Lending by Servicing: Monetary Policy Transmission through Shadow Banks*

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Abstract

We propose a new conceptual framework for monetary policy transmission through shadow banks in the mortgage market that highlights the role of mortgage servicing in generating non-deposit funds for lending. We document that mortgage servicing acts as a natural hedge against interest rate shocks and dampens the effect of monetary policy on shadow bank mortgage lending. Higher interest rates reduce prepayment risk, increasing the collateral value of mortgage servicing assets and cashflow from servicing income. This enables shadow banks with greater exposure to mortgage servicing to obtain more funding. The mortgage servicing channel is weaker for traditional banks due to their reliance on deposit funding and the capital charge on mortgage servicing assets. Our estimates suggest that the rising share of shadow banks in mortgage servicing may have weakened the pass-through of monetary policy to aggregate mortgage lending.

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1 Introduction

The residential mortgage market is the largest consumer credit market in the United States and central to the monetary transmission mechanism. In recent years, shadow banks (i.e., non-depository mortgage lenders) have become increasingly prominent in this market, originating more than 50% of mortgages by volume (Buchak et al., 2018).[1] How shadow banks adjust their lending in response to interest rate changes is therefore of first-order importance when thinking about the effects of monetary policy on aggregate mortgage credit. Despite the rising importance of shadow banks in the U.S. residential mortgage market, we know little about what shapes the transmission of monetary policy to shadow bank credit supply. In this paper, we propose and test a new conceptual framework for monetary policy transmission through shadow banks that incorporates the unique institutional features of shadow banks in the U.S. mortgage market.

This conceptual framework underscores important interactions between mortgage lending and mortgage servicing, the two principal sources of revenue for shadow banks. In contrast to traditional banks that rely on deposits for funding, shadow banks use non-deposit funds for loan origination and working capital needs (Kim et al., 2018; Jiang et al., 2020; Jiang, 2023). Shadow banks' servicing business significantly affects the availability of these non-deposit funds and their ability to originate new mortgages. The transmission of monetary policy to shadow bank mortgage lending depends on how changes in interest rates affect the availability of these non-deposit sources of funding. By owning the claim to service a mortgage for its duration—i.e., a mortgage servicing right (MSR)—a shadow bank holds an asset whose value is positively correlated with interest rates and that can be pledged as collateral for external funding. When interest rates rise, prepayment speeds decline and the expected duration of outstanding loans lengthens, increasing the value of MSRs. These rising valuations expand the collateral base and enhance the pledgeability

[1] Following Buchak et al. (2018), we use the term "shadow bank" or "nonbank" to refer to non-depository mortgage lenders, as defined by the Financial Stability Board.

of MSRs, strengthening balance sheets and allowing shadow banks to secure funding on relatively favorable terms. This pledgability effect helps sustain lending activity precisely when external financing conditions tighten. At the same time, servicing provides shadow banks with a relatively stable stream of fixed income that is typically unaffected by changes in interest rates. Thus, for shadow banks, servicing acts as a natural hedge against interest rate shocks and attenuates the effects of monetary policy on their mortgage lending.[2] We call this the *mortgage servicing channel* of monetary policy transmission.

The mortgage servicing channel is economically meaningful for two reasons. First, mortgage servicing rights are the second largest asset on shadow banks' balance sheets following mortgages held for sale. The hedging properties of servicing with respect to interest rate shocks thus imply that exposure to mortgage servicing has the potential to significantly affect the transmission of monetary policy to nonbank mortgage lenders. Second, we document that the higher capital charge on MSRs introduced by the Basel III reforms led to a staggering shift of the servicing business from banks to nonbanks, with shadow banks now servicing a substantial fraction of mortgage debt.[3] Despite this, the consequences of shadow banks' involvement in mortgage servicing have been understudied in the literature, especially in the context of monetary policy transmission. By focusing on the business model of shadow banks and linking it to monetary policy transmission, our paper advances the literature on shadow banks as it provides an organizing economic framework to think about monetary policy transmission to nonbank lending via the mortgage servicing channel.

[2]E.g., during a period of monetary tightening in spring 2022, the *Wall Street Journal* wrote, "Mortgage companies have a not-so-secret weapon as they deal with rising interest rates and decreasing volumes: Mortgage-servicing rights." See https://www.wsj.com/articles/mortgage-firms-antidote-to-rising-rates-11648551600. Consistent anecdotal evidence can be found in the 2020 annual report of Rocket Companies Inc. (previously Quicken Loans): "...we believe our two principal sources of revenue, mortgage loan originations and mortgage loan servicing, contribute to a stable business profile by creating a natural hedge against changes in the interest rate environment." See https://www.sec.gov/Archives/edgar/data/1805284/000180528421000010/rkt-20201231.htm.

[3]In 2023, the share of loans serviced by shadow banks for Freddie Mac and Fannie Mae was 60% while that for Ginnie Mae was 83%. See https://home.treasury.gov/system/files/261/FSOC-2024-Nonbank-Mortgage-Servicing-Report.pdf

In order to test the mortgage servicing channel of monetary policy, we require data on the balance sheets, funding, and mortgage origination activity of shadow banks. We obtain their balance sheet and funding data from Mortgage Call Reports by submitting Freedom of Information Act requests to state regulators in Washington and Massachusetts. We merge these with data on loan originations from the confidential Home Mortgage Disclosure Act to analyze how involvement in mortgage servicing affects the transmission of monetary policy through shadow banks.

Estimating the effects of monetary policy suffers from a well known endogeneity problem: most changes in the Federal Reserve's policy rate reflect its systematic response to macroeconomic variables (Cristiano et al., 1999; Romer and Romer, 2004). To overcome this identification challenge, we follow Gürkaynak et al. (2022) in using the high-frequency movement of the three-months-ahead federal funds futures around policy rate announcements to measure shocks to monetary policy. This is important because, to the extent that changes in monetary policy were anticipated by market participants, they would already be priced into the value of MSRs through their effect on prepayment risk.

Our main empirical finding is that, in response to a contractionary monetary policy shock, shadow banks with a higher *ex ante* share of mortgage servicing rights in total equity reduce their mortgage lending relatively less. This result is robust to varying the definition of lender-level exposure to mortgage servicing, measurement of monetary policy shocks, and classification of lenders into shadow banks. We also conduct several robustness tests to ensure that our results are not driven by differences in shadow banks' balance sheet characteristics that could be correlated with their MSR exposure.

The active participation of shadow banks in mortgage servicing insulates their balance sheets from interest rate shocks through both a pledgability effect and a cashflow effect. The *pledgability effect* operates through the role of MSRs in supporting access to external credit. Shadow banks rely heavily on short-term warehouse lines of credit, the terms and availability of which depend on the value of pledged collateral and the overall balance sheet strength of the shadow bank. When interest rates rise unexpectedly, prepayment speeds decline (Eichenbaum et al., 2022; Greenwald, 2018), increasing the expected duration and valuation of MSRs. This increase in value improves the lender's credit profile, enabling them to maintain or expand access to external funding on favorable terms, including on warehouse lines of credit. In addition, MSRs are routinely pledged to secure credit facilities supporting working capital for origination platforms. Increase in MSR values also helps sustain working capital financing and this lending activity during periods of monetary tightening. Using detailed data on the secured credit lines of shadow banks, we show that following a contractionary monetary policy shock, shadow banks with greater *ex ante* MSR exposure draw more heavily on their credit lines and do so at lower cost.

The *cashflow effect* stems from the fact that servicing revenues are less sensitive to interest rate movements than origination income. When interest rates rise, origination volumes tend to decline, reducing fee income from new loan production. However, conditional on loans not being prepaid, shadow banks continue to receive servicing fees on outstanding mortgages. Consistent with this mechanism, we find that shadow banks with greater ex ante MSR holdings report relatively higher earnings following a contractionary monetary policy shock and derive a larger share of gross income from servicing. These findings underscore the role of MSRs in stabilizing both funding access and internal cashflow, thereby dampening the transmission of monetary policy to shadow bank lending.

To provide further support for the mortgage servicing channel, we explore its heterogeneity across the capital, risk exposure, and liquidity of shadow banks. In the presence of information asymmetry between shadow banks and their financiers, shadow banks with *ex ante* low capital or riskier portfolios may pay a lemon's premium in order to secure funding when interest rates rise. Having access to MSRs attenuates this problem and allows them to access funding at a cheaper rate. Hence, the mortgage servicing channel should be stronger for shadow banks with lower *ex ante* capital ratios and riskier portfolios. Our results support this hypothesis. Meanwhile, a shadow bank's stock of liquid assets reflects its ability to use internal funding. If a shadow bank lacks surplus liquidity upon which to draw when interest rates rise, the hedging role of MSRs can be more valuable. We hypothesize that the mortgage servicing channel is stronger for nonbanks with a low stock of liquid assets. Our results are consistent with this hypothesis as well.

An important question to ask is whether the mortgage servicing channel has significant effects on the transmission of monetary policy to *aggregate* mortgage lending. At the intensive margin, it depends on whether the strength of the mortgage servicing channel differs for traditional banks and shadow banks. At the extensive margin, it depends on the composition of lenders in a given region. To study the intensive margin, we use a combined sample of banks and nonbanks to show that, conditional on having the same *ex ante* exposure to servicing, nonbanks reduce mortgage origination less compared to banks after a contractionary monetary policy shock. This is because the marginal value of an additional dollar of mortgage servicing rights is relatively lower for banks. MSRs are not the marginal source of funding for banks, given their large reliance on deposit funding. Furthermore, MSRs carry a capital charge for banks, making it costlier for them to retain such assets on their balance sheet. Thus, the mortgage servicing channel is weaker for depository institutions.

Because the mortgage servicing channel operates differently for banks and nonbanks, the exact composition of mortgage servicers is relevant for the transmission of monetary policy shocks to aggregate lending. We hypothesize that, in regions with a larger nonbank servicing share, the pass-through of monetary policy shocks to mortgage origination should be weaker. Within a given region, however, shadow banks' involvement in servicing and lending could be simultaneously driven by unobservable shocks. To address this endogeneity concern, we exploit the U.S. implementation of Basel III capital requirements on banks' holdings of mortgage servicing rights to generate plausibly exogenous variation in the nonbank share of servicing (Berrospide and Edge, 2016; Irani et al., 2021). We show that, in regions where banks had lower capital adequacy prior to Basel III, shadow banks increased their share of the servicing market more. Using banks' aggregate capital adequacy as a proxy for shadow bank servicing share, then, we find that the effect of monetary policy on mortgage lending is weaker in regions that experienced greater reallocation of servicing towards nonbanks.

The rest of the paper proceeds as follows. Section 2 connects our paper to the related literature. Section 3 describes institutional features of the mortgage servicing industry, outlines a conceptual framework and provides empirical evidence on the relationship between interest rates and MSR valuation, and describes how MSRs facilitate funding for shadow banks. Section 4 describes data used in the empirical analysis. Section 5 presents our main findings on how exposure to mortgage servicing rights dampens the transmission of monetary policy to mortgage lending through shadow banks. Section 6 studies implications of the mortgage servicing channel for aggregate mortgage lending. Section 7 concludes.

2 Related Literature

Our paper is motivated by studies that have documented the rise of shadow banks in the U.S. mortgage origination market and examined its implications for credit intermediation.[4] Following Buchak et al. (2018), who first documented the dramatic rise of shadow banks in mortgage origination, attributing it to a combination of regulatory arbitrage and technological innovation, subsequent work has investigated various factors driving this growth (Gete and Reher, 2021; Sarto and Wang, 2023) and examined the implications of this shift for aggregate lending and borrower outcomes (Buchak et al., 2023, 2024) and efficiency of mortgage lending (Fuster et al., 2019). While this literature has focused primarily on shadow banks' rise in mortgage origination, the role of their servicing

[4]Shadow banks' lending share has also been increasing in other credit markets in the U.S., including the market for small business loans (Gopal and Schnabl, 2022), loans to middle-market firms (Chernenko et al., 2022; Davydiuk et al., 2024), and syndicated corporate loans (Irani et al., 2021).

business remains less understood, especially in the context of monetary policy. Our paper contributes to this literature by connecting shadow banks servicing business to monetary policy transmission, thus uncovering a new channel through which shadow banks can affect lending in the U.S. mortgage market.

Our primary contribution is to show that mortgage servicing—an asset traditionally studied in the context of borrower distress—plays an active role in shaping shadow banks' lending response to monetary policy. Specifically, we demonstrate that mortgage servicing can support shadow banks' funding during periods of monetary tightening. This connects our work to the literature on the funding and capital structure of shadow banks, which has emphasized their reliance on short-term, non-deposit funding sources such as warehouse lines of credit (Jiang et al., 2020; Jiang, 2023). We extend this literature by uncovering the complementary and often overlooked role of MSRs in improving funding capacity. Because MSR valuations tend to rise with interest rates, they expand the collateral pool and increase pledgability, thereby improving access to external financing when liquidity is scarce. This makes MSRs a natural hedge against monetary tightening. In this sense, our analysis deepens the understanding of MSR valuation—a topic of increasing importance as MSRs now constitute the second largest asset on many shadow banks' balance sheets—and highlights their role in hedging interest rate risk.

In addition, our work contributes to a small but growing literature on mortgage servicing by highlighting a distinct economic role for MSRs. Existing studies have emphasized how servicer liquidity constraints influence loan modification and foreclosure outcomes during borrower distress (Agarwal et al., 2017; Piskorski and Seru, 2018; Cherry et al., 2021, 2022; Kim et al., 2024), while others have assessed servicing quality (Degerli and Wang, 2021). More recently, Hamdi et al. (2023) have investigated the secondary market for MSRs and the characteristics of loans transferred to nonbanks. In contrast, our paper shows that servicing can be a source of liquidity when interest rates rise. This perspective complements Kim et al. (2018) who emphasize the financial stability concerns associated with the rise of nonbanks in the servicing market. By uncovering the liquidity benefits of MSRs during periods of monetary tightening, our work connects to the research on optimal mortgage market design during periods of distress, where servicers' balance sheet strength plays a key role in shaping debt relief outcomes (Piskorski and Seru, 2018; Cherry et al., 2022).

Finally, we contribute to recent work on monetary policy transmission through nonbank financial institutions, but uncover a new channel.[5] Existing studies highlight deposit flows as the primary margin of adjustment, focusing on how rising rates prompt outflows from banks to nonbanks (Xiao, 2020) or accelerate deposit flight from online banks (Erel et al., 2023). In contrast, we identify a servicing-based channel that operates through the asset side of shadow bank balance sheets. This channel is particularly relevant in the U.S. mortgage market, where nonbanks dominate both origination and servicing. The servicing channel we identify is conceptually analogous to traditional bank lending channels, which emphasize heterogeneity in size, liquidity, capital, or competition in loan or deposit markets as key determinants of monetary policy transmission to bank lending (Kashyap and Stein, 2000; Van den Heuvel et al., 2002; Scharfstein and Sunderam, 2016; Drechsler et al., 2017; Indarte, 2023; Wang et al., 2022). Our work similarly highlights MSR exposure as an important source of asset-side heterogeneity that shapes shadow banks' lending response to monetary policy. To our knowledge, this is the first study to demonstrate that variation in MSR exposure generates cross-sectional heterogeneity in shadow banks' lending response to monetary tightening, offering a new perspective on how monetary policy transmits through the nonbank financial system.

[5] Cucic and Gorea (2022) study the role of nonbanks in monetary policy transmission in the context of unsecured credit to firms and households in Denmark. Elliott et al. (2021) show that monetary contraction leads to a shift in credit supply from banks to nonbanks in several consumer and corporate credit markets.

3 Institutional Background and Conceptual Framework

The conventional bank lending channel of monetary policy operates through the role of deposits in funding loans. When monetary policy tightens, deposit spreads widen due to banks' market power, leading to deposit outflows and reduced lending (Drechsler et al., 2017). Fixed-rate mortgage lending might be particularly affected as banks match the relatively interest-insensitive deposit funding with interest-insensitive long-term fixed rate lending (Drechsler et al., 2021). In contrast, shadow banks cannot issue deposits and rely on non-deposit sources of funding to originate loans. This suggests that the deposit channel of monetary policy may not be relevant for nonbanks and monetary policy might be transmitted to their lending through non-deposit sources of funding. In what follows, we describe mortgage servicing, effect of interest rates on MSR values, the role of servicing in generating non-deposit sources of funding for shadow banks, and its expected effect on monetary policy transmission.

3.1 Mortgage Servicing Rights

Mortgage servicing involves a wide range of loan administration duties after the loan is originated. These include collecting and recording monthly payments from borrowers, distributing those payments to investors, local governments, and insurance companies, and handling delinquencies and foreclosures. A mortgage servicing right is an asset that is created when a primary lender sells its originated mortgage but retains the right to service the mortgage.[6] In exchange for performing servicing duties, the servicer (i.e., the MSR holder) is compensated with a fee equal to a fixed share—typically 25-50 basis points—of

[6] A secondary market for mortgage servicing rights exists, so a primary lender may also choose to sell the mortgage servicing right to another intermediary, who would then be responsible for servicing the loan.

the outstanding mortgage balance.[7] Importantly, the right to service a loan generates a stream of future cash flows from servicing and is booked as a financial asset on the servicer's balance sheet. Beyond fee income, MSRs are economically important because they can be pledged as collateral for external funding and directly affect a firm's equity value through changes in fair value.

Interest Rates and MSR Valuation The fair value of a mortgage servicing right, is the present discounted sum of expected revenue from servicing the underlying loan. This value is decreasing in prepayment risk: as the probability of prepayment declines, the expected duration of a loan increases and the MSR holder will receive income from servicing over a longer time horizon. Since higher interest rates reduce prepayment risk, the value of MSRs generally increases when interest rates rise.

To better understand the interest rate sensitivity of mortgage servicing rights (MSRs), it is useful to conceptualize them as interest-only (IO) strips of mortgage-backed securities—a characterization widely used by regulators and market practitioners.[8] IO strips separate the cash flows from a mortgage pool into a tranche that entitles the holder to receive only the interest payments. These payments are highly sensitive to prepayment behavior, as they cease when borrowers refinance or repay their mortgages early. MSRs share this structure. They entitle the holder to a stream of fixed servicing fees—typically a percentage of the outstanding mortgage balance—which similarly cease upon prepayment. This common exposure to prepayment risk results in similar duration properties, making IO strips a natural conceptual benchmark for understanding MSR duration.[9]

[7] Figure 1 illustrates the flow of funds between borrowers, servicers, and investors in the mortgage servicing market.

[8] See, for example, Reserve (2016) and Aldrich et al. (2001). The white paper released by Wilary Winn, a company that provides valuations of MSRs for mortgage lenders also describes MSRs as a modified interest-only strip. See `https://wilwinn.com/resources/mortgage-servicing-rights-valuation-input-assumption-shocks-white-paper/`

[9] Unlike IO strips, which are passively held financial assets requiring no operational involvement, MSRs are active servicing assets. The MSR holder must perform a range of administrative duties, including payment collection, escrow management, delinquency tracking, and foreclosure handling. Nevertheless, the valuation mechanics of MSRs closely resemble those of IO strips, as both derive value from future income streams that are highly sensitive to interest rate-driven changes in prepayment risk.

Existing studies have documented that IO securities typically have a negative duration (Marcus and Kling, 1987). While higher interest rates decrease the present value of fixed cash flows through a standard discounting effect, they also extend the life of the mortgage by reducing prepayment incentives. In practice, the prepayment effect dominates the discounting effect, leading to asset values that rise when interest rates rise and fall when rates decline. Becketti (1988) notes that because of their negative duration, interest-only securities are often used as hedging instruments in fixed income portfolios, which typically exhibit positive duration. Similar valuation dynamics apply to MSRs, which also exhibit negative duration. This has been widely documented in regulatory reports and mortgage servicer disclosures. For example, the 2016 Report to Congress on the Effect of Capital Rules on Mortgage Servicing Assets notes that MSR values have historically risen in periods of increasing interest rates and declined during rate cuts.[10] Consistent anecdotal evidence can be found in servicers' financial statements. For instance, Rocket Mortgage's 2024 annual report states that "in periods of rising interest rates, the fair value of the MSRs generally increases as prepayments decrease, and therefore the estimated life of the MSRs and related expected cash flows increase."[11]

Empirical Evidence Empirically estimating the duration of MSRs is inherently challenging because these assets do not trade on public exchanges, and reliable market prices are rarely observed. As a result, direct estimates of their interest rate sensitivity are scarce, and most prior discussions remain either conceptual or anecdotal. To overcome this limitation, we leverage the best available source of supervisory data and construct a new panel dataset on interest rate sensitivities of MSRs from the Federal Reserve's confidential Y-14Q filings. These reports, submitted by stress-tested bank holding companies, include detailed information on the fair value of MSR portfolios under standardized hypothetical

[10] See https://www.federalreserve.gov/publications/2016-capital-rules-mortgage-servicing-assets-executive-summary.htm

[11] See https://www.sec.gov/Archives/edgar/data/1805284/000180528425000010/rkt-20241231.htm.

yield curve shifts. To our knowledge, this dataset has not been previously used in academic research. We undertake a substantial data collection effort to manually compile and harmonize these disclosures across institutions and quarters. We provide a summary of sensitivity estimates in Table A.2, with a full description of the data construction in Appendix Section A.1. We find that a 25-basis point upward shift of the yield curve is associated with an average increase in MSR valuations of approximately 9 percent, consistent with the notion of negative duration.[12]

To validate the duration mechanism—that higher rates lower prepayments and extend expected mortgage life—we link the observed MSR rate sensitivity in the Y-14 data to factors that govern prepayment risk. Existing literature has identified moneyness of the prepayment option on the mortgage as a key factor that determines how a small change in interest rates affects prepayment probability (Fuster et al., 2022), which would then determine the change in expected life of the mortgage and, hence, MSR value. For fixed-rate mortgages, prepayment incentives rise when the market rate falls below the loan coupon, making the prepayment option "in the money" and fall when the market rate rises ("out of the money"). Portfolios with higher moneyness of the prepayment option, i.e., those with mortgages whose prepayment option is in the money, are more exposed to prepayment risk so a given rate change would produce a larger change in prepayments. Consequently, these portfolios should display stronger negative duration—bigger MSR valuation gains when rates rise and bigger losses when rates fall.

To empirically examine the relationship between the servicing portfolio's moneyness and MSR interest rate sensitivities, we merge lenders' MSR sensitivities from the Y-14 data (the percent change in MSR fair value under a +25 bps interest rate shock) with the Fannie Mae and Freddie Mac Single Family Loan-Level datasets that identify each

[12]The fact that MSR values increase on average by about 9% when interest rates rise implies that the prepayment channel, where higher rates extend the life of the loan, dominates other forces. In particular, higher rates would otherwise reduce MSR values through (i) a discounting effect, which lowers the present value of servicing income, and (ii) a delinquency effect, as tighter policy may increase defaults, raising the costs of servicing non-performing loans.

institution's servicing portfolio. Following Fuster et al. (2022), we measure moneyness as the difference between the weighted average coupon rate and the monthly average 30-year fixed-rate mortgage rate across all mortgages in the servicer's portfolio, so higher values indicate a more in-the-money refinance option. To test whether higher moneyness is associated with larger MSR sensitivities, we estimate the following regression:

$$\text{MSR Sens}_{it} = \alpha + \beta \, \text{Moneyness}_{it} + \gamma X_{it} + \varepsilon_{it}. \quad (1)$$

where the dependent variable is the interest rate sensitivity of the MSR portfolio of lender i at time t and the main independent variable is the moneyness of the MSR portfolio of lender i at time t. X_{it} includes lender-level controls such as size, equity, profitability, liquidity, and leverage. Results from this estimation are reported in Table A.3. Column 1 does not include any fixed effects or controls, column 2 adds lender and valuation model fixed effects, and column 3 adds lender-level controls. We find that β is positive and statistically significant, suggesting that portfolios with higher moneyness experience larger MSR gains when rates rise (and correspondingly larger losses when rates fall). By tying the cross-section of MSR sensitivities to observable portfolio characteristics that govern prepayment incentives, these results provide support to the underlying duration mechanism through which interest rates affect MSR values.

3.2 Servicing and Monetary Policy Transmission

Shadow banks fund mortgages using warehouse lines of credit and internally generated cash from their origination and servicing platforms. While most drawdowns on these warehouse lines of credit are collateralized by the mortgages they fund, MSRs play a central role in enhancing a shadow bank's overall collateral pool and shaping the availability and terms of these credit lines, particularly following monetary tightening. When the value of the underlying mortgage collateral declines—such as during periods of monetary tightening—

lenders may reduce the advance rate on warehouse lines or require additional collateral.[13] In such cases, having access to MSR collateral can enable shadow banks to maintain access to funding without disruptions.

