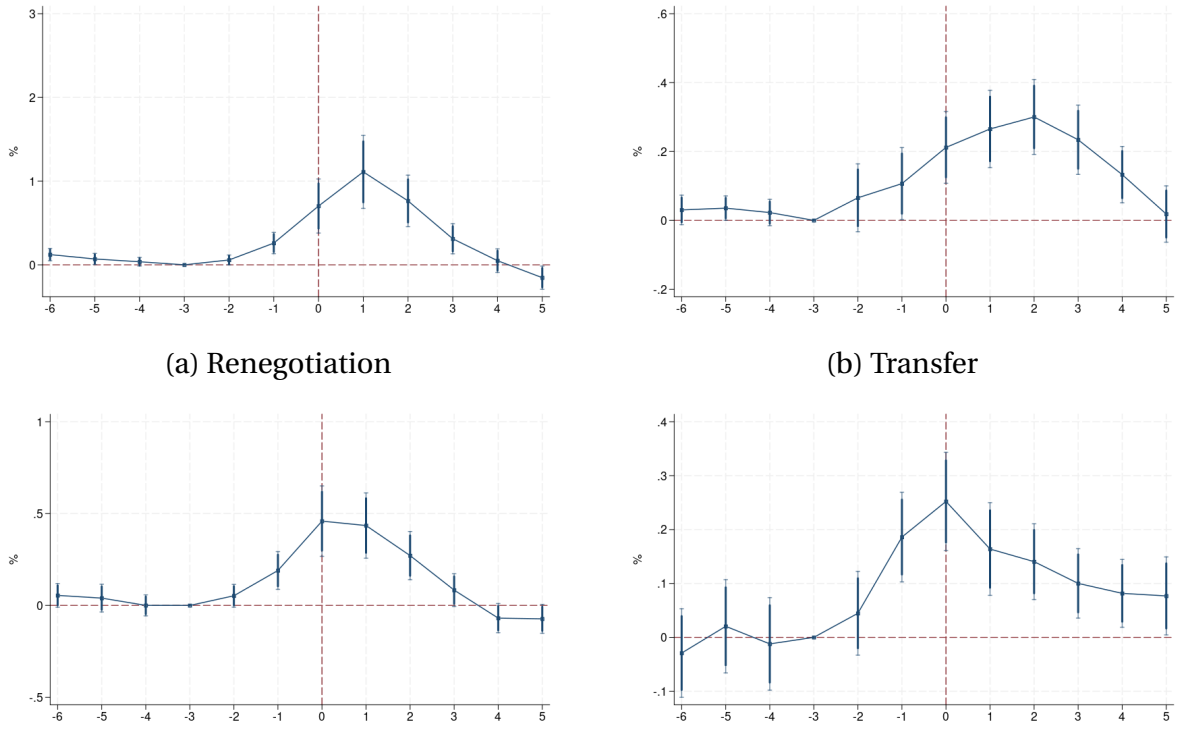
This figure shows the mean change in the mortgage rate for 12-month resettable ARMs that reset in each calendar month over the period between January 2020 and December 2025. It also shows the yearly change in the total amount (in millions of euro) of mortgage loans that undergo each action: renegotiation with the current bank (Panel A), transfer to another bank (Panel B), partial prepayment (Panel C), and full prepayment (Panel D). 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.

Figure IA.2: 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.3: Household Responses Around Mortgage Rate Resets: Alternative Tightening Cycle




(a) Renegotiation

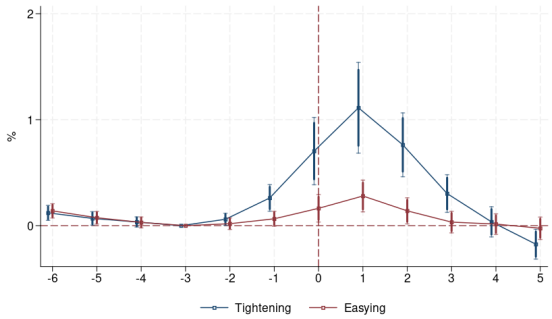
(b) Transfer

(c) Partial Prepayment

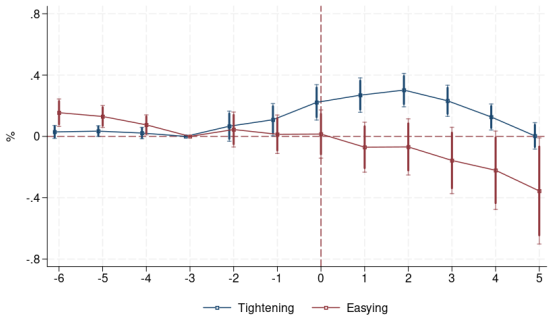
(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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.

