The Rise of Non-Banks in Servicing Household Debt *

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Abstract

Over the past few decades, the mortgage industry has been transformed from the traditional bank-centered deposit taking, lending, and servicing model to a fragmented market with high non-bank participation. We document a novel mechanism for this unbundling – mortgage servicing transfers – and study the role of bank regulation in transforming servicing. Using a near universe of consumer credit records, we show that banks increase transfers of mortgage servicing rights (MSRs) to non-banks following the announcement of Basel III's higher regulatory costs of holding MSR assets for banks. Based on predictions of a simple model of servicing transfers, we demonstrate which types of banks and loans experience the highest transfer rates. We find that banks selectively transferred below-median income, subprime, and 60+ day delinquent MSRs to non-banks. Loans subject to transfer due to regulatory pressure experienced more foreclosures and personal bankruptcies. Our results suggest that growth in the unbundling of mortgage servicing increased existing disparities in financial risks across households.

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The traditional business model of lending featured an integration of origination, financing, and servicing (Hanson et al., 2015; Egan et al., 2022). This structure has been transformed over the last two decades. First, securitization unbundled origination from ownership over the loans and dispersed ownership rights to outside investors. Second, the right to service a loan, meaning collecting payments and dealing with financial distress, was stripped from the ownership of the loan. This allowed servicing rights to be sold from one financial institution to another, which we refer to as servicing transfer. While the unbundling of mortgage ownership rights via securitization has been thoroughly explored,[1] the transfer of servicing rights is under-studied. Servicers facilitate provision of debt relief, which affects optimal risk sharing (Cherry et al., 2021, 2022; Padi et al., 2023; Kim et al., 2022) and realized return to mortgage investors (Aiello, 2022). Servicing transfers can hinder optimal risk sharing and decrease returns to mortgage investors by creating information asymmetries and increasing coordination costs between investors and servicers. This paper studies servicing rights transfers as an important margin of transformation in the $10 trillion US residential mortgage market.

Using a near-universe of credit bureau data, we document a rise in servicing transfers during the 2011-2015 time frame, centered around a rule change in Basel III that increased the regulatory cost of carrying the servicing rights of securitized mortgages. We show that the transfers induced by the rule change were mostly from banks to non-banks, contributing to the rise of non-banks in this market. Moreover, loans of low income and low credit score borrowers were more likely to experience servicing right transfers. We then quantify and document the real impacts on households' financial distress by analyzing the effect of the regulatory change on foreclosure and personal bankruptcy rates. We discuss the implications of our findings for unbundling of banking services, financial stability and resilience, and disparities in financial risks across households.

A mortgage servicing right (MSR) is an asset created when the mortgage originator sells the right to collect and deliver mortgage payments to the investors in return for monthly fee revenues. There are regulatory costs of carrying MSR assets for banks. Between 2012Q2-2013Q2, the Federal Reserve gradually adopted Basel III's stricter MSR regulations, which increased the capital required for holding MSR assets on securitized loans. The rule change increased the regulatory cost for banks to hold MSRs, but did not affect non-banks.

We begin by introducing a stylized model in which banks make optimal decisions to adjust their holdings of MSR assets by trading with non-banks in an efficient market. Banks are subject to a regulatory cost of carrying MSR assets, and transfers of MSR assets are always

[1] See, for example, DeMarzo (2005); Ashcraft et al. (2008); Hartman-Glaser et al. (2012).

associated with value discount due to information asymmetries and increased coordination costs. Our model shows that a higher regulatory cost of holding MSRs induces banks to transfer additional MSRs to non-banks. Consistent with our model, we show that Basel III was associated with a spike in transfers from banks to non-banks — MSRs of more than 3 million loans were transferred in 2013Q2 alone; seven times the number of transfers in 2013Q1. Non-banks persistently held more servicing rights post-regulation. By the end of 2015, non-banks serviced about 30% of total outstanding mortgages, compared to about 10% in 2011.

We then identify the causal effect of the Basel III MSR rule. Using a difference-in-differences (DiD) design, we examine whether banks are more likely to sell MSRs than non-banks after the regulatory change. We find that the final adoption of Basel III in 2013Q2 increased banks' likelihood of selling MSRs by 4% relative to that of non-banks. Banks' higher likelihood of MSR transfers persisted for several quarters and stayed around 2% higher than that of non-banks by the end of 2015. Moreover, prior to the initial proposal of the Basel III rule, bank MSR transfers were not statistically more likely than non-bank MSR transfers. The lack of pre-trend alleviates the concern that different unobservable loan characteristics might drive the different bank versus non-bank transfer likelihoods.

Our model further suggests that banks' exposure to the rule change, reflected by their amount of MSR holdings prior to the change, is positively associated with their incentive to unbundle origination and servicing post-regulation. To empirically test this, we limit our analysis to MSRs held by banks only and exploit the variation in banks' treatment intensity. We empirically proxy a bank's treatment intensity with its MSR-to-CET1 ratio in 2011. Consistent with the model intuition, we find that a 10% increase in a bank's MSR-to-CET1 ratio in 2011 corresponds to a .4% higher likelihood of MSR transfers post-regulation.