In addition, MSRs are routinely pledged as collateral in separate financing arrangements, such as MSR-backed credit lines, secured notes and notes payable. These MSR facilities support origination activity by providing working capital essential for the ongoing operations of origination platforms of nonbanks (Kim et al., 2018). While most shadow banks do not disclose detailed information on which lines are secured by MSRs, regulatory filings for a few shadow banks offer insights into the importance of MSR financing. For instance, Ocwen's 10-Q filing in 2022Q2 indicates that MSR-secured facilities accounted for roughly 41% of its borrowing capacity.[14]

Changes in MSR valuations also contribute to the equity base of nonbank mortgage lenders and thus bolster their overall credit profile. In a setting where monetary tightening increases the value of MSRs, this improved balance sheet strength can lead to better financing terms or higher credit limits, even for facilities that are not directly backed by MSRs. In this way, MSRs function as a form of second-layer collateral that supports overall lending capacity of shadow banks, particularly in periods of tight external financing conditions.

Finally, servicing also provides shadow banks with a relatively stable income stream because servicing fees collected from existing mortgages are invariant to future changes in market interest rates. Hence, the servicing business of shadow banks provides

[13] See https://www.sec.gov/Archives/edgar/data/1783398/000178339824000044/uwmc-20240930.htm

[14] See https://www.sec.gov/Archives/edgar/data/873860/000162828022021121/ocn-20220630.htm. Rocket Mortgage, PHH Mortgage, NewRez, and Mr. Cooper similarly disclose MSR-secured borrowing facilities in their financial statements. We manually collected data on these facilities from the annual reports of these lenders over the period 2019–2024 and constructed the average share of MSR-secured financing in total debt facilities reported by each lender. We focus on this set of lenders and years because consistent disclosures are available only for this period, which ensures comparability across institutions while capturing the main public nonbank servicers active in the MSR market. The resulting numbers are reported in Table A.4 and suggest that MSR-backed facilities form a nontrivial share of total debt facilities for these lenders.

diversification benefits and insulates their balance sheets from monetary policy shocks.

4 Data and Methodology

4.1 Shadow Bank Balance Sheets and Funding Sources

We obtain shadow bank balance sheet data and credit line data from Mortgage Call Reports (MCRs) filed under the Nationwide Multistate Licensing System (NMLS). Pursuant to the S.A.F.E. Mortgage Licensing Act of 2008, shadow banks that hold a state license or state registration to conduct mortgage origination have been required to file a call report in each state in which they perform lending activities on an annual or quarterly basis since 2011. Following existing studies that have used shadow bank call reports data (Jiang, 2023), we submit Freedom of Information Act requests to the states of Washington and Massachusetts. As long as a shadow bank is registered in either Washington or Massachusetts, i.e., it does business in these states, we can obtain its MCR data at the mortgage company level regardless of where it is headquartered. Sampling these two states allows for an extensive coverage of nearly 80% of total mortgage volume originated by U.S. shadow banks (see Figures A.1 and A.2).[15]

MCRs have two segments, Financial Condition (FC) and Residential Mortgage Loan Activity (RMLA). The FC segment provides data on standard balance sheet variables at the mortgage company level, while the RMLA segment collects information on loan applications, closed loans, the identity of the individual mortgage loan originator, lines of credit, servicing, and repurchases by state for each mortgage company. Both segments are available at quarterly frequency.[16] We obtain balance sheet variables for shadow banks

[15] Each state has its own public disclosure law. Washington and Massachusetts are the two states that allow disclosure of Financial Condition (balance sheet) data of shadow banks. Other states, such as Florida, prohibit the disclosure of these data to the public.

[16] There are two types of Mortgage Call Reports, Standard and Expanded. The RMLA segment is available at quarterly frequency for both the Standard MCR and Expanded MCR. The FC segment is available at annual frequency for the Standard MCR and quarterly frequency for the Expanded MCR.

such as size, capital, liquidity, interest costs, mortgage servicing rights, etc., from the FC segment; funding information such as credit limit, used credit, and credit line provider names from the company-level RMLA segment; and the FICO distribution of closed loans from the state-specific RMLA segment.[17]

4.2 Mortgage Origination

To observe the mortgage origination activity of shadow banks and traditional banks, we use loan application data from the confidential Home Mortgage Disclosure Act (HMDA) dataset. HMDA requires financial institutions satisfying minimum asset and loan origination thresholds to disclose information about the mortgage loan applications they receive, making the resultant dataset the most comprehensive source of information on the U.S. residential mortgage market. It contains a rich set of characteristics about the lender, borrower, and mortgage itself at the application level. For example, we observe the location, income, race, ethnicity, and gender of borrowers. For lenders, we observe their name and address, as well as a unique lender identifier.

Critically for our empirical analysis, the confidential version of the dataset discloses the date of origination for each application, conditional on it being approved, whereas the public-use version only discloses the year in which a loan is originated. We are thus able to aggregate origination activity to quarterly frequency. This is needed to credibly identify the effects of monetary policy shocks on mortgage lending.

Fannie Mae and Freddie Mac seller/servicers or Ginnie Mae issuers must submit an Expanded MCR. Companies should complete either the Expanded or Standard MCR, not both for any period. We use Financial Condition data from Expanded MCR, which is at quarterly frequency.

[17] The RMLA component reports line of credit and servicing data at the company level and other information at the state level by company. We have the state-specific RMLA data for Washington and Massachusetts.

4.3 Other Data

To obtain comparable information on the balance sheets of traditional banks, we use Form FR Y-9C reports that collect consolidated financial data for domestic bank holding companies at quarterly frequency. The reports contain a balance sheet, income statement, and supporting schedules for each holding company. We download them from the Wharton Research Data Services' Bank Regulatory Database.

To construct a measure of nonbank and bank shares of mortgage servicing at a regional level, we use the Fannie Mae and Freddie Mac Single Family Loan-Level Datasets. These datasets provide characteristics of mortgage originations purchased or guaranteed by the GSEs—including the identity of the financial institution servicing the loan and the MSA of the mortgaged property—at quarterly frequency.

4.4 Sample Construction

To obtain our main results on the mortgage servicing channel in Section 5, we merge data from the Mortgage Call Reports and the Home Mortgage Disclosure Act. We identify a lender in HMDA as a shadow bank if it is classified as an "independent mortgage bank" following the Avery file.[18] We merge the two datasets using the name and address of shadow banks. This yields a sample of 346 shadow banks over the period 2012–2019.[19] It includes major shadow banks operating in the U.S. mortgage market, such as Nationstar Mortgage and Quicken Loans.

To investigate the role of exposure to mortgage servicing rights on the external funding of shadow banks, we merge line of credit data from the Residential Mortgage Loan Activity

[18] See https://sites.google.com/site/neilbhutta/data for the Avery file. All results reported in this paper are robust to including lenders classified as "independent mortgage bank affiliated with a depository institution" in our sample. These affiliated shadow banks make up only a small fraction of lenders under this broader definition.

[19] The 2018 Q4 Financial Condition data are largely missing and only available for 34 mortgage companies. The reason is that our FC data were generated from the NMLS system in January 2019, when most of mortgages companies had not filed their Q4 reports. All results remain unchanged if we use interpolated data for this quarter.

segment of the MCR with balance sheet data from Financial Condition segment. For each active line of credit reported by a shadow bank, the RMLA segment reports the lender name, credit limit, and the remaining credit available. We assign a lender ID to the lender name by manually matching the lender name with its FDIC ID from the FDIC website. We aggregate the credit line data at the shadow bank-lender bank pair level and merge the credit line data with the FC segment for shadow banks.

To measure the risk profile of shadow banks' lending portfolio, we obtain the FICO distribution of closed loans from the RMLA segment. For each mortgage company, we can observe the amount and count of mortgages originated in each FICO category in a state at quarterly frequency. We compute the fraction of mortgages with low FICO scores (i.e., ≤ 650) and merge this risk measure with the HMDA dataset.

To test if the mortgage servicing channel differs across banks and nonbanks, we construct a combined sample of both types of financial institutions using the MCR, HMDA, and FR Y-9C datasets. To estimate how the increased share of nonbanks on mortgage servicing has affected the pass-through of monetary policy shocks to aggregate mortgage lending, we use the FR Y-9C and GSE datasets to calculate aggregate bank regulatory capital adequacy and the share of mortgages serviced by shadow banks, respectively, at the metropolitan statistical area (MSA) level.

4.5 Summary Statistics

To provide a description of shadow banks' balance sheets and funding variables more generally, Table 1 contains summary statistics from the shadow bank Mortgage Call Reports for the period 2012–2019. Panel A of Table 1 summarizes the balance sheet variables from the Financial Condition segment. On average, shadow banks hold \$0.51 billion in assets with a standard deviation of \$1.38 billion.[20] Mortgage loans account on

[20]We compare our shadow bank call reports data with Jiang (2023), which also uses shadow banks call reports data for the period 2011–2017. We find that, over the period 2012–2017, the size distribution of shadow banks in our sample is comparable to the size distribution reported in Jiang (2023). Shadow

average for 57% of their assets. Following mortgage loans held for sale, mortgage servicing rights are the second largest asset. More than 80% of shadow banks have some exposure to MSRs, and they account on average for 8% and 32% of their assets and equity, respectively. The average shadow bank has an equity ratio of 28%.

Panels B and C of Table 1 report summary statistics on the funding structure of shadow bank from the Residential Mortgage Loan Activity segment. Panel B shows summary statistics for funding-related variables aggregated at the shadow bank level. In each year-quarter, a shadow bank in our sample has a mean total credit limit from banks of $0.86 billion with a utilization rate of 52%. The average estimated annualized interest rate on credit lines is 2.7%.[21] Panel C displays summary statistics on funding at the shadow bank-lender bank pair level. During our sample period, our data contains 27,137 lines of credit for 384 shadow banks and 224 banks. The average credit limit that a shadow bank receives from a bank in our sample is $0.21 billion.

Table 2 contains summary statistics for the merged data set of Mortgage Call Reports and the Home Mortgage Disclosure Act for the period 2012–2019 that we use in our empirical analysis. Panel A of Table 2 summarizes the merged dataset at shadow bank-county level. On average, shadow banks originate 3.27 mortgages and $632,700 of new mortgage lending in a county in a year-quarter. Panel B of Table 2 summarizes the merged dataset at the lender-county level, where lenders include both banks and shadow banks. On average, lenders originate of 3.60 mortgages and $658,523 of new mortgage lending in a county in a year-quarter. Compared to shadow banks, banks originate more mortgages

banks in our sample hold an average $0.49 billion in assets with a standard deviation of $1.49 billion during 2012–2017, whereas, in Jiang (2023), the mean and standard deviation of assets are $0.47 billion and $1.51 billion, respectively.

[21] Following Jiang (2023), we estimate the interest rate using the following formula: $\text{Expense}_{i,q} = \left(1 + r_{i,t}^{\text{daily}} + \text{Qave\_Libor}_{i,q}\right)^{90} \times \text{LineUsage}_{i,q} - \text{LineUsage}_{i,q}$, where $\text{Expense}_{i,q}$ is shadow bank i's total warehouse interest expense in quarter q, $\text{Qave\_Libor}_{i,q}$ is the average overnight LIBOR rate in quarter q, and $\text{LineUsage}_{i,q}$ is the sum of shadow bank i's usage of all credit lines in quarter q. We obtain the quarterly LIBOR data from the Federal Reserve Bank of St. Louis. We annualize $r_{i,t}^{\text{daily}}$ to obtain the annual interest cost for a shadow bank i in quarter q.

and slightly larger mortgages.

4.6 Monetary Policy Shocks

Higher interest rates lower borrowers' incentives to refinance, which in turn affect the valuation of mortgage servicing rights by increasing the expected duration of outstanding loans. To the extent that market participants anticipate future changes in monetary policy, the current value of MSRs should already reflect those expectations and not respond to observed changes in the policy rate. To capture the unanticipated component of changes in monetary policy, we use the surprise movement in the three-months-ahead federal funds futures from Gürkaynak et al. (2022) from 2012–2019 as our monetary policy shock.

This measure employs the high-frequency identification strategy based on the assumption that monetary policy news dominates other factors within a 30-minute window around the U.S. Federal Open Market Committee (FOMC) policy announcements. To match the frequency of the shadow bank balance sheet and HMDA data, we convert the surprises from meeting-by-meeting to quarterly frequency by summing all meeting surprises within a year-quarter.

5 Results on the Mortgage Servicing Channel

In this section, we present evidence that shadow banks with higher exposure to mortgage servicing reduce their mortgage lending less after a contractionary monetary policy shock. Next, we document that this mortgage servicing channel of monetary policy transmission operates through a pledgability effect and a cashflow effect. Both effects illustrate how participation in mortgage servicing hedges the origination business of shadow banks against interest rate shocks. Finally, we show that the mortgage servicing channel is stronger for shadow banks with *ex ante* lower capital ratios, riskier lending portfolios, and lower stock of liquid assets. These results are consistent with mortgage servicing rights alleviating the frictions that shadow banks face in raising external finance.

5.1 The Mortgage Servicing Channel for Shadow Banks

The distinct funding structure of shadow banks and the institutional features of the mortgage servicing market suggest a role for servicing in affecting the transmission of monetary policy to nonbanks' mortgage lending. When interest rates rise, MSRs appreciate in value. Shadow banks that hold MSRs on their portfolio can either pledge them as collateral to obtain secured funding or sell them for cash. The increase in MSR values following monetary policy tightening also improves shadow banks' balance sheet strength, enabling them to maintain or expand access to external funding on relatively favorable terms. Furthermore, cashflows from servicing existing loans should be relatively insulated from changes in current interest rates because servicing fees are predetermined. In either case, we expect that the mortgage lending of shadow banks with higher *ex ante* holdings of MSRs should be less negatively affected by a contractionary monetary policy shock. This is the mortgage servicing channel of monetary policy transmission.

To test this hypothesis, we estimate the regression model

$$\begin{aligned} Y_{l,c,t} = {} & \beta_1 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_2 \mathrm{FFF3m}_{t-1} + \beta_3 \mathrm{MSREquity}_{l,t-1} \\ & + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + \epsilon_{l,c,t}, \end{aligned} \tag{2}$$

where $Y_{l,c,t}$ is the log loan count or log loan amount originated by shadow bank l in county c in year-quarter t. $\mathrm{FFF3m}_{t-1}$ is the lagged cumulative change in the three-months-ahead federal funds futures in a 30-minute window around FOMC announcements, discussed in Section 4.6. $\mathrm{MSREquity}_{l,t-1}$ is the lagged share of mortgage servicing rights in total equity of shadow bank l and captures its exposure to mortgage servicing.[22] We add a vector of

[22] To measure a shadow bank's exposure to mortgage servicing, we scale MSRs by equity. This choice reflects the central role of equity in determining a shadow bank's lending capacity, particularly through its effect on access to non-deposit funding. MSRs are a significant asset on shadow banks' balance sheets, and their valuation significantly affects shadow banks' equity. By scaling MSRs by equity, we capture the

lagged time-varying lender-level controls $X_{l,t-1}$ from shadow bank balance sheet data.[23] Following Drechsler et al. (2017), we saturate the model with lender (FE_t), year-quarter (FE_l), and county-year-quarter ($FE_{c,t}$) fixed effects. We further add lender-county fixed effects ($FE_{c,l}$) to control for the selection of shadow bank entry into different counties. We cluster standard errors at the lender-county level. The coefficient of interest is β_1, which captures the differential effect of exposure to MSRs on the transmission of monetary policy shocks to shadow bank mortgage lending. If the mortgage servicing channel holds in the data, we expect β_1 to be positive.

Table 3 reports the results. Columns 1–3 and 4–6 display regression estimates using log loan count and log loan amount as the dependent variable, respectively. To aid the economic interpretation of our results, we standardize $\text{MSREquity}_{l,t-1}$ to a mean of 0 and a standard deviation of 1 when estimating the regressions presented in this section. The coefficient on the interaction term between the monetary policy shock and shadow bank MSR exposure is positive and statistically significant across all specifications and for both measures of mortgage origination. This indicates that credit supplied by shadow banks with higher *ex ante* exposure to MSRs is less negatively affected by contractionary monetary policy compared to shadow banks with lower MSR exposure. The estimated coefficients imply that, for a given 25bp contractionary monetary policy shock, raising the MSR-to-equity ratio of a shadow bank by one standard deviation leads to a 13.4% smaller decline in the number of originations and a 13.0% smaller decline in loan volume.[24]

importance of MSRs in supporting the bank's capital base and, by extension, its capacity to originate loans—especially in response to monetary policy shocks. In Section 5.2.2, we also use MSR-to-asset ratio as an alternative measure of a shadow bank's exposure to mortgage servicing and find that our results remain robust to this measure (see Appendix Table A.11). However, it is not our preferred measure of exposure because the asset side of mortgage companies' balance sheets primarily reflects mortgages held for sale, which are directly related to prior lending. As such, scaling MSRs by assets would essentially amount to scaling them by lagged lending, which introduces a mechanical correlation with our dependent variable.

[23]These include assets, equity, return on equity, share of unpaid mortgage balances held in prime conforming loans, ratio of unpaid mortgage balances to assets, liquidity ratio, and capital ratio.

[24]Since the inclusion of various time fixed effects in Table 3 doesn't allow us to observe the standalone effect of monetary policy shock on lending, we re-estimate Equation (2) without time and county-time fixed effects, and instead including time varying controls at the county level, to assess the extent to which

5.2 Robustness Checks and Additional Results

5.2.1 MSR Exposure and Balance Sheet Characteristics

One potential concern with the results in Section 5.1 is that exposure to MSRs could be correlated with other balance sheet attributes that might drive the response of shadow bank lending to monetary policy. To address this concern, we implement four complementary strategies. First, we conduct a difference-in-means test for balance sheet characteristics of shadow banks with high and low MSR exposure to compare balance sheet characteristics of the two groups. Second, we augment our baseline specification in Equation (2) by including interaction terms between the monetary policy shock and key lender characteristics that may co-vary with MSR exposure. This approach ensures that any variation in shadow banks' lending response to monetary policy shocks that is driven by their balance sheet characteristics is absorbed by these interaction terms. Third, we strengthen our identification by using two methods to achieve covariate balance between shadow banks with high and low MSR exposure: entropy balancing and propensity score matching. Finally, we use an instrumental variable estimation strategy exploiting the Basel III capital regulation on mortgage servicing to generate plausibly exogenous variation in shadow banks' servicing activity. Below, we describe each approach in detail.

Comparing balance sheet characteristics: We begin by comparing the balance sheet characteristics of shadow banks with high versus low MSR exposure. This descriptive comparison helps assess whether these two groups are observably different in ways that could shape their lending response to changes in monetary policy.

the mortgage servicing channel dampens the effect of monetary policy. Results are reported in Table A.5. We find that a 25 bp monetary policy shock reduces lending volume of a shadow bank with the average MSR exposure by 26 percent (exp(-1.2082 $\times$ 0.25)-1) corresponding to a decline of \$172,000 in dollar value. Increasing the MSR exposure by one standard deviation generates a reduction in lending of roughly 22.5 percent (exp(-1.2082 + 0.19889 $\times$ 0.25)-1). This translates to \$31,700 lower decline in lending per lender-quarter in a given county. Compared to the decline in lending for the average shadow bank, one standard deviation higher servicing exposure thus offsets over 17% of the decline in loan volume. Similar calculation for loan originations suggest that, compared to the decline in originations for the average shadow bank, one standard deviation higher servicing exposure offsets approximately 28% of the reduction in loan originations caused by monetary tightening.

To formally examine the correlation between shadow banks' MSR exposure and their balance sheet characteristics, we conduct a difference-in-means test for balance sheet characteristics of shadow banks with high and low MSR exposure. Shadow banks with high MSR exposures are those with MSR ratios greater than the median ratio. We consider balance sheet characteristics that have been identified in the literature as important determinants of monetary policy transmission to bank lending. In particular, we test whether shadow banks with high versus low exposure to MSRs differ along size, capital, profitability, and liquidity (Kashyap and Stein, 2000; Van den Heuvel et al., 2002). Table A.6 presents the results. We find that balance sheet differences in these characteristics are not statistically significant with the exception of size and liquidity. Treated shadow banks tend to be slightly larger than control lenders, consistent with the presence of scale economies in servicing. However, the magnitude of the size difference is small. In contrast, treated lenders exhibit somewhat lower liquidity ratios on average. This pattern may reflect the fact that mortgage servicing rights can themselves be used to generate liquidity—either by being pledged as collateral or sold to raise funds. As a result, shadow banks with greater MSR holdings may not need to maintain as many traditional liquid assets on their balance sheets.

These observed differences have opposing implications for the interpretation of our main results. On one hand, the larger size of shadow banks with high MSR exposure may make them more resilient to monetary policy shocks, which could lead us to overestimate the dampening effect of the MSR channel. On the other hand, their lower levels of traditional liquidity may make them more sensitive to funding pressures in a tightening environment, suggesting that—absent these liquidity differences—the attenuating effect of MSRs on monetary policy transmission might actually be stronger. Taken together, these opposing forces may partially offset each other, mitigating concerns about the potential bias in the estimated coefficient on the MSR channel.

Including interactions between monetary policy and balance sheet charac-

teristics: To allay any remaining concerns that these balance sheet differences may be driving our results, we re-estimate our baseline specification in Equation (2) while explicitly interacting the monetary policy shock with balance sheet characteristics such as size, capital, profitability, and liquidity. This approach ensures that any variation in shadow banks' lending response to monetary policy shocks that is driven by their balance sheet characteristics is absorbed by these interaction terms. We show in Table A.7 that our main result is robust to including these interaction terms. This ensures that the result on the servicing channel is not entirely driven by lenders' balance sheet characteristics that could shape shadow banks' servicing decision.

Entropy balancing and propensity score matching: For additional robustness, we improve comparability between high- and low-MSR shadow banks by matching shadow banks based on their balance sheet characteristics. To implement this, we employ two rebalancing techniques: entropy balancing and propensity score matching. In the first approach, we re-estimate our baseline specification in Equation (2) using entropy balancing of covariates. Entropy balancing reweights observations in the data so that the covariate distributions for shadow banks with high vs low MSR exposure become balanced. This reweighting ensures that the two groups resemble each other on average across balance sheet characteristics. In the second approach, we use propensity score matching which creates matched pairs of treated and control shadow banks. We match treated shadow banks with control shadow banks that have similar characteristics using a 1:1 matching without replacement and a 1% caliper. We then re-estimate the baseline specification on this matched sample. Results reported in Panels (A) and (B) of Table A.8 show that the estimated effect of MSR exposure on monetary policy transmission remains positive and statistically significant. These findings reinforce the conclusion that our main result is not driven by observable differences in balance sheet characteristics.

IV Estimation: To further address the concern that shadow banks with specific characteristics select into servicing which could impact their response to monetary policy, we exploit the Basel III regulation to generate plausibly exogenous variation in shadow banks' MSR exposure. In 2012Q2, the U.S. implementation of Basel III made holding MSRs relatively more costly for banks. In particular, the cap on MSRs' contribution to Tier 1 capital was lowered from 50% to 10% and their risk weight was increased from 100% to 250%. As a result, many banks began divesting their servicing portfolios, creating an opportunity for shadow banks to acquire them.

Our identification strategy leverages the idea that servicing requires local operational presence. Therefore, shadow banks with a larger pre-reform origination footprint in counties where Basel-affected banks operated were more likely to acquire these servicing portfolios. We exploit this mechanism to construct an instrument that captures the shadow bank's predicted exposure to MSRs based on its pre-Basel III geographic footprint and local exposure to banks subject to the regulation.

Formally, we the construct the instrument for the MSR exposure of shadow bank nb as

$$MSR_{nb} = \underbrace{\sum_{c} \frac{Orig_{nb,c}}{Orig_{nb}}}_{(A)} \times \underbrace{\sum_{b} \frac{Orig_{b,c}}{Orig_{c}} \times \frac{MSR_{b}}{Tier1Capital_{b}}}_{(B)} \tag{3}$$

where $Orig_{nb,c}$ denotes the originations of shadow bank nb in county c, $Orig_{b,c}$ refers to the originations of bank b in county c, and $MSR_b/Tier1Capital_b$ captures the pre-reform exposure to Basel III of bank b, measured by its pre-reform MSR-to-capital ratio.