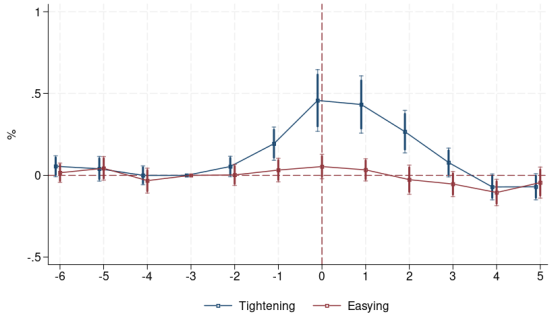
Figure IA.4: Household Responses Around Mortgage Rate Resets: Tightening versus Easing Cycles



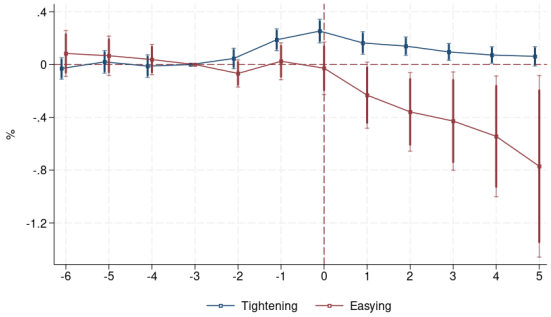

(a) Renegotiation




(b) Transfer




(c) Partial Prepayment



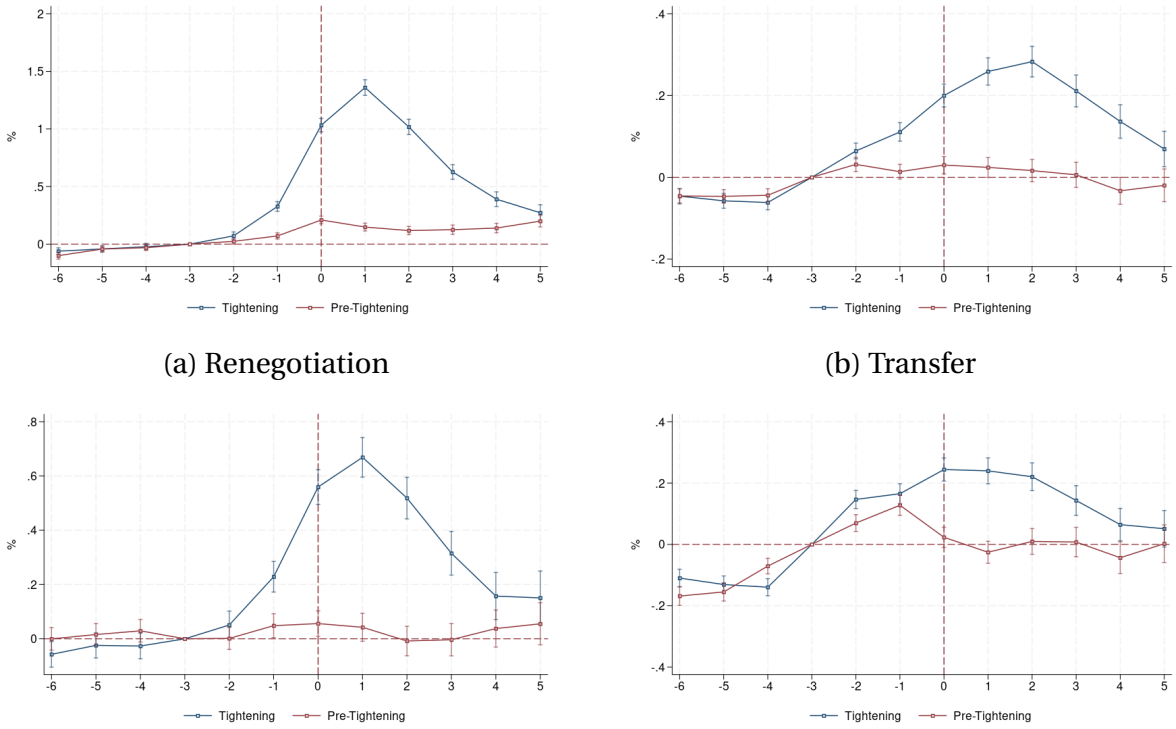

(d) Full Prepayment

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

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

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 June 2025, 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 12-month resettable ARMs originated after 2007 and issued for owner-occupied properties in Portugal, with at least one mortgage rate reset occurring between January 2021 and December 2025. Standard errors are clustered at the municipality and month-year levels.