Moreover, we find that banks selectively transferred MSRs for below median income, subprime, and 60+ day delinquent loans to non-banks following Basel III. This finding is consistent with the prediction of our model which assumes higher discounts on the transfers of high-risk MSRs than on those of low-risk MSRs. The intuition is as follows. Because high-risk MSRs have higher transfer discounts, presumably due to higher information asymmetry, they have higher baseline balance-sheet retention than low-risk MSRs. As the regulatory cost of holding MSRs increases, high-risk loans are the marginal loans for adjustment because their return on adjustment to regulatory changes is higher. Therefore, the transfers of high-risk loans are more sensitive to changes in the regulatory cost.

The MSR transfers from banks could lead to two possible changes to mortgage servicing at the market level. If the banking sector as a whole had enough regulatory capacity to

retain MSRs, the regulation could potentially lead to a reshuffling of mortgage servicing within the banking sector. Otherwise, the regulation would lead to a migration of servicing to outside the banking sector, contributing to the rise of non-banks.

To understand how the MSR regulation transforms the servicing market, we then examine non-banks' cumulative holding of mortgage servicing rights. We find that the total share of outstanding loans serviced by non-banks increased by 8.3% after the final adoption of Basel III, even after controlling for the identity of the loan's original servicer. Moreover, following the policy change, non-banks increased their cumulative likelihood of servicing loans for low-income and subprime borrowers relative to high-income and prime borrowers. The increased likelihood of non-bank servicing is therefore consistent with non-banks receiving MSRs transferred by banks rather than non-banks increasing originations post policy change or changes occurring in the composition of loans or servicers over time. When we add loan fixed effects to isolate the effect of the policy change within loan and partial out the effect of time invariant loan characteristics, the likelihood of servicing rights being transferred to non-banks increased to 9.7% on average.

The documented selective transfers of servicing rights from banks to non-banks can have profound real impacts. Since servicing transfers could disrupt efficient communication with borrowers, and non-banks face more balance sheet constraints to bridge liquidity shortfalls (Cherry et al., 2022), the changes in the servicing market caused by the MSR regulation may impede optimal risk sharing. More importantly, as more transfers happen among loans of low income and low credit score borrowers, who are more likely to experience liquidity shocks and face the largest losses from financial distress, the welfare implications of the potential reduction in optimal risk sharing would be amplified.

To further shed light on real impacts, we study whether the change in incentives to transfer MSRs due to regulatory constraints had an impact on borrower financial distress. We first document aggregate statistics about loan performance post-regulation. In particular, the foreclosure rate of loans serviced by banks in 2011 started rising in 2012Q2 and continued climbing until it peaked in 2015Q1. In contrast, the foreclosure rate of loans serviced by non-banks in 2011 stayed low and experienced close to no fluctuation during the treatment period or after. Similarly, the personal bankruptcy rate of bank-serviced borrowers increased more than that for non-bank-serviced borrowers. The timing of the diverging loan performance between the two groups is in line with the increased MSR transfers by banks. We further show that the diverging loan performance was indeed driven by loans whose MSRs were transferred.

We formally examine the patterns in foreclosure and personal bankruptcy rates by es-

timating an intent-to-treat (ITT) estimator. The research design tracks a single cohort of loans and defines loans as treated if they were serviced by a bank in 2011Q1, and control if they were serviced by a non-bank in 2011Q1. This definition is regardless of whether or not a loan was actually transferred. Thus we are using "serviced by bank in 2011Q1" as an instrument for transfer and we are capturing the average effect on the entire portfolio of mortgages that the servicer held prior to the shock. Given that the shock is during 2012Q2-2013Q2, this specification looks at the average change in all loans' bankruptcy and foreclosure status following the shock, relative to prior to the shock, for banks versus non-banks.

We find that prior to the policy change, the performance of loans serviced by banks and by non-banks were on parallel trends. After the policy change, the foreclosure likelihood and the personal bankruptcy rate of the 2011 bank-serviced portfolio of loans increased significantly relative to the 2011 non-bank-serviced portfolio of loans. The findings imply that the MSR regulation aimed at increasing financial stability might have the perverse consequence of reducing local resilience. Finally, we show heterogeneous effects on foreclosure and bankruptcy rates for subprime and prime borrowers. MSR regulation worsened loan performance and financial distress disproportionately for subprime borrowers. These results suggest that transfers worsen existing disparities across borrowers.

Overall, our findings have several implications for the function and regulation of the servicing market. First, we establish that servicing transfers are increasing in frequency and continuing to unbundle debt markets, even in the presence of post-crisis regulation intended to re-establish traditional lending patterns. Second, we demonstrate that prudential regulation that is intended to decrease the fragility of the financial system can give banks incentives to use servicing transfer to remove MSR assets from oversight by banking regulators. Third, we show that transfers of MSRs to non-banks worsens household financial distress, as proxied by foreclosure and bankruptcy. Non-banks face less regulatory scrutiny than banks and have less access to liquidity. Therefore, the selective transfer of riskier loans to the non-bank sector, followed by worse performance by transferred loans, results in increasing inequality in household financial risk. Our results show that Basel III results in a permanent shift in the composition of bank MSR portfolios, relative to non-bank portfolios. The result is a two-tiered servicing market, with banks decreasing the risk of their MSR holdings at the expense of non-banks, who service high risk, high delinquency loans with limited regulatory oversight.

