The ARM Share

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Abstract

Since the Global Financial Crisis, the share of new mortgages in the US that are Adjustable-Rate Mortgages (ARMs) has been low (10% by dollar value). Prior to this, the ARM share was often much higher, repeatedly reaching 50% or more. Although it is often assumed that fluctuations in the ARMs share are driven by changes in borrowers' demand, we show that they are in fact primarily due to lenders' credit supply, since the ARMs share is strongly negatively related to ARMs' price (their interest spreads). We argue that the supply of ARMs is determined by the relative availability of high-beta (floating-rate) versus low-beta (fixed-rate) funding to the financial sector from bank deposits and short-term financial debt ("shadow deposits"). When high-beta funding is plentiful (scarce), banks increase (decrease) ARMs loans to match their beta, and the ARMs spread contracts (widens). The main driver of variation in the beta of bank funding is the deposits channel of monetary policy, which controls the relative supply of low-beta savings deposits versus high-beta time deposits. We further show that the collapse in the market for shadow deposits in 2007 permanently contracted the supply of high-beta funding, leading to the sharp post-2007 decline in ARMs. We document these mechanisms at the aggregate level, in the cross section of U.S. banks and individual loans, and in European data.

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1 Introduction

The choice between an adjustable-rate mortgage (ARM) and a fixed-rate mortgage (FRM) is a first-order feature of the U.S. mortgage market. The ARM share of new originations has varied dramatically over time, ranging from about 10% to as much as 80%. Because the mortgage is the largest liability of most households, this choice determines how much interest rate risk households bear (Campbell and Cocco, 2003), and it shapes how monetary policy is transmitted to household balance sheets: when mortgages are adjustable, changes in the policy rate pass through directly to the payments of existing borrowers, whereas when mortgages are fixed-rate, pass-through operates only slowly through refinancing and new originations. Understanding what drives the ARM share is therefore central to understanding the impact of monetary policy on households.

The ARM share fell dramatically after 2008 and has never recovered. Before the Global Financial Crisis (GFC) the ARM share was often close to 50% of new originations, and in the 1980s it reached as high as 80%. Since the GFC it has averaged roughly 10% by dollar value, with only a modest comeback since interest rates rose in 2022. The existing literature focuses mainly on explanations driven by households' *demand* for ARMs: households' risk preferences and exposures (Campbell and Cocco, 2003), or mortgage timing based on rule-of-thumb comparisons of long-term and short-term rates (Koijen et al., 2009). Under these explanations, the post-GFC collapse in the ARM share reflects a persistent fall in households' demand for ARMs. Demand-driven explanations carry a sharp implication for prices: shifts in demand move prices and quantities in the *same* direction. If households' demand for ARMs falls, the quantity of ARMs falls and, as lenders compete for the remaining borrowers, the interest spread they charge on ARMs falls with it. Changes in the ARM share and changes in ARM spreads should therefore be *positively* correlated.

We find the opposite. Using loan-level data on U.S. mortgage originations from 1985 to 2023, we measure the ARM spread as the initial ARM rate minus the maturity-matched Treasury rate. The ARM spread and the ARM share move strongly in *opposite* directions: the correlation is -0.65 in the raw data, and -0.73 when we residualize spreads with respect to loan and borrower characteristics to remove composition effects. Similar results hold for the ARM margin, the spread over the reference rate that the borrower pays after the initial fixed-rate period. When the ARM share is high, ARMs are cheap, and when the ARM share is low, ARMs are expensive. The same pattern extends to the price of ARMs relative to FRMs. The ARM share is high precisely when lenders offer ARMs cheaply relative to FRMs. Since prices and quantities move in opposite directions, fluctuations in the ARM share are driven mainly by net shifts in the *supply* of ARMs, not by shifts in household demand. The

central question of this paper is therefore: what drives the supply of ARMs?

Our answer is that the supply of ARMs is driven by the relative availability of floating- versus fixed-rate funding to the financial sector. The starting point is that a mortgage lender bears interest rate risk whenever the interest rate sensitivity of its loan cash flows does not match that of its funding costs (Drechsler et al., 2021, 2024). An ARM generates cash flows that are sensitive to changes in short-term interest rates, so it is naturally funded with liabilities whose cost also rises and falls with short-term rates. FRM, by contrast, produces fixed interest income, so it is funded with liabilities whose cost is insensitive to short-term rates. A lender that mismatches the two sides, for example by funding fixed-rate mortgages with floating-rate liabilities, exposes itself to interest rate risk, as the savings and loan crisis made clear. The mix of mortgages that lenders supply, therefore, depends on the mix of funding available to them. When floating-rate funding becomes more abundant relative to fixed-rate funding, lenders expand the supply of ARMs, lowering ARM spreads and raising the ARM share. There are two main sources of floating- versus fixed-rate funding to the financial sector, and hence two main drivers of ARM supply: (1) the composition of bank deposits and (2) conditions in the market for short-term financial debt, which we call "shadow deposits."

The deposit mechanism works as follows. Banks match the interest rate sensitivities (betas) of the cash flows of their assets and liabilities (Drechsler et al., 2021). On the liability side, deposits differ sharply in their betas: time deposits (CDs) have high betas, i.e., their rates closely track the Fed funds rate, whereas savings and checking deposits have low betas. On the asset side, ARMs have high betas whereas FRMs have low betas. Beta matching therefore leads banks to fund ARMs with time deposits and FRMs with savings deposits. The composition of deposits, in turn, is driven by the short rate through the deposits channel of monetary policy (Drechsler et al., 2017): when the Fed funds rate rises, banks widen the spreads they charge on low-beta savings deposits, and depositors substitute toward high-beta time deposits. The resulting shift in banks' funding toward high-beta liabilities induces banks to raise the supply of high-beta assets, such as ARMs, and to cut the supply of low-beta assets, such as FRMs. The deposits channel thus generates a positive relationship between the short rate and the ARM share, and a negative relationship between the short rate and the ARM spread.

The aggregate data line up strongly with this mechanism. The one-year Treasury rate is strongly negatively correlated with the ARM spread and strongly positively correlated with the ARM share. When the Fed funds rate rises, time deposit rates increase far more than savings deposit rates, and deposit quantities respond exactly as the deposits channel predicts: time deposit growth is strongly positively correlated with the short rate, while

savings deposit growth is strongly negatively correlated with it. Deposit flows in turn line up with the price and quantity of ARMs: time deposit growth predicts a low ARM spread and a high ARM share, while savings deposit growth predicts the opposite.

A natural question is why banks do not simply obtain more floating-rate funding synthetically, by paying floating and receiving fixed in the interest rate swap market. They can, and do, but doing so has a price: the (negative of the) swap spread, the difference between the fixed swap rate and the maturity-matched Treasury yield. We show that the swap spread moves inversely with the ARM spread, so that the swap market offers no "arbitrage" of the ARM spread: when floating-rate funding is scarce, ARM spreads are high and swap spreads are low (more negative), meaning that swapping into floating-rate funding is expensive precisely when it is most needed.

We document the deposit mechanism not only in the aggregate time series but also in the cross-section of banks and of individual loans. In the cross-section of U.S. banks, the share of ARMs in a bank's mortgage portfolio is strongly positively related to the share of time deposits in its deposits, after absorbing time fixed effects. This matching reflects beta matching: banks with high time deposit shares have high deposit expense betas, banks with high ARM shares have high mortgage income betas, and expense and income betas line up tightly across banks, consistent with Drechsler et al. (2021) and Supera (2021). Using local projections, we show that a monetary policy tightening raises time deposits and lowers savings deposits, and simultaneously raises banks' ARM holdings and lowers their FRM holdings. Moreover, the banks that gain more time deposits when the Fed funds rate rises are precisely the banks that expand ARMs by more, and the banks that lose more savings deposits cut FRMs by more.

The same mechanism operates also in Europe. When the ECB tightens, euro-area depositors substitute from savings deposits toward time deposits. European banks with higher liability expense rate betas hold assets with higher income rate betas. In addition, ARM origination co-moves strongly with new time deposits over time, and countries with stronger growth in time deposits experience stronger growth in ARM lending. These results show that the matching mechanism is not specific to U.S. mortgage market.

To identify the effect of deposit composition on ARM supply at the micro level, we use loan-level data on mortgages retained on banks' balance sheets from Corelogic. The identification challenge is that deposit flows could respond to local ARM demand. We therefore compare mortgages originated by different banks in the same zip code in the same quarter, so that the comparison holds local mortgage demand fixed. We find that banks receiving time deposit inflows originate more ARMs relative to FRMs, at lower initial spreads and at lower margins, than banks lending in the same zip code at the same time. We also

show that savings deposit inflows have precisely the opposite effects. These results establish that deposit composition shifts the supply of ARMs at the individual bank level.

The second driver of ARM supply, shadow deposits, explains why the ARM share collapsed around the GFC and has remained low since. Short-term financial debt, chiefly financial commercial paper and asset-backed commercial paper, is the market analogue of high-beta (time) deposits. The collapse of this market began with the run on asset-backed commercial paper on August 7, 2007, more than a year before the Lehman bankruptcy. From that date, the ARM share fell sharply and the ARM spread rose by more than 100 basis points. A second money market panic in October 2008, this time in commercial paper, amplified the contraction. At the same time, swapping into floating-rate funding also became expensive, as swap spreads fell and turned negative, where they have remained. With shadow deposits impaired and the swap route costly, floating-rate funding stayed scarce, and the supply of ARMs never recovered.

We also address the leading alternative explanation for the post-GFC decline in the ARM share: regulation. Post-crisis capital regulation cannot explain it, because capital rules do not differentiate between ARMs and FRMs. The main ARM-specific tightening came through underwriting rules, according to which ARM borrowers must qualify at the fully indexed rate rather than the initial teaser rate. This can help explain the decline in ARM lending to subprime borrowers, but subprime borrowers accounted for a relatively small share of ARMs (less than 15%) even at their peak, and exotic ARMs (balloon, two-step, and graduated-payment ARMs) peaked at just 7%. Moreover, ARM shares co-move strongly across the entire FICO distribution, and the decline in the ARM share occurred across the entire FICO distribution.

Our findings have several implications. First, they provide a new answer to the question of what determines the FRM–ARM mix, a question usually framed entirely in terms of household choice. We show that the mix is set to a large extent by the funding structure of the financial sector: households can only choose from the menu of mortgage rates that lenders supply, and that menu moves with the availability of floating-rate funding. Second, the results extend the deposits channel of monetary policy to the composition of credit: monetary policy changes not only how much banks lend but also the type of loans they make, reallocating interest rate risk between households and the financial sector. Third, the results offer a supply-side explanation for the post-GFC disappearance of the ARM, which was driven by the collapse of time and shadow deposits and the associated rise in the cost of floating-rate funding.

2 Related Literature

Our paper relates to three strands of literature. The first studies the determinants of the mortgage choice between FRMs and ARMs. Most of this literature focuses on demand-side explanations, which attribute the FRM–ARM mix to households' preferences and expectations. Campbell and Cocco (2003) show that the choice trades off the income risk of an ARM against the wealth risk of an FRM, and that the attractiveness of each contract varies with household characteristics. Koijen et al. (2009) argue that households time the mortgage market using a rule-of-thumb bond risk premium, the difference between the long-term rate and a moving average of short rates. Badarinza et al. (2018) document international evidence on the sensitivity of mortgage choice to current and expected rate differentials. A smaller supply-side literature documents that lender funding conditions matter: Moench et al. (2010) attribute part of the low post-crisis ARM share to the pricing of securitization; Fuster and Vickery (2015) show that the FRM share falls when securitization is disrupted; Foà et al. (2019) and Guiso et al. (2022) show that Italian banks steer households across mortgage types using non-price features when their funding conditions change. Relative to this literature, our contribution is to show that the ARM share is driven primarily by supply, as prices and quantities move in opposite directions, and to identify the availability of floating-rate funding, arising from deposit composition and shadow deposits, as the factor driving ARM supply over the past four decades.

The second strand studies monetary policy and the mortgage market, including Fuster and Willen (2010), Bhutta and Keys (2016), Di Maggio et al. (2017), Agarwal et al. (2023), Abel and Fuster (2021), Berger et al. (2021), Drechsler et al. (2022), Eichenbaum et al. (2022), and Drechsler et al. (2024). These papers examine how monetary policy affects the price and quantity of mortgage credit, and how it passes through to households through refinancing, rate resets, and home equity extraction. We show that monetary policy shapes the contract structure of the mortgage market itself: by changing the composition of bank deposits, it changes the relative supply of ARMs and FRMs, and hence the allocation of interest rate risk between households and intermediaries.

The third strand studies bank risk management and the structure of bank balance sheets, including Diamond and Dybvig (1983), Calomiris and Kahn (1991), Allen and Gale (1994), Diamond and Rajan (2001), Acharya and Naqvi (2012), Hanson et al. (2015), Gomez et al. (2021), Drechsler et al. (2017), Drechsler et al. (2021), and Supera (2021). Drechsler et al. (2021) show that banks match the interest rate sensitivities of their interest income and expense, so that the deposit franchise hedges the interest rate risk of long-term fixed-rate lending. Supera (2021) shows that banks fund high-beta assets, such as commercial and

industrial loans, with high-beta time deposits. We build on this matching logic and show that it extends to the composition of mortgage lending: the FRM–ARM margin is the asset-side counterpart of the savings–time deposits margin on the liability side.

3 Data

Our analysis combines bank-level and loan-level data.

Call Reports. We obtain bank balance sheet and income statement data from the quarterly Reports of Condition and Income (Call Reports) for U.S. commercial banks. The Call Reports provide bank-level quantities of adjustable- and fixed-rate residential mortgages, the composition of deposits across time, savings, and checking deposits, and interest expenses on the different deposit categories as well as interest income on mortgages. The income statement data allow us to estimate deposit expense betas and mortgage income betas at the bank level, which we use to test the beta-matching mechanism.

CoreLogic (LLMA and Deeds). We obtain loan-level mortgage data from CoreLogic's Loan-Level Market Analytics (LLMA) and Deeds databases, covering 1985 to 2023. For each loan we observe loan characteristics: mortgage type (ARM versus FRM), origination amount, maturity, property value, loan-to-value ratio (LTV), the initial fixed-rate period, the initial fixed interest rate, the margin over the index, and points. We observe borrower characteristics, including the FICO score and property zip code, and lender characteristics, including the originator name and whether the loan is retained on the lender's balance sheet or securitized (from loan performance data). The ability to distinguish retained from securitized loans is central to our loan-level analysis, which focuses on mortgages held on banks' balance sheets. Our main loan-level sample contains purchase and refinance mortgages retained by banks.

ECB Balance Sheet Items (BSI). For the euro area, we use the ECB's Balance Sheet Items statistics, which provide harmonized country-level data on bank balance sheets. From the BSI we obtain the composition of deposits, distinguishing time deposits (deposits with agreed maturity) from savings and checking deposits (deposits redeemable at notice and overnight deposits), as well as the volumes of adjustable- and fixed-rate mortgage lending, for both outstanding amounts and new business. These data underlie the euro-area time series and the cross-country analysis in Section 8.

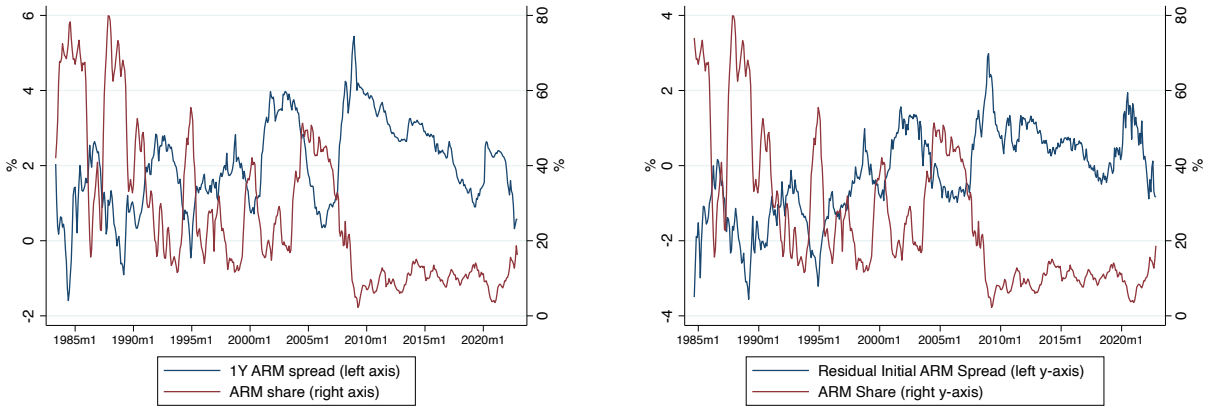
Bank-level EBA supervisory data. We obtain bank-level balance sheet and income statement data for European banks from supervisory reporting collected by the European Banking Authority. These data allow us to estimate the rate betas of European banks' liabilities and the income rate betas of their assets.