Figure IA.5: Household Responses Around Mortgage Rate Resets: Staggered Difference-in-Differences




(a) Renegotiation

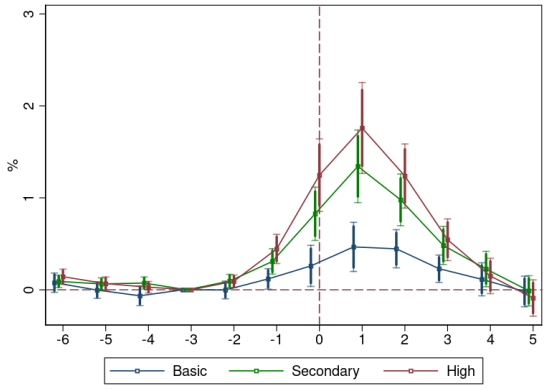
(b) Transfer

(c) Partial Prepayment

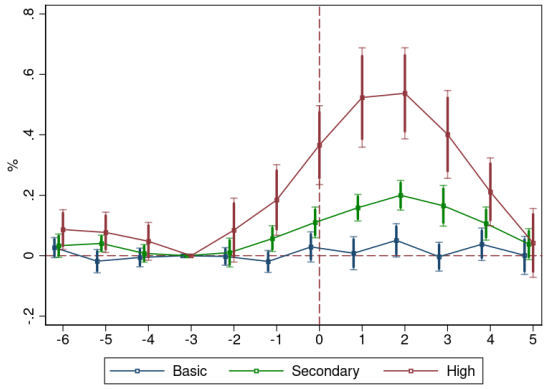
(d) Full Prepayment

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)), a dummy variable for transfer (Panels (b)), a dummy variable for partial prepayment (Panel (c)), a dummy variable for full prepayment (Panel (d)) or a dummy variable for any action (Panels (e)). 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 12-month resettable ARMs originated after 2007 and 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.

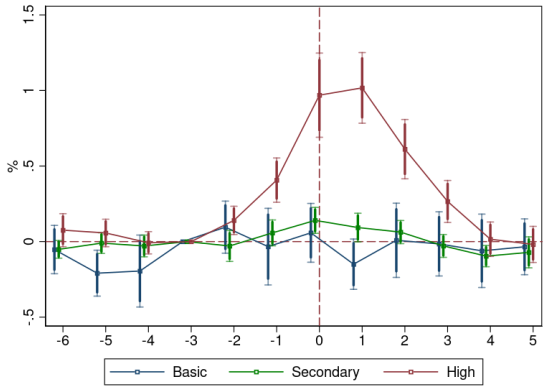
Figure IA.6: Household Responses Around Mortgage Rate Resets: Anticipation Effects and Education



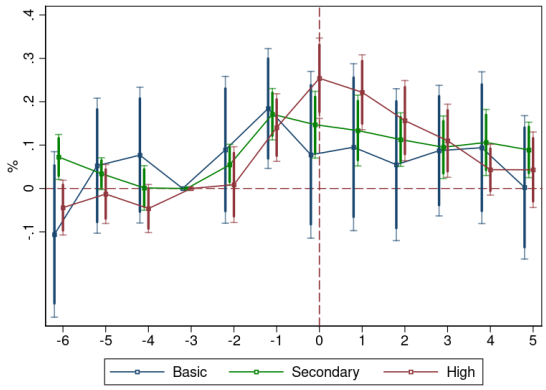

(a) Renegotiation




(b) Transfer



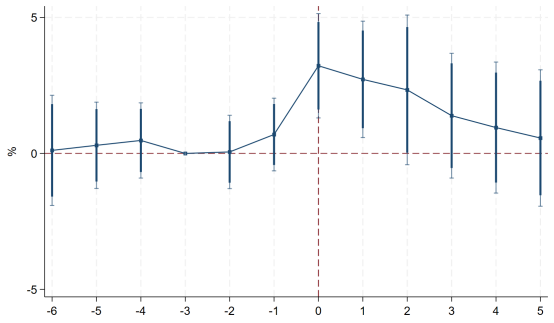

(c) Partial Prepayment



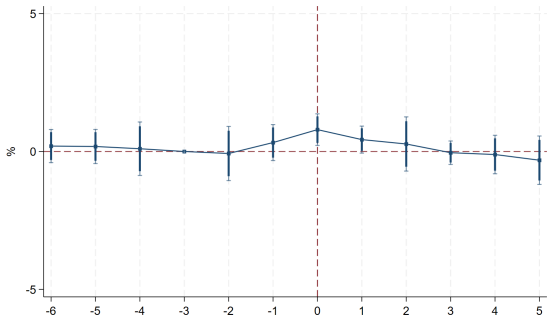

(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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.