Literature Review Our paper relates to three main strands of literature. First, we contribute to the literature that studies the transformation of credit supply. The increased

amount of bank-like activity taking place outside the traditional banking system has attracted increased attention. Existing papers have documented the rise of non-banks or shadow banks in the mortgage origination market (Buchak et al., 2018b; Fuster et al., 2019; Gete and Reher, 2021), the mortgage servicing market (Cherry et al., 2022), the small business lending market (Gopal and Schnabl, 2022), and the corporate loan market (Chernenko et al., 2022; Davydiuk et al., 2020). The rise of non-banks have important implications for monetary policy transmissions (Xiao, 2020; Buchak et al., 2018a), financial risk in the economy (Kim et al., 2018; Lewis, 2023), and distributional effects for financial inclusion (Berg et al., 2020; Jiang, 2019; Jiang et al., 2022). Various factors, such as technological development, regulation, and policies, have contributed to the rise of non-banks in various financial product markets (Irani et al., 2021; Drechsler et al., 2022; Balyuk et al., 2022). We focus on the mortgage servicing market. We are the first to systematically examine the transfers of MSRs from banks as an important driver of the rise of non-banks across all segments of the mortgage servicing market. Amid the rise of non-banks, traditional banking services that used to be conducted by the same institution — e.g., deposit taking, loan origination, and monitoring — are gradually unbundled. We show that the increased regulatory cost of in-house servicing contributed to the separation of two important banking services, origination and servicing.

Our paper relates to the literature that studies the impacts of post-crisis banking regulation (Sundaresan and Xiao, 2018; Allen and Gale, 2018; Begenau and Landvoigt, 2022). More specifically, existing literature has debated whether the Basel III MSR rule change affected the regulated banking sector. The Report to the Congress on the Effect of Capital Rules on Mortgage Servicing Assets[2] argues that the policy change would have a minor effect on the market if any. However, Hendricks et al. (2016) propose that Basel III had a large effect. Hendricks et al. (2016) shows that Basel III regulation led to MSR sales from high-MSR banks to low-MSR banks within the regulated banking sector. Without loan level data on the transfer of mortgage servicing rights, it is difficult to settle this debate. Our paper is able to resolve the debate by carefully following loans for both bank and non-bank mortgage servicers over time. This setting allows us to observe the transfer of mortgage servicing rights. We construct an identification strategy which isolates Basel III's causal role in increasing banks' mortgage servicing right transfers to non-banks, leading to the rise of non-banks in mortgage servicing. Our careful analysis of the policy change allows us to establish that regulatory policies which place a risk-blind constraint on MSRs will induce banks to sell riskier mortgage servicing rights outside of the regulated banking sector. This has direct

[2] Available here: https://www.federalreserve.gov/publications/capital-rules-mortgage-servicing-assets.htm.

implications for Ginnie Mae and the Conference of State Bank Supervisors' (CSBS) current debate whether to place a risk-blind or risk-based constraint on non-bank MSRs.[3]

Finally, we contribute to a small but growing literature that studies the important role of mortgage servicing. Cherry et al. (2022) establishes that servicer identity matters for the passthrough of government forbearance programs during a crisis. Padi et al. (2023) finds that regulation requiring servicers to improve communication with borrowers improves consumer outcomes, consistent with discretionary servicer behavior affecting borrowers' loan performance. Mayock and Shi (2022) use data from the 12 largest banks to show that servicing transfers have grown over time and use Fannie Mae data to test their model prediction about the positive correlation between default and prepayment risk and servicing transfer probability. Aiello (2022) finds that to minimize their obligation to extend financing to distressed borrowers, constrained servicers aggressively pursue foreclosures at the expense of investors, borrowers, and future mortgage performance. Kuong and Zeng (2021) finds that servicers play an important role in optimal information sensitivity design of securities. In addition, literature has also shown the importance of mortgage servicing for financial stability (Kim et al., 2018) and monetary policy transmission (Agarwal et al., 2022). Drawing on insights from this literature, our paper documents general trends in servicing transfers from a representative sample of mortgages across the US. We then tie the developments in servicing to bank regulation. We show that servicing transfers have contributed to the growth of non-banks, which are not subject to oversight by banking regulators. Finally, we estimate the real effects of this changing market on borrower outcomes, and establish their effects on disparities between high and low risk borrowers.