Equation (3) measures the likelihood of a shadow bank nb to acquire the MSRs transferred by banks affected by the Basel III regulation. It shows that this likelihood depends on two factors (i) the shadow bank's lending exposure in a given county (part (A) in Equation (3)) and (ii) the exposure of that county to Basel III regulation through the exposure of banks operating in that county before the reform (Part (B) in Equation (3)). Hence a shadow bank is more likely to acquire MSRs relative to another shadow bank if it had a greater pre-reform exposure to counties more affected by the Basel III capital regulation on servicing. In line with this intuition, the first-stage results in Column 1 of Table A.9 confirm a strong relationship between the instrument and actual MSR exposure of shadow banks.

To support the exclusion restriction, we examine whether the instrumented variation in MSR exposure is correlated with other observable shadow bank characteristics that could independently affect lending responses to monetary policy. Specifically, we compare the balance sheet attributes—size, capital, liquidity, and profitability—of shadow banks with high versus low instrumented MSR exposure. Table A.10 shows that there are no statistically significant differences across these variables, providing evidence that our instrument is not simply capturing pre-existing heterogeneity in lender balance sheet fundamentals. This supports the interpretation that the instrument affects shadow bank lending outcomes primarily through its impact on their MSR exposure.

Finally, columns 2-7 of Table A.9 report second stage results, estimating the effect of instrumented MSR exposure on the sensitivity of lending to monetary policy. The coefficient on the interaction term between the instrumented MSR exposure and the monetary policy shock remains positive and significant, providing further support to our main result – shadow banks with a higher exposure to mortgage servicing reduce their lending by less when monetary policy tightens.

5.2.2 Other Robustness Checks and Additional Results

We conduct a number of additional robustness tests regarding the mortgage servicing channel of monetary policy transmission; a full description of these results is in Section A.2 of the appendix. Our main result is robust to using the ratio of mortgage servicing rights to total assets as an alternative measure of lender-level exposure to mortgage servicing, using alternative measures of the monetary policy shock, controlling for loan demand, clustering standard errors at lender-county and time level, and using an alternative classification of shadow banks.

Dynamic Effects: Additionally, to characterize the dynamics of the lending response, we estimate impulse responses of nonbank lending to monetary-policy shocks using panel local projections (Jordà, 2005), following Daniel et al. (2021). We estimate the impulse responses for loan amounts at the quarterly level, for horizons h=0-12 quarters. The impulse response functions (Figure A.3) show a conventional tightening effect: lending contracts through quarters 3–4, but the contraction is smaller for high-MSR lenders, defined as those with MSR ratios greater than the median ratio, and by 8–12 quarters lending of the high-MSR group recovers more strongly than that of the low-MSR group. See Appendix A.2 for a full description of the estimation.

Asymmetric Effects: We also consider the possibility that the servicing channel might operate asymmetrically under monetary tightening versus easing. During tightening, higher interest rates raise MSR values, enabling shadow banks to pledge or sell them for liquidity and sustain lending. In contrast, when policy eases and rates fall, MSR values decline as prepayments accelerate, weakening shadow banks' balance sheets and raising funding costs for MSR-exposed lenders, potentially reducing their lending. However, since the marginal value of having additional liquidity in periods of tight financial conditions might be higher than the additional cost of funding in a period of abundant liquidity, the MSR channel may generate asymmetric effects on lending. To test whether this is the case, we re-estimate Equation (2) and analyse the effect of the servicing channel for positive and negative monetary policy shocks separately. We find that the servicing channel dampens monetary policy transmission for both positive and negative shocks but the effect of this channel is larger for contractionary shocks (see Table A.18). This result confirms the stabilizing role of MSRs, particularly during periods of monetary tightening. We provide a full description of these results in Section A.2.7.

Prepayment Risk: To better capture changes in prepayment incentives following monetary policy shocks, we reestimate our baseline specification by replacing the monetary policy shock with changes in mortgage rates instrumented by the shock. This strategy isolates the component of mortgage rate movements driven by unexpected policy actions and thus provides a direct measure of how monetary policy affects borrowers' incentives to prepay. Since most U.S. mortgages are fixed-rate, higher policy rates raise rates on new loans while leaving existing contracts unchanged, thereby reducing refinancing incentives and lowering prepayment risk. The resulting decline in prepayment risk increases the value of MSRs and strengthens the equity position of exposed shadow banks, enabling them to sustain lending despite tighter conditions. Consistent with this mechanism, the results in Table A.20 show that shadow banks with greater MSR exposure expand lending more strongly when prepayment incentives fall, underscoring the central role of prepayment dynamics in the servicing channel of monetary policy transmission. Additional details on this analysis are provided in Appendix A.2.

5.3 The Pledgability Effect of Mortgage Servicing Rights

Having established the existence of the mortgage servicing channel for shadow banks, we now consider two mechanisms through which participation in servicing may hedge loan origination against interest rate shocks. First, we hypothesize that exposure to mortgage servicing rights affects lending through a *pledgability effect*. Over 70% of shadow bank funding comes from credit lines provided by banks (Jiang, 2023). MSRs can play a key role in affecting the availability and terms of these credit lines when interest rates rise. When monetary policy tightens, the value of MSRs increases. At the same time, the value of the underlying mortgage collateral typically declines, prompting lenders to reduce advance rates, cut funding, or require additional collateral. Because MSRs appreciate with interest rates and are routinely pledged to secure funding, they expand the available collateral pool precisely when traditional collateral becomes less valuable. This mitigates funding pressures, strengthens balance sheets, and supports continued access to credit during periods of monetary contraction. We hypothesize that shadow banks with more exposure to MSRs experience a relative increase in their secured funding after a contractionary monetary policy shock. To the extent that collateral can mitigate adverse selection frictions in the funding market, we also expect to see a lower cost of borrowing on credit lines used by shadow banks with greater holdings of MSRs on their balance sheet.

To test these hypotheses, we use the detailed credit line data from the RMLA segment of the Mortgage Call Reports to provide direct evidence on the link between shadow banks' MSR exposure and their ability to secure funding during monetary tightening. To begin, we aggregate credit line data at the shadow bank level and estimate the regression model

$$\begin{aligned} Y_{l,t} = {} & \beta_1 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_2 \mathrm{FFF3m}_{t-1} + \beta_3 \mathrm{MSREquity}_{l,t-1} \\ & + \gamma X_{l,t-1} + FE_l + FE_t + \epsilon_{l,t}. \end{aligned} \tag{4}$$

The dependent variable $Y_{l,t}$ is log used credit, utilization rate, or estimated average interest rate on credit lines paid by shadow bank l in year-quarter t. Other variables are as previously defined in Equation (2). We saturate the model with lender (FE_l) and year-quarter (FE_t) fixed effects to control for time-invariant lender characteristics and time-varying credit market conditions, respectively. The standard errors are clustered at the lender level. Our variable of interest remains the interaction term between the monetary policy shock and a shadow bank's *ex ante* holdings of MSRs. The coefficient β_1 captures the effect of a monetary policy shock on the used credit, utilization rate, or funding cost of shadow banks with heterogeneous exposure to mortgage servicing rights.

Panel A of Table 4 reports the results. Columns 1–3 and 4–6 display regression estimates for log used credit and utilization rate as the dependent variable, respectively. The coefficient on the interaction term is positive and statistically significant at the 1% level for credit limit and used credit across all specifications. These results indicate that, relative to shadow banks with lower *ex ante* exposure to mortgage servicing rights, those with higher exposure draw down on their credit lines more. Because credit line drawdowns are typically done to originate mortgages, this provides direct evidence that shadow banks with more MSRs can supply relatively more credit after a contractionary monetary policy shock. Columns 7–9 display results on the effect of monetary policy shocks on the external funding cost of shadow banks with varying MSR exposure. The estimated coefficient on the interaction term is negative and statistically significant across all three specifications. This implies that shadow banks with more MSRs on their balance sheet can access external funding at relatively lower cost after an unexpected monetary contraction.[25]

One possible concern with estimating this regression at the shadow bank level is that non-random matching between shadow banks and banks may interfere with interpretation of the results. Shadow banks choose the banks from which they borrow, and it may be that shadow banks that are relatively more involved in mortgage servicing obtain credit lines from banks that experience positive credit supply shocks.[26] To address the selection problem, we also conduct our analysis at the shadow bank-bank pair level. Specifically, we estimate the equation

$$
\begin{aligned}
Y_{l,b,t} = {} & \beta_1 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_2 \mathrm{FFF3m}_{t-1} + \beta_3 \mathrm{MSREquity}_{l,t-1} \\
& + \gamma X_{l,t-1} + FE_l + FE_t + FE_{b,t} + \epsilon_{l,b,t},
\end{aligned}
\tag{5}
$$

where the dependent variable $Y_{l,b,t}$ is now log used credit, utilization rate, or estimated

[25] Our findings on the pledgability effect of mortgage servicing rights complement the results in Jiang (2023). Jiang (2023) shows that shadow banks' reliance on warehouse funding from traditional banks, who simultaneously operate as competitors in the mortgage origination market, can lead to higher borrowing costs for shadow banks. This is because banks with market power in the upstream funding market may strategically raise warehouse interest rates to dampen competition in the downstream origination market. In contrast, our analysis emphasizes how heterogeneity in balance sheet strength across shadow banks can moderate this adverse effect. Specifically, we show that MSR exposure helps alleviate increases in warehouse funding costs following contractionary monetary policy shocks. This is due to the fact that MSRs appreciate in value when interest rates rise, thereby improving the shadow bank's financial condition and reducing its perceived credit risk. As a result, shadow banks with higher MSR exposure face lower risk premiums on warehouse credit lines during tightening cycles. Put differently, while Jiang (2023) highlights the general strategic disadvantage shadow banks face due to their dependence on bank funding, our results underscore a relative advantage among shadow banks with stronger MSR positions. These institutions are better positioned to absorb monetary tightening due to the dual role of MSRs as both an income stream and a source of collateral.

[26] Relatedly, Jiang (2023) shows that strategic interactions between banks and shadow banks could play a key role in shaping shadow banks' funding costs. In Appendix A.3, we modify the conceptual framework in Jiang (2023) to account for default risk and study how these strategic interactions influence the funding costs of shadow banks with varying MSR exposures in response to monetary policy shocks.

average interest rate paid by shadow bank l from financier b in year-quarter t. We aggregate used credit and utilization rates at the shadow bank-bank pair level. Note that the estimated interest rate does not vary across banks. As in Equation (4), we saturate the model with shadow bank lender (FE_l) and year-quarter (FE_t) fixed effects. More importantly, we add bank-year-quarter fixed effects ($FE_{b,t}$) to control for the time-varying supply of credit at the financier level. In this regression, then, we are exploiting cross-sectional variation across shadow banks that borrow from the *same* bank lender.

We report results for the shadow bank-bank pair-level analysis in Panel B of Table 4. Columns 1–3 and 4–6 contain results using log used credit and utilization rate as the dependent variable, respectively. The coefficient on the interaction term remains positive, significant at 1% level, and similar in magnitude across all specifications. These results indicate that, among multiple shadow banks that borrow from the same bank, shadow banks with higher *ex ante* MSR exposure draw down on their credit lines more when monetary policy is tightened compared to those with lower exposure. Similarly, results in columns 7–9 show that the cost of borrowing increases less for shadow banks with higher *ex ante* holdings of MSRs after a contractionary monetary policy shock. These results validate the underlying mechanism: shadow banks with greater exposure to mortgage servicing obtain relatively more funding when monetary policy tightens.[27] More broadly, these findings contribute to a broader literature that highlights the importance of bank-provided liquidity backstops to nonbanks through committed credit lines, emphasizing how such arrangements shape credit supply (Acharya et al., 2024, 2025; Chernenko et al., 2025; Haque et al., 2025).

[27] Our results on the pledgability effect are related to Lewis (2023), who shows that stronger creditor rights on private-label mortgage collateral increased dealers' ability to fund independent mortgage companies. Unlike this regulatory channel, we focus on the interest-rate-driven revaluation of MSRs, which links monetary policy directly to nonbanks' funding capacity.

5.4 The Cashflow Effect of Mortgage Servicing Rights

A second mechanism by which exposure to mortgage servicing may attenuate the pass-through of monetary policy to shadow bank lending is a *cashflow effect*. By design, servicing fees are a relatively certain source of income because they are equal to fixed share of a mortgage's outstanding balance. Conditional on the mortgage not being prepaid, this makes the size of the servicing fee invariant to future changes in interest rates. By contrast, income generated through loan origination is likely more sensitive to interest rate fluctuations. Thus, we hypothesize that shadow banks with higher exposure to MSRs should experience an increase in their net income relative to shadow banks with lower exposure to MSRs when there is a contractionary monetary policy shock as origination income is negatively affected by higher interest rates and shadow banks with MSR exposure are relatively insulated from this negative effect on income.

To test this hypothesis, we estimate the lender-level regression in Equation (4) using net income scaled by total assets of shadow bank l in year-quarter t as our dependent variable and measure of cashflow. The coefficient of interest remains β_1, which represents the differential effect of a monetary policy shock on the earnings of shadow banks with varying exposure to mortgage servicing rights. If higher *ex ante* exposure to MSRs insulates shadow banks' cashflow from contractionary monetary policy shock, then β_1 should be positive.

We report regression results in columns 1–2 of Table 5. The coefficient on the interaction term β_1 is positive, statistically significant, and similar in magnitude across all specifications. These results indicate that shadow banks with higher *ex ante* MSR-to-equity ratios have relatively higher earnings following an unexpected monetary tightening. They confirm our hypothesis that participation in mortgage servicing helps insulate the cashflow of shadow banks against interest rate shocks.[28] These results are in the spirit of Gelman et al. (2023), who show that banks with more diversified assets have more resilient

[28] The obvious direct effect of MSR exposure is that more funds are available for loan origination. A more subtle indirect effect is that higher cashflow today implies higher expected net worth in the future, all else equal. This may also alleviate constraints on shadow bank funding.

lending and are better able to absorb negative shocks.

To provide additional support for the cashflow effect, we also estimate Equation (4) with the ratio of servicing income to gross income of shadow bank l in year-quarter t as the dependent variable. To the extent that shadow banks with more holdings of MSRs can offset declines in other sources of income with revenue from servicing, we expect their current income to become relatively more reliant on servicing. Columns 3–4 in Table 5 display estimates for this regression. The coefficient on the interaction term is positive and statistically significant in both columns, corroborating the findings in columns 1–2.

5.5 Heterogeneity Tests

In this section, we conduct several heterogeneity tests to provide further evidence on the role of shadow banks' exposure to mortgage servicing rights in dampening the transmission of monetary policy to mortgage lending. We consider three characteristics of shadow banks that could make MSRs a useful hedge against contractionary monetary policy shocks: their capital to asset ratio, exposure to risky borrowers, and stock of liquid assets. The first two characteristics measure the intensity of adverse selection frictions faced by shadow banks in raising external finance. We expect shadow banks facing higher adverse selection frictions to benefit more from MSR holdings during contractionary monetary policy periods. Thus, the mortgage servicing channel should be stronger for such lenders. The third characteristic captures a shadow bank's capacity to use internal funding. We expect shadow banks with less liquidity to benefit more from exposure to mortgage servicing when interest rates rise, so the servicing channel should be stronger for these institutions as well.

5.5.1 Capital to Asset Ratio

Information asymmetry in the market for short-term debt implies that shadow banks trying to raise external finance to fund mortgages will face adverse selection frictions and should be more negatively affected by contractionary monetary policy. This is especially true for nonbanks with low capital, as they may have to pay a lemon's premium in order to secure funding when interest rates rise. Having access to MSRs can attenuate the adverse selection problem that shadow banks face in the funding market and allow them to access funding at a cheaper rate. If this is true, we expect the dampening effect of MSRs to be stronger for shadow banks with low *ex ante* capital ratios.

To test this hypothesis, we estimate the regression model

$$
\begin{aligned}
Y_{l,c,t} = {} & \beta_1 \text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{CapitalRatio}_{l,t-1} \\
& + \beta_2 \text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} + \beta_3 \text{FFF3m}_{t-1} \times \text{CapitalRatio}_{l,t-1} \\
& + \beta_4 \text{MSREquity}_{l,t-1} \times \text{CapitalRatio}_{l,t-1} + \beta_5 \text{FFF3m}_{l,t-1} + \beta_6 \text{MSREquity}_{l,t-1} \\
& + \beta_7 \text{CapitalRatio}_{l,t-1} + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + \epsilon_{l,c,t},
\end{aligned}
\tag{6}
$$

where $\text{CapitalRatio}_{l,t-1}$ is the lagged ratio of capital to total assets of shadow bank l. All other variables are as previously defined in Equation (2), and we cluster standard errors at the lender-county level. The coefficient on the triple interaction term, β_1, captures how a shadow bank's *ex ante* capital ratio affects the strength of the mortgage servicing channel.

Columns 1–2 in Table 6 contain estimates for Equation (6) using log loan count and log loan amount as the dependent variable, respectively. The coefficient on the triple interaction term is negative and statistically significant. This implies that the dampening effect of MSRs on monetary policy transmission is greater for shadow banks with lower capital ratios. This suggests that MSRs weaken monetary policy transmission by alleviating adverse selection frictions faced by shadow banks in the external funding market.

5.5.2 Exposure to Risky Borrowers

Shadow banks that lend to riskier borrowers should face higher adverse selection frictions while raising external finance. Because MSRs can attenuate adverse selection frictions, we expect the mortgage servicing channel to be greater for shadow banks with riskier lending portfolios. To test this hypothesis, we estimate the model

$$
\begin{aligned}
Y_{l,c,t} = {} & \beta_1 \text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{LowFICO\%}_{l,t-1} \\
& + \beta_2 \text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} + \beta_3 \text{FFF3m}_{t-1} \times \text{LowFICO\%}_{l,t-1} \\
& + \beta_4 \text{MSREquity}_{l,t-1} \times \text{LowFICO\%}_{l,t-1} + \beta_5 \text{FFF3m}_{t-1} + \beta_6 \text{MSREquity}_{l,t-1} \\
& + \beta_7 \text{LowFICO\%}_{l,t-1} + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + \epsilon_{l,c,t},
\end{aligned}
\tag{7}
$$

where $\text{LowFICO\%}_{l,t-1}$ is the lagged share of mortgages originated by shadow bank l to borrowers with a FICO score less than or equal to 650 and measures its exposure to risky borrowers. All other variables are as previously defined in Equation (2), and we cluster standard errors at the lender-county level. Our coefficient of interest β_1 captures how the *ex ante* riskiness of a shadow bank's lending portfolio affects the strength of the mortgage servicing channel.

Columns 3–4 in Table 6 contain estimates for Equation (7) using log loan count and log loan amount as the dependent variable, respectively. The coefficient on the triple interaction term is positive and statistically significant, suggesting that the mortgage servicing channel is stronger for shadow banks with a riskier lending portfolio. We expect such shadow banks to encounter more severe adverse selection frictions in the external finance market. Thus, our findings again support the hypothesis that MSRs weaken the effect of monetary policy shocks on nonbank mortgage lending by alleviating those frictions.

5.5.3 Stock of Liquid Assets

When interest rates rise, external funding becomes more expensive and may induce induce shadow banks to curtail lending. This can be somewhat mitigated for shadow banks with a high *ex ante* stock of liquid assets, such as cash or short-term securities, which can be used as a source of internal funding for new mortgages. For highly liquid shadow banks, exposure to mortgage servicing may not provide much additional insulation. For shadow banks with less liquidity, however, MSRs could enable them to originate relatively more mortgages by servicing as an imperfect substitute for liquid assets during monetary tightening.

To test this hypothesis, we estimate the regression model

$$
\begin{aligned}
Y_{l,c,t} = {} & \beta_1 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} \times \mathrm{LiquidityRatio}_{l,t-1} \\
& + \beta_2 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_3 \mathrm{FFF3m}_{t-1} \times \mathrm{LiquidityRatio}_{l,t-1} \\
& + \beta_4 \mathrm{MSREquity}_{l,t-1} \times \mathrm{LiquidityRatio}_{l,t-1} + \beta_5 \mathrm{FFF3m}_{t-1} + \beta_6 \mathrm{MSREquity}_{l,t-1} \\
& + \beta_7 \mathrm{LiquidityRatio}_{l,t-1} + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + \epsilon_{l,c,t},
\end{aligned} \tag{8}
$$

where $\mathrm{LiquidityRatio}_{l,t-1}$ is the lagged ratio of liquid assets to total assets of shadow bank l. All other variables are as previously defined in Equation (2), and we cluster standard errors at the lender-county level. Our coefficient of interest β_1 captures how the *ex ante* liquidity of a shadow bank's balance sheet affects the strength of the mortgage servicing channel.

Columns 5–6 in Table 6 contain estimates for Equation (8) using log loan count and log loan amount as the dependent variable, respectively. The coefficient on the triple interaction term is negative and statistically significant across both specifications, suggesting that the mortgage servicing channel is weaker for shadow banks with more liquidity. This finding supports our hypothesis that participation in mortgage servicing weakens the pass-through of monetary policy to new lending by providing an alternative source of financing for shadow banks with comparatively less internal funding.

6 Implications for Aggregate Lending

Having established the existence of the mortgage servicing channel of monetary policy transmission for shadow banks in Section 5, we now widen our empirical analysis and ask if this channel is relevant for the transmission of monetary policy to *aggregate* mortgage lending. This is critical for assessing the broader implications of the reallocation of mortgage servicing from banks to nonbanks. If the marginal effect of exposure of mortgage servicing is the same for both types of lenders, then the composition of financial institutions in mortgage servicing is irrelevant for the transmission of monetary policy. If the strength of the mortgage servicing channel differs across banks and nonbanks, though, then the rise of shadow banks as servicers suggests the transmission of monetary policy to the mortgage market may have dampened at the aggregate level.

Our results support the latter view. To begin, we document that the mortgage servicing channel is significantly weaker for traditional banks compared to shadow banks. Motivated by this, we next quantify the extent to which the change in the composition of financial institutions in the mortgage servicing market has influenced the transmission of monetary policy to mortgage lending at the regional (i.e., MSA) level. We find weaker pass-through of monetary policy to lending in regions with larger increases in the nonbank share of mortgage servicing. Our estimates therefore imply that shadow banks could have attenuated the transmission of monetary policy to aggregate mortgage lending.

We add several caveats to help interpret the findings in this section. While our analysis provides a data-driven assessment of the heterogeneous importance of the MSR channel across banks and nonbanks—controlling, where feasible within a reduced-form empirical framework, for other observable drivers of heterogeneity—it is important to emphasize its limitations. In particular, our estimates capture partial-equilibrium, short-run responses to monetary policy shocks. In reality, monetary transmission may evolve over time through general equilibrium channels.

For instance, servicing rights may be dynamically reallocated in response to changes in loan performance—e.g., a rise in delinquencies following a monetary tightening could prompt nonbanks to sell MSRs, as suggested by Cherry et al. (2022). Similarly, bank–nonbank linkages in upstream funding markets or downstream lending could amplify or dampen the transmission effects (Jiang, 2023). Our framework abstracts from such dynamic and equilibrium interactions. Capturing these forces would require a structural approach, which we view as a promising direction for future research.

6.1 Comparing the Mortgage Servicing Channel for Banks and Shadow Banks

To assess whether the servicing channel is different for banks and nonbanks, we estimate the following triple-difference regression model

$$
\begin{aligned}
Y_{l,c,t} = \; & \beta_1 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} \times \mathrm{Nonbank}_{l,t} \\
& + \beta_2 \mathrm{FFF3m}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_3 \mathrm{MSREquity}_{l,t-1} \times \mathrm{Nonbank}_{l,t} \\
& + \beta_4 \mathrm{MSREquity}_{l,t-1} \times \mathrm{Nonbank}_{l,t} + \beta_5 \mathrm{FFF3m}_{t-1} + \beta_6 \mathrm{MRSEquity}_{l,t-1} \\
& + \beta_7 \mathrm{Nonbank}_{l,t} + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + FE_{nb,t} + FE_{nb,c} + \epsilon_{l,c,t}
\end{aligned} \tag{9}
$$

for a combined sample of bank and nonbank lenders. The dependent variable $Y_{l,c,t}$ is now the log loan count or log loan amount originated by lender l in county c in year-quarter t. $\mathrm{MSREquity}_{l,t-1}$ is the lagged MSR to equity ratio of lender l, and $\mathrm{Nonbank}_{l,t}$ is an indicator variable that takes a value of 1 if lender l is a shadow bank in year-quarter t and 0 otherwise. The monetary policy shock $\mathrm{FFF3m}_{t-1}$ remains as previously defined in Section 5. We include a vector of lagged time-varying lender-level controls $X_{l,t-1}$ and saturate the model with lender (FE_l), year-quarter (FE_t), county-year-quarter ($FE_{c,t}$), lender-county ($FE_{c,l}$), lender type-year-quarter ($FE_{nb,t}$), and lender type-county ($FE_{nb,c}$) fixed effects. Standard errors are clustered at the lender-county level. β_1 is the coefficient of interest and captures the difference in the strength of the mortgage servicing channel for nonbanks relative to banks.