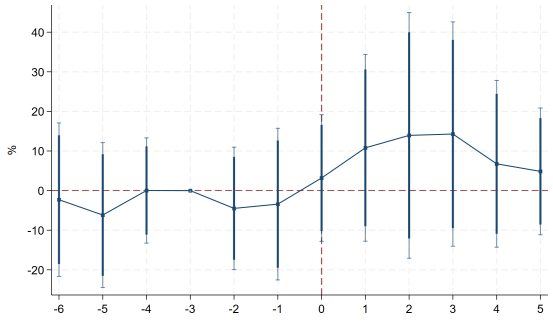
Figure IA.7: Short-Term Consumer Credit Around Mortgage Rate Resets: Inactive Households




(a) Credit-Card Drawndown



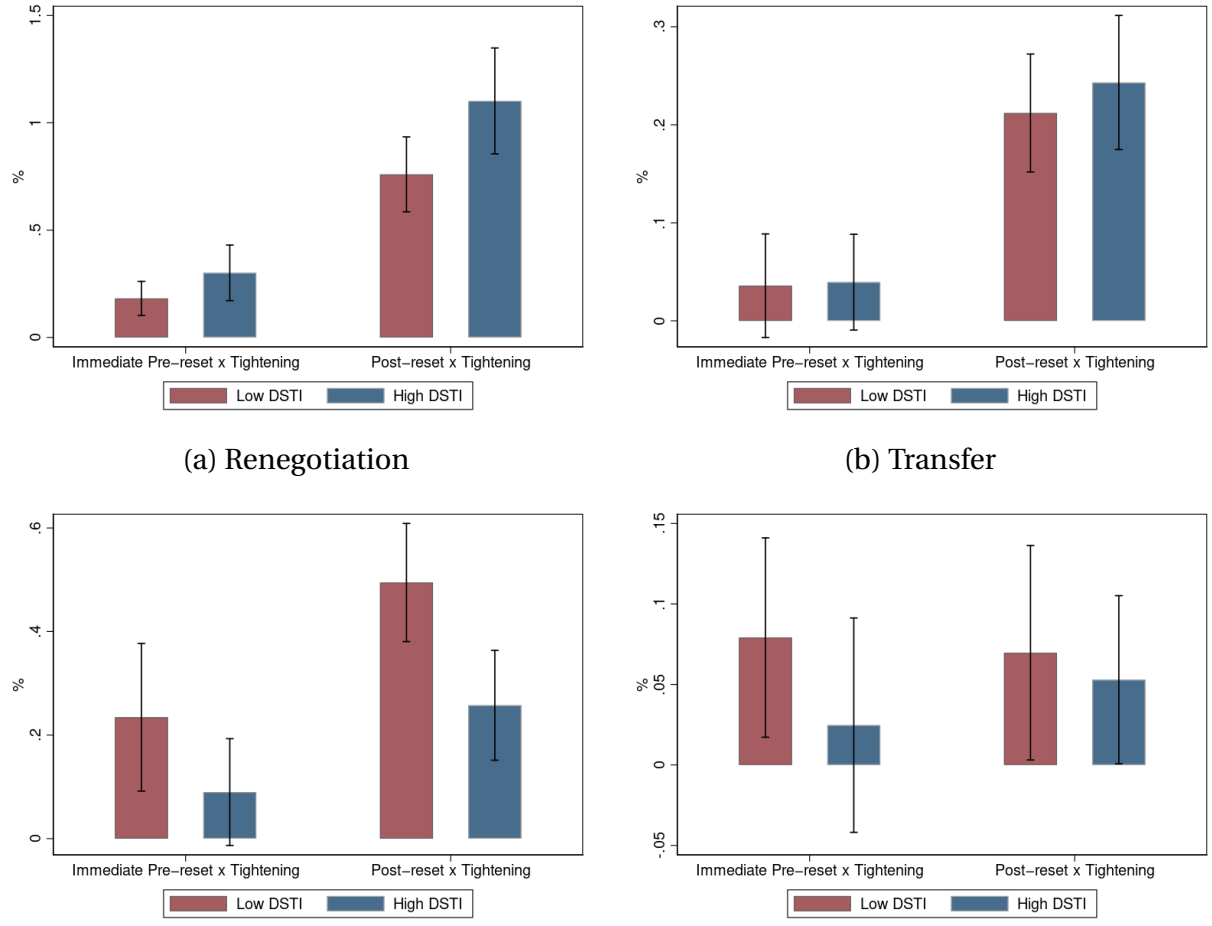

(b) Credit-Card Limit




(c) Overdrafts

This figure presents point estimates and 90% and 95% confidence intervals for the $\beta$ coefficients from a Poisson pseudo-likelihood regression of short-term consumer credit usage, estimated for the subsample of inactive households as specified in equation (1). The dependent variable corresponds to the amount of credit card drawdown (Panel (a)), the amount of credit card limit (Panel (b)), and the 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 12-month resettable ARMs originated after 2007 and 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