1 Institutional Background

1.1 Mortgage Servicing Right (MSR)

In the U.S. residential mortgage market, loan originators often sell the right to service loans. An asset called a mortgage servicing right (MSR) is created when the originator sells the servicing right. MSR holders are referred to as loan servicers, who are responsible for collecting mortgage payments and resolving borrowers' financial distress.[4] When borrowers miss

[3] See for example: https://www.ginniemae.gov/newsroom/Documents/issuer_eligibility_faq_09_20_2022.pdf and https://www.ginniemae.gov/newsroom/publications/Documents/GNMA_Issuer_Eligibility_%20Fact_Sheet.pdf

[4] It is worth noting that many financial institutions conduct both loan origination and loan servicing businesses, and mortgage servicers are different from debt collectors. The key distinction between a "loan servicer" and a "debt collector" depends on whether the loan was in default at the time it was obtained.

payments, loan servicers are required to make payment advances to investors on behalf of delinquent borrowers until the distress resolution process is complete.

Servicers receive revenues from servicing fees.[5] The value of an MSR is the present value of future revenues from servicing the loan for its expected duration.

1.2 Increased Regulatory Cost of Holding MSRs

Following the Global Financial Crisis (GFC), the Basel Committee proposed several regulatory changes aimed at strengthening the banking sector. These included changes pertaining to intangible assets, including MSRs. As background, banks are required to hold enough tier 1 equity capital that is available for unrestricted and immediate use to meet losses as soon as they occur. This regulatory measure is called a capital requirement and is given by the following formula:

$$\frac{\text{Tier1 Equity}}{\text{Risk Weighted Assets (RWA)}} \geq \text{Capital Requirement.} \tag{1}$$

Tier 1 equity capital is made up of the common equity component of tier 1 equity capital (CET1), disclosed reserves, and additional tier 1 capital.[6] With the exception of MSRs, goodwill and other intangibles are typically deducted from tier 1 equity. This equation can be rewritten in terms of MSRs:

$$\frac{\overbrace{\text{Common Equity} + \text{Allowable MSR}}^{\text{CET1}} + \text{Additional Tier1}}{\text{Risk Weight} \times \text{Allowable MSR} + \text{Additional RWA}} \geq \text{Capital Requirement.} \tag{2}$$

Basel III increases the regulatory burden of holding MSRs by changing two things: (1) the amount of MSRs allowed to be added back to tier 1 equity and (2) the risk weighting of MSRs in banks' risk weighted assets (RWA). Prior to Basel III, the amount of MSRs that banks were able to include in tier 1 equity was the lesser of 90 percent of the MSR's fair value or 100 percent of its carrying amount.[7] Basel III proposes restricting MSRs to comprise 10% of banks' common equity component of tier 1 equity capital, at maximum. This restriction alone is very costly. According to estimates in the literature, for a bank that must maintain an 8% capital requirement, it equates to a risk weighting on the order of 1,250%. In addition

[5] See Jiang et al. (2023) for information about servicing fees.
[6] Basel Accord Annex 1D - Definition of Capital Elements (p 14.)
[7] Fed Report to the Congress on the Effect of Capital Rules on Mortgage Servicing Assets

to reducing banks' equity capital, the risk weighting on the portion of MSRs included in equity increased from 100% to 250%. The two changes together significantly increased the regulatory burden of holding MSR assets for traditional banks.

Timeline From 2012Q2 to 2013Q2, the regulatory change progressed from being proposed by Basel to adopted by the Federal Reserve, and thus applicable to US commercial banks.

Prior to 2012Q2, Basel's progress report classified the US as stage "1-Draft regulation not published." In June 2012, the Federal Reserve Board issued a proposal to adopt the Basel III's treatment of MSRs and invited comments by September 2012. This moved Basel's classification of the US to stage "2-Draft regulation published." However, the final terms of the proposal were not agreed upon since the Federal Reserve Board was actively seeking comments.

On July 2, 2013, the Federal Reserve Board adopted Basel III's treatment of MSRs and the new regulatory framework took effect. This early July 2013 adoption date indicates that the final version of the regulation was finalized at the end of the second quarter of 2013. In October 2013, Basel re-categorized the US as phase "3 - Final rule published." We include a full timeline of the policy change in Appendix A.

2 Economic Framework

In this section, we present a stylized model in which banks make optimal decisions to adjust their holdings of MSR assets by trading with non-banks in an efficient market. Banks are subject to a regulatory cost of carrying MSR assets, and transfers of MSR assets are always associated with a value discount due to information asymmetries and increased coordination costs. We use the model to describe how an increase in the regulatory cost of holding MSRs affects banks' incentive to transfer MSRs.

2.1 A Model of MSR Transfer

Consider an economy with two types of financial intermediaries, banks (b) and non-banks (s). Banks make optimal adjustments to their MSR holdings by trading with non-banks in an efficient market. Banks face regulatory cost of holding MSRs, while non-banks do not.