A potential concern with estimating Equation (9) on the full sample of banks and nonbanks is that banks and shadow banks differ on the asset side of their balance sheets (Buchak et al., 2018, 2024). Shadow banks typically sell most of their originated mortgages, whereas banks retain a larger share and also engage in a broader set of activities outside mortgage lending. These differences could generate heterogeneous responses to monetary policy shocks that are unrelated to their exposure to mortgage servicing rights. To address this issue, we construct two comparison groups of banks that more closely resemble shadow banks, following Jiang et al. (2020).

We first identify a subset of banks that operate under a model of mortgage origination and loan sales that is comparable to that of shadow banks. Specifically, we classify as Originate to-distribute (OTD) banks those institutions that report more than 10 percent of mortgages as held for sale on their balance sheets. As shown in Jiang et al. (2020), this threshold corresponds to banks selling more than 80 percent of originated mortgages under reasonable assumptions about loan turnover. Thus, this group captures banks that rely primarily on loan sales to fund new origination activity, making them similar to shadow banks with respect to loan retention.

Second, we follow Jiang et al. (2020) in constructing a set of "synthetic mortgage banks". These are commercial banks whose capital and funding structures are projected to match those of shadow banks if they were fully specialized in mortgage lending. This is done by estimating a regression of capital structure and funding variables on the share of mortgage assets and other balance sheet controls, such as size, the composition of loan categories, and the share of fixed assets. We then use these estimates to simulate capital and funding ratios for a hypothetical bank whose balance sheet is composed entirely of mortgage assets. This approach allows us to abstract from heterogeneity in asset composition across banks and construct capital and funding ratios that are better suited for an asset side of the balance sheet that is dominated by mortgage lending.

Table 7 displays the estimated coefficients with log loan count and log loan amount as the dependent variable in columns 1–3 and 4–6, respectively.[29] Columns 1 and 4 show

[29]Because the mean MSR to equity ratio for banks and nonbanks differs substantially, we do not standardize $\text{MSREquity}_{l,t-1}$ when estimating Equation (9).

results for the full sample of banks and nonbanks. Columns 2 and 5 show results for the subsample of OTD banks and shadow banks, while columns 3 and 6 show results for the sample of synthetic mortgage banks and shadow banks. The coefficient of interest β_1 is positive and statistically significant in all samples, implying that mortgage servicing channel is stronger for nonbanks than banks. β_1 higher for the sample of OTD banks compared to the full sample, suggesting that making the loan retention margin similar across banks and nonbanks makes the mortgage servicing channel even stronger for nonbanks relative to banks. In other words, conditional on the same *ex ante* exposure to mortgage servicing, comparable traditional banks reduce their mortgage lending more relative to shadow banks following an unexpected monetary contraction.[30]

Interpretation and Mechanisms What explains the stronger MSR channel among nonbanks relative to banks? While rising interest rates increase MSR values by extending cashflow duration, they also raise discount rates and could strain servicers' liquidity if delinquencies rise following monetary policy shocks. These forces may, in principle, offset the increase in MSR values due to longer duration of cashflows—especially for nonbanks, which tend to service riskier mortgages (Hamdi et al., 2023; Cherry et al., 2022). A priori, then, the sign of β_1 is ambiguous.

Our empirical results suggest that, on net, these offsetting forces do not erode the servicing channel for nonbanks. One possibility is that the prepayment duration channel dominates. This view aligns with industry practice, regulatory reports, and prior work (e.g.,

[30]A related concern is that banks may switch between selling and retaining loans depending on their balance-sheet health (Buchak et al., 2024). If constrained lenders systematically react more to monetary policy, our baseline coefficient could partly reflect this heterogeneity rather than the mortgage-servicing channel. To address this, we allow the effect of monetary policy to vary flexibly with lenders' balance-sheet conditions by interacting the shock with proxies for size, capital adequacy, liquidity, and profitability. Specifically, we augment Equation (9) with terms of the form $\text{FFF3m}_{t-1} \times H_{l,t-1}$, where $H_{l,t-1}$ denotes (lagged) log assets, capital ratio, liquidity ratio, and ROE of lender l. These interactions absorb any systematic differences in monetary policy transmission that are attributable to lenders' health. As reported in Table A.22, the triple-interaction coefficient remains positive and statistically significant, and its magnitude is similar to that in Table 7, indicating that our results are not driven by differential policy sensitivity tied to balance-sheet health of lenders.

Aldrich et al. (2001)), all of which point to prepayment risk as the primary determinant of MSR valuations, as discussed in Section 3.

To directly assess whether default risk significantly undermines the MSR channel for nonbanks, we examine the delinquency response to monetary shocks across servicer types. Using loan-level data on servicing portfolios, we test whether loans serviced by nonbanks are more likely to be delinquent following monetary tightening. Our results reported in Table A.23 suggest that while nonbanks service riskier loans on average, these loans are not more likely to become delinquent after monetary tightening. This result may reflect the structure of the U.S. mortgage market, where the prevalence of fixed-rate loans potentially insulates borrowers from higher short-term rates, limiting the impact of monetary policy on defaults (Campbell and Cocco, 2015; Di Maggio et al., 2017; Elenev and Liu, 2024).

Taken together, these findings suggest that the stronger MSR channel for nonbanks is likely driven by institutional and regulatory differences—particularly in how MSRs are treated for capital and funding purposes. Nonbanks face no regulatory capital charges on MSRs and are able to pledge them as collateral in funding markets, making MSRs an important source of funding elasticity. In contrast, banks are subject to capital requirements on MSR holdings and rely primarily on deposits to fund lending, reducing the marginal funding benefit of MSRs. These differences likely attenuate the transmission of monetary policy through the servicing channel for banks relative to nonbanks.

Caveats Several caveats apply to this interpretation. First, how interest rates affect servicers' liquidity positions due to advance obligations would depend on the intensity of borrower distress following monetary policy shocks. If increase in interest rates coincide with economic expansions, the adverse effect on borrower default might be muted. Nevertheless, in economies where monetary policy is procyclical—tightening into downturns—borrower distress could rise more sharply, heightening default risk and funding stress. In such cases, nonbanks may respond by selling servicing rights (Cherry et al., 2022), leading to endogenous future reallocations of mortgage servicing that could affect the persistence of the MSR channel in the long run. Second, banks may adjust their funding relationships with nonbanks in response to monetary policy shocks, which would subsequently affect the strength of the MSR channel. Our reduced form analysis abstracts from such considerations.

6.2 Accounting for the Rise of Shadow Banks in Servicing

The evidence on the differential strength of the MSR channel for banks and nonbanks from Section 6.1 suggests that the composition of servicers in the mortgage market is nontrivial for the transmission of monetary policy to aggregate mortgage lending. Next, we quantify the dampening of monetary policy transmission attributable to the rising share of shadow banks in mortgage servicing. To do this, we use MSA-level data on the share of shadow banks in mortgage servicing. Our approach is to exploit MSA-level heterogeneity in shadow banks' share in mortgage servicing and see if it differentially affects the transmission of monetary policy to regional mortgage lending. One concern with this approach is that the MSA-level heterogeneity in shadow bank servicing exposure could be correlated with unobservable characteristics, such as MSA-level loan demand, that simultaneously affect shadow bank servicing share and mortgage lending in a given region.

To address this concern, we exploit differences across the regulatory capital of *traditional banks* prior to the U.S. implementation of Basel III capital regulation to predict variation in shadow banks' participation in servicing across MSAs.[31] In 2012Q2, U.S. regulators announced a decrease in the cap on MSRs' contribution to Tier 1 capital from 50% to 10% and an increase in their risk weight from 100% to 250%. Their treatment of MSRs was more punitive compared to international standards and largely unanticipated by market participants (Berrospide and Edge, 2016; Irani et al., 2021). This increase in

[31] Irani et al. (2021) use differences in regulatory treatment of MSRs in Basel III to study the implications for loan sales by banks.

capital requirement on banks' MSR holdings, combined with *ex ante* variation in banks' sensitivity to the additional capital charge arising from Basel III, yields plausibly exogenous variation in the MSR holdings of *shadow banks*. We hypothesize that, in regions where banks had relatively higher regulatory capital shortfalls in the pre-policy period, shadow banks increased their share of the servicing market more.[32]

We define our treatment variable at the MSA level, $\text{MSR\%}_M$, as servicing-weighted MSRs as a percent of traditional banks' Tier 1 capital in MSA M in 2012Q2,

$$\text{MSR\%}_M = \sum_{b \in M} \left(\frac{MSR_{b_{2012Q2}}}{Tier1Capital_{b_{2012Q2}}} \times \frac{Servicing_{b_{2012Q2}}}{\sum_{b \in M} Servicing_{b_{2012Q2}}} \right) \times 100, \tag{10}$$

where $\frac{MSR_{b_{2012Q2}}}{Tier1Capital_{b_{2012Q2}}}$ is the share of MSRs in Tier 1 capital of traditional bank b in 2012Q2 and measures the exposure of bank b to the regulatory change in the capital treatment of MSRs. We aggregate bank-level exposure to Basel III to the MSA level by using bank b's servicing share in a given MSA, $\frac{Servicing_{b_{2012Q2}}}{\sum_{b \in M} Servicing_{d_{2012Q2}}}$.

Conceptually, $MSR\%_M$ captures the extent to which a given MSA experiences a greater shift toward shadow bank participation in the servicing market following the Basel III capital regulation on MSRs. This shift depends on two factors. First, the degree to which local banks were exposed to the Basel III rule that increased the capital cost of holding MSRs. This is measured by the ratio of MSR assets to Tier 1 capital for each bank, $\frac{MSRb_{2012Q2}}{Tier1Capital_{b_{2012Q2}}}$ — the first component of Equation (10). Second, the relative importance of these exposed banks in the MSA's servicing market, captured by their share of total servicing activity in the MSA, $\frac{Servicing_{b_{2012Q2}}}{\sum_{b \in M} Servicing_{b_{2012Q2}}}$—the second component of Equation (10). If exposed banks accounted for only a small portion of local servicing, their exit may not

[32]This is complementary to the analysis in Buchak et al. (2018), which examines whether regions in which traditional banks faced greater regulatory burdens experienced a larger rise in shadow bank originations. In contrast, our analysis investigates whether those same regions witnessed a greater expansion in shadow bank servicing. We focus on servicing rather than originations because the monetary policy transmission channel we propose operates specifically through shadow banks' exposure to mortgage servicing. By exploiting regional heterogeneity in servicing exposure, we are able to assess how monetary policy transmission varies across regions through the shadow bank servicing channel.

have created sufficient room for shadow banks to expand. Therefore, we interact a bank's regulatory exposure with its local servicing share to construct a more informative measure of the potential for shadow bank entry into the servicing market in a given MSA.[33].

We construct this treatment variable using the GSE single-family loan-level datasets because they disclose the identity of the servicer, as well as the MSA of the mortgaged property. This allows us to observe the shares of banks and nonbanks in regional servicing markets over time. While these data do not capture the full universe of the residential mortgage market, loans purchased or guaranteed by the GSEs have accounted for around two-thirds of originations since the global financial crisis.[34]

To document the effect of the Basel III capital requirements on the share of nonbanks in the servicing market, we estimate an event-study regression

$$Y_{M,t} = \sum_{\tau=-10}^{10} (\beta_\tau \text{MSR\%}_M \times \text{Post}_{t+\tau}) + \gamma X_{M,t-1} + FE_M + FE_t + \epsilon_{M,t}. \tag{11}$$

The dependent variable $Y_{M,t}$ is the share of mortgages serviced by shadow banks in MSA M in year-quarter t. $\text{MSR\%}_M$ is the treatment variable defined in Equation (10), and $\text{Post}_{t+\tau}$ equals 1 if year-quarter t is τ periods away from 2012Q2.[35] We include a vector of lagged time-varying MSA-level characteristics $X_{M,t-1}$, as well as MSA (FE_M) and year-quarter (FE_t) fixed effects.[36] The standard errors are clustered at the MSA level. If the Basel III capital requirements led to a reallocation of servicing away from traditional banks towards

[33]This approach differs from the approach in Buchak et al. (2018), where the share of MSRs in Tier 1 capital is weighted by banks' origination share — appropriate for their objective of explaining the rise of shadow bank originations. In contrast, since our focus is on shadow bank servicing, weighting by servicing share is more suited to our context. However, given that servicing and origination are usually complementary activities, our results may not be highly sensitive to the weighting scheme. We verify the robustness of our MSA-level results from Equation (13) by using the origination-weighted measure from Buchak et al. (2018) as an alternative measure of exposure to servicing at the MSA level (see Table A.27)

[34]See `https://www.urban.org/sites/default/files/publication/102776/august-chartbook-2020.pdf`.

[35]In undocumented results, we estimate Equation (11) using an alternate treatment measure — Basel III Tier 1 shortfall, which is the difference between a given traditional bank's Tier 1 capital and the regulatory capital announced in the U.S. implementation of Basel III — and find similar results. We thank Jose Berrospide for kindly sharing his data on capital shortfalls of traditional banks.

[36]See Table A.26 for summary statistics of variables used in the MSA-level analysis.

shadow banks, we should expect that $\beta_\tau > 0$ for $\tau \geq 1$.

Figure 2 plots estimated values of β_τ, with $\tau = 0$—i.e., the quarter in which the Basel III capital requirements on mortgage servicing rights were announced—as the omitted category. This figure visually confirms that, prior to the policy, the nonbank servicing share did not vary significantly with respect to the aggregate MSR-to-Tier 1 capital ratio of banks across MSAs. After the policy, greater reallocation of servicing towards nonbanks occurred in more heavily treated MSAs.

To capture the average effect of the Basel III capital requirements on shadow banks' involvement in regional servicing markets, we also estimate the difference-in-differences regression

$$\begin{aligned} Y_{M,t} = {} & \beta_1 \text{MSR\%}_M \times \text{Post}_t + \beta_2 \text{MSR\%}_M + \beta_3 \text{Post}_t \\ & + \gamma X_{M,t-1} + FE_M + FE_t + \epsilon_{M,t}, \end{aligned} \tag{12}$$

where Post_t is an indicator variable equal to 1 if year-quarter t is 2012Q3 or later and other variables are as previously defined in Equation (11). The coefficient of interest β_1 represents the effect of the Basel III capital requirements on MSRs on nonbank servicing shares in MSAs that were differentially exposed to the policy.

We present results in columns 1–4 of Table 8 using the share of mortgages serviced by nonbanks in MSA M in year-quarter t as the dependent variable. Consistent with the event-study analysis, the estimate for β_1 is positive and statistically significant at the 1% level in all the specifications. In columns 5–8 of Table 8, we additionally estimate Equation (12) with the share of mortgages originated by shadow banks in MSA M in year-quarter t as the dependent variable. The coefficient of interest is also positive and statistically significant in these regressions, indicating that shadow banks increased their share in the lending market more in MSAs where banks had higher regulatory capital shortfalls prior to the implementation of Basel III. These aggregate results provide evidence of a significant reallocation of servicing from banks to nonbanks after the Basel III reforms.[37]

[37] As a validation check for our aggregate results, we consider the effect of the Basel III capital

Combined with our lender-level analysis on the mortgage servicing channel for shadow banks in Section 5, these results suggest that there could be significant changes in the transmission of monetary policy after the Basel III policy.

6.3 The Dampening Effect of the Mortgage Servicing Channel on Monetary Policy Transmission

Having shown that aggregate bank capital adequacy prior to the announcement of the Basel III capital requirements on mortgage servicing rights predicts plausibly exogenous and economically meaningful variation in the share of loans serviced by nonbanks, we now quantify the contribution of the rise of shadow banks in mortgage servicing to the dampening of monetary policy transmission. To do so, we estimate the triple-difference regression

$$\begin{aligned} Y_{M,t} = {} & \beta_1 \mathrm{MSR\%}_M \times \mathrm{FFF3m}_{t-1} \times \mathrm{Post}_t + \beta_2 \mathrm{MSR\%}_M \times \mathrm{FFF3m}_{t-1} \\ & + \beta_3 \mathrm{MSR\%}_M \times \mathrm{Post}_t + \beta_4 \mathrm{FFF3m}_{t-1} \times \mathrm{Post}_t + \beta_5 \mathrm{MSR\%}_M + \beta_6 \mathrm{FFF3m}_{t-1} \\ & + \beta_7 \mathrm{Post}_t + \gamma X_{M,t-1} + FE_M + FE_t + \epsilon_{M,t}, \end{aligned} \tag{13}$$

where $Y_{M,t}$ is log total loan count or log total loan amount originated in MSA M in year-quarter t and other variables are as previously defined in Equation (11). Crucially, we use the treatment variable $\mathrm{MSR\%}_M$ from Equation (10) as a proxy for nonbank participation in aggregate mortgage servicing in order to alleviate endogeneity concerns. The coefficient of interest on the triple interaction term β_1 captures pass-through of monetary policy shocks to aggregate mortgage lending in MSAs that vary in the participation of nonbanks in servicing markets. Consistent with our lender-level results on the mortgage servicing channel, we hypothesize that the transmission of monetary policy has weakened more

requirements on *bank-level* participation in mortgage servicing. We find that, among a sub-sample of large bank servicers, those with lower ex ante capital adequacy decreased the holdings of mortgage servicing rights more after the implementation of Basel III. Details are provided in Section A.4 of the appendix.

in MSAs where banks were more affected by the Basel III capital requirements and the reallocation of servicing towards nonbanks was strongest.

We present our regression estimates in Table 9. For ease of interpretation, we standardize the treatment variable $MSR\%_M$ to a mean of 0 and a standard deviation of 1. Columns 1–4 and 5–8 report results using log loan count and log loan amount as the dependent variable, respectively. In all the specifications we consider, the coefficient on the triple interaction term is positive and statistically significant at the 1% level. This indicates that, after the announcement of more strict capital requirements on MSRs, mortgage lending declined less after a contractionary monetary policy shock in MSAs where there was more nonbank involvement in the servicing market. This is consistent with our hypothesis that the mortgage servicing channel of monetary policy that we have already documented at the individual lender level also holds at the regional level.[38]

To estimate the aggregate effect of the Basel III-induced reallocation of servicing to nonbanks on mortgage origination in response to a given monetary policy shock, we re-estimate Equation (13) using a treated-control design as it simplifies calculations and facilitates easier interpretation of the regression coefficients. We find that because of the Basel III-induced reallocation of mortgage servicing from banks to shadow banks, mortgage lending was around 8% greater than it would have been in response to a 25bp contractionary monetary policy shock.[39]

The dampening effect of servicing reallocation to nonbanks on the transmission of monetary policy is particularly noteworthy given recent findings by Hamdi et al. (2023), who show that banks selectively transferred riskier loans—such as those associated with subprime and low-income borrowers—to nonbank servicers following the implementation

[38] Scharfstein and Sunderam (2016) finds that concentration in mortgage lending in the local area can influence the transmission of monetary policy. To account for this, we re-estimate Equation (13) including an interaction between monetary policy shocks and MSA-level market concentration. Following Scharfstein and Sunderam (2016), we use two measures of concentration: the market share of the top four lenders and the Herfindahl-Hirschman Index (HHI). Our results, reported in Table A.28, remain robust to both measures, indicating that the effects we document are not driven by differences in local market structure.

[39] We provide details of this calculation in Appendix A.5.

of Basel III. These transferred loans subsequently experienced higher foreclosure and bankruptcy rates, raising the possibility that MSRs held by shadow banks may be, on average, of lower quality.

Nonetheless, we identify a positive marginal effect of nonbank servicing on the resilience of mortgage lending to contractionary monetary policy shocks. Several factors may help reconcile these findings. First, the positive effect of interest rates on MSR valuation through the prepayment channel may outweigh the impact of potential default risk. Given the predominance of fixed-rate mortgages in the U.S., increases in interest rates may not automatically raise borrower payments, especially if rate hikes are procyclical and coincide with economic expansions. In such environments, delinquency rates may remain relatively stable (Elenev and Liu, 2024), while extended MSR durations enhance MSR values. Second, shadow bank servicing portfolios are unlikely to consist solely of loans transferred from banks post-Basel III. Many nonbanks also retain servicing rights on loans they originate or acquire MSRs on the secondary market. If these loans are of higher average quality, they may attenuate the high default risk associated with transferred assets.

Taken together, these considerations provide a potential explanation for why transfer of MSRs to nonbanks may have dampened the contractionary effects of monetary policy shocks, despite the lower average quality of MSRs transferred to nonbanks. Understanding how the composition of MSRs owned by nonbanks affects their liquidity positions and poses financial stability risks to the broader financial system is a promising area for future research.

Distributional Consequences. Our findings suggest that the MSR servicing channel may have important distributional implications. Prior research documents that shadow banks disproportionately lend to lower-income and minority borrowers (Buchak et al., 2018; Kim et al., 2018). Since mortgage servicing rights insulate shadow banks from the negative effects of contractionary monetary policy, and shadow banks disproportionately serve low-income and minority borrowers, monetary policy may have differential effects on credit access for these groups. We explore the distributional implications of the servicing channel of monetary policy in Online Appendix Section A.6.

7 Conclusion

This paper proposed a new conceptual framework for the transmission of monetary policy through shadow banks in the U.S. mortgage market. This framework highlights the importance of shadow banks' involvement as mortgage servicers in generating non-deposit funding for loan origination and the sensitivity of mortgage servicing rights to changes in interest rates. We presented evidence that the lending of shadow banks with greater exposure to mortgage servicing is less affected by monetary policy shocks. The collateral value of mortgage servicing rights and the relative stability of income generated through servicing give rise to a distinct mortgage servicing channel of monetary policy.

We showed that, relative to nonbanks, the mortgage servicing channel is weaker for traditional banks, which have access to deposit funding for new lending and must satisfy capital requirements on their holdings of mortgage servicing rights. Combined with the increase in the share of mortgages being serviced by shadow banks induced by those capital requirements, this implies that mortgage lending may have become relatively more insulated from unexpected changes in interest rates.

Our findings open several avenues for future research. First, the state-dependent effects of the servicing channel on monetary policy transmission warrant deeper exploration. In particular, while rising interest rates increase MSR valuations, the combination of higher interest rates and economic downturns could also lead to financial stability risks, as MSRs may become a source of liquidity stress in distressed environments. Second, the incentives to hold MSRs to hedge interest rate risk may be shaped by evolving expectations of government intervention and lender-of-last-resort support (Cherry et al., 2021, 2022; Jiang et al., 2024). Future work could thus investigate whether observed MSR exposures reflect not only hedging incentives but also beliefs about the likelihood of future bailouts or liquidity backstops. Finally, capturing the general equilibrium effects of monetary policy in a system with bank–nonbank linkages, endogenous MSR reallocation, and dynamic funding networks would benefit from a structural framework to better understand how policy shocks propagate and affect lending over time.

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Figures and Tables

Figure 1: Structure of the U.S. Mortgage Servicing Market

This figure presents a simplified description of the U.S. mortgage servicing market. A mortgage servicing right is created when a mortgage is sold on the secondary market, with rights to servicing retained. A borrower makes a stream of monthly mortgage payments that are ultimately received by investors that own the mortgage-backed security in which the borrower's loan has been packaged. A servicer (i.e., MSR holder) is responsible for collecting payments from borrower and disbursing funds to investors. In exchange, the servicer collects a mortgage servicing fee from the borrower equal to a fixed, predetermined share of the outstanding loan balance. The value of a mortgage servicing right equals the present discounted value of expected revenue from servicing the loan.