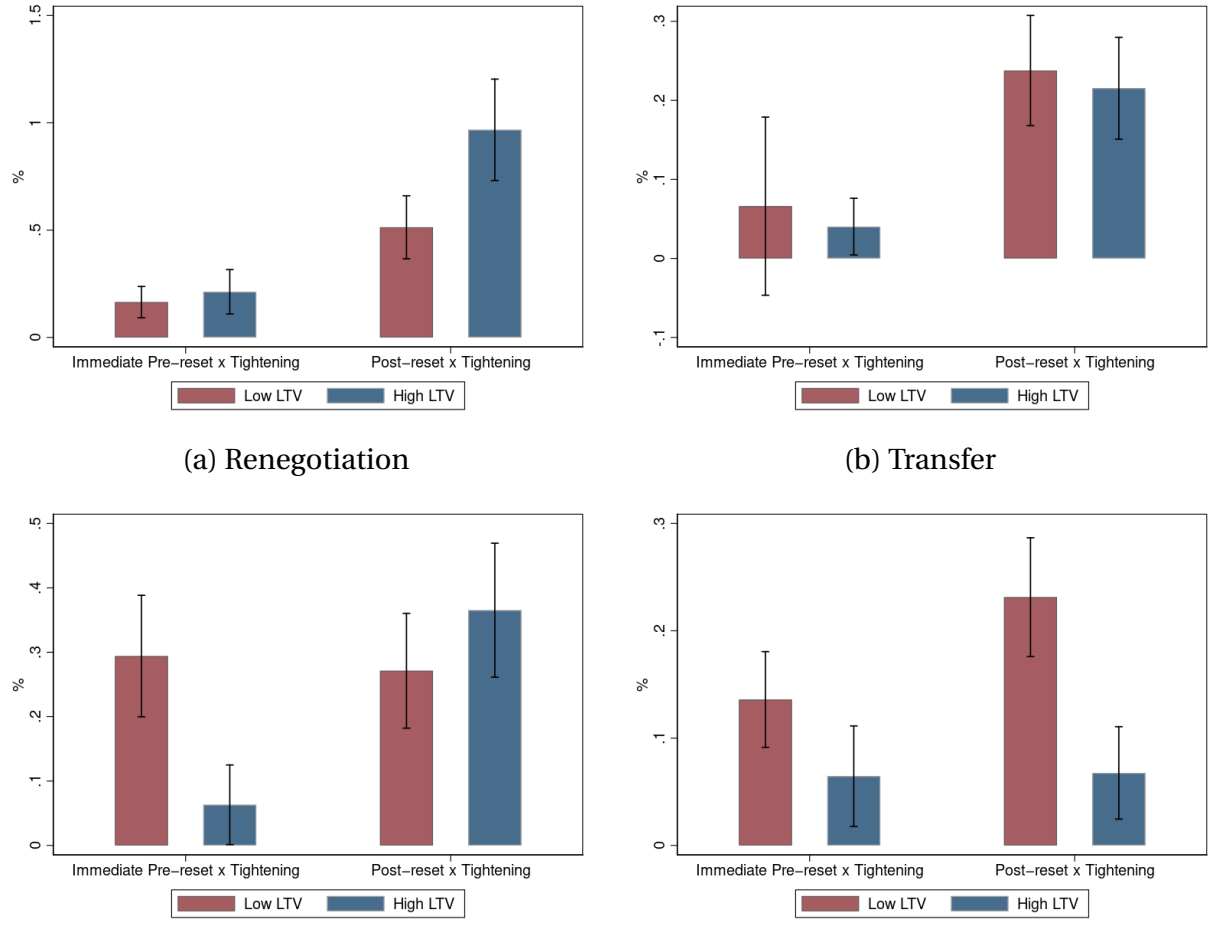
(b) Transfer

(c) Partial Prepayment

(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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 12-month resettable ARMs originated after 2007 and 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: Household Responses Around Mortgage Rate Resets: The Role of Loan-to-Value