4 The Supply of ARM: Aggregate Evidence

In this section we establish the paper's first main result: fluctuations in the ARM share are driven by net shifts in the supply of ARMs. The logic is the classic price–quantity identification argument. Shifts in household demand move the price and quantity of ARMs in the same direction, whereas shifts in lender supply move them in opposite directions. We therefore examine the joint behavior of the ARM share and ARM interest spreads.

4.1 The ARM Spread and the ARM Share

We measure the price of an ARM by its interest spread: the initial ARM rate minus the maturity-matched Treasury rate. Matching by maturity ensures that the spread isolates the pricing of the mortgage itself rather than the level or slope of the yield curve. Panel (a) of Figure 1 plots the ARM spread for loans with initial fixation period of 1 year against the ARM share of new originations. The two series move strongly in opposite directions and the correlation is -0.65. Periods when the ARM share is high—the late 1980s, the mid-1990s, the mid-2000s—are periods when ARM spreads are low, and the post-GFC period of a low ARM share is a period of persistently high ARM spreads. The negative co-movement implies that fluctuations in the ARM share are driven by net shifts in the supply of ARM credit. If the ARM share were driven by household demand, the opposite pattern would obtain: strong demand would push the ARM share and ARM spreads up together.



(a) ARM spread and ARM share

(b) Residual ARM spread and ARM share

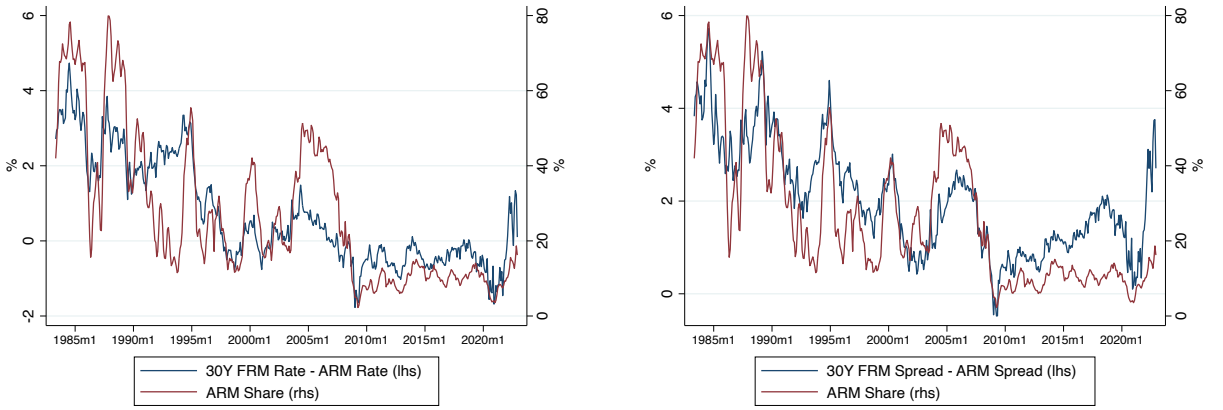
Figure 1: The ARM spread and the ARM share. Panel (a) plots the ARM spread for ARMs with initial fixation period of 1 year against the ARM share of new mortgage originations (dollar weighted). The 1-year ARM spread is the initial ARM rate minus the 1-year Treasury rate. Panel (b) considers all initial fixation periods and plots the residual ARM spread—the ARM spread (initial ARM rate minus the maturity-matched Treasury rate) controlling for loan characteristics—against the ARM share, averaging residuals across all initial fixed-rate periods.

A potential concern with the raw spread is composition: the mix of loan and borrower characteristics changes over time, and with it the average spread. To isolate true price movements, we construct a *residual* ARM spread by regressing loan-level spreads on loan and borrower characteristics—the initial fixed-rate period, product type, FICO score, loan-to-value ratio (LTV), and related controls—and averaging the residuals by month. Panel (b) of Figure 1 plots the residual ARM spread for all initial rate fixation periods against the ARM share. Removing composition effects *strengthens* the relationship: the correlation rises to -0.73. The supply interpretation is thus not an artifact of shifts in the composition of loans or borrowers. In the Appendix we show that the residual spread co-moves closely across FICO buckets (Figure A18), so the movements we pick up are market-wide price changes rather than changes in the pricing of particular borrower segments.

4.2 The Price of ARMs Relative to FRMs

The choice margin facing a household is between an ARM and an FRM, so an important factor is also a relative price between the two options. Figure 2 examines the relative price of the two contracts. The left panel plots the difference between the 30-year FRM rate and the initial ARM rate against the ARM share; the correlation is 0.79. The right panel compares spreads rather than rates: the 30-year FRM spread (the 30-year FRM rate minus the 10-year Treasury yield) minus the ARM spread, plotted against the ARM share; the correlation is

0.78. Both panels deliver the same message: the ARM share is high exactly when ARMs are cheap relative to FRMs. Together with Figure 1, this establishes that movements in the ARM share trace out shifts in the relative supply of the two contracts along a demand curve, rather than shifts in demand.



(a) (FRM rate − ARM rate) vs. ARM share

(b) (FRM spread − ARM spread) vs. ARM share

Figure 2: The ARM rate versus the FRM rate and the ARM share. Panel (a) plots the difference between the 30-year FRM rate and the initial ARM rate against the ARM share. Panel (b) plots the difference between the 30-year FRM spread and the ARM spread against the ARM share, where the 30-year FRM spread is the 30-year FRM rate minus the 10-year Treasury rate.

4.3 The Initial Spread and the Margin

An ARM has two interest rates. The first is the *initial fixed rate*, paid during the initial fixed-rate period (one, three, five, seven, or ten years); the initial spread is this rate minus the maturity-matched Treasury yield. The second is the *margin*: after the initial period, and for the remaining life of the loan, the borrower pays the margin plus the value of the ARM index (SOFR, Libor, or the one-year Treasury rate). If movements in ARM spreads reflect the shadow value of floating-rate funding to lenders, they should show up in both prices. Figure 3 shows that they do: the residual initial spread and the residual margin co-move strongly over time, with a correlation of 0.68. The initial spread is the more volatile of the two, consistent with the initial rate being the price that clears the origination market period by period, while the margin prices the loan's floating-rate cash flows over the long run. The fact that both prices of the ARM contract move together confirms that we are capturing changes in the supply of ARM credit, rather than a change of one rate that is offset by the other.

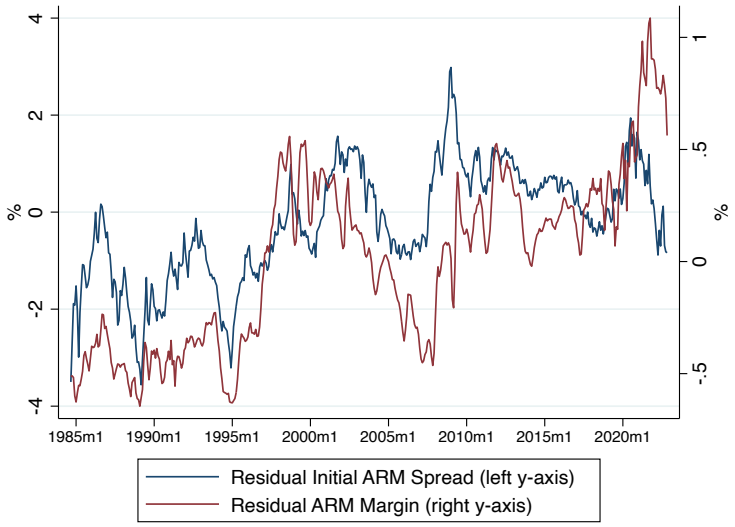


Figure 3: The ARM initial spread and margin. The figure plots the residual ARM initial spread against the residual ARM margin. The initial spread is the initial fixed rate minus the maturity-matched Treasury yield, paid during the initial fixed-rate period (1, 3, 5, 7, or 10 years). The margin is the spread over the ARM index (SOFR, Libor, or the 1-year Treasury rate) paid for the remaining life of the loan. Both series are residualized on loan characteristics.

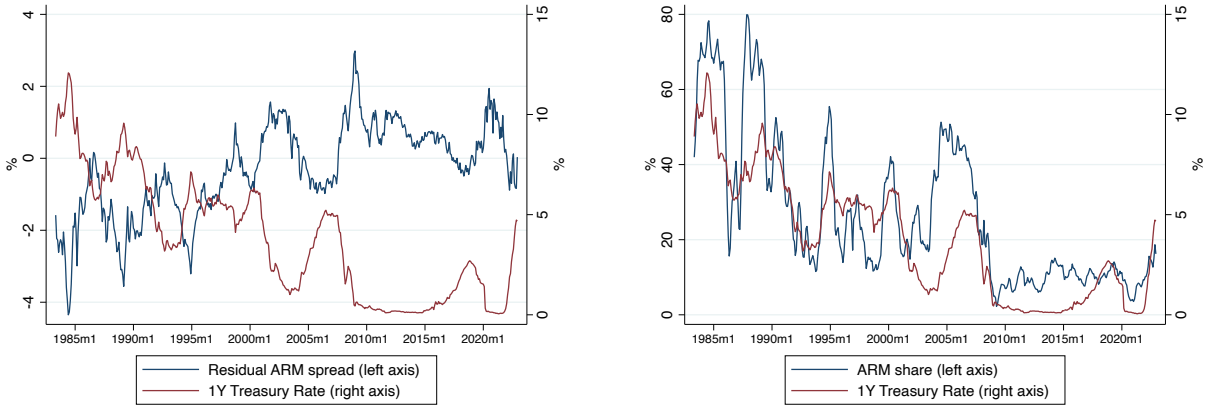
4.4 The Short Rate, the ARM Spread, and the ARM Share

What drives these supply shifts? A first indication comes from their relationship with the short-term interest rate. Figure 4 plots the one-year Treasury rate against the residual ARM spread (left panel) and the ARM share (right panel). The short rate is strongly *negatively* correlated with the ARM spread (correlation -0.87) and strongly *positively* correlated with the ARM share (correlation 0.82). When the short rate is high, ARMs are cheap and plentiful; when it is low, ARMs are expensive and scarce. The ARM share reached roughly 80% in the 1980s and 50% in the mid-2000s, both high-rate periods, and collapsed when rates fell to zero after 2008. The Appendix shows that the same relationships hold using the Fed funds rate (Figure A4) and the three-year Treasury rate (Figure A5), and for the equal-weighted ARM share (Figure A1).

The positive relationship between the short rate and the ARM share is difficult to square with demand-based explanations. In the mortgage-timing view, households compare the long-term rate to recent short rates and choose ARMs when the gap is wide—that is, when short rates are *low* relative to long rates. This view therefore predicts a high ARM share when the short rate is low, the opposite of what Figure 4 shows.[1] And like any demand-

[1] Appendix Figure A3 plots a rule-of-thumb bond risk premium of the kind used in the mortgage-timing literature—the long-term rate minus a moving average of past short rates—against the ARM share. Its

based explanation, it predicts that the ARM share and ARM spreads co-move positively, again the opposite of the data. The strong positive relationship between the short rate and ARM supply instead points directly to the mechanism we develop next: the short rate drives the composition of bank funding, and the composition of bank funding drives the supply of ARMs.



(a) 1Y rate and ARM spread

(b) 1Y rate and ARM share

Figure 4: The short rate and the ARM spread and share. Panel (a) plots the one-year Treasury rate against the residual ARM spread (correlation $= -0.87$). Panel (b) plots the one-year Treasury rate against the ARM share of new originations, dollar weighted (correlation $= 0.82$).

5 Mechanism: Bank Funding and the Supply of ARMs

5.1 Beta Matching and the Deposits Channel

Our explanation for what drives the supply of ARMs rests on two building blocks. The first is that banks match the interest rate sensitivity (the beta) of the cash flows of their assets and liabilities (Drechsler et al., 2021). A bank's liabilities differ widely in their betas. Savings and checking deposits have low betas: their rates barely move when the Fed funds rate changes, because banks exercise market power over liquid retail deposits. Time deposits (CDs) have high betas: their rates track the short rate closely. On the asset side, FRMs have low betas as their coupons are locked in at origination, whereas ARMs have high betas, since their rates reset with the short rate. Beta matching implies a specific pairing on the two sides of the balance sheet: savings deposits fund FRMs, and time deposits fund ARMs. A

correlation with the ARM share (0.44) is lower than that of deposit composition, the channel we explore in this paper (0.68). Moreover, because short rate was at the zero-lower-bound for several years during the post-GFC period, the rule of thumb predicts a high ARM share in precisely those years, when the ARM share was in fact at its lowest.

bank funded with low-beta savings deposits that made ARM loans would see its income fall with the short rate while its funding costs stayed fixed, while a bank funded with high-beta time deposits that made FRM loans would see its funding costs rise with the short rate while its income stayed fixed. Matching high-beta liabilities with high-beta assets keeps the bank's net interest margin insulated from interest rate shocks.

The second building block is that the composition of deposits is driven by the short rate through the deposits channel of monetary policy (Drechsler et al., 2017; Supera, 2021). When the Fed funds rate rises, banks widen the spreads they charge on low-beta deposits, making savings and checking deposits more expensive to hold relative to time deposits. Depositors respond by substituting from savings deposits into time deposits. When the Fed funds rate falls, the substitution runs in reverse.

Putting the two blocks together yields the mechanism at the heart of the paper. An increase in the short rate shifts the composition of bank funding from low-beta savings deposits toward high-beta time deposits. To keep their balance sheets matched, banks respond by increasing the supply of high-beta assets—they originate more ARMs and cut their ARM spreads—and by reducing the supply of low-beta assets—FRMs. A decrease in the short rate does the opposite. The mechanism therefore predicts exactly the patterns documented in Section 4: the ARM share is positively related to the short rate, the ARM spread is negatively related to the short rate, and the ARM share and spread move in opposite directions. In the remainder of the paper we document each step of this mechanism in the aggregate time series (Section 6), in the cross-section of U.S. banks (Section 7), in Europe (Section 8), and at the level of individual loans (Section 9).

5.2 A Brief History of ARMs in the United States

The origin of the ARM market itself illustrates the link between deposit betas and mortgage betas. ARMs were legalized nationally by the Garn–St. Germain Act of October 1982, the banking law that phased out Regulation Q's ceilings on deposit rates. The two provisions were linked deliberately: Congress recognized that uncapping deposit rates would raise the interest rate sensitivity of thrifts' funding and thereby expose fixed-rate mortgage lenders to significant interest rate risk. High-beta funding requires high-beta assets, and the adjustable-rate mortgage was the instrument that allowed lenders to match the two. The reform came too late to prevent the Savings and Loan crisis as the S&Ls' legacy portfolios of fixed-rate mortgages, funded at newly uncapped deposit rates, produced exactly the mismatch that beta matching is designed to avoid. Consistent with the mechanism, the ARM share became very high in the years following the reform, in line with the sharp increase in banks' deposit

betas, reaching approximately 80% of originations at its peak in the 1980s.