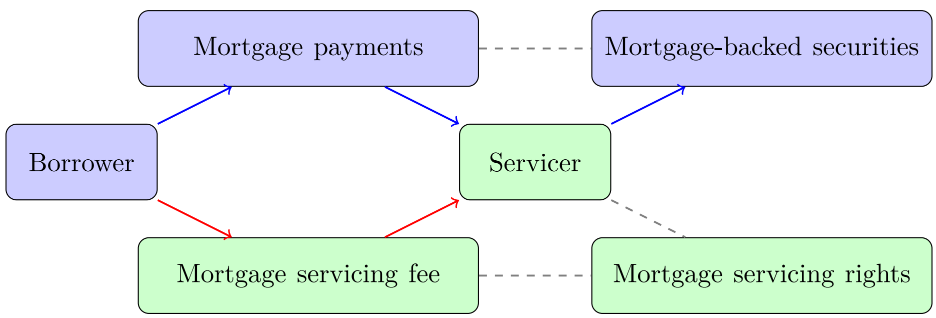

Figure 2: The Effect of Basel III Capital Requirements on Nonbank Servicing Share

This figure reports estimates and 95% confidence intervals for $\{\beta_\tau\}_{\tau=-10}^{10}$ from Equation (11) for MSAs for the period 2010–2015 using public Home Mortgage Disclosure Act (HMDA) Loan Application Registry and public GSE single-family loan-level. The dependent variable is the share of mortgages serviced by nonbanks in MSA M in year-quarter t. The main independent variables are $\{\text{MSR\%}_M \times \text{Post}_{t+\tau}\}_{\tau=-10}^{10}$, the interaction between MSA-level exposure to the Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$) and the post dummy variable ($\text{Post}_{t+\tau}$). MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2. The post dummy variable takes a value of 1 if year-quarter t is τ periods away from 2012Q2 and 0 otherwise. The dashed black line denotes 2012Q2 (i.e., τ = 0), when the U.S. implementation of Basel III capital requirements on mortgage servicing rights was announced.

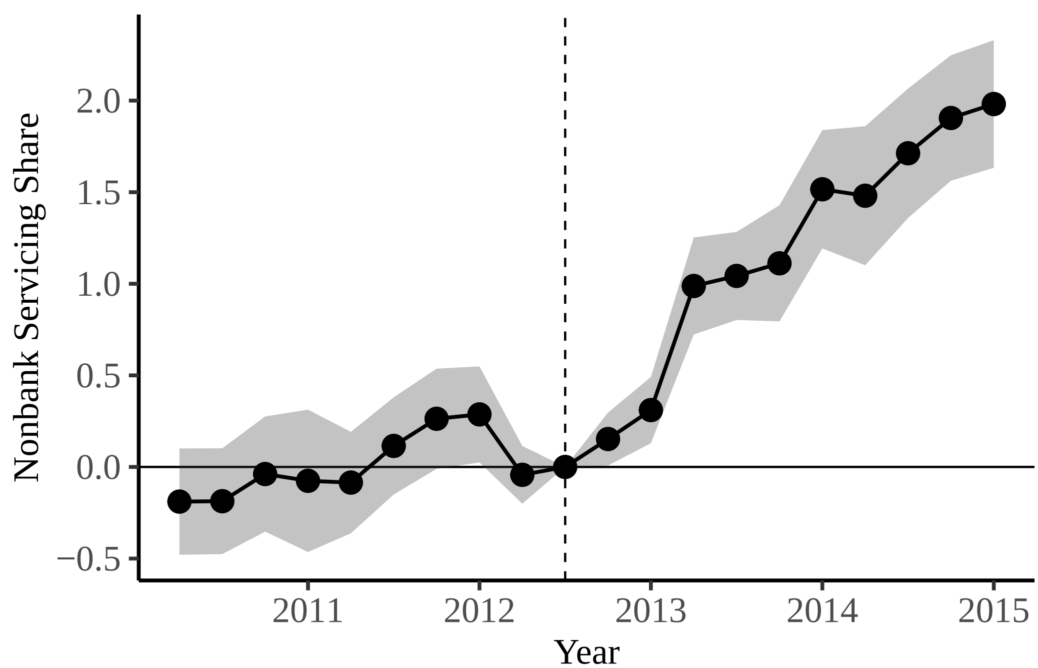

Table 1: Summary Statistics: Shadow Banks

This table reports summary statistics for all variables used in the empirical analysis for the period 2012–2019 using lender-quarter data from publicly sourced Mortgage Call Reports (MCRs). Panel A shows the summary statistics for balance sheet variables from the Financial Condition segment of the MCRs. Panel B and C show summary statistics for funding-related variables for shadow banks from the Residential Mortgage Loan Activity segment of the MCRs. Panel B shows the summary statistics at the shadow bank level, while Panel C shows the summary statistics at the shadow bank-lender bank pair level.

Panel A: Shadow Bank Balance Sheet Variables						
Variable	N	Mean	SD	25%	50%	75%
Assets (Billions)	9,549	0.51	1.38	0.03	0.08	0.26
Equity (Billions)	9,549	0.09	0.24	0.01	0.02	0.05
MSR/Equity (%)	9,537	31.98	43.91	0.00	12.02	51.00
MSR/Assets (%)	9,546	8.33	14.01	0.00	1.90	11.02
Return on Equity (%)	9,537	6.02	14.81	0.00	4.51	12.27
Capital Ratio (%)	9,546	27.70	21.51	13.24	20.26	34.42
Liquidity Ratio (%)	9,546	11.32	15.41	3.19	6.06	12.18
Prime Conforming/Total Mortgages (%)	8,297	48.24	27.81	32.69	51.60	65.08
Mortgage Unpaid Balance/Assets (%)	9,546	57.32	31.71	36.27	70.64	81.74
% Mortgages with FICO $\leq$ 650	1,461	18.46	22.01	5.27	10.59	21.45
Panel B: Shadow Bank Funding						
Variable	N	Mean	SD	25%	50%	75%
Credit Limit (Billions)	7,643	0.86	6.90	0.06	0.12	0.34
Used Credit (Billions)	7,269	0.42	2.84	0.03	0.07	0.19
Utilization Rate (%)	7,269	51.98	21.09	37.37	52.07	67.34
Interest Rate (%)	4,648	2.74	2.06	1.58	2.43	3.50
Panel C: Shadow Bank-Lender Bank Pair Funding						
Variable	N	Mean	SD	25%	50%	75%
Credit Limit (Billions)	27,137	0.22	3.69	0.02	0.04	0.10
Used Credit (Billions)	27,137	0.10	1.48	0.01	0.02	0.05
Utilization Rate (%)	27,137	50.50	28.17	29.18	51.47	72.89

Table 2: Summary Statistics: Lender-county Level

This table reports summary statistics of variables used in the main empirical analysis using aggregate data at lender-county-quarter level. The data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry covering the period 2012–2019. Panel A contains summary statistics of variables for the sample of shadow banks at the lender-county level. Panel B contains summary statistics of variables for the combined sample of banks and shadow banks at the lender-county level.

Panel A: Summary Statistics for Shadow Banks at the Lender-County Level

Variable	N	Mean	SD	25%	50%	75%
Log Loan Count	1,173,900	1.17	1.29	0.00	0.69	1.95
Log Loan Amount	1,173,900	6.45	1.46	5.35	6.14	7.33
MSR/Equity (%)	1,173,900	52.36	50.55	9.20	38.60	81.57
Monetary Policy Shock (bps)	1,111,580	-0.69	2.77	-2.00	0.00	1.00
Log Total Assets	1,173,900	19.76	1.74	18.59	19.69	20.92
Log Equity	1,173,900	18.02	1.76	16.86	18.04	19.11
Return on Equity (%)	1,173,900	7.34	13.15	0.31	4.96	12.94
Liquidity Ratio (%)	1,173,900	6.22	6.47	2.71	4.26	7.52
Capital Ratio (%)	1,173,900	20.00	11.32	12.22	17.47	24.57
Prime Conforming/Total Mortgages (%)	1,173,900	48.23	25.00	35.16	51.45	63.98
Mortgage Unpaid Balance/Assets (%)	1,173,900	67.60	19.61	59.19	72.27	81.81
% Mortgages with FICO $\leq$ 650	330,087	14.26	15.53	4.85	9.86	19.03

Panel B: Summary Statistics for Banks and Shadow Banks at the Lender-County Level

Variable	N	Mean	SD	25%	50%	75%
Log Loan Count	1,814,441	1.28	1.36	0	0.69	2.08
Log Loan Amount	1,814,441	6.49	1.54	5.35	6.21	7.44
MSR/Equity (%)	1,814,441	35.11	47.21	1.00	9.58	57.24
Monetary Policy Shock (bps)	1,814,441	-0.77	2.65	-2.00	0	1.00
Log Total Assets	1,814,441	18.85	2.29	17.65	19.17	20.33
Log Equity	1,814,441	16.94	2.44	15.79	17.32	18.50
Return on Equity (%)	1,814,441	5.58	11.10	1.34	2.95	8.05
Liquidity Ratio (%)	1,814,441	9.74	8.69	3.34	7.07	14.37
Capital Ratio (%)	1,814,441	17.07	10.36	10.79	13.43	20.49

Table 3: The Mortgage Servicing Channel

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using aggregate data at lender-county-quarter level. The data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.2601***	0.3707***	0.5359***	0.2105***	0.3609***	0.5186***
	(0.0288)	(0.0270)	(0.0256)	(0.0334)	(0.0298)	(0.0287)
$\text{MSREquity}_{l,t-1}$	0.0353***	0.0818***	0.1363***	0.0201***	0.0807***	0.1358***
	(0.0039)	(0.0035)	(0.0033)	(0.0043)	(0.0036)	(0.0034)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE		Yes	Yes		Yes	Yes
Lender × County FE			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.812	0.129	0.483	0.812

Table 4: The Pledgability Effect of Mortgage Servicing Rights

This table reports estimates from Equations (4) and (5) for U.S. shadow banks for the period 2012–2019 using data from publicly sourced Mortgage Call Reports (MCRs) in Panel A and Panel B, respectively. Panel A shows the results at shadow bank-year-quarter-level and Panel B shows the results at credit line-year-quarter level. The dependent variables are log used credit (columns 1–3), utilization rate (columns 4–6), and estimated interest rate on credit lines (columns 7–9) of shadow bank l in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. In Panel A, columns 1, 4, and 7 do not include any fixed effects; columns 2, 5, and 8 add year-quarter fixed effects; and columns 3, 6, and 9 add lender fixed effects. In Panel B, columns 1, 4, and 7 add year-quarter fixed effects; columns 2, 5, and 8 add lender fixed effects; and columns 3, 6, and 9 add bank-year-quarter fixed effects. Standard errors clustered at the lender level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Used Credit			Utilization Rate			R		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Panel A: Shadow Bank-Level Analysis								
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	1.035**	1.030**	0.8061**	0.1193	0.3056***	0.2715***	-0.0450***	-0.0352***	-0.0383***
	(0.4323)	(0.4525)	(0.3136)	(0.0879)	(0.0835)	(0.0768)	(0.0104)	(0.0110)	(0.0103)
$\text{MSREquity}_{l,t-1}$	0.1241**	0.1217**	0.1756***	0.0112	0.0154**	0.0045	-0.0011	-0.0008	-0.0016
	(0.0583)	(0.0569)	(0.0514)	(0.0079)	(0.0076)	(0.0089)	(0.0010)	(0.0010)	(0.0011)
FFF3m_{t-1}	-1.792***			-0.8243***			0.0263**		
	(0.3880)			(0.0910)			(0.0112)		
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE		Yes	Yes		Yes	Yes		Yes	Yes
Lender FE			Yes			Yes			Yes
Observations	6,515	6,515	6,515	6,515	6,515	6,515	4,251	4,251	4,251
R^2	0.668	0.681	0.872	0.155	0.239	0.444	0.0522	0.0943	0.428
	Panel B: Credit Line-Level Analysis								
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.8078*	0.8167*	0.7100*	0.2757***	0.2427***	0.2797***	-0.0288**	-0.0381***	-0.0360***
	(0.4238)	(0.4207)	(0.4033)	(0.0950)	(0.0899)	(0.1015)	(0.0135)	(0.0124)	(0.0126)
$\text{MSREquity}_{l,t-1}$	0.0909**	0.0869*	0.0663*	0.0307***	0.0023	-0.0008	-0.0012	-0.0003	-0.0003
	(0.0421)	(0.0447)	(0.0396)	(0.0080)	(0.0095)	(0.0091)	(0.0009)	(0.0014)	(0.0015)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE		Yes	Yes		Yes	Yes		Yes	Yes
Bank × Year-Quarter FE			Yes			Yes			Yes
Observations	20,799	20,799	20,799	21,696	21,696	21,696	13,668	13,668	13,668
R^2	0.384	0.513	0.675	0.127	0.228	0.385	0.0936	0.395	0.486

Table 5: The Cashflow Effect of Mortgage Servicing Rights

This table reports estimates from Equation (4) for U.S. shadow banks using lender-quarter data from publicly sourced Mortgage Call Reports (MCRs) for the period 2012–2019. The dependent variables are net income relative to assets (columns 1–2) and servicing income relative to gross income (columns 3–4) for shadow bank l in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 3 add year-quarter fixed effects; and columns 2 and 4 add lender fixed effects. Standard errors clustered at the lender level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Net Income/Assets		Servicing Income/Gross Income	
	(1)	(2)	(3)	(4)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.0271***	0.0229**	0.1772*	0.2205**
	(0.0100)	(0.0096)	(0.0969)	(0.0909)
$\text{MSREquity}_{l,t-1}$	-0.0010	0.0011	0.0147	0.0328***
	(0.0010)	(0.0015)	(0.0120)	(0.0093)
Lender Controls	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
Lender FE		Yes		Yes
Observations	7,724	7,724	7,711	7,711
R^2	0.105	0.408	0.425	0.740

Table 6: Heterogeneity Tests: Capital, Risk Exposure, and Liquidity

This table reports estimates from Equations (6), (7), and (8) for U.S. shadow banks for the period 2012–2019 using aggregate data at lender-county-quarter level. The data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are log loan count (columns 1, 3, and 5) and log loan amount (columns 2, 4, and 6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable in columns 1–2 is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{CapitalRatio}_{t-1}$, the triple interaction between the lagged monetary policy shock, nonbank exposure to mortgage servicing rights, and nonbank capital ratio. The main independent variable in columns 3–4 is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{LiquidityRatio}_{l,t-1}$, the triple interaction between the lagged monetary policy shock, nonbank exposure to mortgage servicing rights, and nonbank liquidity ratio. The main independent variable in columns 5–6 is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{LowFICO\%}_{l,t-1}$, the triple interaction between the lagged monetary policy shock, nonbank exposure to mortgage servicing rights, and the fraction of low FICO score (i.e, $\leq$ 650) mortgages originated by shadow banks. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. All columns include lender, year-quarter, lender-county, and county-year-quarter fixed effects. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Count	Log Amount	Log Count	Log Amount	Log Count	Log Amount
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{CapitalRatio}_{l,t-1}$	-0.0425***	-0.0450***				
	(0.0027)	(0.0031)				
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{LowFICO\%}_{l,t-1}$			0.0330***	0.0295***		
			(0.0045)	(0.0051)		
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{LiquidityRatio}_{l,t-1}$					-0.0235***	-0.0277***
					(0.0040)	(0.0054)
$\text{FFF3m}_{t-1} \times \text{CapitalRatio}_{l,t-1}$	0.0185***	0.0133***				
	(0.0024)	(0.0028)				
$\text{MSREquity}_{l,t-1} \times \text{CapitalRatio}_{l,t-1}$	-0.0041***	-0.0034***				
	(0.0002)	(0.0002)				
$\text{FFF3m}_{t-1} \times \text{LowFICO\%}_{l,t-1}$			0.0274***	0.0274***		
			(0.0035)	(0.0039)		
$\text{MSREquity}_{l,t-1} \times \text{LowFICO\%}_{l,t-1}$			-0.0007***	-0.0000		
			(0.0002)	(0.0002)		
$\text{FFF3m}_{t-1} \times \text{LiquidityRatio}_{l,t-1}$					0.0445***	0.0398***
					(0.0041)	(0.0054)
$\text{MSREquity}_{l,t-1} \times \text{LiquidityRatio}_{l,t-1}$					-0.0057***	-0.0065***
					(0.0003)	(0.0003)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	1.3229***	1.3337***	0.4299***	0.5492***	0.7797***	0.7833***
	(0.0534)	(0.0623)	(0.0795)	(0.0901)	(0.0324)	(0.0371)
$\text{MSREquity}_{l,t-1}$	0.1962***	0.1870***	0.0938***	0.0778***	0.1552***	0.1569***
	(0.0042)	(0.0045)	(0.0068)	(0.0071)	(0.0034)	(0.0036)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender × County FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,119,593	1,119,593	314,747	314,747	1,119,593	1,119,593
R^2	0.812	0.812	0.822	0.825	0.812	0.812

Table 7: The Mortgage Servicing Channel for Banks and Nonbanks

This table reports estimates from Equation (9) using aggregate mortgage data at lender-county-quarter level over 2012–2019 for (i) the full U.S. sample of banks and nonbanks and (ii) a combined subsample pairing nonbanks with comparable commercial banks—OTD banks and synthetic mortgage banks as defined in Section 6.2. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by lender l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{Nonbank}_{l,t}$, the triple interaction between the lagged monetary policy shock (FFF3m_{t-1}), lender exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$), and a shadow bank dummy variable ($\text{Nonbank}_{l,t}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The lender exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity. The shadow bank dummy variable equals 1 if lender l is classified as an independent mortgage company in the Avery file in year-quarter t. Lender controls include log assets, log equity, ROE, liquidity-asset ratio, and capital ratio. All columns include lender type-year-quarter-, lender type-county-, lender-, year-quarter-, country-year-quarter-, and country-lender-fixed effects. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{Nonbank}_{l,t}$	0.2088***	0.3972***	0.2098***	0.2397***	0.4039***	0.2424***
	(0.0141)	(0.0291)	(0.0136)	(0.0170)	(0.0325)	(0.0165)
$\text{MSREquity}_{l,t-1} \times \text{Nonbank}_{l,t}$	0.0071**	0.1935***	0.0082***	0.0261***	0.1983***	0.0260***
	(0.0029)	(0.0123)	(0.0029)	(0.0034)	(0.0122)	(0.0034)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	-0.1995***	-0.3873***	-0.2013***	-0.2310***	-0.3943***	-0.2345***
	(0.0141)	(0.0291)	(0.0136)	(0.0170)	(0.0325)	(0.0165)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year–Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year–Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender × County FE	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	OTD	Synthetic	Full	OTD	Synthetic
Observations	1,730,064	1,216,625	1,704,991	1,730,064	1,216,625	1,704,991
R^2	0.798	0.798	0.800	0.777	0.800	0.779

Table 8: The Effect of Basel III Capital Requirements on Nonbank Servicing and Lending Shares

This table reports estimates from Equation (12) estimated at the MSA-quarter level over the period 2010–2019 using the GSE single-family loan-level data. The dependent variables are the nonbank servicing share (columns 1–4) and nonbank origination share (columns 5–8) of mortgages originated in MSA M in year-quarter t. The main independent variable is $\text{MSR\%}_M \times \text{Post}_t$, the interaction between MSA-level exposure to the Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$) and the post dummy variable (Post_t). MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2 and defined in Equation (10). The variable is standardized with mean of 0 and standard deviation of 1. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). Columns 2 and 6 add MSA controls; columns 3 and 7 add MSA fixed effects; and columns 4 and 8 add year-quarter fixed effects. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Nonbank Servicing Share				Nonbank Origination Share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{MSR\%}_M \times \text{Post}_t$	4.187***	3.416***	2.989***	2.978***	3.312***	2.725***	2.369***	2.373***
	(0.2690)	(0.2665)	(0.2531)	(0.2327)	(0.2705)	(0.2712)	(0.2566)	(0.2465)
Post_t	18.18***	7.550***	-0.9092**		14.13***	6.404***	0.3894	
	(0.2778)	(0.5117)	(0.3559)		(0.2726)	(0.4764)	(0.3588)	
$\text{MSR\%}_M$	0.4247*	-0.1442			1.122***	0.5725*		
	(0.2164)	(0.2800)			(0.2537)	(0.3187)		
MSA Controls		Yes	Yes	Yes		Yes	Yes	Yes
MSA FE			Yes	Yes			Yes	Yes
Year-Quarter FE				Yes				Yes
Observations	16,835	11,238	11,238	11,238	16,831	11,238	11,238	11,238
R^2	0.383	0.515	0.814	0.861	0.366	0.434	0.759	0.806

Table 9: Mortgage Servicing and Monetary Policy Transmission

This table reports estimates from Equation (13) using aggregate mortgage data at MSA-quarter level for the period 2011–2019. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–4) and log loan amount (columns 5–8) of mortgages originated in MSA M in year-quarter t. The main independent variable is $\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$, the interaction between the MSA-level exposure to Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$), lagged monetary policy shock (FFF3m_{t-1}), and post dummy variable (Post_t). MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2 and defined in Equation (10). The variable is standardized with mean of 0 and standard deviation of 1. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). Columns 3 and 7 add MSA fixed effects; and columns 4 and 8 add year-quarter fixed effects. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count				Log Loan Amount			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$	1.4077***	1.1018***	0.9821***	1.1269***	1.6585***	1.4931***	1.3371***	1.4941***
	(0.3979)	(0.3875)	(0.3326)	(0.3199)	(0.3984)	(0.3979)	(0.3354)	(0.3226)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1}$	-1.7678***	-1.4623***	-1.1024***	-1.2234***	-2.0824***	-1.8444***	-1.4689***	-1.6054***
	(0.3819)	(0.3939)	(0.3284)	(0.3150)	(0.3746)	(0.4030)	(0.3322)	(0.3173)
$\text{MSR\%}_M \times \text{Post}_t$	0.1183***	0.1004***	0.1032***	0.0846***	0.1431***	0.1144***	0.1207***	0.1015***
	(0.0176)	(0.0227)	(0.0112)	(0.0107)	(0.0191)	(0.0244)	(0.0120)	(0.0118)
$\text{FFF3m}_{t-1} \times \text{Post}_t$	-8.5729***	-7.7104***	-6.7688***		-10.8782***	-9.3424***	-8.4202***	
	(0.3992)	(0.5168)	(0.3644)		(0.4228)	(0.5495)	(0.3670)	
FFF3m_{t-1}	6.9785***	6.1123***	5.3991***		8.5073***	7.2785***	6.6038***	
	(0.3805)	(0.4189)	(0.3408)		(0.3949)	(0.4237)	(0.3385)	
Post	0.0037	0.0049	-0.0060		0.0926***	0.0142	0.0088	
	(0.0182)	(0.0517)	(0.0127)		(0.0202)	(0.0579)	(0.0138)	
$\text{MSR\%}_M$	0.0091	-0.0900**			0.0939	-0.0326		
	(0.0520)	(0.0436)			(0.0573)	(0.0466)		
MSA Controls		Yes	Yes	Yes		Yes	Yes	Yes
MSA FE			Yes	Yes			Yes	Yes
Year-Quarter FE				Yes				Yes
Observations	12,361	11,682	11,682	11,682	12,361	11,682	11,682	11,682
R^2	0.0341	0.475	0.956	0.985	0.0127	0.417	0.953	0.984

A Appendix

A.1 Interest Rates and MSR Valuation: Evidence using Y-14 Data

To quantify the impact of monetary policy on MSR valuations, we construct a novel dataset from confidential regulatory filings that, to our knowledge, provides the first empirical estimate of how MSR valuations respond to changes in interest rates. Specifically, we draw on the Federal Reserve's Y-14Q Schedule I filings, which require large bank holding companies (BHCs) subject to CCAR stress testing to report the fair value of their MSRs under a set of standardized interest rate 'shock' scenarios. These data, covering the period between 2012 and 2019, have not previously been exploited in academic research. We manually transcribe this data and ensure its harmonization across banks and quarters, given substantial heterogeneity in reporting structures and disclosure formats. This yields the first structured panel of MSR valuation sensitivities derived from supervisory reports, and we use this data to study how interest rates affect MSR valuations.

Although the supervisory sample comprises regulated banks rather than shadow banks, the economic forces that drive MSR valuation—such as the effect of interest rates on prepayment risk and the duration of servicing cash flows—are structurally similar across both institutional types. As a result, the evidence provided here offers a valuable benchmark for interpreting the magnitude of the mechanism identified in our main analysis.

Data Description and Summary Statistics The Y-14Q Schedule I MSR valuation reports include sensitivity metrics that quantify how the fair value of a bank's MSR portfolio would change under a standardized set of hypothetical interest rate shock scenarios. Specifically, each bank reports changes in its MSR portfolio under six scenarios of parallel yield curve movements, looking at 25, 50, and 100 basis points upward and downward parallel shift in the yield curve. These scenarios are designed to capture the effects of interest rate changes on MSR valuations driven by both changes in cashflow duration due to refinancing incentives as well as discount rate adjustments—two key determinants of MSR valuation. The dataset is limited to standard 15- and 30-year fixed-rate mortgages and sensitivity metrics are reported quarterly.

Table A.2 reports summary statistics for MSR valuation sensitivity to interest rates for the sample of stress-tested banks available in the Y-14Q data. Our findings reveal a clear positive relationship between yield curve shifts and MSR valuation: positive yield curve movements consistently increase MSR valuation while negative yield curve movements significantly decrease MSR valuation. Specifically, we find that in response to a 25-basis points upward shift in the yield curve, the average MSR portfolio appreciates in value by around 9% with significant heterogeneity in the cross-section. These descriptive statistics offer direct evidence on the effect of interest rates on MSR valuations and provide support to the servicing channel of monetary policy transmission that we propose in the paper.