(a) Renegotiation

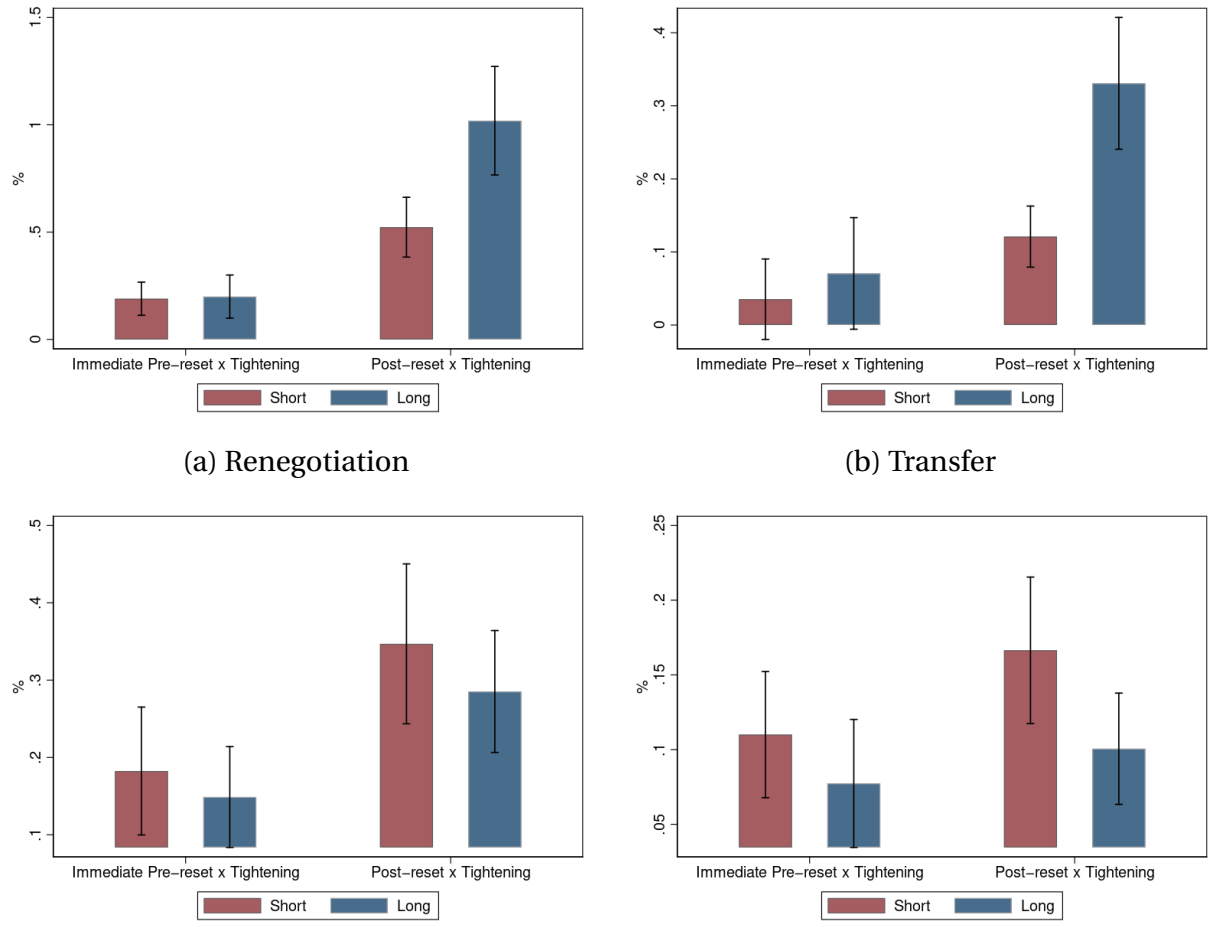
(b) Transfer

(c) Partial Prepayment

(d) Full Prepayment

This figure reports point estimates and 90% and 95% confidence intervals for the $\beta_t$ 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) Loan-to-Value (LTV) 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 12-month resettable ARMs originated after 2007 and 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.10: Interest Rate Shocks and Household Responses: Residual Maturity