5.3 The GFC and Post-Crisis Regulation

The ARM share declined markedly after the GFC, from around 50% to under 20%, and a common presumption is that post-crisis regulation is responsible. However, the regulatory record does not support this claim. In fact, capital regulation does not differentiate between ARMs and FRMs: under the standardized approach, first-lien residential mortgages receive a 50% risk weight regardless of rate type, and only large banks using internal ratings-based models face (small) differences arising from modeled payment-reset risk. The main regulatory tightening specific to ARMs came instead through underwriting rules. Specifically, under the Ability-to-Repay/Qualified Mortgage (ATR/QM) provisions of the Dodd-Frank Act, borrowers must qualify at the fully indexed rate rather than the initial teaser rate. This rule bites for marginal borrowers and can help explain the relative decline in ARM lending to *subprime* borrowers. However, subprime borrowers were only a small fraction the ARM market: loans to borrowers with FICO scores below 600 peaked at less than 15% of ARMs, and ARMs with exotic features (balloon, two-step, and graduated-payment ARMs) peaked at 7% (Appendix Figure A16). Moreover, ARM shares co-move strongly over time across the entire FICO distribution, and the decline in the ARM share after 2010 occurred across the entire FICO distribution, not only among subprime borrowers (Appendix Figure A17).

6 Monetary Policy, Deposit Composition, and ARMs: Aggregate Evidence

In this section we document the mechanism in the aggregate time series, following its two steps: from the short rate to deposit composition, and from deposit composition to the price and quantity of ARMs.

6.1 Monetary Policy and Deposit Rates

Figure 5 plots the average rate paid on time deposits and the average rate paid on savings deposits along with the Fed funds rate. The two deposit rates behave very differently. The time deposit rate tracks the Fed funds rate closely implying that time deposits have a high beta. At the same time, the savings deposit rate adjusts weakly and sluggishly resuling in savings deposits having a low beta. Consequently, when the Fed funds rate rises, the time deposit rate increases by much more than the savings deposit rate, and the opportunity cost

of holding savings deposits widens. This relative price change is the impulse that sets the deposits channel in motion.

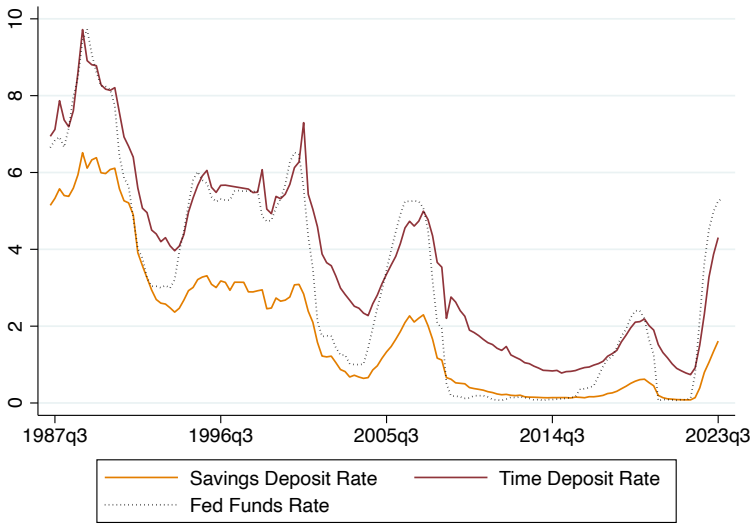
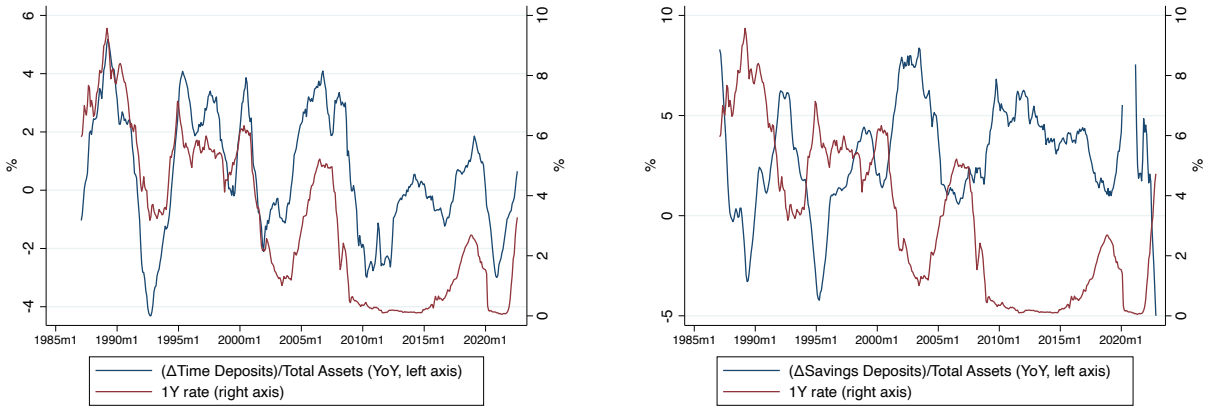


Figure 5: Monetary policy and deposit rates. The figure plots the average rate on time deposits and the average rate on savings deposits, together with the Fed funds rate.

6.2 The Short Rate and Deposit Composition

Figure 6 shows the quantity response. The left panel plots the year-over-year growth of time deposits (scaled by bank assets) against the one-year Treasury rate, and the two series track each other closely, with a correlation of 0.67. The right panel plots the growth of savings deposits, which moves in the opposite direction, with a correlation of -0.60. The flows follow from the behavior of deposit rates in Figure 5. When the policy rate rises, the time deposit rate rises with it while the savings deposit rate changes little. Savings deposits therefore become more expensive to hold, and depositors substitute into time deposits. When the policy rate falls, the gap between the two deposit rates closes and the substitution reverses (Drechsler et al., 2017; Supera, 2021).



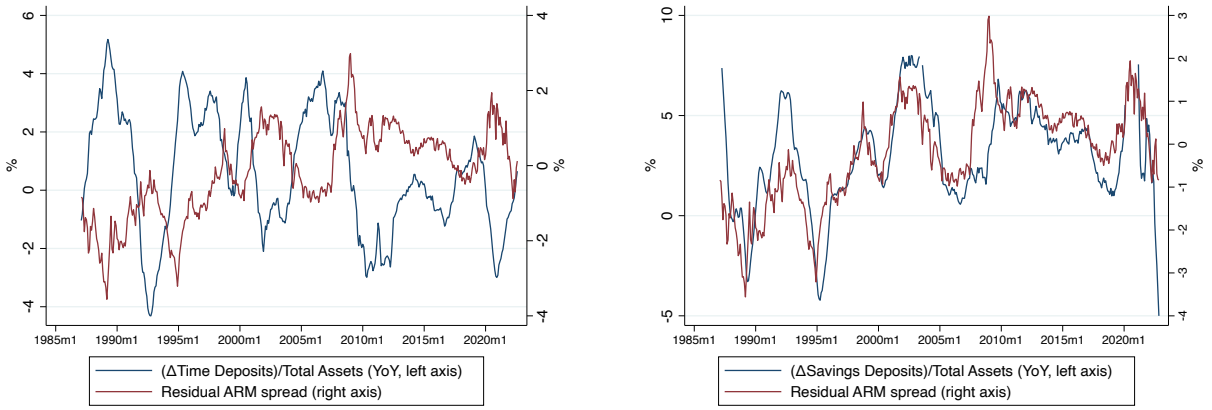
(a) 1Y rate and time deposits (corr = 0.67) **(b)** 1Y rate and savings deposits (corr = −0.60)

Figure 6: The short rate and deposit composition. Panel (a) plots the twelve-month change in time deposits as a share of bank assets against the one-year Treasury rate. Panel (b) plots the twelve-month change in savings deposits as a share of bank assets against the one-year Treasury rate.

6.3 Deposit Flows and the ARM Spread

The second step of the mechanism runs from deposit composition to the pricing of ARMs. Figure 7 plots deposit flows against the residual ARM spread. In the left panel, high growth of time deposits is associated with a *low* ARM spread, with a correlation of −0.51. In the right panel, high growth of savings deposits is associated with a *high* ARM spread: the correlation is 0.66. This evidence is consistent with the funding mechanism. Inflows of high-beta time deposits expand banks' capacity to hold high-beta assets, pushing the price of ARM down. Instead, inflows of low-beta savings deposits tilt banks toward fixed-rate assets and push the price of ARM credit up.[2]

[2]Appendix Figure A6 shows the same relationship with the time deposit series inverted, which makes the co-movement of the two series visually transparent.



(a) Time deposits and ARM spread

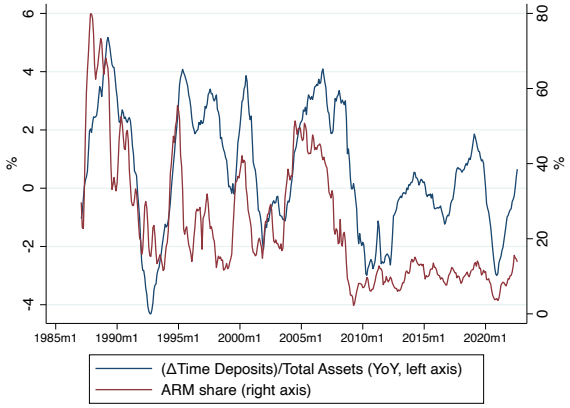
(b) Savings deposits and ARM spread

Figure 7: Deposit flows and the ARM spread. Panel (a) plots the twelve-month change in time deposits as a share of bank assets against the residual ARM spread. Panel (b) plots the twelve-month change in savings deposits as a share of bank assets against the residual ARM spread.

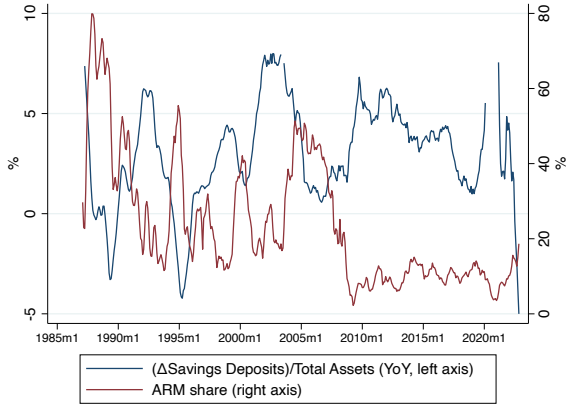
6.4 Deposit Flows and the ARM Share

Figure 8 completes the aggregate picture by relating deposit flows to the quantity of ARMs. Panel (a) plots time deposit growth against the ARM share. The relationship is strongly positive, with a correlation of 0.60. Panel (b) shows the mirror image for savings deposits: their growth is negatively related to the ARM share. Panel (c) combines the information in the two deposit categories into a single measure of deposit composition, which is an even stronger predictor of the ARM share, with a correlation of 0.68. Over a sample spanning four decades and eight monetary policy cycles, the composition of bank deposits traces out the ARM share of new originations remarkably closely.

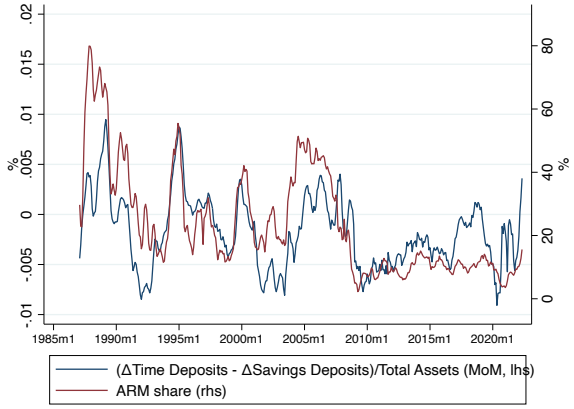
Taken together, the aggregate evidence documents every link of the chain in the aggregate: the short rate affects deposit rates and the substitution between savings and time deposits, and the resulting shift in the composition of bank funding moves the price and the quantity of ARM credit in opposite directions, in line with shifts in credit supply. The next three sections provide supporting evidence for the mechanism using micro-data on the cross-section of banks and individual loans, where we can hold aggregate conditions fixed.



(a) Time deposits and ARM share



(b) Savings deposits and ARM share



(c) Deposit composition and ARM share

Figure 8: Deposit flows and the ARM share. Panel (a) plots the twelve-month change in time deposits as a share of bank assets against the ARM share of new originations. Panel (b) plots the corresponding change in savings deposits against the ARM share. Panel (c) plots a combined measure of deposit composition against the ARM share.

7 Deposit Flows and ARM Supply in the Cross-Section of Banks

If the composition of deposits drives the supply of ARMs, the mechanism should be visible not only in the aggregate but across banks. In particular, at any point in time, banks funded with more time deposits should hold more ARMs. In this section we use bank balance sheet data from the Call Reports to test this prediction, to document the beta-matching mechanism that underlies it, and to trace out the dynamic responses of deposits and mortgages to monetary policy at the bank level.

7.1 ARMs and Time Deposits Across Banks

For each bank we compute the ARM share of its residential mortgage portfolio and the time deposit share of its deposits. Figure 9 presents a binned scatter plot of the bank-level ARM share against the bank-level time deposit share after absorbing time fixed effects, so that the relationship is identified purely from cross-sectional variation within each quarter and is unaffected by the aggregate co-movement documented above. The relationship is strong and positive: banks with higher share of time deposits hold systematically more adjustable-rate mortgages, mirroring the aggregate time-series relationship. The cross-sectional matching of time deposits and ARMs is exactly what beta matching implies, and it is inconsistent with explanations in which the ARM share is set purely by borrower demand, which would generate no systematic link to the funding mix of the particular bank making the loan.

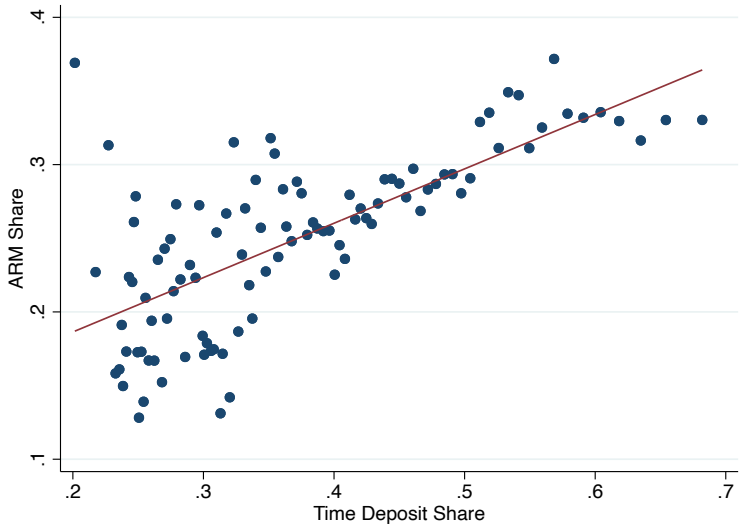
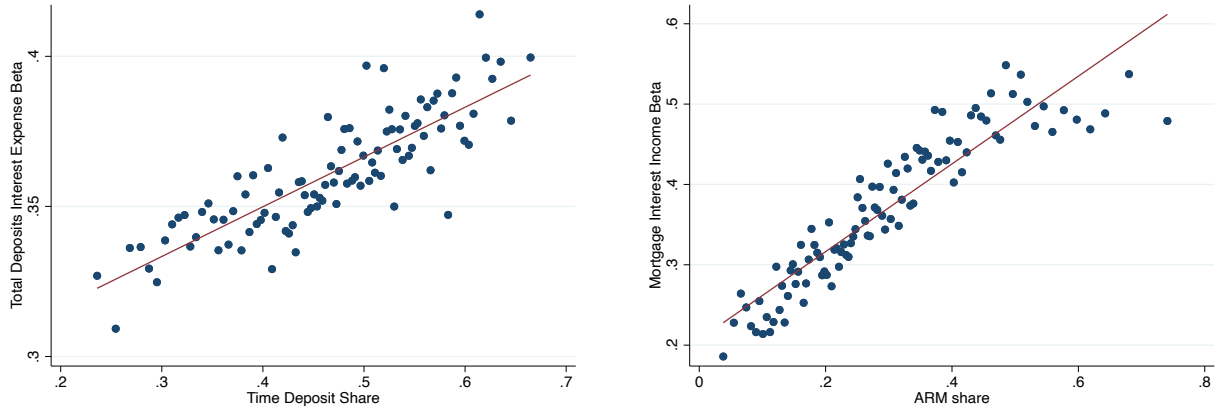


Figure 9: ARMs and time deposits in the cross-section of banks. The figure presents a binned scatter plot of the bank-level ARM share of residential mortgages against the bank-level time deposit share of deposits, after absorbing time fixed effects.