Bank b starts each period with σ_b^H high-risk MSR and σ_b^L low-risk MSR. It adjusts its

MSR holdings to maximize the total profit:

$$\max_{\Delta_b^H, \Delta_b^L} \underbrace{\Delta_b^H \phi^H + \Delta_b^L \phi^L}_{\text{gain from MSR adjustment}} + \underbrace{(\sigma_b^H - \Delta_b^H) v_b^H + (\sigma_b^L - \Delta_b^L) v_j^L}_{\text{expected gain from holding MSR}} - \underbrace{\delta[(\sigma_b^H - \Delta_b^H) v_b^H]^2 - \delta[(\sigma_b^L - \Delta_b^L) v_b^L]^2}_{\text{shadow cost of regulation}}. \tag{3}$$

Δ_b^H and Δ_b^L are bank b's adjustment to its holdings of high- and low-risk MSRs, respectively. ϕ^H and ϕ^L are the trading prices of high- and low-risk MSRs, and v_b^H and v_b^L are the net present value of holding the MSR of high- and low-risk loans. We will define ϕ^H, ϕ^L, v_b^H, and v_b^L later.

Lastly, δ is the shadow cost of regulation. The function form captures the idea that the regulatory cost increases as the bank's capital ratio approaches the capital requirement.

NPV and Trading Price of MSR To find the net present value of MSR, we first define per-period profits of servicing high- and low-risk MSRs, π_j^H and π_j^L, $j \in \{b, s\}$. Let $p^i \in \{p^H, p^L\}$ denote the default probability of mortgage loan i, where $p^H > p^L$. In every period, the total profit of servicing loan i for servicer j is

$$\pi_j^i = f^i + \eta_j^i - c_j^i. \tag{4}$$

f^i is the servicing fee, which varies by loan. On top of servicing fees, servicer j also derives other benefits from servicing loan i, which includes additional revenue generated by informational synergies with other financial products offered to the same customer. Such additional benefits, denoted by η_j^i, vary by servicer. Since banks offer more financial products than non-banks, and information matters more for high-risk borrowers, we assume $\eta_b^H - \eta_s^H > \eta_b^L - \eta_s^L > 0$.

c_j^i is the cost of servicing. For loans initially serviced by banks, we assume $c_s^H - c_b^H > c_s^L - c_b^L > 0$. The cost of servicing is lower for banks than for non-banks because as the initial servicers, banks have already established servicing relationship with the borrower and/or obtained soft information about the borrower (Mayock and Shi (2022)). Such difference is presumably larger for high-risk loans because soft information matters more for distressed loans.

The above parametric assumptions about η and c capture the idea that initial servicers (or originators) are more efficient at servicing mortgages, MSR transfers are always associated with value discounts, and the discounts are larger for high-risk loans.

Given per-period profit, for servicer j in period t, the net present value of holding the MSR of loan i with maturity date T is

$$v_j^i = \sum_{\tau=0}^{T} (1-p^i)^\tau \pi_j^i = \beta^i \pi_j^i \tag{5}$$

where $\beta^i \equiv \frac{(1-(1-p^i)^{T+1})}{p^i}$ is the geometric factor.

Since MSR transfers are always associated with reduction in surplus, the losses have to be borne by the seller for the transactions to happen. For example, the trading price of MSR sold by bank b is

$$\phi^i = \min\{v_s^i, v_b^i\} = v_s^i, \quad i \in \{H, L\} \tag{6}$$

2.2 Model Predictions and Discussions

Optimal Adjustment Since MSR transfers are always associated with value discounts, banks would want to keep all MSRs if there was no regulation, i.e., $\delta = 0$. In the world with some regulatory cost of holding MSR assets, banks want to sell some MSRs. In particular, banks sell more low-risk MSRs, which have lower value discounts if transferred, than high-risk MSRs, which have higher value discounts if transferred. These results can be formally derived from the first order conditions of Equation 3:

$$(\Delta_j^H)^* = \sigma_j^H + \frac{\phi^H - v_j^H}{2\delta(v_j^H)^2} \tag{7}$$

$$(\Delta_j^L)^* = \sigma_j^L + \frac{\phi^L - v_j^L}{2\delta(v_j^L)^2} \tag{8}$$

Effects of Regulation When the shadow cost of regulation increases (i.e., a bigger δ), banks sell more MSR to non-banks. From Equations 6 and 7 we can easily derive the following comparative statistics that yield this result:

$$\frac{\partial \Delta_b^H}{\partial \delta} = \frac{v_b^H - v_s^H}{2\delta^2(v_b^H)^2} > 0 \tag{9}$$

$$\frac{\partial \Delta_b^L}{\partial \delta} = \frac{v_b^L - v_s^L}{2\delta^2(v_b^L)^2} > 0 \tag{10}$$

Moreover, since $\left|v_b^H - v_s^H\right| > \left|v_b^L - v_s^L\right|$ and $v_b^H < v_b^L$, banks sell more high-risk MSRs as the regulatory cost of holding MSRs increases. The intuition is as follows. First of all,

because high-risk MSRs have higher transfer discounts, presumably due to higher information asymmetry, high-risk MSRs have higher baseline balance-sheet retention than low-risk MSRs. As the regulatory cost of holding MSRs increases, high-risk loans are the marginal loans for adjustment because their return on adjustment to regulatory changes is higher. Therefore, the transfers of high-risk loans are more sensitive to changes in the regulatory cost.