A.2 Robustness Checks

A.2.1 Alternative Measure of MSR Exposure

We examine whether our results on the mortgage servicing channel of monetary policy transmission for shadow banks in Section 5.1 are sensitive to the measure of mortgage servicing rights exposure. MSR holdings can be normalized by different balance sheet characteristics in order to capture shadow banks' exposure to mortgage servicing. Throughout our empirical analysis, we normalize MSR holdings by equity to in order to capture the importance of mortgage servicing relative to capital. Another natural candidate for the denominator is assets, as large shadow banks may hold more MSRs than small ones. Normalizing by assets allows us to control for the effect of size.

Therefore, we re-estimate Equation (2) using lagged MSRs scaled by assets of shadow bank l ($\text{MSRAsset}_{l,t-1}$) as our proxy for its exposure to mortgage servicing. We present results in Table A.11. The effect of *ex ante* exposure to MSRs on shadow banks mortgage lending during monetary policy tightening is robust to our choice of MSR exposure measure. The coefficients on the interaction term between the lagged MSR to asset ratio and the monetary policy shock are positive and statistically significant in all specifications. This indicates that shadow banks with higher MSR exposure relative to their size originate relatively more mortgages than those with lower MSR exposure during monetary policy tightening.

A.2.2 Alternative Measures of Monetary Policy Shocks

Accounting for anticipated changes in monetary policy: Another potential concern is the measurement of monetary policy shocks. Recent studies (Bauer and Swanson, 2023a,b; Karnaukh and Vokata, 2022) have raised concerns about the exogeneity of high-frequency monetary policy surprises around FOMC announcements, showing that they are predictable based on economic and financial news that are publicly available prior to FOMC meetings.[40] To account for the possibility that the monetary policy shocks described in Section 4.6 may contain anticipated changes in the policy rate and thus bias our estimates of their effect on mortgage lending, we follow Karnaukh and Vokata (2022) in orthogonalizing them with respect to revisions in Blue Chip analysts' GDP growth forecasts. We use these orthogonalized shocks to re-estimate our main specification in Equation (2). Results are reported in Table A.12. We find that our main result on the mortgage servicing channel is robust to these orthogonalized monetary policy shocks.

The robustness of our results suggests that the partial predictability of monetary policy shocks is not a concern for our analysis. This could be because the majority (85%) of the

[40]For example, Karnaukh and Vokata (2022) document that revisions in the Blue Chip analysts' GDP growth forecasts predict monetary policy news shocks with an R^2 of approximately 15%. They note that only 85% of the variation in interest rates around FOMC announcements is truly unexpected by all market participants, while 15% of the variation is a delayed reaction to the information contained in the Blue Chip professionals' GDP growth forecasts. Similarly, Bauer and Swanson (2023a) find that economic and financial news releases ahead of the FOMC meetings predict the GSS target shock with an R^2 of approximately 15%.

variation in interest rates around FOMC announcements is unanticipated as shown in Karnaukh and Vokata (2022). Second, Karnaukh and Vokata (2022) emphasize that asset markets do not fully price in the information contained in the Blue Chip professionals' forecast until the FOMC announcement. They attribute this sluggishness in response of asset prices to market participants overweighing the public signal from the Fed's FOMC announcement while forming their expectations about future interest rates. Hence, even if some private actors form expectations based on macroeconomic news prior to the FOMC announcement, the market reaction is still primarily shaped by the Fed's announcement. Lastly, Bauer and Swanson (2023a) note that the private sector does not know the Fed's response function. So, while there might be ex post correlation between monetary policy surprises and macroeconomic news, monetary policy surprise is unpredictable ex ante, making it plausibly exogenous for asset pricing implications.

Using monetary policy shocks from other studies: We further test if our results are sensitive to our choice of monetary policy shock. An alternative measure of unexpected changes to monetary policy is the "policy news shock" from Nakamura and Steinsson (2018). The policy news shock is the scaled first principal component of price changes over a 30-minute window around scheduled FOMC announcements of five interest rate futures: the fed funds future for the current month; fed funds future for the month of next FOMC meeting; and 3-month Eurodollar future at horizons of 2Q, 3Q, and 4Q. Consistent with our previous approach, we use the cumulative sum of shocks within a given year-quarter as our monetary policy shock, denoted by NS. Table A.13 displays results when we estimate Equation (2) using NS_{t-1} as our monetary policy shock measure. Our results remains robust to the choice of monetary policy shock: the coefficient of the interaction term between the monetary policy shock and MSR exposure remains positive and significant across all specifications.

Using contemporaneous monetary policy shocks: We check if our main result on the mortgage servicing channel is robust to using the contemporaneous surprise change in the three-months-ahead federal funds futures. This addresses the concern that nonbank mortgage lending may respond to an unexpected change in monetary policy within the same quarter. Table A.14 displays results when we estimate Equation (2) using FFF3m_t as our measure of monetary policy shocks. The coefficient on the interaction term remains positive and statistically significant across all specifications, indicating our result is robust to using contemporaneous instead of lagged monetary policy shocks.

A.2.3 Controlling for Loan Demand

To ensure that our results are not driven by demand for loans, we control for demand-side variation by conditioning loan outcomes on the volume of mortgage applications. Specifically, we re-estimate (2) using the ratio of approved or originated loans to total applications as the dependent variable, capturing the likelihood of loan approval conditional on demand. This approach filters out confounding demand fluctuations by holding application volume constant. Results, reported in columns 1-3 of Table A.15, show that our main findings remain robust: banks with higher MSR exposure continue to display greater approval likelihood in response to monetary tightening. Complementing this analysis, we estimate (2) at the loan level, using binary indicators for approval or origination as the outcome variable. Results for this specification are reported in columns 4-6 of Table A.15. Our results confirm that shadow banks with higher MSR exposure maintain higher loan approval probabilities during periods of rising rates, reinforcing our interpretation that the observed lending responses reflect supply-side adjustments rather than shifts in borrower demand.

A.2.4 Alternative Clustering of Standard Errors

To account for the common exposure to aggregate monetary policy shocks across all institutions, we re-estimate (2) clustering standard errors two ways: at the lender-county level and at the time (year-quarter) level. This adjustment ensures inference remains valid given the presence of a single monetary policy realization per time period. The results, reported in Table A.16, remain quantitatively and statistically robust under this clustering strategy, confirming that our findings are not driven by underestimated standard errors due to cross-sectional correlation in residuals.

A.2.5 Alternative Definition of Shadow Banks

We test if our results are robust to our classification of shadow banks. Due to the complex industrial organization of the U.S. mortgage market, classifying mortgage lenders into depository versus non-depository institutions is a nontrivial task. In our baseline analysis, we used the Avery file, which classifies financial institutions as a bank, thrift institution, credit union, or an independent mortgage bank based on their self-identification in their HMDA filing and from a match to the National Information Center (NIC) structure database. We consider a financial institution a shadow bank if it is listed as an independent mortgage bank in the Avery file.

For robustness, we follow the definition of shadow banks from Buchak et al. (2018) and see if our main results are sensitive to this definition, which is the most commonly used classification methodology in the literature on nonbank mortgage lenders. In Table A.17, we show results when estimating Equation (2) for the sample of shadow banks in Buchak et al. (2018).[41] We find that the coefficient on the interaction term between MSR exposure and the monetary policy shock is positive and significant, suggesting that our results are not dependent on our definition of shadow banks.

A.2.6 Dynamic Effects

To study the dynamics of lending after monetary policy shocks, we estimate impulse responses via panel local projections at the quarterly frequency (Jordà, 2005), following the

[41]There are 253 shadow banks in Buchak et al. (2018). We manually match shadow bank names to their identifiers (NMLS ID) in Nationwide Multistate Licensing System & Registry (NMLS). We can find 247 NMLS IDs for these shadow banks and the merged sample has 161 shadow banks.

methodology in Daniel et al. (2021), running separate regressions for low- and high-MSR shadow banks (defined by whether the MSR ratio is above or below the median). For each horizon h=0,...,12, we estimate:

$$\ln L^g_{i,t+h} = \alpha^g_h + \beta^g_h \, \text{FFF3m}_t + \mu^g_i + \varepsilon^g_{i,t+h}, \quad g \in \{\text{Low MSR}, \text{High MSR}\}, \; h = 0, 1, \ldots, 12. \tag{A.1}$$

where $\ln L^g_{i,t+h}$ is the loan amount for shadow bank i in group g at time t, FFF3m_t is the monetary policy shock from Gürkaynak et al. (2022) constructed as the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings aggregated to quarterly frequency, and μ^g_i are bank fixed effects.

The resulting impulse response functions in Figure 3 show the standard tightening pattern—loan amounts contract through quarters 3–4 but the contraction is smaller for the high-MSR group. By quarters 8–12, lending of high-MSR shadow banks recovers more strongly than that of low-MSR institutions.

The persistence of these effects may reflect longer-term balance sheet dynamics for shadow banks with high MSR exposure. Contractionary monetary policy shocks raise MSR valuations, which strengthen equity positions in the short run and also create persistence, as higher equity today implies stronger capitalization tomorrow. This dynamic balance sheet strengthening could help explain the more persistent recovery in lending observed among high-MSR shadow banks.

A.2.7 Asymmetric Effects

In this section, we examine the asymmetric effects of the mortgage servicing channel in response to monetary policy tightening versus easing. Monetary tightening typically reduces the availability of credit in the broader financial system and raises borrowing costs. Having exposure to mortgage servicing acts as a stabilizing force during monetary policy contraction as MSRs increase in value when interest rates rise. This allows shadow banks with greater holdings of MSRs to either pledge these higher-value MSRs as collateral or sell them for cash to generate non-deposit funding. As a result, they can maintain their lending capacity during periods of monetary tightening, while other institutions without such a buffer may reduce lending.

By contrast, the effect of expansionary monetary policy may operate differently. When policy eases and interest rates fall, prepayments accelerate and the value of MSRs declines. Hence, shadow banks with high exposure to MSRs may experience a relative worsening of their balance sheet as interest rates fall. This deterioration in balance sheet quality raises funding costs for shadow banks with high MSR exposure and may constrain their ability to originate new loans. As a result, we might observe a relative decrease in lending by these institutions compared to others with lower MSR exposure following expansionary shocks.

However, the marginal value of having additional liquidity in periods of tight financial conditions might be higher than the additional cost of funding in a period of abundant liquidity and high mortgage demand. This might generate asymmetric effects of the MSR channel for positive and negative monetary policy shocks. To test whether this is the case, we re-estimate Equation (2) and analyse the effect of the servicing channel for positive and negative monetary policy shocks separately. Results are reported in Table A.18. Columns (1) and (2) show results for log loan amount while columns (3) and (4) show results for log loan count. Results for positive (contractionary) monetary policy shocks are reported in columns (1) and (3) while those for negative (expansionary) shocks are shown in columns (2) and (4). Results reported in Table A.18 show the servicing channel dampens monetary policy transmission for both positive and negative shocks but the effect of this channel is larger for contractionary shocks. This result confirms the stabilizing role of MSRs, particularly during periods of monetary tightening.

A.2.8 Incentives to Prepay

Our results on the mortgage servicing channel rely on the negative relationship between interest rates and prepayment risk. Borrowers' repayment incentives are largely determined by differences between current interest rates on new loans and predetermined interest rates on outstanding loans (Berger et al., 2021; Eichenbaum et al., 2022). Because fixed-rate loans have accounted for around 90% of U.S. residential mortgages over our sample period, monetary policy can influence prepayment speeds by affecting interest rates on new mortgage lending while rates on existing loans remain largely unchanged.

To study the effect of monetary policy on mortgage prepayment—and, by extension, the latter's role in accounting for the mortgage servicing channel—we estimate the regression equation

$$\begin{aligned} Y_{l,c,t} = {} & \beta_1 \widehat{\mathrm{MR}}_{t-1} \times \mathrm{MSREquity}_{l,t-1} + \beta_2 \widehat{\mathrm{MR}}_{t-1} + \beta_3 \mathrm{MSREquity}_{l,t-1} \\ & + \gamma X_{l,t-1} + FE_l + FE_t + FE_{c,t} + FE_{c,l} + \epsilon_{l,c,t}, \end{aligned} \tag{A.2}$$

where $\widehat{\mathrm{MR}}_{t-1}$ is the lagged change in the interest rate on 30-year fixed-rate mortgages predicted by the monetary policy shock $\mathrm{FFF3m}_{t-1}$. Under the assumption that interest rates on existing mortgages are fixed, $\widehat{\mathrm{MR}}$ is a proxy for the change in prepayment incentives induced by unexpected movements in the policy rate.[42] Other variables remain as defined in Equation (2). If the effect of nonbanks' exposure to mortgage servicing on loan origination in response to monetary policy shocks is indeed driven through a prepayment channel, then the coefficient β_1 should be positive. Table A.20 presents regression results that confirm this hypothesis.

[42] We obtain $\widehat{\mathrm{MR}}$ by using estimated coefficients from the regression $\mathrm{MR}_t = \alpha + \beta \mathrm{FFF3m}_t + \epsilon_t$. See Table A.19 for regression estimates.

A.3 Strategic Interactions and Shadow Banks' Funding Costs

A growing literature highlights the strategic interactions between traditional banks and shadow banks in shaping credit market dynamics of the U.S. mortgage market. Notably, Jiang (2023) documents that shadow banks obtain a significant share of their debt funding from traditional banks that originate similar loans in the same markets. These overlapping roles give rise to strategic interactions, as banks act both as upstream lenders to shadow banks and downstream competitors. Jiang (2023) shows that competition in the downstream mortgage origination market can influence the availability of warehouse funding offered to shadow banks in the upstream funding market. Buchak et al. (2018, 2024) similarly emphasize the importance of interactions between banks and shadow banks in these markets. In this section, we build on the conceptual framework developed in Jiang (2023) by explicitly incorporating shadow banks' default risk into the pricing of credit lines offered by banks in the upstream funding market. We then examine how this modified framework aligns with the results presented in Section 5.3.

Specifically, Jiang (2023) models banks as vertically integrated financial institutions. When setting interest rates on warehouse lines of credit to shadow banks in the upstream lending market, banks consider both monopoly power in the upstream warehouse lending market and downstream competition in the mortgage origination market. Jiang (2023) formalizes this framework by showing that the warehouse interest rate charged by a bank to a shadow bank can be expressed as:

$$r = MC + \text{Baseline Markup} + \text{Additional Markup (Cannibalization Channel)}, \qquad \text{(A.3)}$$

where MC denotes a bank's marginal cost of providing warehouse credit to a shadow bank. The baseline markup reflects the bank's market power in the upstream warehouse lending market, while the additional markup accounts for the fact that shadow banks compete with banks in the downstream mortgage origination market and cannibalize banks' market share of mortgages. This additional markup captures banks' strategic incentive to limit downstream mortgage market competition.

We extend this framework by arguing that, warehouse lenders account for borrower-specific default risk when pricing credit lines. This risk-based component is not explicitly modeled in Jiang (2023), but is empirically supported in earlier work (Jiang, 2019), which finds that stronger shadow bank balance sheets are associated with lower warehouse funding rates. Incorporating this consideration, we modify the pricing equation as follows:

$$r = MC(\delta) + \text{Baseline Markup} + \text{Additional Markup (Cannibalization Channel)}, \quad \text{(A.4)}$$

where the marginal cost MC is now a function of δ, which captures the default risk of lending to shadow banks in the upstream lending market.

Our core hypothesis is that, shadow banks with significant holdings of mortgage servicing rights—whose valuations rise with interest rates—experience less balance sheet deterioration following contractionary monetary policy shocks. As a result, banks' marginal cost of lending to such shadow banks increases by less, resulting in lower increase in warehouse funding cost of shadow banks with higher MSR exposure. Our findings in Section 5.3 are consistent with this view, where we empirically document that shadow banks with higher MSR-to-equity ratios face smaller increases in warehouse funding rates following monetary policy tightening. This suggests that banks price in the default risk of shadow banks in the upstream lending market.

More generally, we can express interest rate on credit lines as a function of shadow banks' balance sheet strength or default risk as well as the market structure. Formally,

$$r = f(\delta, \Gamma) \quad \text{(A.5)}$$

where δ captures the risk of lending to a shadow bank and Γ captures the market structure including the intensity of competition in both upstream and downstream lending markets. Using Taylor's expansion up to second order around $\delta = 0$ & $\Gamma = 0$, we can write:

$$r \approx f(0,0) + f_\delta(0,0)\delta + f_\Gamma(0,0)\Gamma + \frac{1}{2!}\Big[f_{\delta\delta}(0,0)\,\delta^2 + 2f_{\delta\Gamma}(0,0)\,\delta\Gamma + f_{\Gamma\Gamma}(0,0)\,\Gamma^2\Big] \quad \text{(A.6)}$$

where the second order term $f_{\delta\Gamma}$ captures how market structure affects the sensitivity of credit line interest rates to shadow banks' default risk, and vice versa. Our reduced form analysis in Section 5.3 assumes that the second order terms in Equation (A.6) are small. Therefore, default risk and market structure independently affect shadow banks' funding cost, and are the primary drivers of warehouse lending rates.

In this section, we explicitly test whether this assumption holds in the data. Specifically, we examine how the pricing of shadow banks' default risk varies with downstream market concentration following monetary policy shocks. According to Jiang (2023), when a shadow bank operates in a highly concentrated downstream market, banks' exposure to the cannibalization channel is greater: each loan originated by the shadow bank represents a more significant loss in profits for the incumbent banks. This increases the strategic incentive for banks to limit shadow banks' expansion by maintaining higher funding costs. This reasoning suggests that the positive effect of MSR exposure on shadow banks' funding costs following monetary policy tightening might be lower if the shadow bank operates in more concentrated downstream origination market.

To test this, we estimate a modified version of Equation (4):

$$\begin{aligned} r_{lt} = {} & \beta_1(\text{FFF3m}_{t-1} \times \text{MSR}_{lt-1} \times \text{HighHHI}_l) + \beta_2(\text{FFF3m}_{t-1} \times \text{MSR}_{lt-1}) + \\ & \beta_3(\text{FFF3m}_{t-1} \times \text{HighHHI}_l) + \beta_4(\text{MSR}_{lt-1} \times \text{HighHHI}_l) + \beta_5\text{FFF3m}_{t-1} + \\ & \beta_6\text{MSR}_{lt-1} + \beta_7\text{HighHHI}_l + \gamma X_{lt-1} + \text{FE}_l + \text{FE}_t + \epsilon_{lt}, \end{aligned} \quad \text{(A.7)}$$

where r_{lt} is the interest rate on credit lines obtained by shadow bank l at time t, and HighHHI_l is an indicator for shadow banks operating in concentrated origination markets.

The main coefficient of interest is β_1 which captures how downstream market concentration affects the pricing of shadow bank balance sheet shocks to the interest rate on credit lines. If the cannibalization channel dampens the positive effect of MSR-induced balance sheet improvement on shadow banks' funding cost, we expect β_1 to be positive. In other words, if downstream markets are concentrated (higher HHI), then the dampening effect of MSRs on shadow banks' funding costs (negative β_2) would be somewhat mitigated by a positive β_1.

We present results from this estimation in Table A.21. We find that β_1 is economically small and is not statistically significant, suggesting that the cannibalization channel does not significantly alter the dampening effect of MSR exposure on shadow banks' cost of funding following monetary policy shocks. One possible explanation is that banks place value on preserving long-term relationships with shadow banks. Because warehouse lending is a repeated interaction, banks may prioritize the length of these relationships—which generate revenues through future lending, securitization, and ancillary services—over the short-term gains from keeping shadow banks' funding costs higher in concentrated origination markets. This is consistent with the long-term insurance view of lending relationships proposed by Beraldi (2025).

These findings provide suggestive evidence that market competition plays only a limited role in the pricing of shadow banks' default risk following monetary policy shocks. However, further research is needed to better understand how relationship lending, market competition, and default risk interact in the longer run, where the dynamics of repeated lending relationships and market structure may lead to different implications.

A.4 Effect of Basel III on Bank-Level MSR Holdings

To provide validation of our MSA-level evidence on the effect of Basel III capital requirements on the nonbank share of mortgage servicing in Section 6.2, we estimate its effects on bank-level mortgage servicing for a subsample of large bank servicers. We focus on large servicers because, even if small bank servicers reduce their holdings of MSRs significantly after the implementation of Basel III, their adjustments would have minimal impact on the composition of servicers within a given MSA. Specifically, we estimate the regression equation

$$\begin{aligned} Y_{l,t} = {} & \beta_1 \text{MSRCapital}_l \times \text{Post}_t + \beta_2 \text{MSRCapital}_{l,t-1} + \beta_3 \text{Post}_t \\ & + \gamma X_{l,t-1} + FE_l + FE_t + \epsilon_{l,t}, \end{aligned} \tag{A.8}$$

where the dependent variable $Y_{l,t}$ is the MSR-to-equity or MSR-to-asset ratio of bank l in year-quarter t. The ratio of mortgage servicing rights to Tier 1 capital, MSRCapital_l, measures the exposure of bank l to the Basel III capital requirements in 2012Q2, and Post_t is a dummy variable equal to 1 if year-quarter t is 2012Q3 or later. $X_{l,t-1}$ is a set of lagged time-varying lender-level controls, and we include lender (FE_l) and year-quarter (FE_t) fixed effects.[43] Standard errors are clustered at the lender level.

If the implementation of Basel III capital requirements led large bank servicers to reduce their involvement in mortgage servicing, the coefficient on the interaction term β_1 should be negative. We report estimates in Table A.25. β_1 is negative and statistically significant at the 1% level in both specifications, indicating that large bank servicers with lower *ex ante* capital adequacy decreased their holdings of MSRs—regardless of whether they are scaled by equity or assets—more after the implementation of Basel III.

A.5 Counterfactual Exercise

Our objective is to measure the extent to which Basel III–induced reallocation of mortgage servicing rights has dampened the transmission of monetary policy to mortgage lending. We do this by re-estimating the aggregate lending specification with a treated–control

[43]See Table A.24 for summary statistics.

design. We estimate:

$$\begin{aligned}Y_{M,t} = &\beta_1 D_M \times \text{FFF3m}_{t-1} \times Post_t + \beta_2 D_M \times \text{FFF3m}_{t-1} + \beta_3 D_M \times Post_t \\ &+ \beta_4 \text{FFF3m}_{t-1} \times Post_t + \beta_5 D_M + \beta_6 \text{FFF3m}_{t-1} + \beta_7 Post_t \\ &+ \gamma X_{M,t-1} + FE_M + FE_t + \varepsilon_{M,t}.\end{aligned} \tag{A.9}$$

where $Y_{M,t}$ is log loan count or amount in MSA M at time t, $D_M = 1$ if MSR$\%_M$ is above the sample median, capturing the MSAs that saw a significant reallocation of mortgage servicing from banks to nonbanks after the Basel III reform, FFF3m_{t-1} is the lagged monetary policy shock, and $Post_t = 1$ for the post-Basel III period ($t \geq$ 2012Q2).

Step 1: Counterfactual (no reallocation of servicing) Conceptually, the counterfactual is the policy transmission that treated MSAs *would have experienced* in the post period had servicing reallocation not occurred. In a difference-in-differences framework, this is the post–pre change that is common to both treated and control MSAs, captured by β_4. This can be seen clearly from the table below, which maps the coefficients from Equation (A.9) to the pre-post policy transmission change.

Table A.1: Policy Transmission by Group and Period

	Pre (Post=0)	**Post (Post=1)**	**Post − Pre (Δ)**
Control (D=0)	β_6	$\beta_6 + \beta_4$	β_4
Treated (D=1)	$\beta_6 + \beta_2$	$\beta_6 + \beta_2 + \beta_4 + \beta_1$	$\beta_4 + \beta_1$

From the table, the counterfactual post–pre change for treated MSAs (had reallocation not occurred) is the Δ for the control group, $\Delta^C = \beta_4$.