7.2 The Beta-Matching Mechanism

We next document the mechanism underlying the matching of time deposits and ARMs. Using the Call Report income statements, we estimate for each bank a *deposit expense beta*—the sensitivity of its interest expense on deposits (scaled by assets) to changes in the Fed funds rate—and a *mortgage income beta*—the sensitivity of its interest income on mortgages to changes in the Fed funds rate. Betas are estimated by regressing changes in the expense or income rate on contemporaneous and lagged changes in the Fed funds rate and summing the coefficients, as in Drechsler et al. (2021).

Figure 10 verifies that the balance sheet shares capture the betas they are meant to capture. The left panel shows that a bank's time deposit share lines up strongly with its deposit expense beta: time deposits are the high-beta liability. The right panel shows that a bank's ARM share lines up strongly with its mortgage income beta: ARMs are the high-beta mortgage asset. Figure 11 then puts the two sides together, plotting banks' mortgage income betas against their deposit expense betas. The relationship is strong and positive: banks with more rate-sensitive funding hold mortgage portfolios with more rate-sensitive income. Banks match the interest rate sensitivities of the cash flows of their assets and liabilities (Drechsler et al., 2021), and they do so by funding high-beta assets with high-beta deposits (Supera, 2021)—ARMs with time deposits, and FRMs with savings deposits.



(a) Time deposit share vs. deposit expense beta **(b)** ARM share vs. mortgage income beta

Figure 10: Balance sheet composition and cash-flow betas. Panel (a) presents a binned scatter plot of banks' time deposit shares against their deposit expense betas, estimated as the sensitivity of interest expense on deposits to the Fed funds rate. Panel (b) plots banks' ARM shares against their mortgage income betas, estimated as the sensitivity of interest income on mortgages to the Fed funds rate.

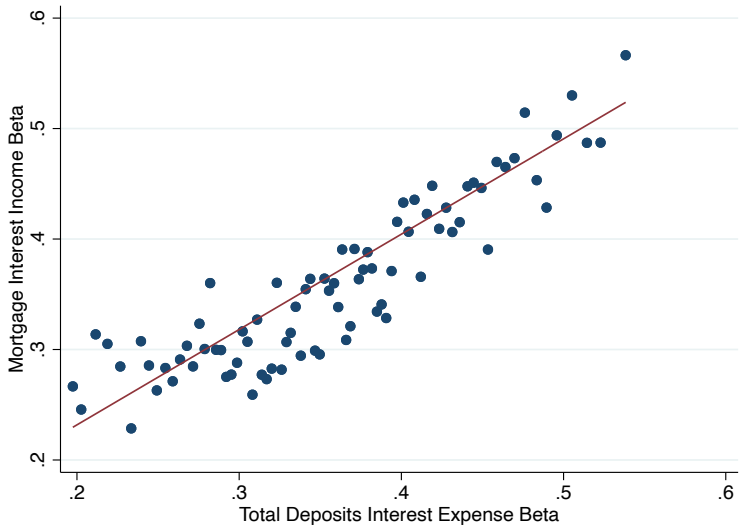


Figure 11: Beta matching of deposits and mortgages. The figure presents a binned scatter plot of banks' mortgage income betas against their deposit expense betas.

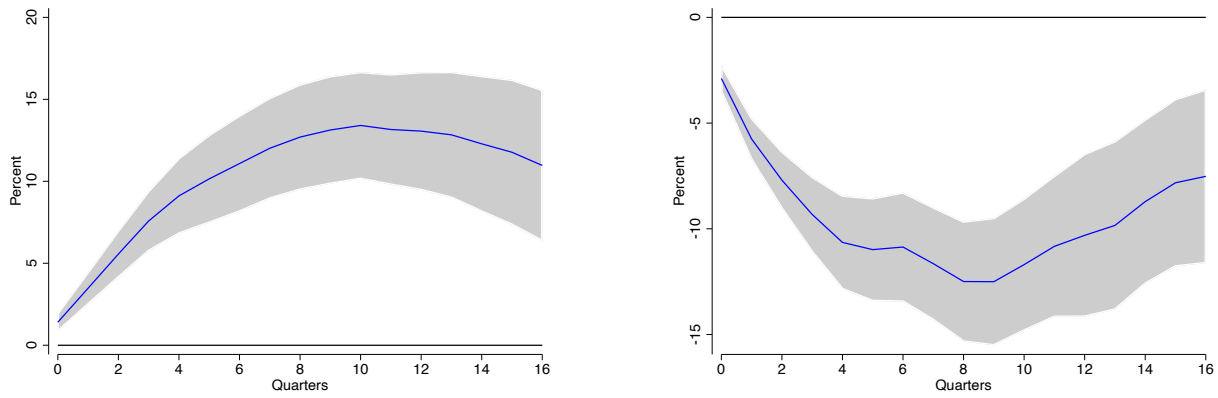
7.3 The Dynamic Response to Monetary Policy

We next trace out the dynamic response of bank balance sheets to monetary policy using local projections. For bank b and horizon h, we estimate

$$y_{b,t+h} - y_{b,t-1} \;=\; \alpha_h + \alpha_b + \beta_h \, \Delta FFrate_t + \gamma X_{t-1} + \epsilon_{t+h}, \tag{1}$$

where y is the log of the balance sheet quantity of interest, $\Delta FFrate_t$ is the change in the Fed funds rate, α_b are bank fixed effects, and X_{t-1} is a vector of lagged controls, which include U.S. GDP growth and inflation. The coefficients β_h trace out the cumulative response of y at horizon h to a monetary policy tightening.

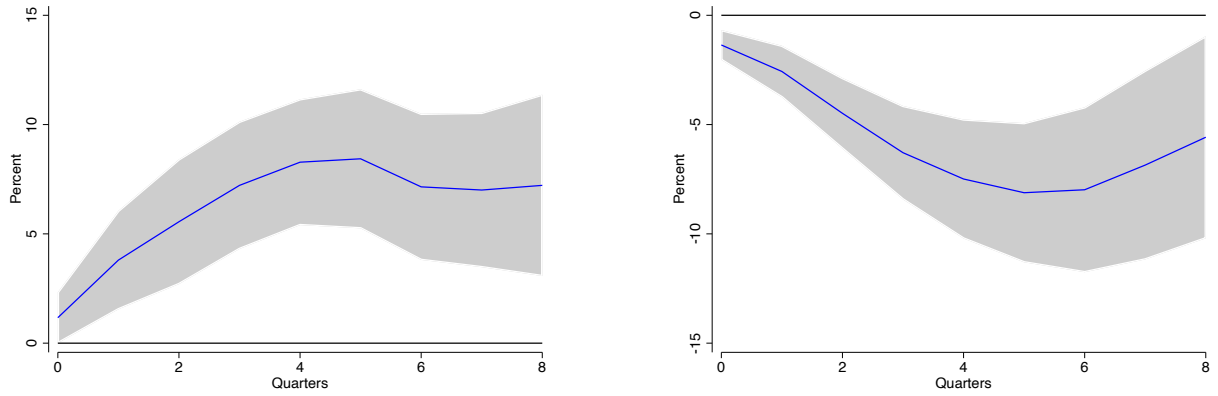
Figure 12 shows the response of deposit quantities. Following an increase in the Fed funds rate, time deposits rise steadily and significantly, while savings deposits fall. This is the deposits channel operating at the bank level: the tightening raises the rate on time deposits by much more than the rate on savings deposits, and depositors substitute from the latter to the former.



(a) Time deposits **(b)** Savings deposits

Figure 12: The response of deposit quantities to monetary policy. The figure plots local projection estimates of the response of bank deposit quantities to a monetary policy tightening, from equation (1). Panel (a) shows time deposits and panel (b) shows savings deposits.

Figure 13 shows the corresponding response of mortgage quantities, estimated from the same specification. Following a tightening, banks' holdings of ARMs increase while their holdings of FRMs decrease. The two figures together display the mechanism in motion: the tightening tilts bank funding toward high-beta time deposits, and banks re-balance their mortgage books toward high-beta ARMs and away from low-beta FRMs. The asset side follows the liability side.



(a) ARMs **(b)** FRMs

Figure 13: The response of mortgage quantities to monetary policy. The figure plots local projection estimates of the response of banks' residential mortgage holdings to a monetary policy tightening, from equation (1). Panel (a) shows adjustable-rate mortgages and panel (b) shows fixed-rate mortgages.

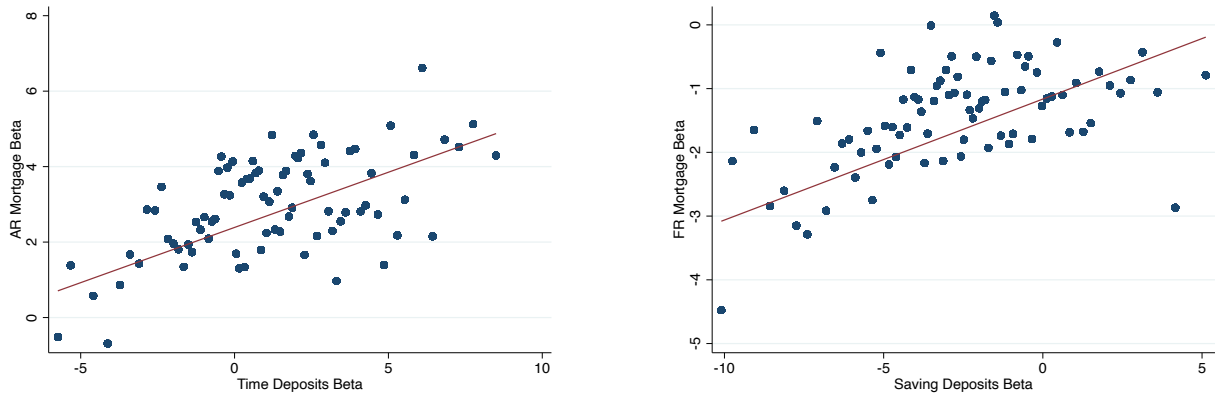
7.4 Cross-Sectional Sensitivities to Monetary Policy

Finally, we link the deposit and mortgage responses bank by bank. For each bank we estimate the sensitivity of its deposit and mortgage quantities to the Fed funds rate from

$$\Delta y_{b,t} \;=\; \alpha_b + \sum_{\tau=0}^{4} \beta_{y,b}^{\tau}\, \Delta FFrate_{t-\tau} + \gamma X_{t-1} + \epsilon_{b,t}, \tag{2}$$

where the bank-specific sensitivity is the sum of the coefficients $\sum_\tau \beta_{y,b}^{\tau}$. The mechanism predicts that the banks whose time deposits are most responsive to the Fed funds rate should be the banks whose ARM lending is most responsive.

Figure 14 confirms this prediction. The left panel plots each bank's ARM sensitivity against its time deposit sensitivity: banks that gain more time deposits when the Fed funds rate rises increase their ARM lending by more. The right panel plots each bank's FRM sensitivity against its savings deposit sensitivity: banks that lose more savings deposits when the Fed funds rate rises cut their FRM lending by more.[3] Monetary policy thus reallocates mortgage supply across contract types through each bank's own deposit flows.



(a) Time deposits and ARMs **(b)** Savings deposits and FRMs

Figure 14: Deposit and mortgage sensitivities to monetary policy in the cross-section of banks. For each bank, sensitivities of deposit and mortgage quantities to the Fed funds rate are estimated from equation (2) as the sum of the coefficients on contemporaneous and lagged Fed funds rate changes. Panel (a) presents a binned scatter plot of banks' ARM sensitivities against their time deposit sensitivities. Panel (b) plots banks' FRM sensitivities against their savings deposit sensitivities.

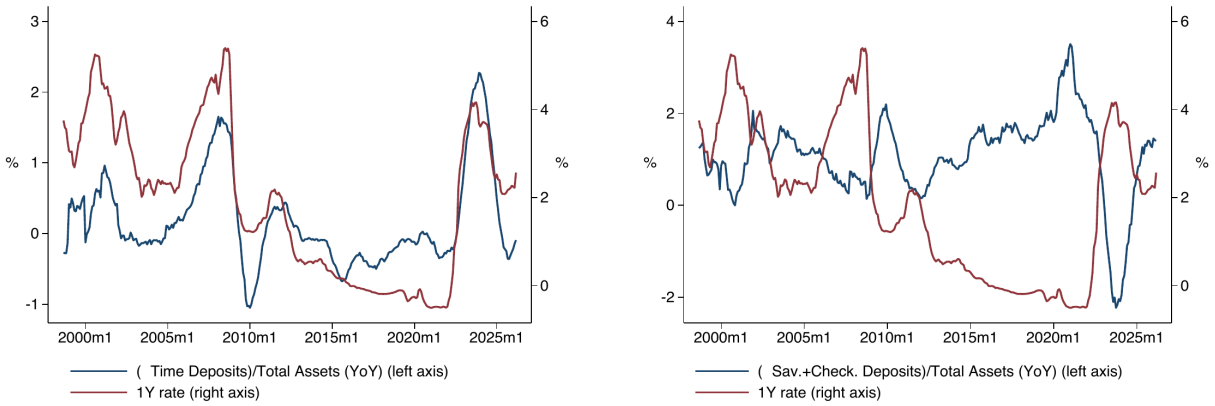
[3] Appendix Figure A8 shows that the results are essentially identical under an alternative definition of ARMs and FRMs based on repricing maturity.

8 Evidence from Europe

The mechanism we propose is not specific to U.S. institutions: wherever banks fund mortgages with deposits and match cash-flow betas, deposit composition should drive the FRM–ARM mix. Europe provides an independent testing ground with its own monetary policy cycle, its own deposit market, and wide cross-country variation in mortgage structure. In this section we show that all the main pieces of the mechanism replicate in Europe.

8.1 The Deposits Channel in Europe

Figure 15 documents the deposits channel in the euro area. The left panel plots the year-over-year change in time deposits against the one-year Euribor rate and shows a strong positive relationship between the two series, with a correlation of 0.71. The right panel plots the change in savings and checking deposits against the one-year Euribor and shows a similarly strong negative relationship, with a correlation of −0.63. As in the U.S., when the ECB tightens, depositors substitute from savings deposits into time deposits, and when it eases they substitute back. The 2022–2023 ECB tightening cycle, the first significant tightening in over a decade, produced a particularly sharp reallocation from savings into time deposits.



(a) 1Y Euribor and time deposits

(b) 1Y Euribor and savings deposits

Figure 15: The deposits channel in Europe: the short rate and deposit composition. Panel (a) plots the year-over-year change in euro-area time deposits against the one-year Euribor rate. Panel (b) plots the year-over-year change in euro-area savings and checking deposits against the one-year Euribor.

8.2 Beta Matching by European Banks

We next test the balance sheet behavior that underlies the mechanism: do European banks, like U.S. banks, match the interest rate sensitivities of their assets and liabilities? Using supervisory data from the European Banking Authority, we compute for each bank the rate beta of its total liabilities and the income rate beta of its total assets. Figure 16 presents a binned scatter plot of the two. The relationship is strongly positive: as in the U.S., European banks with higher liability rate betas hold assets with higher income rate betas. Beta matching is thus a general feature of bank balance sheet management, not an artifact of U.S. regulation or market structure.