Finally, the effect of regulation varies by pre-shock MSR level. Denote ζ_b^i the pre-shock equilibrium level of MSR holding, i.e., $\zeta_b^i \equiv \sigma_b^i - \Delta_b^i = \frac{v_b^i - v_s^H}{2\delta(v_j^i)^2}$. Equation 9 can be rewritten as a function of ζ_b^i:

$$\frac{\partial \Delta_j^i}{\partial \delta} = \frac{\zeta_j^i}{\delta} \tag{11}$$

Therefore, the effect of regulation increases with pre-shock MSR level.

3 Data and Servicer Classification

3.1 Credit Registration Data

Our primary dataset is a detailed anonymized tradeline-level credit bureau panel with near-universal coverage of the United States. The data includes anonymous information about each mortgage on an individual's credit report, including the loan's origination date and characteristics such as loan type, loan amount, loan term and borrower characteristics such as credit score, and monthly payment status. We select a representative 1% sample of the entire nation for our primary analysis.[8] We keep monthly data between 2011 and 2015 and drop all individuals who do not have an active mortgage at some time in this window. We provide summary statistics of the full sample and the 1% sample in Table 1. The two samples are very similar.

Identifying Servicing Transfer and Servicer Classification We augment the data by identifying servicing transfers. Servicing transfers can be observed as the closing of one trade line, followed immediately by the opening of another trade line with the same origination characteristics, but different servicer characteristics.

We code the servicer transfer indicator as one in the calendar month when this transition happens, as described above, and zero otherwise. Based on this classification, 5.1% of loans

[8] We select a 1% sample of unique loan IDs active between 2011-2015 and then follow them through time.

experience at least one servicing transfer throughout the life of the loan during our sample period 2011-2015. We use publicly available data on deposit-taking institutions to classify servicers as banks or non-banks.[9]

Merging with Bank Call Reports We construct MSR-to-CET1 (MSR/CET1) ratio for each bank using publicly available Y9C data in 2011 and merge it with the 1% sample of our credit registration data. We report summary statistics for this sample in Table 1. It is very similar to both the 1% and full samples.

4 MSR Regulation and Bank MSR Transfers

4.1 Aggregate Facts

Basel III's MSR rule, described in 1.2, should change banks' incentives to hold MSRs. Our model predicts that a more binding regulatory constraint would cause banks to transfer MSR assets. Our data shows the expected pattern - Figure 1 documents the large spike in transfers of mortgage servicing rights around 2013Q2. We plot the number of overall transfers in the raw data each quarter, as well as transfers from banks to non-banks, from banks to banks, from non-banks to banks, and from non-bank to non-bank, in the 2011 to 2015 period.

The plot shows that the total number of MSR transfers had a slight increase in 2012Q2 followed by a spike up in 2013Q2. Following 2013Q2, transfers remained at an elevated level relative to their pre-2012Q2 level. Quantitatively, there were more than 3 million loans whose MSRs were transferred in 2013Q2 alone, which was seven times the number of transfers in 2013Q1. This number declined in the following quarter, but there were still 2 million MSR transfers in 2013Q3. After the major wave of MSR transfers in 2013, the quarterly number of MSR transfers stayed at about 1 million, which was five times the pre-2012Q2 level.

The timing of the MSR transfer wave, which started in 2012Q2 and was followed by a larger spike up in 2013Q2, coincides with the Federal Reserve's gradual adoption of the Basel III regulations. The regulations both limited the amount of MSRs that could be included in tier 1 equity and increased the risk weighting of MSRs. As we introduced in Section 1.2, the Fed issued the proposal to adopt Basel III's treatment of MSRs in 2012Q2 and finally adopted it in 2013Q2.

[9] Our classification results in 3,427 banks, 798 non-banks and 1,890 credit unions and savings and loan associations. This classification is validated by comparing the estimated number of banks in this dataset with the number estimated in other datasets.

About 82% of the transfers were from banks to non-banks, which is consistent with the spike being driven by bank regulation. These large market shifts could have spillover effects on other sales, which is reflected in the slight increase in transfers from non-banks to banks and from banks to other banks at this time.

4.2 MSR Regulation and Incentive to Transfer

After documenting the time-series aggregate statistics, we move to the loan-level data to estimate difference-in-difference specifications that help assess the causal effect of the Basel III MSR rule on banks' incentive to transfer MSR. Our model makes three predictions about servicing transfers. First, banks should sell mortgage servicing rights more than non-banks in response to more stringent bank regulation. Second, within the bank sample, banks with higher MSR/CET1 ratio should sell more MSRs. Third, across all loans, banks sell more high-risk MSRs.