Step 2: Dampening due to servicing reallocation. The observed post–pre change for treated MSAs is $\Delta^T = \beta_4 + \beta_1$. Relative to the counterfactual β_4, the dampening effect due to Basel III-induced servicing reallocation is

$$\text{Dampening} = \Delta^T - \Delta^C = \beta_1.$$

Step 3: Relative dampening. To gauge the magnitude, we express dampening relative to the counterfactual transmission estimate:

$$\text{Relative dampening} = \frac{\beta_1}{|\beta_4|}.$$

Using column 7 of Table A.29, $\hat{\beta}_1 = 2.1659$ and $\hat{\beta}_4 = -9.5273$. The relative dampening in treated MSAs is thus:

$$\frac{\hat{\beta}_1}{|\hat{\beta}_4|} = \frac{2.1659}{9.5273} = 0.2273 \approx 22.73\%.$$

To illustrate with a 25 bps monetary policy shock: comparing the treated vs. control groups, the lending would have fallen by $[\exp(-9.5273 + 7.8671 \times 0.25) - 1] = -33.9\%$ without the reallocation of MSRs from the banking sector to the shadow banking sector in the post period. With the reallocation, the contractionary effect is dampened by $-33.9\% \times 22.73\% = 7.71\%$, which means that the lending reduction in treated MSAs in the post period is -33.9% $+ 7.71\% = -26.19\%$. Hence, the Basel-III induced reallocation of mortgage servicing has dampened monetary policy transmission by approximately 8 percent.

A.6 Distributional Consequences

This section examines whether the servicing channel of monetary policy has heterogeneous effects across borrower groups. Prior work shows that shadow banks disproportionately serve minority and lower-income households (Buchak et al., 2018; Kim et al., 2018), raising the possibility that the servicing channel of monetary policy could have distributional consequences. At the same time, recent evidence highlights that debt-to-income (DTI) underwriting standards can bind sharply when interest rates rise. Bosshardt et al. (2024), for example, show that the 2022–2023 rate hikes disproportionately reduced mortgage originations among households near DTI cutoffs—particularly low-income borrowers. These observations suggest that while servicing exposure may dampen the negative effect on shadow bank funding following monetary policy shocks, the extent to which this translates into credit access for low-income groups is an empirical question.

A key consideration is that GSE and FHA underwriting guidelines impose maximum DTI ratios, which cap the share of income that can be devoted to monthly debt payments. Since many lower-income households have relatively high DTIs, increases in mortgage rates can push them above these thresholds, rendering them ineligible for loans that can be underwritten or sold into GSE or FHA programs. As a result, even when shadow banks' servicing exposure allows them to obtain funding following monetary tightening, they may be unable to extend additional credit to low-income borrowers, as underwriting rules become the binding constraint.

To test this empirically, we re-estimate Equation (13) using, as dependent variables, the share of lending to (i) minority borrowers and (ii) low-income borrowers. Results reported in Table A.30 do not provide strong evidence for distributional consequences operating through the servicing channel. These preliminary findings suggest that borrower-level constraints, such as debt-to-income rules, may be critical for shaping the distributional effects of monetary policy—a fuller assessment of which we leave for future research.

A.7 Figures and Tables

Figure A.1: Shadow Bank Sample Coverage by Year

This figure shows the number of mortgages originated by shadow banks in the Home Mortgage Disclosure Act (HMDA) sample compared to those in our sample. The blue bar shows the number of mortgages originated by all shadow banks in HMDA and the red bar shows the number of mortgages originated by the shadow banks covered in our sample.

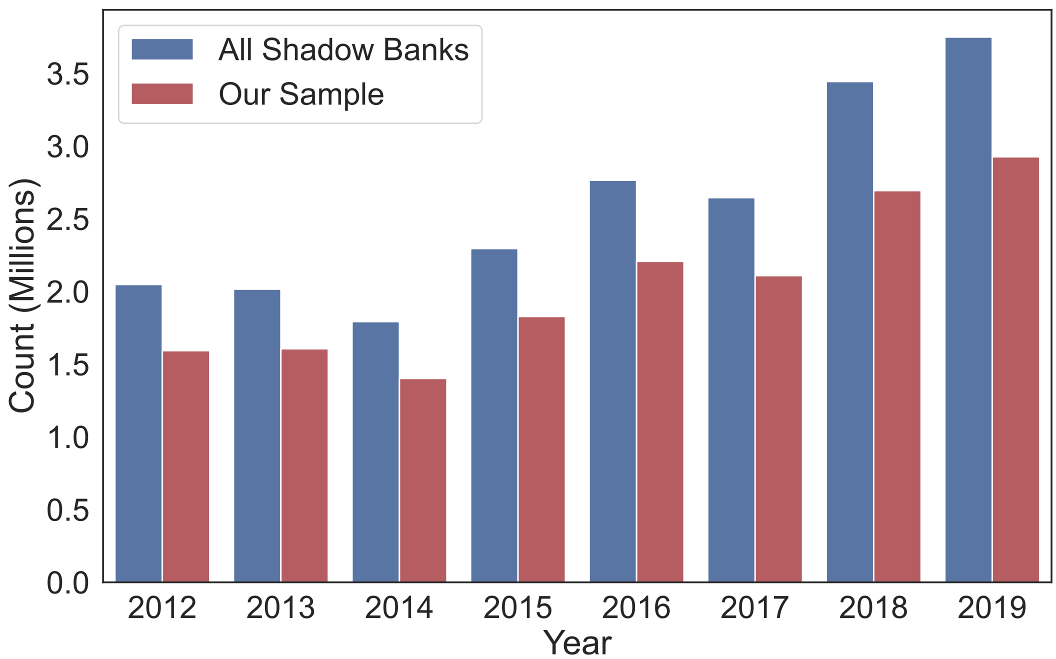

Figure A.2: Sample Size Distribution

This figure compares the size distribution of shadow banks in our sample and in the Home Mortgage Disclosure Act (HMDA). The x axis is the log total dollar amount of mortgages originated by shadow banks during 2012–2019. The gray bar shows the size distribution of shadow banks in HMDA and the green bar shows the size distribution of shadow banks in our sample.

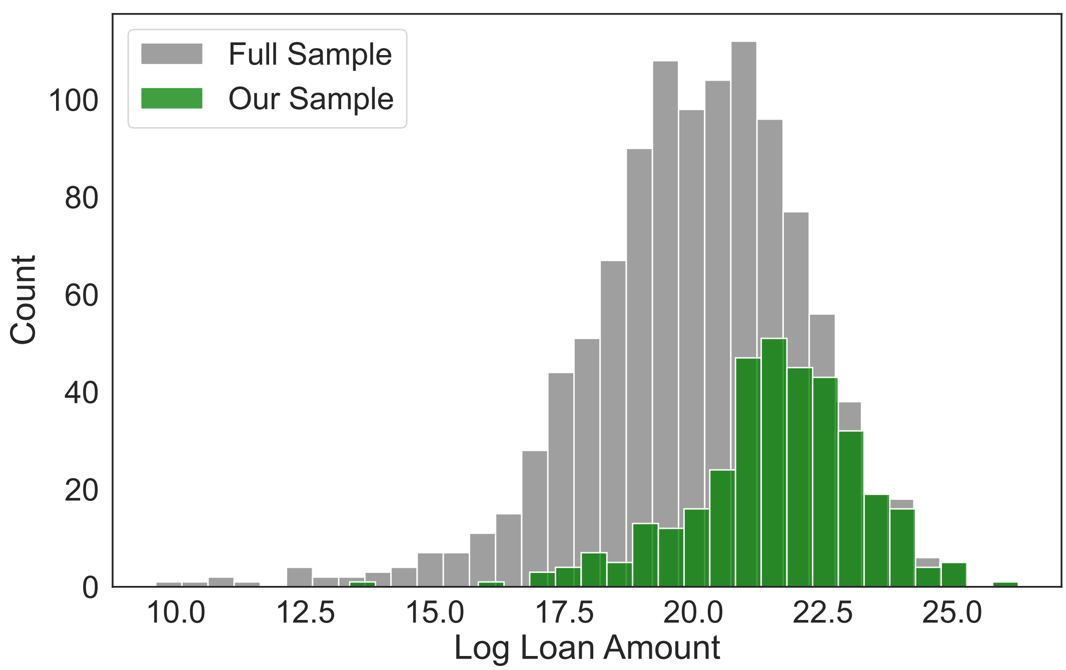

Figure A.3: Impulse Response

This figure presents the impulse response of shadow banks to a 1% monetary policy shock using aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The estimation model is $Y_{l,c,t+h} = \beta_h \text{FFF3m}_t + \gamma' X_{l,t} + FE_{l,c} + \varepsilon_{l,c,t+h}$, and the sample period spans 2011–2019. The sum of the coefficients, $\sum_{h=1}^{n} \beta_h$, represents the cumulative lending amount change up to n quarters following a 1% change in the monetary policy shock. The solid line and the dashed line plot $\sum_{h=1}^{n} \beta_h$ for shadow banks with high exposure to mortgage servicing rights (MSRs) and those with low exposure, respectively; thin dotted lines indicate the 95% confidence intervals. Exposure level is measured as the ratio of MSRs to equity ($\text{MSREquity}_{l,t-1}$). Shadow banks with exposure levels above the median are classified as high exposure, and those below as low exposure. Standard errors are clustered at the lender and year–quarter level.

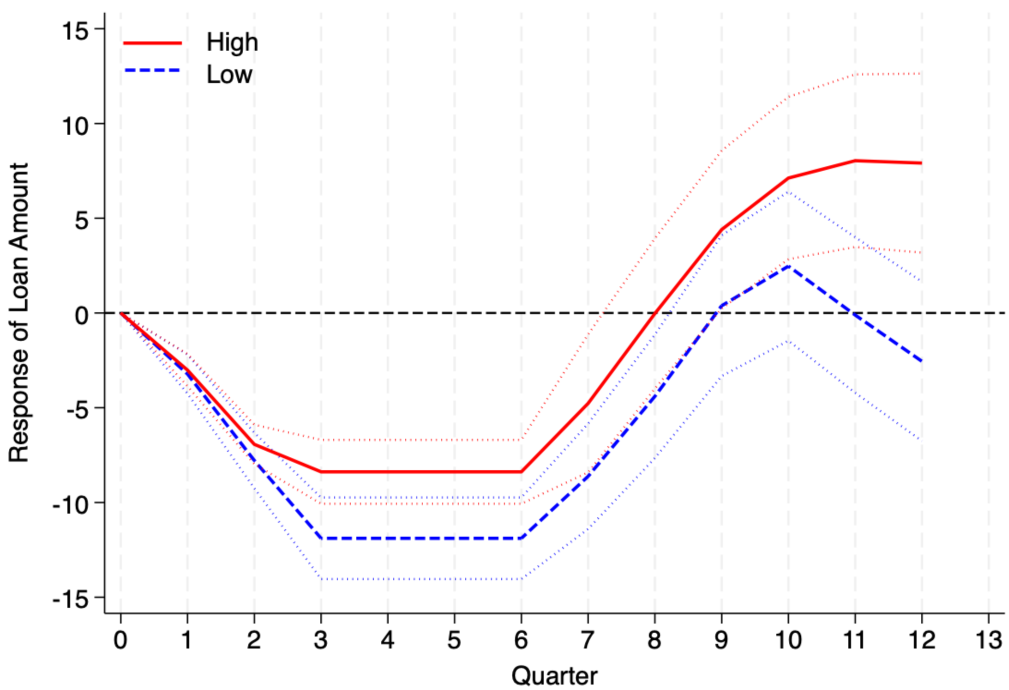

Table A.2: MSR Value Sensitivity to Interest Rate Changes

This table reports summary statistics for the sensitivity of mortgage servicing rights (MSRs) to parallel shifts in the yield curve using lender level data from the Federal Reserve's Y-14Q Schedule I filings over the period 2012–2019. MSR sensitivity is defined as the percentage change in the fair value of MSRs in response to a parallel move in interest rates. The sample includes large bank holding companies (BHCs) subject to CCAR stress testing. As part of the Federal Reserve's Y-14Q Schedule I filings, these BHCs are required to disclose the fair value of their MSRs under a standardized set of interest rate 'shock' scenarios.

Parallel move in the yield curve	N	Mean	SD	P25	P50	P75
+100bps	416	19.356	20.364	10.755	15.842	21.345
+50bps	416	12.539	20.633	5.429	8.751	11.598
+25bps	416	8.557	21.217	1.597	4.535	6.067
-25bps	416	-0.429	23.402	-7.303	-5.394	-3.988
-50bps	416	-5.325	24.944	-14.487	-11.102	-8.348
-100bps	416	-15.455	28.599	-27.831	-22.693	-17.919

Table A.3: MSR Interest Rate Sensitivity and Moneyness of Servicing Portfolio

This table reports estimates from Equation (1) using lenders in the Federal Reserve's Y-14Q Schedule I filings over the period 2012-2019. The dependent variable is a lender's MSR interest rate sensitivity to a 25 bps monetary policy shock, measured as the percent change in the value of the lender's MSR portfolio in response to a 25bps parallel move in the yield curve. The main independent variable is Moneyness of the servicing portfolio of lender i at time t, constructed as the difference between the weighted average coupon rate and the monthly average 30-year fixed-rate mortgage rate across all mortgages in the lender's servicing portfolio at time t. Column 1 does not include any controls or fixed effects. Column 2 adds bank fixed effects and valuation method fixed effects. Column 3 adds bank-level controls: lagged log assets, log equity, capital ratio, liquidity ratio, and return on equity. Standard errors clustered at the lender level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variable:	MSR Sensitivity		
	(1)	(2)	(3)
$\text{Moneyness}_{i,t}$	0.0250**	0.0403**	0.0489**
	(0.0104)	(0.0164)	(0.0210)
Constant	0.0315***	0.0262***	0.2350
	(0.0023)	(0.0031)	(1.5391)
Lender Controls	No	No	Yes
Bank FE		Yes	Yes
Valuation Method FE		Yes	Yes
Observations	258	258	258
R^2	0.033	0.202	0.275

Table A.4: MSR Financing Facilities of Shadow Banks

This table reports the average share of MSR financing facilities in total debt facilities disclosed in the public annual reports of select public shadow banks from 2019 to 2024.

Shadow Bank	Average MSR Financing Share (%)
Rocket Mortgages	27.67
Onity Group Inc (PHH Mortgage)	26.33
Rithm Capital Corp (NewRez)	21.00
Mr. Cooper	56.67

Table A.5: Baseline Effect of Monetary Policy

This table reports estimates from Equation (2) for U.S. shadow banks using aggregate mortgage data at lender-county-quarter level for the period 2012–2019, excluding time and county-time fixed effects to show the baseline effect of monetary policy on lending. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (column 1) and log loan amount (column 2) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Time varying county controls include log population, log median income, unemployment rate, fraction of white, fraction of residents of income less than 35K, fraction of residents with education level lower than high school, and fraction of residents with a college degree. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count	Log Loan Amount
	(1)	(2)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.2820***	0.1889***
	(0.0251)	(0.0282)
$\text{MSREquity}_{l,t-1}$	0.1041***	0.0990***
	(0.0032)	(0.0034)
FFF3m_{t-1}	-0.9068***	-1.2082***
	(0.0237)	(0.0265)
Lender Controls	Yes	Yes
County Controls	Yes	Yes
Lender	Yes	Yes
Lender×County	Yes	Yes
Observations	1,121,991	1,121,991
R^2	0.799	0.799

Table A.6: Differences in Balance Sheet Characteristics: High vs Low MSR Exposure

This table reports the differences in observable balance sheet characteristics of shadow banks with high vs. low exposure to mortgage servicing rights using lender-quarter data from publicly sourced Mortgage Call Reports (MCRs). Shadow banks with high exposure are those that have MSR-Equity ratio greater than the median ratio. Columns 1 and 2 report the mean of each variable across shadow banks within the low and high MSR exposure group, respectively, and column 3 reports the difference between the two groups. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	Low MSR Exposure	High MSR Exposure	Difference
Log Total Assets	17.997	18.933	-0.935***
Capital Ratio	0.216	0.234	-0.018
Return on Equity	0.063	0.058	0.005
Return on Assets	0.010	0.010	0.000
Liquidity Ratio	0.110	0.071	0.039***

Table A.7: Robustness: Controlling for the Interaction between the Monetary Policy Shock and Balance Sheet Characteristics

This table reports estimates for a modified version of Equation (2), adding interaction terms between the monetary policy shock and four balance sheet characteristics: size, capital, profitability, liquidity and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1}\times\text{MSREquity}_{l,t-1}$	0.2649***	0.3698***	0.5773***	0.2438***	0.3844***	0.5723***
	(0.0368)	(0.0348)	(0.0324)	(0.0426)	(0.0380)	(0.0361)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender Controls × MP Shock	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter FE		Yes	Yes		Yes	Yes
Lender×County FE			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.812	0.129	0.483	0.812

Table A.8: Robustness: Entropy-balanced Controls and Propensity Score Matching

Panels A and B of this table report estimates from Equation (2) using entropy balancing and propensity score matching techniques, respectively, to ensure better comparability between shadow banks with high vs low MSR exposure and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Entropy-balanced controls					
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.2963***	0.4235***	0.6124***	0.2371***	0.4118***	0.5949***
	(0.0288)	(0.0271)	(0.0259)	(0.0334)	(0.0299)	(0.029)
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R-squared	0.135	0.405	0.808	0.129	0.482	0.809
	Panel B: Propensity score matching					
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.1441***	0.3001***	0.6119***	0.1495***	0.3562***	0.6370***
	(0.0478)	(0.0466)	(0.046)	(0.0566)	(0.052)	(0.0527)
Observations	516,335	512,411	460,258	516,335	512,411	460,258
R^2	0.134	0.385	0.827	0.145	0.467	0.829
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter		Yes	Yes		Yes	Yes
Lender×County			Yes			Yes

Table A.9: Robustness: IV Estimation

This table reports estimates from Equation (2) using an instrumented MSR exposure measure constructed using the Basel III capital regulation shock, as defined in Equation (3) and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. Column 1 reports the first stage results where the dependent variable is the MSR-to-Equity ratio of a shadow bank and the instrument is the shadow bank's exposure to the Basel III regulation on MSRs in the pre-reform period. Columns 2–7 report results for the second stage regression which estimates the effect of the instrumented MSR exposure on monetary policy transmission to lending. The dependent variables in columns 2–7 are the log loan count (columns 2–4) and log loan amount (columns 5–7) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \widehat{\text{MSREquity}}_{l,t-1}$, the interaction between the monetary policy shock (FFF3m_{t-1}) and the instrumented nonbank exposure to mortgage servicing rights ($\widehat{\text{MSREquity}}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 2 and 5 include lender and year-quarter fixed effects; columns 3 and 6 add county-year-quarter fixed effects; and columns 4 and 7 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficients of interest for brevity. In column 1, standard errors clustered at the lender level are reported in parentheses. In columns 2–7, standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	IV First Stage	IV Second Stage					
	MSREquity	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\text{Basel III Exposure}_{l,t-1}$	0.1020***						
	(0.0338)						
$\text{FFF3m}_{t-1} \times \widehat{\text{MSREquity}}_{l,t-1}$		0.4440***	0.6280***	0.8968***	0.4134***	0.6477***	0.9229***
		(0.0524)	(0.0496)	(0.0462)	(0.061)	(0.0549)	(0.0519)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lender		Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter			Yes	Yes		Yes	Yes
Lender×County				Yes			Yes
Observations	6,628	1,045,200	1,043,646	1,001,089	1,045,200	1,043,646	1,001,089
R^2	0.383	0.130	0.406	0.809	0.117	0.474	0.808
1st Stage F-Stat	18.81***						

Table A.10: Differences in Balance Sheet Characteristics: High vs Low IV MSR Exposure

This table reports the differences in observable balance sheet characteristics of shadow banks with high vs. low exposure to mortgage servicing rights, constructed using the Basel III regulation-induced transfer of serivicing rights as in instrument as defined in Equation (3) and lender-quarter data from publicly sourced Mortgage Call Reports (MCRs). Shadow banks with high exposure are those that have the instrumented MSR-Equity ratio greater than the median ratio. Columns 1 and 2 report the mean of each variable across shadow banks within the low and high MSR exposure group, respectively, and column 3 reports the difference between the two groups. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

	Low MSR Exposure	High MSR Exposure	Difference
Log Total Assets	18.537	18.575	-0.038
Capital Ratio	0.211	0.206	0.005
Return on Equity	0.062	0.063	-0.001
Return on Assets	0.012	0.011	0.001
Liquidity Ratio	0.081	0.081	0.000

Table A.11: Robustness: Alternative Measure of Exposure to Mortgage Servicing Rights

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using an alternative measure of exposure to mortgage servicing rights and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSRAsset}_{l,t-1}$, the interaction between the monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSRAsset}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to assets and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSRAsset}_{l,t-1}$	0.1153***	0.1902***	0.3018***	0.0320	0.1434***	0.2551***
	(0.0293)	(0.0275)	(0.0254)	(0.0340)	(0.0302)	(0.0284)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County $\times$ Year-Quarter FE		Yes	Yes		Yes	Yes
Lender $\times$ County FE			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.811	0.129	0.483	0.811

Table A.12: Robustness: Orthogonalized Monetary Policy Shocks

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using an orthogonalized measure of monetary policy shock following Karnaukh and Vokata (2022) and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{GS}_{t-1}^{Orth} \times \text{MSREquity}_{l,t-1}$, the interaction between the orthoganized monetary policy shock following Karnaukh and Vokata (2022) (GS_{t-1}^{Orth}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{GS}_{t-1}^{Orth} \times \text{MSREquity}_{l,t-1}$	0.2551***	0.3646***	0.5286***	0.2050***	0.3542***	0.5108***
	(0.0287)	(0.0269)	(0.0255)	(0.0333)	(0.0297)	(0.0286)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter		Yes	Yes		Yes	Yes
Lender×County			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.812	0.129	0.483	0.812

Table A.13: Robustness: Alternative Monetary Policy Shock from Nakamura and Steinsson (2018)

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using monetary policy shocks from Nakamura and Steinsson (2018) and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{NS}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (NS_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the policy news shock from Nakamura and Steinsson (2018) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{NS}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.1502***	0.1617***	0.2112***	0.1377***	0.1515***	0.2004***
	(0.0171)	(0.0160)	(0.0154)	(0.0203)	(0.0180)	(0.0176)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE		Yes	Yes		Yes	Yes
Lender × County FE			Yes			Yes
Observations	1,234,720	1,233,135	1,179,131	1,234,720	1,233,135	1,179,131
R^2	0.134	0.412	0.810	0.128	0.485	0.810

Table A.14: Robustness: Contemporaneous Monetary Policy Shock

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using contemporaneous monetary policy shocks and aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry.. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_t \times \text{MSREquity}_{l,t-1}$, the interaction between the contemporaneous monetary policy shock (FFF3m_t) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_t \times \text{MSREquity}_{l,t-1}$	0.1735***	0.2477***	0.3288***	0.1463***	0.2496***	0.3326***
	(0.0259)	(0.0238)	(0.0217)	(0.0305)	(0.0264)	(0.0247)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE		Yes	Yes		Yes	Yes
Lender × County FE			Yes			Yes
Observations	1,111,580	1,110,324	1,058,785	1,111,580	1,110,324	1,058,785
R^2	0.138	0.410	0.814	0.132	0.481	0.813

Table A.15: Robustness: Controlling for Loan Demand

This table reports estimates from Equation (2) controlling for demand for loans. Columns 1-3 report estimates aggregated at the lender-county-quarter level while columns 4-7 report results estimated from Equation (2) using a random sample at the loan level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variable in columns 1-3 is the the number of mortgages originated as a percent of total applications. In columns 4-7, the dependent variable is dummy variable that takes a value 1 if a loan application is originated. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. The loan-level analysis allows us to include borrower controls, which are added in column 7. These include dummy variables for whether the applicant is female, whether the applicant is white, log of applicant's income, and loan-to-income ratio. We also include loan type and loan purpose fixed effects in the most saturated specification in column 7. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Pct Originated			D(Originated)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\text{FFF3m}_{t-1}\times\text{MSREquity}_{l,t-1}$	0.0346***	0.0225***	0.0221***	0.0513***	0.0562***	0.0584***	0.0604***
	(0.0063)	(0.0062)	(0.0066)	(0.0122)	(0.0125)	(0.0121)	(0.0118)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Controls							Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter FE		Yes	Yes		Yes	Yes	Yes
Lender×County FE			Yes			Yes	Yes
Loan Type FE							Yes
Loan Purpose FE							Yes
Observations	1,173,860	1,172,438	1,119,557	3,061,897	3,060,613	3,034,118	3,034,118
R^2	0.342	0.400	0.518	0.201	0.217	0.256	0.279

Table A.16: Robustness: Alternative Clustering

This table reports estimates from Equation (2) clustering standard errors at both lender-county and time level using aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the contemporaneous monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level and year-quarter level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.2601*	0.3707**	0.5359***	0.2105	0.3609**	0.5186**
	(0.1489)	(0.1559)	(0.1729)	(0.1456)	(0.1576)	(0.1923)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County×Year-Quarter FE		Yes	Yes		Yes	Yes
Lender×County FE			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.812	0.129	0.483	0.812