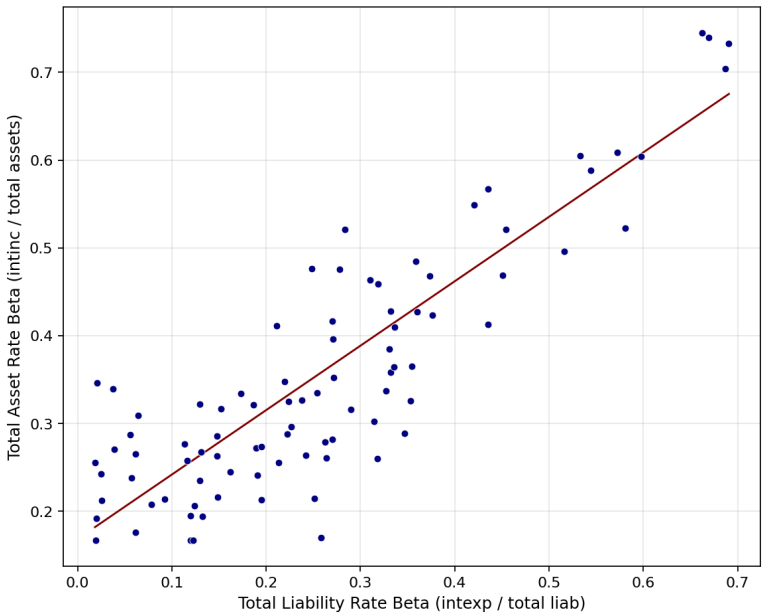


Figure 16: Beta matching in the cross-section of European banks. The figure presents a binned scatter plot of European banks' asset income rate betas against their liability rate betas, computed from EBA supervisory data.

8.3 ARM Lending and Time Deposits in Europe

These two results have a direct implication for mortgage lending. If depositors substitute into time deposits and banks match betas, then ARM lending should rise and fall with time deposit inflows. Figure 17 plots new ARM lending in the euro area against new time deposits. Two features stand out. First, the euro-area ARM share fell sharply after 2010, as the ECB cut rates in response to the Global Financial Crisis and the euro-area sovereign debt crisis, and rebounded briefly around the 2022–2023 tightening. Second, ARM lending co-moves strongly with new time deposits throughout the sample. European banks, like

U.S. banks, expand floating-rate lending when their funding shifts toward high-beta time deposits, matching the rate sensitivity of mortgages and deposits.

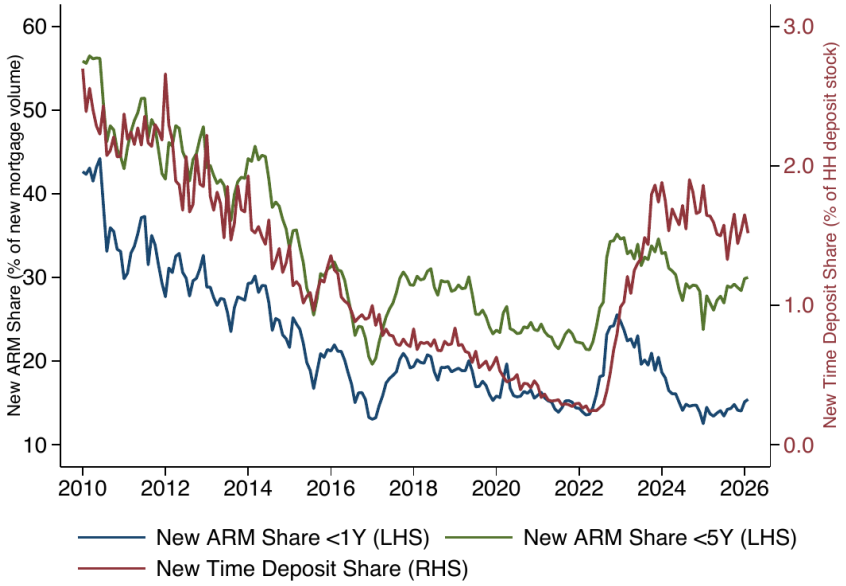


Figure 17: ARM lending and time deposits in Europe. The figure plots new ARM lending in the euro area against new time deposits.

8.4 Cross-Country Evidence

Finally, we exploit variation across European countries. Using country-level bank balance sheet time series from ECB's Balance Sheet Items (BSI) database, we relate the growth of ARM lending to the growth of new time deposits after absorbing time fixed effects, so that identification comes from cross-country differences within each period rather than from the common euro-area cycle. Figure 18 presents the binned scatter plot. Countries experiencing stronger growth in new time deposits also experience stronger growth in ARM lending. The co-movement between ARMs and time deposits is thus present both over time and across countries, exactly as it is present both over time and across banks in the U.S.

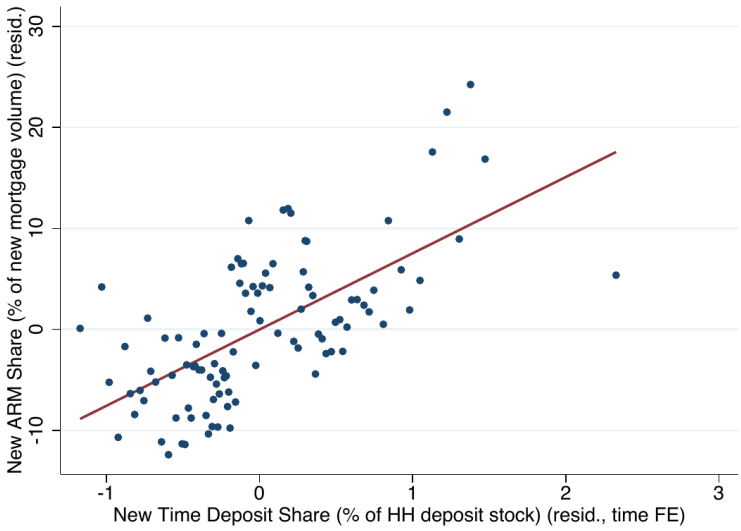


Figure 18: ARM lending and time deposits across European countries. The figure presents a binned scatter plot of country-level growth in new ARM lending against country-level growth in new time deposits, after absorbing time fixed effects.

9 Deposit Flows and the Supply of ARMs: Loan-Level Evidence

9.1 Approach and Empirical Strategy

The aggregate and bank-level evidence is consistent with deposit composition driving ARM supply, but it remains possible that deposit flows respond to mortgage demand rather than the reverse: a bank facing strong local ARM demand might raise time deposits to fund it. In this section we address this identification challenge using loan-level data. Our goal is to examine how different types of deposit flows (time versus savings) affect the composition and pricing of bank portfolio mortgages, comparing banks that face the same local lending opportunities.

To this end, we use individual mortgage loans from CoreLogic over 1985–2023. We include both adjustable- and fixed-rate mortgages and consider loans for home purchase and refinancing only. Importantly, we restrict the sample to loans retained on banks' balance sheets, since these are the loans funded by the bank's own liabilities.

We conduct the analysis at the loan level. For loan i originated by bank b in zip code z in quarter t, we estimate

$$y_{i,z,b,t} = \alpha_{z,t} + \alpha_b + \beta\, \Delta TimeDeposits_{b,t} + \gamma\, \Delta SavingsDeposits_{b,t} + \zeta X_{z,t} + \epsilon_{i,z,b,t}, \quad (3)$$

where $y_{i,z,b,t}$ is the ARM dummy (equal to one if the loan is an ARM and zero if it is an FRM), the initial ARM spread, or the ARM margin. The deposit-flow variables are the changes in bank b's time and savings deposits, each scaled by lagged total assets. $X_{z,t}$ contains loan characteristics, namely the borrower's LTV and FICO score. The key identification concern is that deposit flows may be reacting to ARM demand. We address this by including in the empirical specification the zip code $\times$ quarter fixed effects $\alpha_{z,t}$, which allow us to control for time-varying local mortgage demand. The coefficients are identified by comparing two banks lending in the same zip code in the same quarter, which face the same local pool of borrowers and the same local demand for ARMs versus FRMs, but which differ in their deposit flows. The bank fixed effects α_b control for observable and unobservable time-invariant bank characteristics. In robustness tests we instrument deposit flows with the interaction of the Fed funds rate and the bank's deposit beta. Standard errors are two-way clustered at the bank and zip code level.

9.2 Deposit Flows and the Propensity to Originate ARMs

Table 1 presents estimates of equation (3) for the ARM dummy. Column (1) includes bank fixed effects and state $\times$ time fixed effects; column (2) adds four-digit zip code fixed effects; column (3) tightens the comparison to within four-digit zip code $\times$ quarter; and column (4) uses six-digit zip code $\times$ quarter fixed effects, our most stringent specification. The pattern is uniform across specifications. Time deposit inflows raise the probability that a bank's loan is an ARM. Savings deposit inflows, instead, lower it. The magnitudes are economically large: taking column (4), a time deposit inflow of one percent of assets raises the probability that a given loan is an ARM by 0.73 percentage points, and a savings inflow of the same size lowers it by 0.61 percentage points—relative to loans made by other banks in the same six-digit zip code in the same quarter. Notably, the coefficients grow as the fixed effects become more stringent, indicating that local demand variation, if anything, biases the naive estimates toward zero.

Table 1: ARM origination and deposit flows: loan-level results. This table reports estimates of equation (3). The dependent variable is an ARM dummy equal to one if the loan is an adjustable-rate mortgage and zero if it is a fixed-rate mortgage. The sample consists of mortgages retained on banks' balance sheets, from CoreLogic, 1985–2023. Δ Time Deposits$_{b,t}$ and Δ Savings Deposits$_{b,t}$ are the quarterly changes in bank b's time and savings deposits scaled by lagged total assets. All columns control for the borrower's LTV and FICO score. Standard errors, in parentheses, are double-clustered by bank and zip code. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

	ARM loan dummy			
	(1)	(2)	(3)	(4)
Δ Time Deposits$_{b,t}$/Assets$_{b,t-1}$	0.382***	0.447***	0.487***	0.732***
	(0.0835)	(0.0817)	(0.0954)	(0.114)
Δ Savings Deposits$_{b,t}$/Assets$_{b,t-1}$	-0.535***	-0.466***	-0.558***	-0.610***
	(0.0635)	(0.0626)	(0.0735)	(0.0899)
LTV and FICO controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
4-digit Zip Code FE	No	Yes	-	-
State x Time FE	Yes	Yes	-	-
4-digit Zip Code x Time FE	No	No	Yes	-
6-digit Zip Code x Time FE	No	No	No	Yes
N	1164529	1164247	1103599	955815
R^2	0.117	0.187	0.297	0.423

9.3 Deposit Flows and the Pricing of ARMs

If time deposit inflows shift the *supply* of ARMs, they should show up in prices as well as quantities, and with the opposite sign: banks receiving high-beta funding from time deposits should originate more ARMs *and* price them more cheaply. Table 2 tests this prediction using the initial ARM spread as the dependent variable. We find that time deposit inflows reduce the initial spread in every specification, while savings deposit inflows raise it. Banks with larger inflows of time deposits originate more ARMs at lower spreads, while banks flush with savings deposits originate fewer ARMs at higher spreads. Quantities and prices therefore move in opposite directions bank by bank, within zip code and quarter. This loan-level evidence is consistent with the aggregate supply identification in Section 4.

Table 2: The ARM initial spread and deposit flows: loan-level results. This table reports estimates of equation (3). The dependent variable is the initial ARM spread: the initial fixed rate minus the maturity-matched Treasury yield. The sample consists of ARMs retained on banks' balance sheets, from CoreLogic, 1985–2023. Δ Time Deposits$_{b,t}$ and Δ Savings Deposits$_{b,t}$ are the quarterly changes in bank b's time and savings deposits scaled by lagged total assets. All columns control for the borrower's LTV and FICO score. Standard errors, in parentheses, are double-clustered by bank and zip code. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

	Initial ARM Spread					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Time Deposits$_{b,t}$/Assets$_{b,t-1}$	-0.104***	-0.100***	-0.0925***	-0.0757***	-0.0514***	-0.0596***
	(0.00949)	(0.00939)	(0.00923)	(0.00932)	(0.0109)	(0.0130)
Δ Savings Deposits$_{b,t}$/Assets$_{b,t-1}$	0.0677***	0.0641***	0.0600***	0.0499***	0.0409***	0.0362***
	(0.00621)	(0.00615)	(0.00604)	(0.00620)	(0.00695)	(0.00831)
LTV and FICO controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	Yes	-	-	-	-
4-digit Zip Code FE	No	No	Yes	Yes	-	-
State x Time FE	No	No	No	Yes	-	-
4-digit Zip Code x Time FE	No	No	No	No	Yes	-
6-digit Zip Code x Time FE	No	No	No	No	No	Yes
Product Type x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Rate Reset Freq. FE	Yes	Yes	Yes	Yes	Yes	Yes
N	165068	165067	164496	163854	132069	101099
R^2	0.585	0.587	0.602	0.625	0.718	0.770

The initial spread is only one of the ARM's two prices. Table 3 repeats the analysis for the ARM margin (the spread over the index paid after the initial fixed-rate period) using the same sequence of specifications. The results mirror those for the initial spread: time deposit inflows reduce the margin, while savings deposit inflows raise it. Deposit flows thus move the entire price schedule of the ARM contract, not just the teaser-period rate. This is important because it rules out explanations based on the initial rate alone, such as teaser-rate competition for demand: a bank competing for ARM demand by discounting the initial rate would, if anything, recoup the discount in the margin, whereas a bank passing through cheap floating-rate funding lowers both prices, which is what we find.

Table 3: The ARM margin and deposit flows: loan-level results. This table reports estimates of equation (3). The dependent variable is the ARM margin: the spread over the ARM index (SOFR, Libor, or the one-year Treasury rate) paid after the initial fixed-rate period. The sample consists of ARMs retained on banks' balance sheets, from CoreLogic, 1985–2023. Δ Time Deposits$_{b,t}$ and Δ Savings Deposits$_{b,t}$ are the quarterly changes in bank b's time and savings deposits scaled by lagged total assets. All columns control for the borrower's LTV and FICO score. Standard errors, in parentheses, are double-clustered by bank and zip code. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

	ARM Margin					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Time Deposits$_{b,t}$/Assets$_{b,t-1}$	-0.0390***	-0.0382***	-0.0342***	-0.0323***	-0.0165**	-0.0197***
	(0.00704)	(0.00698)	(0.00677)	(0.00657)	(0.00672)	(0.00739)
Δ Savings Deposits$_{b,t}$/Assets$_{b,t-1}$	0.0381***	0.0366***	0.0347***	0.0224***	0.0173***	0.0157***
	(0.00569)	(0.00563)	(0.00545)	(0.00508)	(0.00495)	(0.00471)
LTV and FICO controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	Yes	-	-	-	-
4-digit Zip Code FE	No	No	Yes	Yes	-	-
State x Time FE	No	No	No	Yes	-	-
4-digit Zip Code x Time FE	No	No	No	No	Yes	-
6-digit Zip Code x Time FE	No	No	No	No	No	Yes
Product Type x Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Rate Reset Freq. FE	Yes	Yes	Yes	Yes	Yes	Yes
N	292861	292860	292315	291739	255406	211462
R^2	0.285	0.292	0.321	0.392	0.598	0.687

Together, Tables 1–3 establish the supply mechanism at the level of the individual loan. Holding fixed the zip code and quarter, and hence the local demand for ARMs, banks receiving time deposit inflows tilt their originations toward ARMs and price them more cheaply on both margins of the contract, while banks receiving savings deposit inflows do the opposite.

10 High-Beta Funding, Swap Spreads, and ARMs

Bank deposits are not the financial sector's only source of floating-rate funding. Short-term financial debt, such as financial commercial paper (CP) and asset-backed commercial paper (ABCP), is the market analogue of high-beta deposits, and we refer to it as "shadow deposits." In this section we show that conditions in the market for shadow deposits are the second driver of ARM supply, that the price of floating-rate funding is visible in the swap spread, and that the collapse of shadow deposits around the GFC explains why the ARM share fell so sharply in 2007–2008 and has remained low since. The analysis draws on our

companion paper, Charoenwong et al. (2026), which develops the link between high-beta funding and swap spreads in full. Here we present the evidence most relevant for the ARM market.