4.2.1 Baseline Result

We start with examining whether banks are more likely to sell MSRs after the regulatory change by estimating the following difference-in-difference (DiD) specification:

$$Transfer_{i,j,t} = \beta_1 Middle_t \times Bank_{i,j,t-1} + \beta_2 Post_t \times Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}. \quad (12)$$

where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i is sold by institution j in quarter t. $Bank_{i,j,t-1}$ is an indicator for whether the servicer of loan i in the quarter before transfer is a bank. $Middle_t$ is an indicator for whether quarter t is between 2012Q2 and 2013Q2. $Post_t$ is an indicator for whether quarter t is in or after 2013Q2. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. In addition to this fully saturated specification, we run less saturated specifications without loan fixed effects. In those, we include initial servicer fixed effects (ν_j) and zip code fixed effects ($_i$). We cluster standard errors at the zip code level, to allow for neighborhood spatial correlation.

Table 2 presents the results. Column 4 corresponds to Equation 12, while columns 1-3 estimate less saturated specifications. We obtain similar effects in terms of both magnitude and statistical significance across columns. Column 4 shows that following the 2012Q2 Fed proposal to adopt Basel III, the differential increase of transfers relative to the pre-period increased for banks by 1.0% more than it did for non-banks. Following the final adoption of Basel III in 2013Q2, banks were 3.1% more likely to sell MSRs than non-banks

on average, relative to the pre-period. The less saturated specifications in columns 1-3 are also informative. Columns 1 and 2, which do not have quarter fixed effects, show the time-series evolution of overall transfer likelihood. They also show the baseline difference in the likelihoods of transfer between banks and non-banks before controlling for loan fixed effects. On average, non-bank MSRs were 1.2% more likely to be sold in the post-2013Q2 period, while the increase in transfer likelihood was 0.6% during the interim period (i.e., 2012Q2-2013Q2). The likelihood of transfer for all loans increases after Basel III in all specifications with similar magnitude. This suggests that transfer is driven by Basel III and not by changes in loan or servicer composition.

We show the dynamic evolution of bank versus non-bank differences in MSR transfers in Figure 2. The figure plots the estimated coefficients in a dynamic version of Specification 12. The final adoption of Basel III in 2013Q2 appears to increase banks' likelihood of selling MSRs by 4% relative to that of non-banks. Banks' higher likelihood of MSR transfers persisted for several quarters and appears to stay more than 2% higher than non-banks by the end of 2015. More importantly, prior to the initial proposal of Basel III adoption, bank MSR transfers were not statistically more likely than non-bank MSR transfers. The lack of pre-trend alleviates the concern that different unobservable loan characteristics might drive different bank versus non-bank transfer likelihoods.

4.2.2 Heterogeneity Across Banks

We then study which banks sell MSRs. As Section 1.2 discussed, Basel III MSR regulation changed the treatment of MSR in the calculation of banks' tier 1 capital ratio. This moved many banks closer to violating their capital requirement. Our model predicts that a bank's response to the regulatory change depends on the magnitude of the increased regulatory burden of holding MSR assets, which increases with the banks' pre-shock MSR-to-CET1 ratio. The intuition is that banks with higher MSR as a fraction of CET1 are closer to the threshold, beyond which MSRs will be deducted from their tier 1 equity capital, which would penalize their capital requirement defined in Equation 1. Guided by the model, we estimate a treatment intensity research design that compares high MSR-to-CET1 banks' sales to low MSR-to-CET1 banks' sales:[10]

[10]To estimate this, we use a sample that removes outlier banks with very high MSR-to-Asset ratio (top 1% of distribution). Outlier banks appear to specialize heavily in servicing and servicing is not the marginal asset category that those banks will adjust in response to a change in regulation.

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \mathbb{1}_k \left(\frac{MSR}{CET1} \right)_{i,j,2011} + \mu_i + \theta_t + \epsilon_{i,j,t}. \quad (13)$$

Where i denotes loan. j denotes the servicer of loan i in $t-1$. t indicates the current quarter. $Transfer_{i,j,t}$ is an indicator for whether loan i experiences a transfer in quarter t. $(\frac{MSR}{CET1})_{i,j,2011}$ is the MSR to common equity tier 1 ratio of servicer j in 2011. The servicer of a loan is defined in the quarter before transfer. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. Banks with higher MSR-to-CET1 ratios prior to the regulation experience more intense treatment. Thus, β_k is the variable of interest, which captures the effect of the treatment intensity on MSR transfers.

Figure 3 plots the estimated β_k in Equation 13. The results indicate that banks with higher MSR-to-CETI ratios increase their transfers of mortgage servicing rights by more than banks with lower MSR-to-CETI ratios. There is a slight dip down in the second half of 2014 which is consistent with more exposed banks selling their MSRs first, followed by less exposed banks selling MSRs later to catch up. Table 3 column (1) estimates the magnitude of the effect. A 10% higher MSR-to-CET1 ratio prior to the regulation leads to a .8% higher likelihood of selling MSRs between 2012Q2-2013Q2 and to a .4% higher likelihood of selling MSRs on average following the adoption of the MSR regulation in 2013Q2. The result is consistent with banks that are more exposed to the policy change choosing to sell more mortgage servicing rights directly following the policy change.