Table A.17: Robustness: Shadow Bank Definition from Buchak et al. (2018)

This table reports estimates from Equation (2) for U.S. shadow banks for the period 2012–2019 using aggregate data at lender-county-quarter level. The data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. We define shadow banks following Buchak et al. (2018). The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 include lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.3246***	0.4655***	0.6490***	0.2937***	0.4754***	0.6485***
	(0.0343)	(0.0320)	(0.0301)	(0.0393)	(0.0350)	(0.0333)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE		Yes	Yes		Yes	Yes
Lender × County FE			Yes			Yes
Observations	881,383	879,678	847,489	881,383	879,678	847,489
R^2	0.121	0.440	0.819	0.105	0.505	0.819

Table A.18: Asymmetric Effects: Positive vs Negative Monetary Policy Shocks

This table reports estimates from Equation (2) for U.S. shadow banks using aggregate mortgage data at lender-county-quarter level for the period 2012–2019, separately for subsamples of positive and negative monetary policy shocks. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–2) and log loan amount (columns 3–4) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the contemporaneous monetary policy shock (FFF3m_{t-1}) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. Column 1 and column 3 use the subsample of contractionary monetary policy shocks (+) and column 2 and column 4 use the subsample of expansionary monetary policy shocks (-). The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. All columns include lender, year-quarter fixed effects, county-year-quarter and lender-county fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count		Log Loan Amount	
Shocks	+	-	+	-
	(1)	(2)	(3)	(4)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.7730***	0.4136***	0.6040***	0.3767***
	(0.1283)	(0.0343)	(0.1433)	(0.0388)
Lender Controls	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
County×Year-Quarter FE	Yes	Yes	Yes	Yes
Lender×County FE	Yes	Yes	Yes	Yes
Observations	360,190	497,947	360,190	497,947
R^2	0.827	0.838	0.829	0.839

Table A.19: First-Stage Regression: Transmission of Monetary Policy Shocks to the 30-Year Mortgage Rate

This table reports estimates from regressing the change in the 30-year mortgage rate on the monetary policy shock using public data from St Louis Federal Reserve Economic Data (FRED). The dependent variable is the change in the 30-year mortgage rate in two-week window around FOMC meetings. The 30-year mortgage rate data are from the Federal Reserve Bank of St. Louis. The independent variable is the high-frequency movement in three-months-ahead federal funds future around FOMC meetings from Gürkaynak et al. (2022) aggregated to monthly frequency. Column 1 reports the regression results using the full sample (1990–2019), and column 2 reports the regression results using the sample period 2012–2019. The projected change in the 30-year mortgage rate used to estimate Equation (A.2) is computed using the coefficient estimate from column 1. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variable:	Change in 30-Year Mortgage Rate	
	(1)	(2)
FFF3m	0.2742*	1.926**
	(0.1490)	(0.9094)
Constant	-0.0181**	0.0090
	(0.0088)	(0.0142)
Observations	262	60
R^2	0.0129	0.0718

Table A.20: The Role of Prepayment Risk in Accounting for the Mortgage Servicing Channel

This table reports estimates from Equation (A.2) for U.S. shadow banks for the period 2012–2019 and using aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–3) and log loan amount (columns 4–6) of mortgages originated by shadow bank l in county c in year-quarter t. The main independent variable is $\widehat{\text{MR}}_{t-1} \times \text{MSREquity}_{l,t-1}$, the interaction between the lagged change in the 30-year mortgage rate projected on the monetary policy shock ($\widehat{\text{MR}}_{t-1}$) and nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures from Gürkaynak et al. (2022) aggregated to quarterly frequency, and the projected change in the 30-year mortgage rate is obtained by estimating the first-stage regression $\text{MR}_t = \alpha + \beta \text{FFF3m}_t + \epsilon_t$. Results from the first stage are reported in Table A.19 of the appendix. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 4 add lender and year-quarter fixed effects; columns 2 and 5 add county-year-quarter fixed effects; and columns 3 and 6 add lender-county fixed effects. Standard errors are clustered at the lender-county level and reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count			Log Loan Amount		
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{\text{MR}}_{t-1} \times \text{MSREquity}_{l,t-1}$	0.9486***	1.3517***	1.9542***	0.7675***	1.3159***	1.8912***
	(0.1051)	(0.0985)	(0.0933)	(0.1219)	(0.1087)	(0.1046)
$\text{MSREquity}_{l,t-1}$	0.0696***	0.1306***	0.2070***	0.0479***	0.1282***	0.2041***
	(0.0057)	(0.0053)	(0.0051)	(0.0065)	(0.0057)	(0.0055)
Lender Controls	Yes	Yes	Yes	Yes	Yes	Yes
Lender FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
County × Year-Quarter FE		Yes	Yes		Yes	Yes
Lender × County FE			Yes			Yes
Observations	1,173,900	1,172,478	1,119,593	1,173,900	1,172,478	1,119,593
R^2	0.136	0.411	0.812	0.129	0.483	0.812

Table A.21: Strategic Interactions Between Banks and Shadow Banks

This table reports estimates from Equation (A.7) for U.S. shadow banks using data from publicly sourced Mortgage Call Reports (MCRs) for the period 2012–2019 and examines if competition in the downstream mortgage market shapes the effect of MSR exposure on shadow banks' cost of funding following monetary policy shocks. The dependent variable is credit line funding cost of shadow bank l in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{Competition}_l$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}), nonbank exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$) and a measure of downstream market competition for shadow bank l. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The nonbank exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity and is standardized with mean of 0 and standard deviation of 1. Shadow banks' downstream market competition is measured by the origination share weighted HHI or the top 4 lender market share in their operating counties. HighHHI_l and HighTop4_l take a value 1 if the competition measure for shadow bank l lies in the top decile and 0 otherwise. Lender controls include log assets, log equity, ROE, prime conforming share of unpaid loan balances, share of unpaid balance of mortgages in assets, liquidity-to-asset ratio, and capital ratio. Columns 1 and 2 include lender and year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficients of interest for brevity. Standard errors clustered at the lender level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variable:	Interest rate	
	(1)	(2)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{HighHHI}_l$	0.0167	
	(0.0239)	
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{HighTop4}_l$		0.0138
		(0.0271)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1}$	-0.0425***	-0.0417***
	(0.0125)	(0.0121)
$\text{FFF3m}_{t-1} \times \text{HighHHI}_l$	-0.0265	
	(0.0366)	
$\text{MSREquity}_{l,t-1} \times \text{HighHHI}_l$	0.0008	
	(0.0023)	
$\text{FFF3m}_{t-1} \times \text{HighTop4}_l$		-0.0485
		(0.0362)
$\text{MSREquity}_{l,t-1} \times \text{HighTop4}_l$		-0.0013
		(0.0037)
$\text{MSREquity}_{l,t-1}$	-0.0018	-0.0016
	(0.0011)	(0.0011)
Lender Controls	Yes	Yes
Lender FE	Yes	Yes
Year-Quarter FE	Yes	Yes
Observations	4,165	4,165
R^2	0.414	0.415

Table A.22: Robustness: Controlling for the Interaction between the Monetary Policy Shock and Lender Health (MSA level)

This table reports estimates for a modified version of Equation (9) estimated for the full combined sample of banks and nonbanks, adding interactions between the monetary policy shock and four balance sheet characteristics: size, capital, profitability, liquidity using aggregate mortgage data at lender-county-quarter level. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (column 1) and log loan amount (column 2) of mortgages originated by lender l in county c in year-quarter t. The main independent variable is $\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{Nonbank}_{l,t}$, the triple interaction between the lagged monetary policy shock (FFF3m_{t-1}), lender exposure to mortgage servicing rights ($\text{MSREquity}_{l,t-1}$), and a shadow bank dummy variable ($\text{Nonbank}_{l,t}$). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The lender exposure to mortgage servicing rights is measured as the ratio of mortgage servicing rights to equity. The shadow bank dummy variable equals 1 if lender l is classified as an independent mortgage company in the Avery file in year-quarter t. Lender controls include log assets, log equity, ROE, liquidity-asset ratio, and capital ratio. All columns include lender type-year-quarter-, lender type-county-, lender-, year-quarter-, country-year-quarter-, and country-lender-fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender-county level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count (1)	Log Loan Amount (2)
$\text{FFF3m}_{t-1} \times \text{MSREquity}_{l,t-1} \times \text{Nonbank}_{l,t}$	0.1947*** (0.0140)	0.2244*** (0.0168)
Lender Controls	Yes	Yes
Lender Controls × MP Shock	Yes	Yes
Lender Type × Year-Quarter FE	Yes	Yes
Lender Type × County FE	Yes	Yes
Lender FE	Yes	Yes
County × Year-Quarter FE	Yes	Yes
County × Lender FE	Yes	Yes
Observations	1,730,064	1,730,064
R^2	0.798	0.777

Table A.23: Delinquency Sensitivity of Servicing Portfolio to Monetary Policy Shocks

This table examines whether loans serviced by nonbanks are more likely to become delinquent following monetary policy shocks. The sample includes a 1% random sample of 30-year fixed-rate home purchase mortgages from the Fannie Mae and Freddie Mac single family loan-level data over the period 2012-2019. The dependent variable is a delinquency dummy that equals one if a loan is more than 60 days delinquent (columns 1–4) or more than 90 days delinquent (columns 5–8). The main independent variable is $\text{FFF3m}_{t-1} \times \text{NonBank}_l$, the interaction between the lagged monetary policy shock (FFF3m_{t-1}) and the nonbank dummy (NonBank_l). The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. Columns 2 and 6 add year-quarter fixed effects and columns 3-4 and 7-8 add servicer fixed effects. Columns 4 and 8 further add lender controls (capital ratio, ROE, log assets, and liquidity ratio). Standard errors clustered at the year-quarter level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	d60				d90			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FFF3m_{t-1}	-0.0013				0.0002			
	(0.0075)				(0.0041)			
NonBank_l		0.0025***				0.0017***		
		(0.0003)				(0.0002)		
$\text{FFF3m}_{t-1} \times \text{NonBank}_l$			-0.0029	-0.0080			-0.0029	-0.0067
			(0.0077)	(0.0069)			(0.0046)	(0.0043)
Year-Quarter FE		Yes	Yes	Yes		Yes	Yes	Yes
Servicer FE			Yes	Yes			Yes	Yes
Lender Controls				Yes				Yes
Observations	2,588,296	2,588,296	2,588,296	2,322,425	2,588,296	2,588,296	2,588,296	2,322,425
R^2	3.64×10^{-7}	0.00073	0.00171	0.00121	1.92×10^{-8}	0.00049	0.00128	0.00081

Table A.24: Summary Statistics: Large Bank Servicers

This table reports additional summary statistics for the main variables used in estimating the effect of Basel III on the MSR exposure of a subsample of large bank servicers using data from public bank Y-9C reports in Section A.4.

Summary Statistics for Banks						
Variable	N	Mean	SD	25%	50%	75%
MSR/Equity (%)	602	4.84	3.39	2.65	4.54	6.33
MSR/Assets (%)	602	0.49	0.33	0.25	0.48	0.64
MSR/Tier 1 Capital (%)	602	5.08	2.52	3.57	5.30	5.70
Log Total Assets	602	19.35	0.43	18.99	19.71	19.71
Log Equity	602	17.04	0.39	16.79	17.33	17.33
Return on Equity (%)	602	2.25	2.43	1.76	2.52	3.19
Liquidity Ratio (%)	602	17.35	7.80	13.60	15.75	18.07
Capital Ratio (%)	602	10.25	1.84	9.01	10.46	11.54

Table A.25: Effect of Basel III Capital Requirements on Banks' Exposure to Mortgage Servicing Rights

This table reports estimates from Equation (A.8) for large bank servicers for the period 2005–2019 using public bank Y-9C reports. The dependent variables are the MSR-to-equity ratio (column 1) and MSR-to-asset ratio (column 2) of bank l in year-quarter t. The main independent variable is $\text{MSRCapital}_l \times \text{Post}_t$, the interaction between the ratio of MSRs to Tier 1 capital of bank l in 2012Q2 (MSRCapital_l) and a post dummy variable (Post_t). The post dummy variable equals 1 if year-quarter t is after 2012Q2. Lender controls include log assets, log equity, ROE, liquidity-asset ratio, and capital ratio. Both specifications include lender and year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the lender level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	MSR/Equity	MSR/Asset
	(1)	(2)
$\text{MSRCapital}_l \times \text{Post}_t$	-0.4629***	-0.0268***
	(0.0827)	(0.0074)
Lender Controls	Yes	Yes
Lender FE	Yes	Yes
Year-Quarter FE	Yes	Yes
Observations	602	602
R^2	0.762	0.783

Table A.26: Summary Statistics: MSA-Level Analysis

This table reports summary statistics for the main variables used in the MSA-quarter level analysis for the period 2012–2019. The mortgage count and amount are from the confidential Home Mortggae Disclosure Act (HMDA) dataset. MSA-level industrial employment shares are from the Quarterly Census of Employment and Wages (QCEW). The local financial health measures (deposit-weighted asset growth rate, deposit-weighted capital ratio, deposit-weight log assets) are constructed following Loutskina and Strahan (2015). Local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19) data are from the United States Census Bureau. Unemployment rate data are from the Bureau of Labor Statistics. Per capita income and GDP growth are from the Bureau of Economic Analysis.

Summary Statistics for MSA-Level Analysis						
Variable	N	Mean	SD	25%	50%	75%
Log Loan Count	12,361	7.05	1.13	6.24	6.88	7.75
Log Loan Amount	12,361	12.16	1.27	11.25	11.98	12.94
MSR/Tier 1 Capital (%)	12,361	3.93	1.35	2.94	4.08	4.99
Monetary Policy Shock (bps)	12,361	-0.48	2.43	-1	0	1
Post	12,361	0.84	0.37	1	1	1
Industry - Mining (%)	12,262	2.59	5.38	0.37	0.83	1.94
Industry - Construction (%)	12,262	5.18	2.52	3.96	5.10	6.48
Industry - Manufacture (%)	12,262	11.95	7.69	6.74	11.02	16.49
Industry - Trade (%)	12,262	24.28	4.55	21.62	23.72	26.17
Industry - Information (%)	12,262	1.42	1.01	0.84	1.36	1.92
Industry - Finance (%)	12,262	5.33	2.53	3.92	5.06	6.56
Industry - Business (%)	12,262	12.70	4.78	9.81	12.28	15.53
Industry - Education (%)	12,262	19.31	5.90	16.19	19.27	22.40
Industry - Leisure (%)	12,262	13.91	4.83	11.37	13.02	15.81
Deposit-Weighted Asset Growth Rate (%)	12,324	9.90	100.69	3.69	5.85	9.14
Deposit-Weighted Capital Ratio (%)	12,324	10.98	1.28	10.44	11.06	11.63
Deposit-Weighted Log Total Assets	12,324	19.42	0.99	18.97	19.60	20.13
Male (%)	12,346	49.32	1.04	48.65	49.16	49.87
White (%)	12,346	83.73	11.05	78.72	86.98	91.79
Population Below 19 (%)	12,346	25.89	3.15	24.19	25.75	27.27
Population Above 65 (%)	12,346	15.30	4.35	12.76	14.75	16.90
Log Per Capita Income	12,266	10.62	0.19	10.49	10.60	10.72
GDP Growth Rate (%)	12,266	3.44	4.05	1.56	3.35	5.15
Unemployment Rate (%)	11,830	5.56	2.63	3.76	5.02	6.73
Growth Rate of Unemployment Rate (%)	11,830	-9.44	9.86	-15.29	-10.20	-3.84

Table A.27: Robustness: Constructing MSA-level Exposure following Buchak et al. (2018)

This table reports estimates from Equation (13) using aggregate mortgage data at MSA-quarter level for the period 2011–2019, constructing the MSA-level exposure to Basel III following Buchak et al. (2018). The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (column 1) and log loan amount (column 2) of mortgages originated in MSA M in year-quarter t. The main independent variable is $\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$, the interaction between the MSA-level exposure to Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$), lagged monetary policy shock (FFF3m_{t-1}), and post dummy variable (Post_t). MSA-level exposure to Basel III is measured as the origination-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2. The variable is standardized with mean of 0 and standard deviation of 1. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). Both columns add MSA fixed effects and year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficients of interest for brevity. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count	Log Loan Amount
	(1)	(2)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$	0.8677**	1.2659***
	(0.4357)	(0.4535)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1}$	-0.9790**	-1.4194***
	(0.445)	(0.4622)
$\text{MSR\%}_M \times \text{Post}_t$	0.0891***	0.1064***
	(0.0153)	(0.0183)
MSA Controls	Yes	Yes
MSA FE	Yes	Yes
Year-Quarter FE	Yes	Yes
Observations	11,682	11,682
R^2	0.984	0.984

Table A.28: Controlling for Mortgage Market Competition at the MSA Level

This table reports estimates from Equation (13) for MSAs for the period 2011–2019, controlling for competition in the mortgage market at the MSA level using aggregate mortgage data at MSA-quarter level, along with its interaction with the monetary policy shock. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1 and 3) and log loan amount (columns 2 and 4) of mortgages originated in MSA M in year-quarter t. The main independent variable is $\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$, the interaction between the MSA-level exposure to Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$), lagged monetary policy shock (FFF3m_{t-1}), and post dummy variable (Post_t). MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2 and defined in Equation (10). The variable is standardized with mean of 0 and standard deviation of 1. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. Two competition measures, $\text{HHI}_{M,t-1}$ and $\text{Top4}_{M,t-1}$ are interacted with the monetary policy shock to control for the effect of local mortgage market competition on origination. $\text{HHI}_{M,t-1}$ is the Herfindahl–Hirschman index for mortgage origination in MSA M at $t-1$ and $\text{Top4}_{M,t-1}$ is the share of mortgages originated by the top 4 lenders in MSA M at $t-1$. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). All columns include MSA fixed effects and year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Count	Amount	Count	Amount
	(1)	(2)	(3)	(4)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$	1.1208***	1.4913***	1.1553***	1.5374***
	(0.3235)	(0.3261)	(0.3216))	(0.3248)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1}$	-1.2337***	-1.6137***	-1.2254***	-1.6057***
	(0.3142)	(0.3161)	(0.3151)	(0.3176)
$\text{MSR\%}_M \times \text{Post}_t$	0.0843***	0.0989***	0.0809***	0.0947***
	(0.0103)	(0.0114)	(0.0103)	(0.0114)
$\text{HHI}_{M,t-1}$	-0.0786	-0.7605*		
	(0.3754)	(0.4363)		
$\text{FFF3m}_{t-1} \times \text{HHI}_{M,t-1}$	-2.9928	-3.3663		
	(3.5735)	(4.0172)		
$\text{Top4}_{M,t-1}$			-0.2697**	-0.4907***
			(0.1254)	(0.1337)
$\text{FFF3m}_{t-1} \times \text{Top4}_{M,t-1}$			-0.2052	-0.1392
			(0.8839)	(0.9945)
MSA Controls	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
Observations	11,546	11,546	11,546	11,546
R^2	0.984	0.985	0.984	0.985

Table A.29: Mortgage Servicing and Monetary Policy Transmission: Identify Treated MSAs using a Dummy Variable

This table reports estimates from Equation (13) using aggregate mortgage data at MSA-quarter level over the period 2011–2019, where treated MSAs are identified using a dummy variable, rather than the continuous measure of MSR exposure used in Table 9. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the log loan count (columns 1–4) and log loan amount (columns 5–8) of mortgages originated in MSA M in year-quarter t. The main independent variable is $\mathrm{D}_M \times \mathrm{FFF3m}_{t-1} \times \mathrm{Post}_t$, the interaction between the servicing exposure dummy (D_M), lagged monetary policy shock ($\mathrm{FFF3m}_{t-1}$), and post dummy variable (Post_t). (D_M) takes a value of 1 if the MSA-level exposure to Basel III capital requirements on mortgage servicing rights ($\mathrm{MSR\%}_M$) is above median and 0 otherwise. MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2 and defined in Equation (10). The variable is standardized with mean of 0 and standard deviation of 1. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). Columns 3 and 7 add MSA fixed effects; and columns 4 and 8 add year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	Log Loan Count				Log Loan Amount			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathrm{D}_M \times \mathrm{FFF3m}_{t-1} \times \mathrm{Post}_t$	1.5440*	1.4683*	1.3629**	1.5908**	2.1854**	2.4520***	2.1659***	2.4084***
	(0.8084)	(0.7575)	(0.6541)	(0.6409)	(0.8595)	(0.7681)	(0.6573)	(0.6468)
$\mathrm{D}_M \times \mathrm{FFF3m}_{t-1}$	-2.3338***	-2.2453***	-1.6675***	-1.8412***	-3.1013***	-3.1863***	-2.4861***	-2.6821***
	(0.7721)	(0.7521)	(0.6413)	(0.6255)	(0.8038)	(0.7520)	(0.6380)	(0.6221)
$\mathrm{D}_M \times \mathrm{Post}_t$	0.2207***	0.1742***	0.1824***	0.1399***	0.2696***	0.1965***	0.2142***	0.1710***
	(0.0366)	(0.0470)	(0.0234)	(0.0208)	(0.0405)	(0.0514)	(0.0255)	(0.0235)
$\mathrm{FFF3m}_{t-1} \times \mathrm{Post}_t$	-9.3464***	-8.4128***	-7.4644***		-11.9952***	-10.5560***	-9.5273***	
	(0.5548)	(0.6831)	(0.5062)		(0.5791)	(0.7179)	(0.5187)	
$\mathrm{FFF3m}_{t-1}$	8.1447***	7.2087***	6.2441***		10.0781***	8.8640***	7.8671***	
	(0.5492)	(0.6216)	(0.4856)		(0.5627)	(0.6342)	(0.4937)	
Post_t	-0.1071***	-0.0824	-0.0954***		-0.0427	-0.0850	-0.0962***	
	(0.0259)	(0.0565)	(0.0174)		(0.0280)	(0.0612)	(0.0184)	
D_M	0.0965	-0.1045			0.2596**	-0.0067		
	(0.1127)	(0.0900)			(0.1241)	(0.0945)		
MSA Controls		Yes	Yes	Yes		Yes	Yes	Yes
MSA FE			Yes	Yes			Yes	Yes
Year-Quarter FE				Yes				Yes
Observations	12,361	11,682	11,682	11,682	12,361	11,682	11,682	11,682
R^2	0.0188	0.417	0.952	0.984	0.0420	0.476	0.955	0.984

Table A.30: Distributional Consequences of the Mortgage Servicing Channel

This table reports estimates from Equation (13) using aggregate mortgage data at MSA-quarter level for the period 2011–2019. The mortgage data come from the anonymized Confidential Home Mortgage Disclosure Act (HMDA) Loan Application Registry. The dependent variables are the share of mortgages originated to minority borrowers (columns 1–2) and to low-income borrowers (columns 3–4) in MSA M in year-quarter t. The main independent variable is $\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$, the interaction between the MSA-level exposure to Basel III capital requirements on mortgage servicing rights ($\text{MSR\%}_M$), lagged monetary policy shock (FFF3m_{t-1}), and post dummy variable (Post_t). MSA-level exposure to Basel III is measured as the servicing-weighted average of banks' ratio of mortgage servicing rights to Tier 1 capital in MSA M in 2012Q2 and defined in Equation (10). The variable is standardized with mean of 0 and standard deviation of 1. The monetary policy shock is the high-frequency movement in the three-months-ahead federal funds futures around FOMC meetings from Gürkaynak et al. (2022) aggregated to quarterly frequency. The post dummy variable equals 1 if year-quarter t is 2012Q3 or later. MSA-level controls include lagged level industrial employment share, local financial health measures, local demographics (fraction of population who are male, fraction of population who are white, fraction of population with age over 65, fraction of population with age under 19), and local economic development (unemployment rate, per capita income, GDP growth). All columns include MSA fixed effects and year-quarter fixed effects. We include all control variables and interaction terms in the estimation, but report only the main coefficient of interest for brevity. Standard errors clustered at the MSA level are reported in parentheses. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Dependent Variables:	% Minority		% Low-income	
	Count (1)	Amount (2)	Count (3)	Amount (4)
$\text{MSR\%}_M \times \text{FFF3m}_{t-1} \times \text{Post}_t$	0.0671**	0.0338	-0.0095	-0.0499
	(0.0310)	(0.0355)	(0.0719)	(0.0767)
MSA Controls	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
Observations	11,682	11,682	11,682	11,682
R^2	0.949	0.936	0.927	0.915