10.1 The ARM Spread and Swap Spreads

Recall from Section 5 that a bank can convert fixed-rate funding into floating-rate funding by paying floating and receiving fixed in the swap market, and that the cost of doing so is the negative of the swap spread, defined as the difference between the fixed swap rate and the maturity-matched Treasury yield. The swap spread is therefore a market price of floating-rate funding, and it should move inversely with the ARM spread, the price of floating-rate credit. Figure 19 plots the negative of the residual ARM spread against the swap spread. The two series track each other closely. Most strikingly, the large and persistent increase in the ARM spread around the GFC coincides exactly with the fall of swap spreads to negative values, where they have remained. The two movements carry the same message. The cost of floating-rate funding rose sharply around the GFC and stayed high. A bank that wanted to fund ARMs after 2008 could not escape this scarcity by swapping into floating-rate funding, since doing so now meant effectively paying the substantial swap spread.

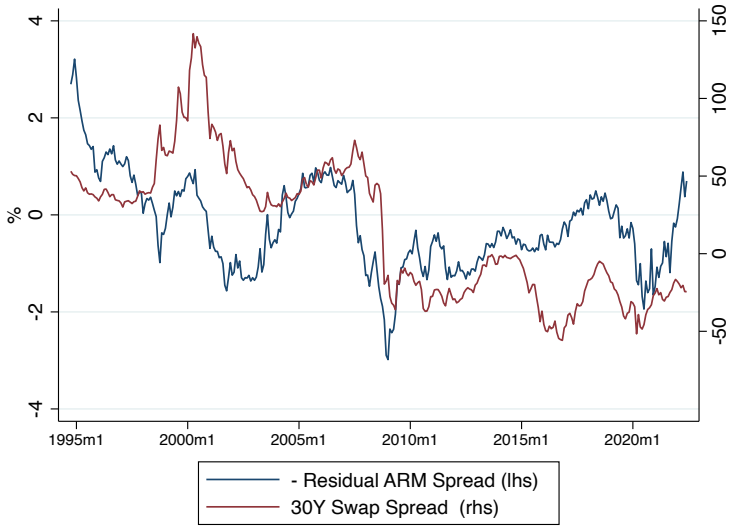
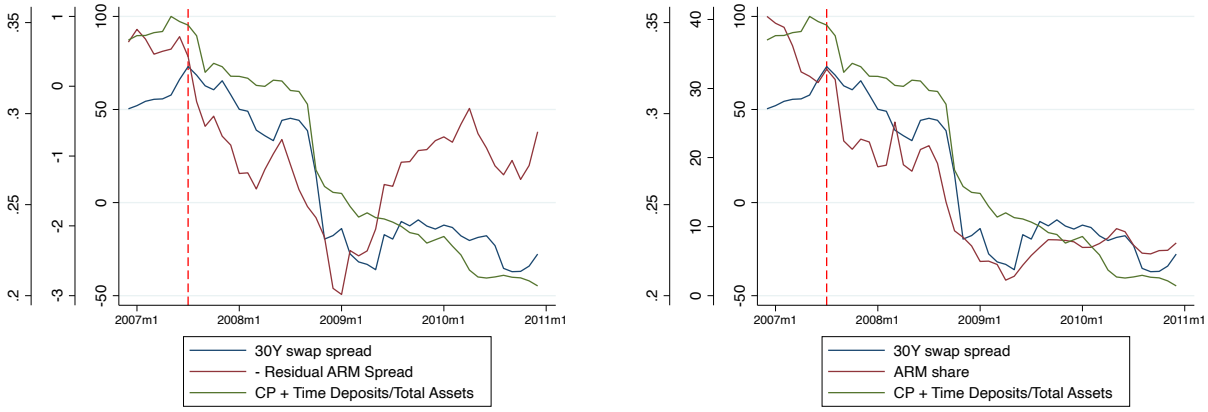


Figure 19: The ARM spread and swap spread. The figure plots the negative of the residual ARM spread against the 30-year swap spread, defined as the 30-year fixed swap rate minus the 30-year Treasury yield.

10.2 Zooming into 2007–2008

Figure 20 zooms into 2007–2008 and adds the quantity of high-beta funding, defined as the sum of domestic financial commercial paper (CP), asset-backed CP (ABCP), and large time deposits, scaled by bank assets. The left panel plots the 30-year swap spread and the quantity of high-beta funding against the negative of the ARM spread, while the right panel plots them against the ARM share. Beginning in August 2007, the ARM spread and the swap spread move sharply together, each changing by over 100 basis points, and the ARM share falls at the same time. The decline in ARM supply and the fall in the swap spread coincide closely with a large contraction in the quantity of short-term financial debt. The collapse of high-beta funding was set off by the run on the ABCP market that began on August 7, 2007. The synchronization of these four series dates the contraction in ARM supply to a specific week in the money markets, more than a year before the failures of September 2008 and long before any post-crisis regulation was written. ARM supply fell again when the CP market suffered a second panic on October 7, 2008, prompting the Federal Reserve to create the Commercial Paper Funding Facility the same day.



(a) ARM spread, swap spread, and high-beta funding

(b) ARM share, swap spread, and high-beta funding

Figure 20: The ARM spread, the ARM share, swap spreads, and high-beta funding around 2007–2008. Panel (a) plots the 30-year swap spread, the negative of the residual ARM spread, and the quantity of high-beta funding, defined as the sum of domestic financial CP, ABCP, and large time deposits, scaled by bank assets. Panel (b) plots the 30-year swap spread, the ARM share, and the quantity of high-beta funding.

The evidence in this section completes the paper's account of the post-GFC mortgage market. Before 2007, the financial sector obtained floating-rate funding from two large sources. The first was time deposits, which fluctuated with the monetary policy cycle. The second was shadow deposits, such as financial and asset-backed commercial paper. The run

that began on August 7, 2007 permanently shrank the second source, and the zero-rate decade that followed suppressed the first. With floating-rate funding scarce, its price rose, and the supply of ARMs contracted. The higher price was visible simultaneously in high ARM spreads and in negative swap spreads. The ARM share accordingly fell from 50% to around 10% and stayed there, while spreads on ARMs remained high, consistent with a supply contraction. When short rates rose in 2022–2023, time deposits flowed back and the ARM share increased. The same funding mechanism that explains four decades of ARM share fluctuations also helps explain the post-GFC collapse of the ARM share and its recent partial recovery.

11 Conclusion

The share of U.S. mortgages originated as ARMs has ranged from 80% in the 1980s to about 10% after the Global Financial Crisis. Discussions of the ARM share usually treat it as a reflection of household demand. We show that it is instead driven by supply: the ARM share and ARM spreads move strongly in opposite directions, so the fluctuations trace out shifts in the supply of ARM credit.

The supply of ARMs is determined by the availability of floating-rate, or high-beta, funding to the financial sector, which comes from two sources: high-beta bank deposits and short-term financial debt, which we call "shadow deposits." Monetary policy drives the first source through the deposits channel: when the Fed funds rate rises, depositors substitute from savings deposits into time deposits, and banks, matching the betas of their assets and liabilities, expand ARM lending and cut ARM spreads. We document this mechanism in the aggregate, in the cross-section of U.S. banks, in Europe, and at the level of individual loans, where banks receiving time deposit inflows originate more ARMs at lower spreads and margins than other banks lending in the same zip code and quarter. Market shocks drive the second source: the August 2007 run on shadow deposits contracted high-beta funding, raised its price, which led to a decline in the supply of ARMs.

The results carry broader implications. The mix of FRMs and ARMs determines the allocation of interest rate risk between households and the financial sector, and we show that this mix is set to an important degree by the liability structure of financial intermediaries. Monetary policy reshapes this liability structure, so it changes not only the quantity of credit but also its contractual form, and with it the exposure of household balance sheets to future policy. The transmission of monetary policy to households therefore depends on the composition of intermediary funding.

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Appendix

A Additional Aggregate Evidence

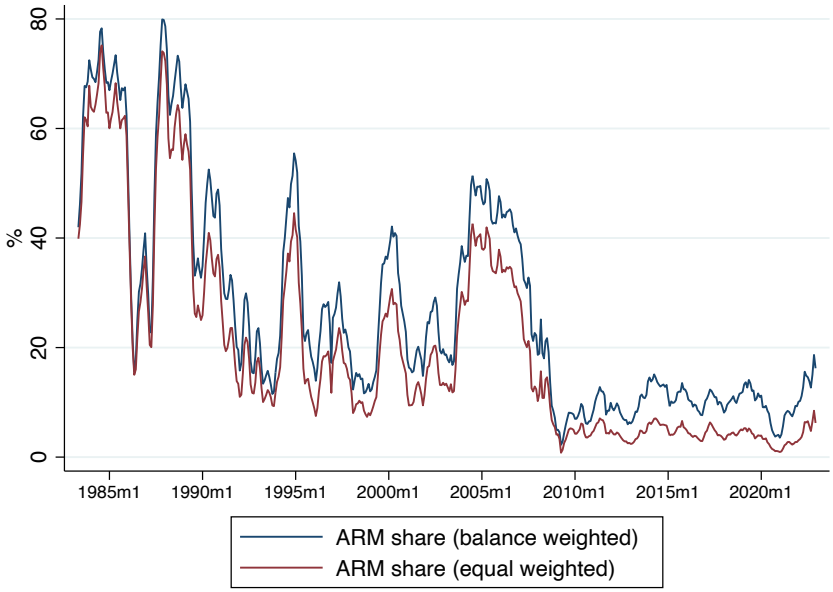


Figure A1: The ARM share: balance versus equal weighted. The figure plots the ARM share of new originations computed on a dollar-weighted (balance) basis and on an equal-weighted (number of loans) basis. The two measures behave very similarly, so the patterns documented in the paper are not driven by the weighting scheme. Source: CoreLogic.

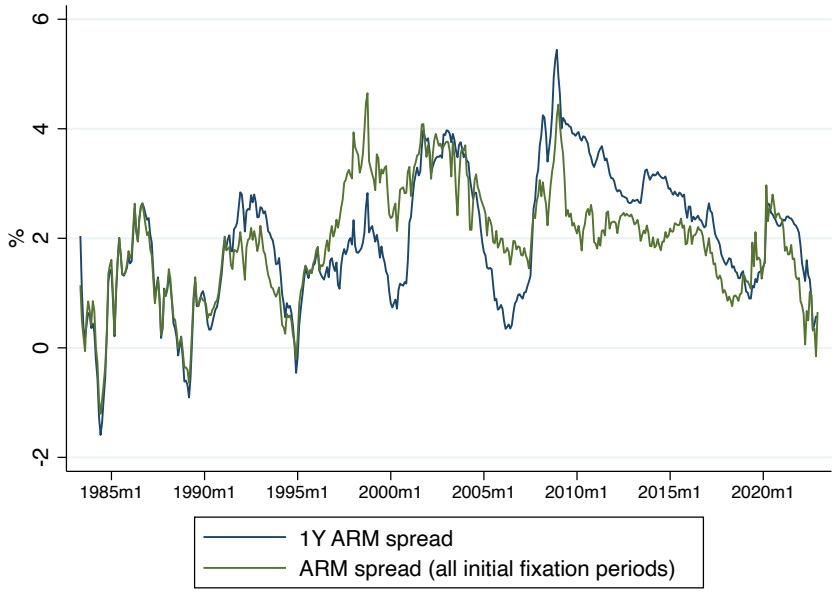
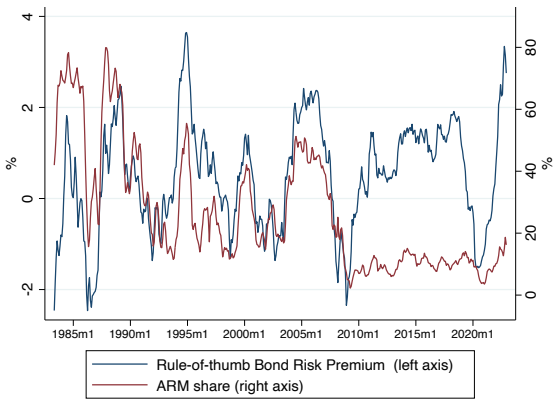
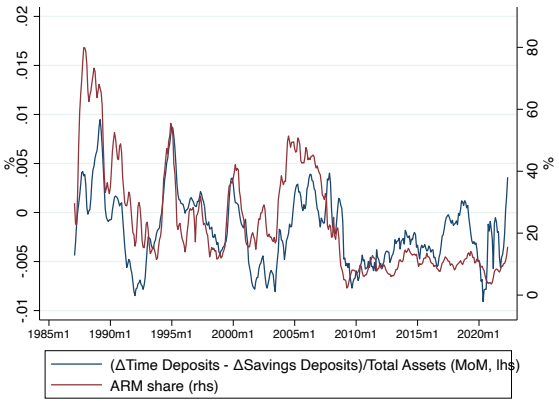


Figure A2: ARM spreads: all initial fixed-rate periods. The figure plots the value-weighted average ARM spread across all initial fixed-rate periods (1, 3, 5, 7, and 10 years) together with the one-year ARM spread. The average spread is similar to the one-year ARM spread. Source: CoreLogic.

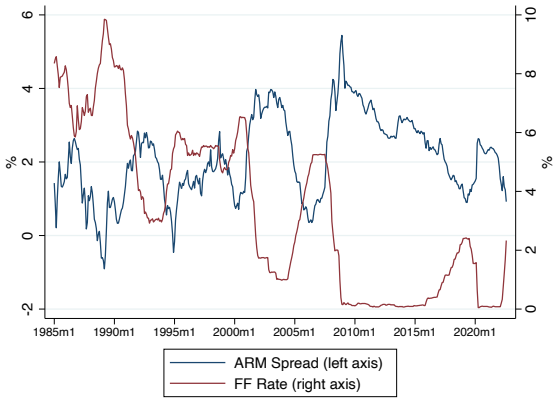


(a) Bond risk premium and ARM share (corr = 0.44)

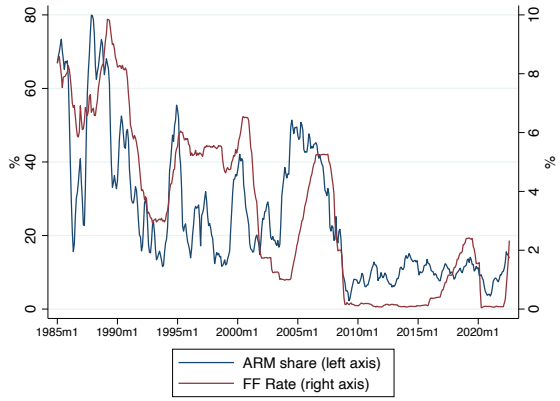


(b) Deposit composition and ARM share (corr = 0.68)

Figure A3: The rule-of-thumb bond risk premium versus deposit composition. Panel (a) plots the rule-of-thumb bond risk premium of Koijen et al. (2009)—the long rate minus a moving average of short rates—against the ARM share (correlation = 0.44). Panel (b) plots deposit composition against the ARM share (correlation = 0.68). Deposit composition is the stronger predictor. More fundamentally, the rule of thumb is a demand-driven explanation and therefore predicts that the ARM share and the ARM spread co-move positively, which is the opposite of what the data show. Sources: FRED, Call Reports, and CoreLogic.

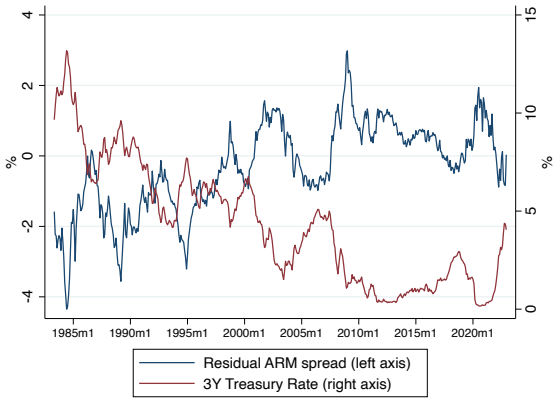


(a) FF rate and ARM spread

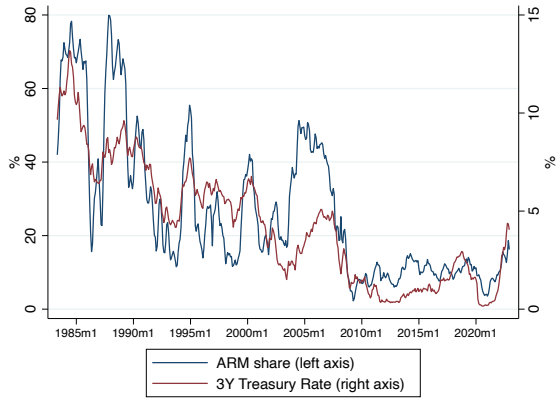


(b) FF rate and ARM share

Figure A4: The Fed funds rate and the ARM spread and share. Panel (a) plots the Fed funds rate against the ARM spread; panel (b) plots the Fed funds rate against the ARM share. As with the one-year rate (Figure 4), the Fed funds rate is negatively correlated with the ARM spread and positively correlated with the ARM share. Sources: FRED and CoreLogic.