(a) Renegotiation

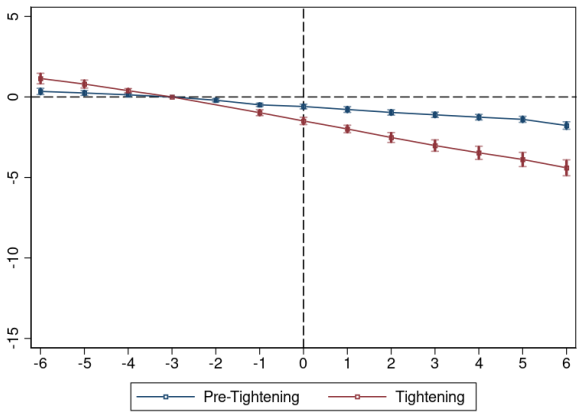
(b) Transfer

(c) Partial Prepayment

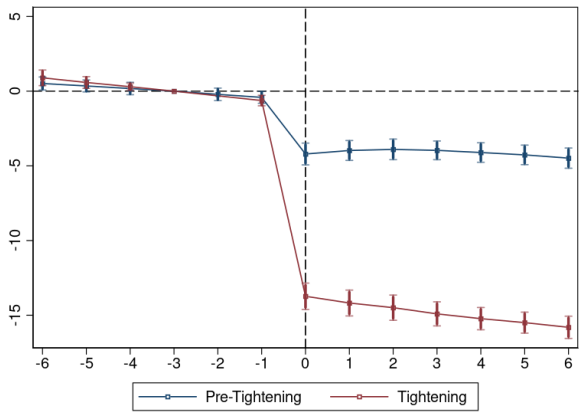
(d) Full Prepayment

This figure presents the point estimates along with the 90% and 95% confidence intervals of $\beta_1$ and $\beta_2$ from equation (2), estimated separately for households with below-median (short) and above-median (long) mortgage residual maturity. 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 12-month resettable ARMs originated after 2007 and 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.

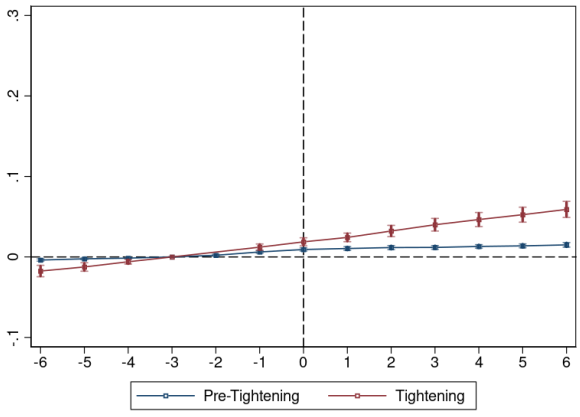
Figure IA.11: Change in LTV and Home Value around Renegotiation and Transfer



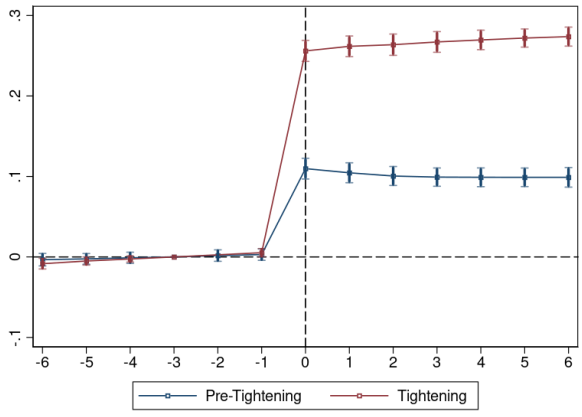

(a) LTV: Renegotiation




(b) LTV: Transfer



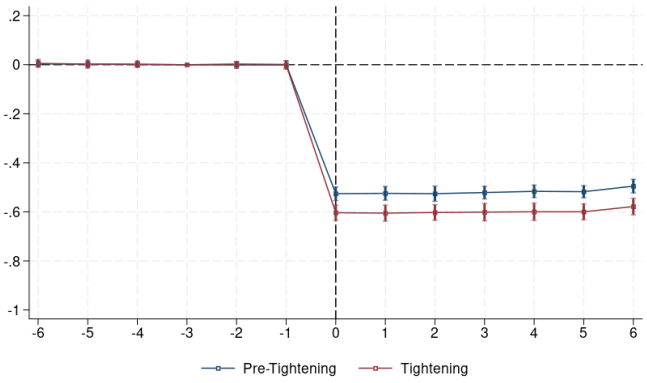

(c) Home Value: Renegotiation



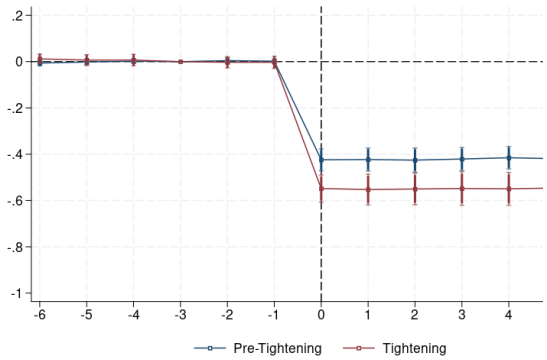

(d) Home Value: Transfer

This figure presents the point estimates along with the 90% and 95% confidence intervals of $\gamma_t$ 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 loan-to-value ratio (LTV). The dependent variable in Panels (c) and (d) is the home value. All regressions control for loan fixed effects. The sample consists of 12-month resettable ARM originated after 2007 and 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.