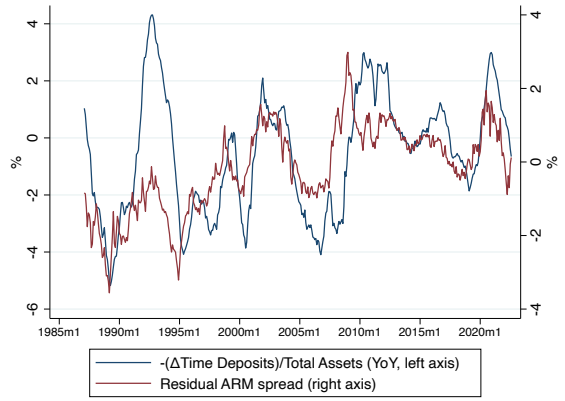


(a) 3Y rate and ARM spread

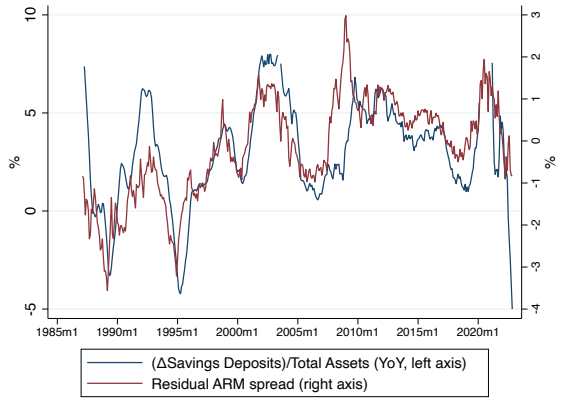


(b) 3Y rate and ARM share

Figure A5: The three-year rate and the ARM spread and share. Panel (a) plots the three-year Treasury rate against the residual ARM spread; panel (b) plots the three-year Treasury rate against the ARM share. The three-year rate is negatively correlated with the ARM spread and positively correlated with the ARM share, as in Figure 4. Sources: FRED and CoreLogic.

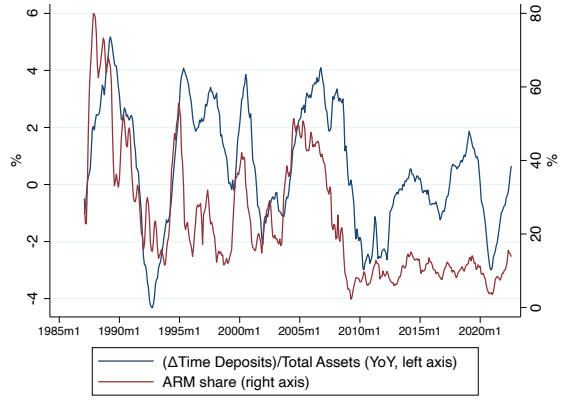


(a) ARM spread and negative of time deposits ($\beta = -0.28$)

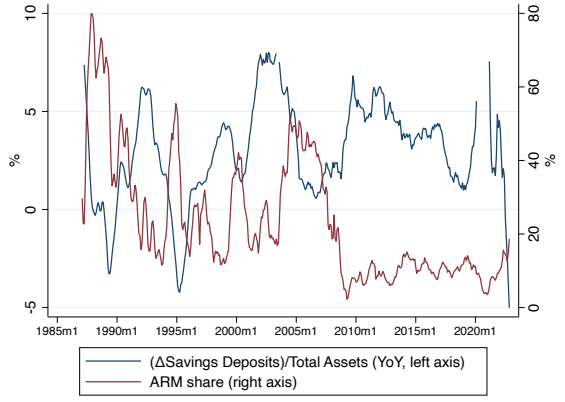


(b) ARM spread and savings deposits ($\beta = 0.3$)

Figure A6: Deposit flows and the ARM spread: alternative presentation. Panel (a) plots the *negative* of the twelve-month change in time deposits against the residual ARM spread ($\beta = -0.28$), which makes the co-movement of the two series visually transparent. Panel (b) plots the change in savings deposits against the residual ARM spread ($\beta = 0.3$). High time deposit growth is associated with a low ARM spread; the pattern is the opposite for savings deposits. Sources: Call Reports and CoreLogic.

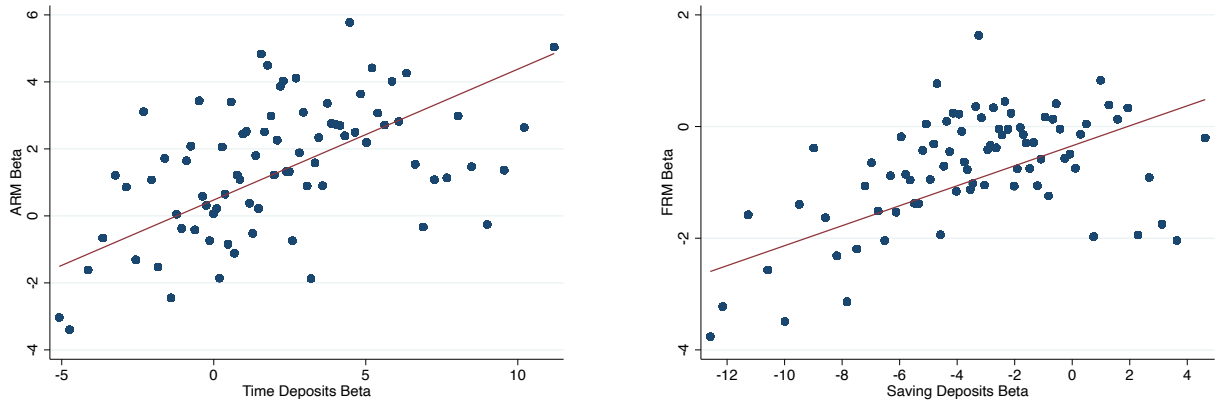


(a) ARM share and time deposits ($\beta = 4.8$)



(b) ARM share and savings deposits ($\beta = -2.9$)

Figure A7: Time deposits versus savings deposits and the ARM share. Panel (a) plots the twelve-month change in time deposits as a share of bank assets against the ARM share ($\beta = 4.8$). Panel (b) plots the twelve-month change in savings deposits against the ARM share ($\beta = -2.9$). High time deposit growth is associated with a high ARM share; the pattern is the opposite for savings deposits. Sources: Call Reports and CoreLogic.



(a) Time deposits and ARMs (t-stat = 11.2)

(b) Savings deposits and FRMs (t-stat = 10.0)

Figure A8: Cross-sectional sensitivities to monetary policy: alternative definition of ARMs and FRMs. The figure repeats the analysis of Figure 14 using an alternative definition in which ARMs (FRMs) are adjustable (fixed) rate closed-end loans secured by first liens on 1–4 family residential properties. Bank-level sensitivities are estimated from $\Delta y_{b,t} = \alpha_b + \sum_{\tau=0}^{4} \beta_{y,b}^{\tau} \Delta R_{t-\tau} + \epsilon_{b,t}$. Banks that gain more time deposits when rates rise increase ARMs by more (t-stat = 11.2); banks that gain more savings deposits when rates fall increase FRMs by more (t-stat = 10.0). Source: Call Reports.

B Additional Loan-Level Results

Table A1: ARM origination and deposit flows: full progression of specifications. This table reports estimates of equation (3) for the ARM loan dummy, showing the full progression from no fixed effects to six-digit zip code × time fixed effects. The sample consists of mortgages retained on banks' balance sheets, from CoreLogic, 1985–2023. Standard errors, in parentheses, are double-clustered by bank and zip code. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

	ARM loan dummy						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Time Deposits$_{b,t}$/Assets$_{b,t-1}$	3.282***	3.670***	0.255***	0.382***	0.447***	0.487***	0.732***
	(0.116)	(0.138)	(0.0756)	(0.0835)	(0.0817)	(0.0954)	(0.114)
Δ Savings Deposits$_{b,t}$/Assets$_{b,t-1}$	-0.631***	-0.488***	-0.235***	-0.535***	-0.466***	-0.558***	-0.610***
	(0.0743)	(0.0711)	(0.0663)	(0.0635)	(0.0626)	(0.0735)	(0.0899)
LTV	-0.00251***	-0.00249***	-0.00251***	-0.00218***	-0.00148***	-0.00153***	-0.00107***
	(0.0000904)	(0.0000825)	(0.0000804)	(0.0000673)	(0.0000420)	(0.0000489)	(0.0000575)
FICO score	0.000676***	0.000684***	0.000711***	0.000626***	0.000391***	0.000379***	0.000211***
	(0.0000216)	(0.0000189)	(0.0000143)	(0.0000121)	(0.0000107)	(0.0000122)	(0.0000146)
Time FE	No	No	Yes	No	No	No	No
Bank FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Zip Code Bin FE	No	No	No	No	Yes	No	No
State x Time FE	No	No	No	Yes	Yes	No	No
Zip Code Bin x Time FE	No	No	No	No	No	Yes	No
Zip Code x Time FE	No	No	No	No	No	No	Yes
N	1165895	1164932	1164930	1164529	1164247	1103599	955815
R^2	0.0333	0.0673	0.0887	0.117	0.187	0.297	0.423

Table A2: The ARM initial spread and deposit flows: full progression of specifications. This table reports estimates of equation (3) for the initial ARM spread, showing the full progression from no fixed effects to zip code × time fixed effects. The sample consists of ARMs retained on banks' balance sheets, from CoreLogic, 1985–2023. Standard errors, in parentheses, are double-clustered by bank and zip code. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

	Initial ARM Spread									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δ Time Deposits$_{b,t}$/Assets$_{b,t-1}$	-0.200***	-0.141***	-0.206***	-0.0679***	-0.104***	-0.100***	-0.0925***	-0.0757***	-0.0514***	-0.0596***
	(0.00494)	(0.00547)	(0.00690)	(0.00695)	(0.00949)	(0.00939)	(0.00923)	(0.00932)	(0.0109)	(0.0130)
Δ Savings Deposits$_{b,t}$/Assets$_{b,t-1}$	0.0515***	0.0544***	0.0587***	0.0211***	0.0677***	0.0641***	0.0600***	0.0499***	0.0409***	0.0362***
	(0.00217)	(0.00219)	(0.00576)	(0.00451)	(0.00621)	(0.00615)	(0.00604)	(0.00620)	(0.00695)	(0.00831)
LTV	0.0000239***	0.0000248***	0.0000144***	0.0000152***	0.0000166***	0.0000133***	0.00000996***	0.00000890***	0.00000667***	0.00000135
	(0.00000193)	(0.00000197)	(0.00000123)	(0.00000125)	(0.000000868)	(0.000000846)	(0.000000872)	(0.000000872)	(0.00000103)	(0.00000131)
FICO score	-0.0000381***	-0.0000382***	-0.0000248***	-0.0000258***	-0.0000274***	-0.0000271***	-0.0000262***	-0.0000239***	-0.0000218***	-0.0000210***
	(0.000000827)	(0.000000792)	(0.000000658)	(0.000000654)	(0.000000566)	(0.000000564)	(0.000000556)	(0.000000530)	(0.000000596)	(0.000000750)
Bank FE	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	No	No	No	No	Yes	No	No	No	No
Zip Code Bin FE	No	No	No	No	No	No	Yes	Yes	No	No
Time FE	No	No	Yes	Yes	Yes	No	Yes	No	No	No
State x Time FE	No	No	No	No	No	No	No	Yes	No	No
Zip Code Bin x Time FE	No	No	No	No	No	No	No	No	Yes	No
Zip Code x Time FE	No	No	No	No	No	No	No	No	No	Yes
Product Type x Time FE	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
N	176130	175396	176130	175394	175332	175331	174767	174113	141153	107756
R^2	0.0549	0.0761	0.416	0.437	0.601	0.605	0.624	0.658	0.764	0.812

C Conforming and Jumbo ARMs and FRMs

This appendix analyzes ARMs and FRMs separately for conforming and jumbo loans. Jumbo loans exceed the conforming loan limit and are ineligible for purchase by the government-sponsored enterprises (GSEs); they must therefore be funded on lenders' balance sheets or through private securitization. The jumbo segment is thus the segment where the funding mechanism should operate most strongly—and it does.

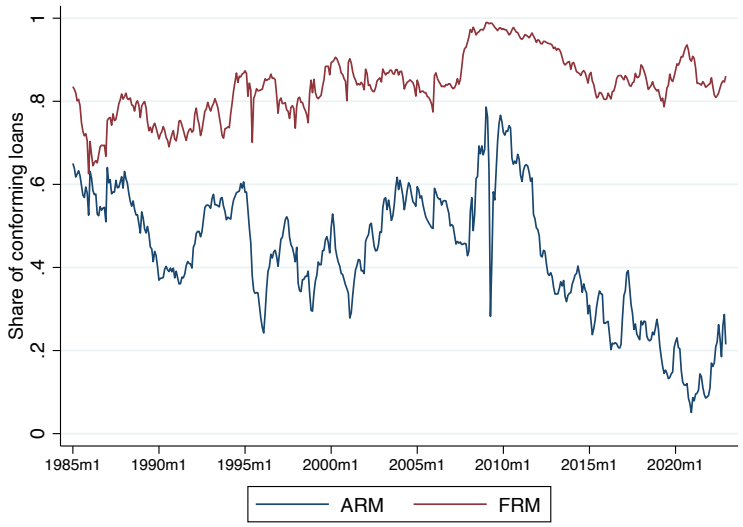


Figure A9: The share of conforming loans among ARMs and FRMs. The figure plots the share of ARMs and of FRMs that are conforming. The conforming share is much lower for ARMs than for FRMs, and the conforming share of ARMs declined markedly after the GFC, from about 60% to about 20%; it was not low in the mid-2000s. Source: CoreLogic.

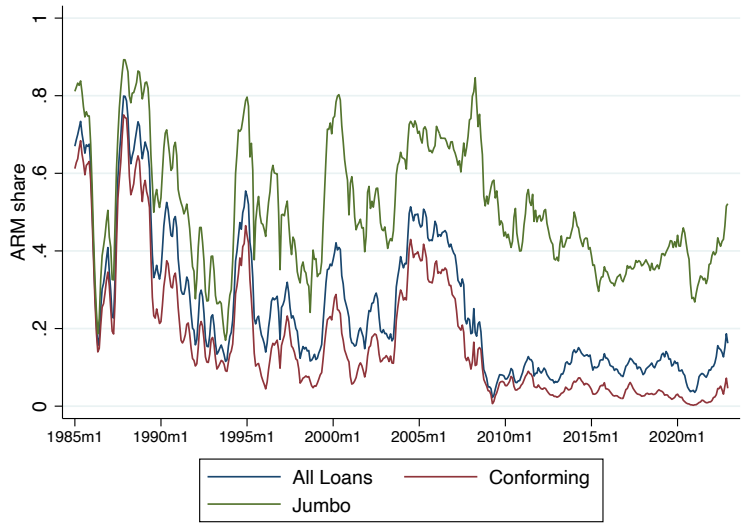


Figure A10: The ARM share among jumbo and conforming loans. The figure plots the ARM share separately for jumbo and conforming loans. The ARM share is much larger for jumbo loans than for conforming loans (about 50% versus 17%). Jumbo loans cannot be sold to the GSEs and are funded on bank balance sheets, which is where the availability of floating-rate funding matters. Source: CoreLogic.