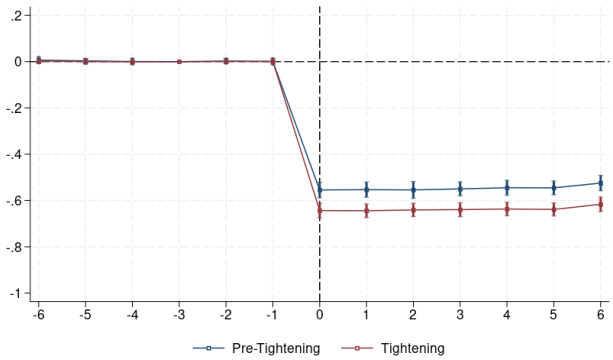
Figure IA.12: Change in Spread around Mortgage Re-Entry




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



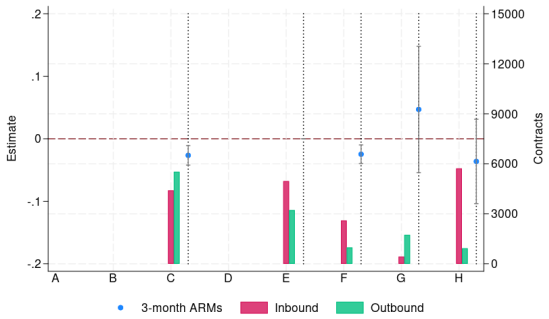

(b) Sell-and-Buy (Small Mortgages)



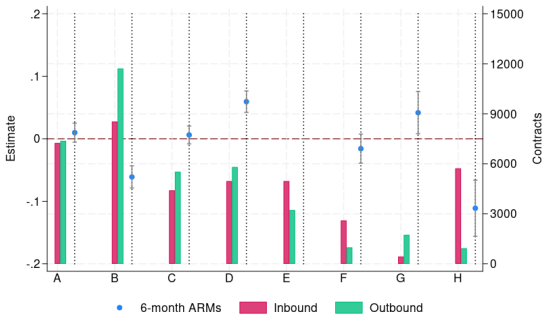

(c) Sell-and-Buy (Large Mortgages)

This figure presents the point estimates along with the 90% and 95% confidence intervals of $\gamma_t$ in equation (3) based on the subsample of mortgages that were fully prepaid and later re-entered. The dependent variable is the mortgage spread. All regressions control for loan fixed effects. The sample consists of 12-month resettable ARM originated after 2007 and 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.

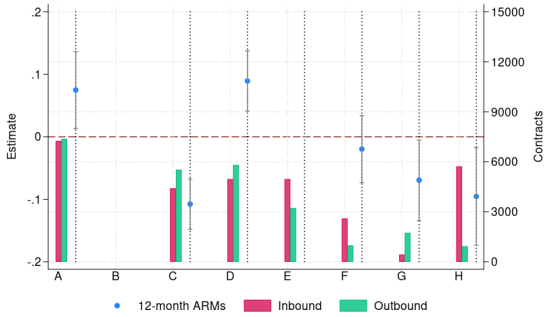
Figure IA.13: Winners and Losers: Mortgage Transfer Flows and Offered Rate



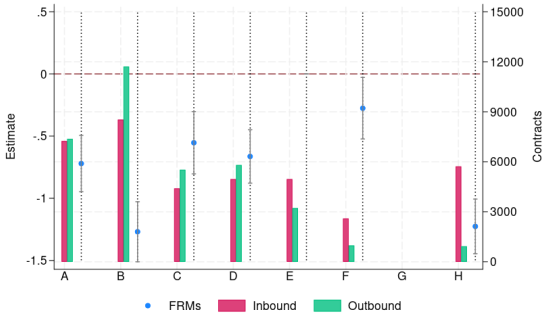

(a) Rates Offered on 3-Month ARMs



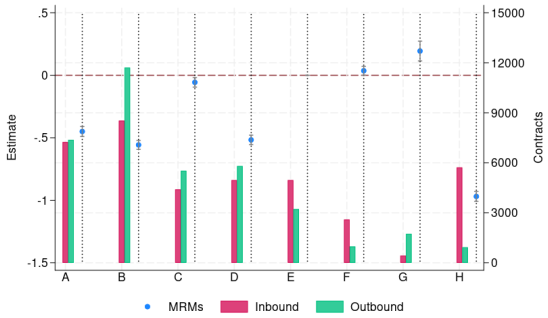

(b) Rates Offered on 6-Month ARMs




(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.