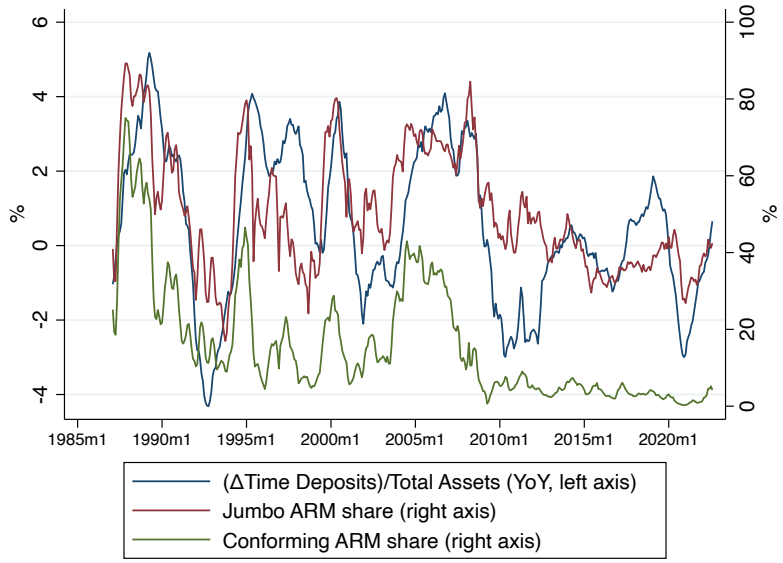
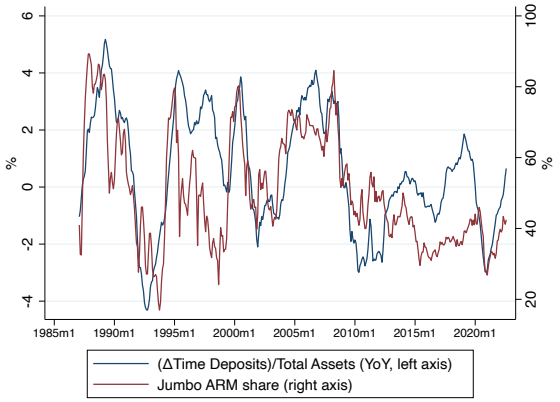
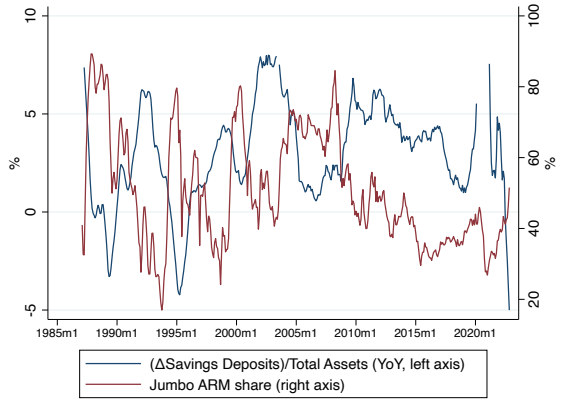


Figure A11: Deposit flows and the ARM share: jumbo versus conforming loans. The figure plots the twelve-month change in time deposits as a share of bank assets against the ARM share computed separately for jumbo and conforming loans. The relationship between time deposit flows and the ARM share is stronger for jumbo loans and weaker for conforming loans, consistent with the funding mechanism operating through bank balance sheets. Sources: Call Reports and CoreLogic.



(a) Jumbo ARM share and time deposits



(b) Jumbo ARM share and savings deposits

Figure A12: Deposit flows and the jumbo ARM share. Panel (a) plots the twelve-month change in time deposits as a share of bank assets against the jumbo ARM share. Panel (b) plots the change in savings deposits against the jumbo ARM share. Time deposit inflows are associated with a high jumbo ARM share and savings deposit inflows with a low one. Sources: Call Reports and CoreLogic.

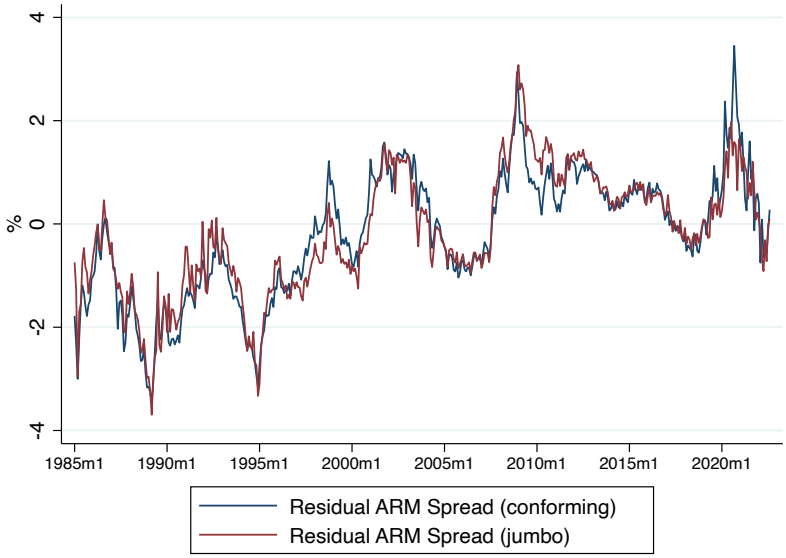
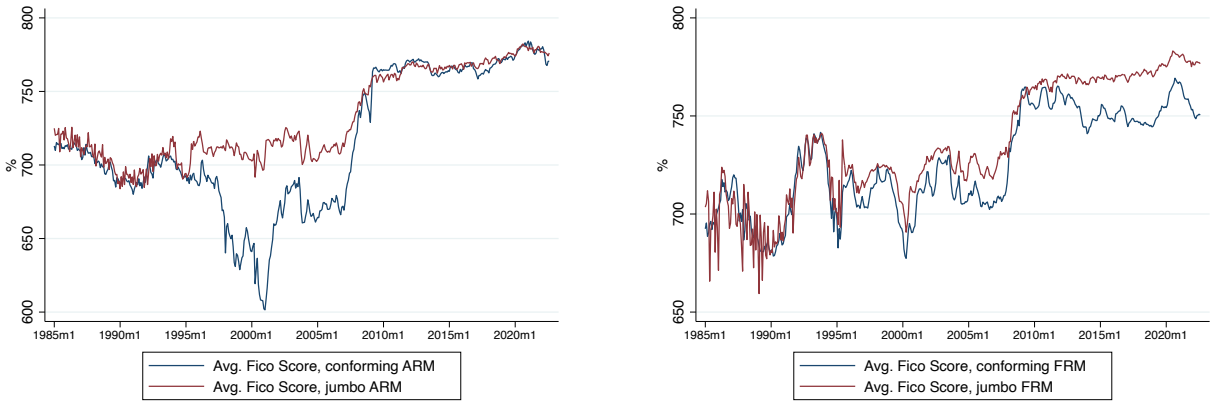
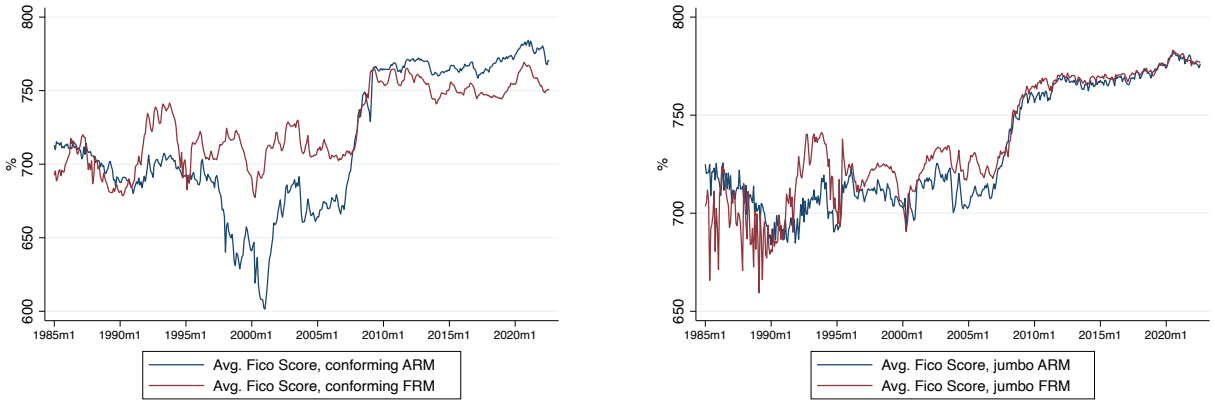


Figure A13: The ARM spread among jumbo and conforming loans. The figure plots the residual ARM spread separately for jumbo and conforming loans. The two series co-move closely, indicating that the price movements we document are market-wide and not specific to either segment. Source: CoreLogic.



(a) ARMs **(b)** FRMs

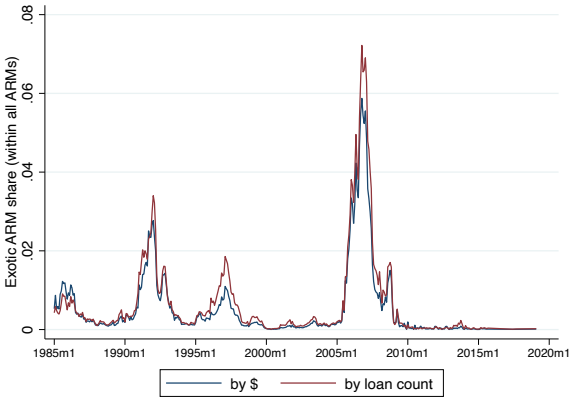
Figure A14: FICO scores among jumbo and conforming loans. The figure plots average FICO scores for jumbo and conforming borrowers, for ARMs in panel (a) and FRMs in panel (b). Jumbo borrowers have higher FICO scores than conforming borrowers for both contract types, with an especially large gap for ARMs during the 1990s and 2000s. FICO scores increase sharply after the GFC, reflecting the tightening of mortgage credit standards. Source: CoreLogic.



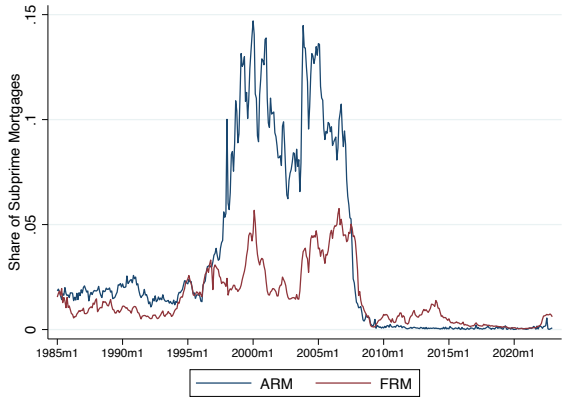
(a) Conforming **(b)** Jumbo

Figure A15: FICO scores among ARMs and FRMs. The figure plots average FICO scores for ARM and FRM borrowers, within conforming loans in panel (a) and jumbo loans in panel (b). Within conforming loans, FICO scores are on average lower for ARMs than for FRMs, with the gap most pronounced during the 1990s and early 2000s; after the GFC, scores rise for both groups, with a larger increase for ARMs. Within jumbo loans, FICO scores for ARMs and FRMs co-move closely throughout. Source: CoreLogic.

D Exotic ARMs, Subprime ARMs, and the FICO Distribution



(a) Exotic ARMs



(b) Share of loans to subprime borrowers (< 600)

Figure A16: Exotic and subprime ARMs. Panel (a) plots the share of ARMs with exotic features, defined as balloon ARMs, two-step ARMs, and graduated-payment ARMs. Panel (b) plots the share of ARMs and FRMs extended to subprime borrowers (FICO below 600). Both shares spiked around the GFC but remained small fractions of all ARMs even at their peaks, at 7% and 15%, respectively. The aggregate ARM share is therefore not driven by exotic or subprime lending. Source: CoreLogic.

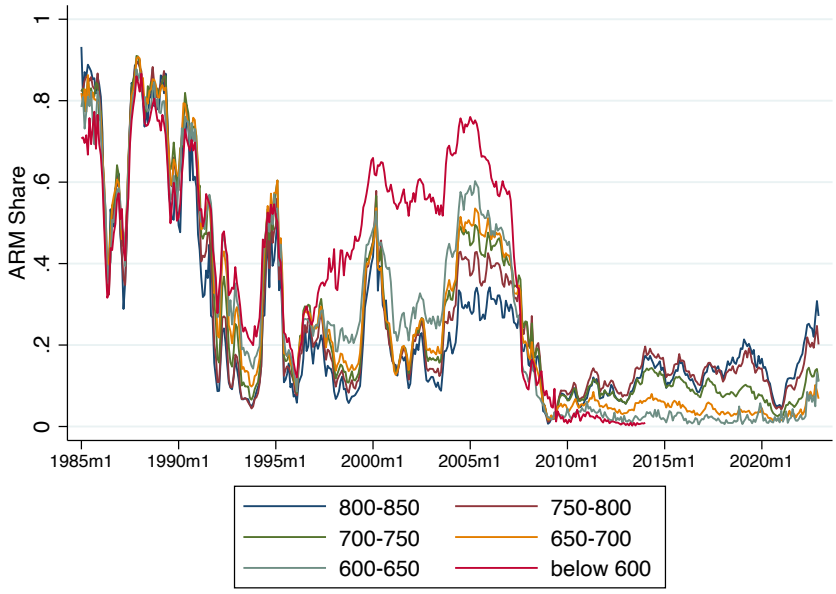
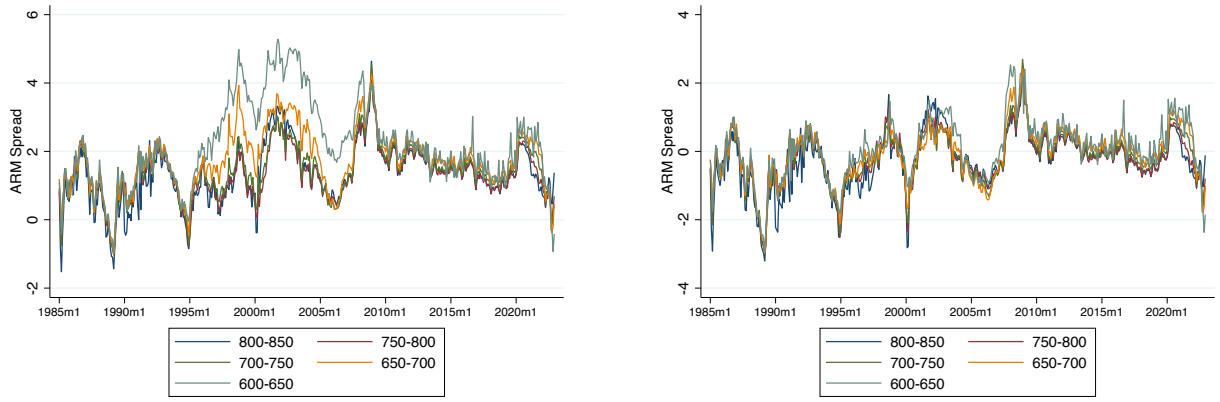


Figure A17: The ARM share across the FICO distribution. The figure plots the ARM share within FICO score buckets. From the late 1990s until the GFC, ARMs were more prevalent among lower-FICO borrowers; since 2010, ARMs are much more prevalent among higher-FICO borrowers. ARM shares co-move strongly over time across the FICO distribution, so the aggregate ARM share is not driven by subprime borrowers, who constitute less than 15% of all ARM loans. Source: CoreLogic.



(a) Raw ARM spread

(b) Residual ARM spread (product FE)

Figure A18: The ARM spread across the FICO distribution. Panel (a) plots the raw ARM spread within FICO score buckets; panel (b) plots the residual ARM spread controlling for product fixed effects. ARM spreads co-move strongly across the FICO distribution, indicating that the spread movements we document are market-wide price changes. Source: CoreLogic.