However, banks with low MSR-to-CETI ratios should not be as affected by the policy change. Following the change, banks who have MSR holdings below 10% of CET1 will not be required to deduct any equity from their tier 1 capital, implying that the numerator of their capital requirement will not be affected. The denominator, which is equal to risk weighted assets, will increase however, by a lesser amount than those banks with high values of MSRs. Therefore documenting that banks with a higher fraction of MSR-to-CET1 sell more mortgages is consistent with banks selling mortgage servicing rights in response to Basel III's change to the regulatory treatment of MSRs.

4.2.3 Heterogeneity Across Loan Type

Finally, we examine the heterogeneous treatment effect across loan types. Our model predicts that banks sell more high-risk MSRs as the regulatory cost of holding MSRs increases. Intuitively, as the regulatory cost of holding MSRs increases, high-risk loans are the marginal loans for adjustment because the return on selling high-risk loans is higher. Therefore, the

transfers of high-risk loans are more sensitive to changes in the regulatory cost.

We estimate the following dynamic DiD specification on each subgroup divided by income, credit score, and loan delinquency status, respectively, in a similar method as Curtis, Garrett, Ohrn, Roberts, and Serrato (2021). This allows us to study differences across subgroups in bank MSR transfers following the policy change:

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_{i,j,t-1} + \mu_i + \epsilon_{i,j,t}, \quad (14)$$

where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i was sold by institution j in quarter t. $Bank_{i,j,t-1}$ is an indicator for whether the servicer of loan i in the quarter before transfer is a bank. $Middle_t$ is an indicator for whether quarter t is between 2012Q2 and 2013Q2. $Post_t$ is an indicator for whether quarter t is in or after 2013Q2. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. In addition to this fully saturated specification, we run less saturated specifications without loan fixed effects. In those, we include initial servicer fixed effects (ν_j) and zip code fixed effects (z_i). We cluster standard errors at the zip code level, to allow for neighborhood spatial correlation.

Figure 4 plots the estimated coefficients, β_k, on the interaction term that denotes whether a bank serviced the loan in each quarter pre and post transfer. Standard errors are clustered at zip code level. The differences between subgroups in each category shown in the figure are equivalent to the triple difference coefficient. Table 3 columns (2)-(4) reports the average triple differences between each subgroup for a given category in the Middle (between 2012Q2-2013Q2) and Post (on or after 2013Q2) period, each relative to the pre-period.

We explain these results in detail below.

Income Panel (a) of Figure 4 shows banks' likelihood of transferring MSRs relative to non-banks' likelihood for two subgroups: loans held by borrowers in above median income and below median income zip codes. Banks transferred statistically significantly more MSRs for borrowers in zip codes with below median income after 2013Q2, and the difference persisted. Moreover, prior to the initial proposal of Basel III adoption, the difference in the transfers of low-income borrowers' MSRs between banks and non-banks was not statistically larger than the difference in the transfers of high-income borrowers' MSRs. Quantitatively, the final adoption of Basel III in 2013Q2 increases banks' likelihood of selling MSRs of loans held by below-median income borrowers by .4% more than that of selling MSRs of loans held by above-median income borrowers during 2013-2015 (Table 3 column 2).

Borrower Creditworthiness Panel (b) of Figure 4 shows banks' likelihood of transferring MSRs relative to non-banks' for prime and subprime borrowers, defined based on borrower's credit score at loan origination. We define subprime borrowers as those with a below 620 credit score and prime borrowers as those with a 620 or above credit score. Banks transferred statistically significantly more MSRs for subprime borrowers, and the difference persists. Quantitatively, the final adoption of Basel III in 2013Q2 increases banks' likelihood of selling MSRs of loans held by subprime borrowers by 2% more than that of selling MSRs of loans held by prime borrowers during 2013-2015 (Table 3 column 3).

Loan Delinquency Status Panel (c) of Figure 4 shows banks' likelihood of MSR transfers relative to non-banks' for loans by delinquency status in the current quarter. Panel (c) shows effects for loans that were current, 60-90-120 days, and 120+ days delinquent at the time of transfer. Banks transferred more MSRs for loans that were already 60-90-120 days delinquent at the time of the transfer relative to loans that were current. Banks transferred loans that were 120+ days delinquent less often than current or 60-120 day delinquent loans. Since loans that are 120+ days delinquent may be foreclosed on, servicers can do little to offer debt relief to this group. These results are consistent with transferred loans being the "highest touch" in terms of communicating with borrowers and offering debt relief. Quantitatively, banks' likelihood of selling MSRs of 60+ days delinquent loans increased by 2.5% more than that of non-delinquent loans after the rule change (Table 3 column 4).

5 Rise of Non-Bank Servicing

The previous section established that banks were more exposed to Basel III disproportionately sold MSRs following the policy change. Banks selling MSRs could potentially lead to a reshuffling of mortgage servicing within the banking sector. For example, a report to Congress finds that more banks entered the servicing market after the MSR regulation.[11] If the banking sector as a whole had enough regulatory capacity to retain MSRs, the regulation would not lead to increased MSR holdings by non-banks. We study whether the MSRs, that banks sold, were transferred to non-banks.

[11] Report to the Congress on the Effect of Capital Rules on Mortgage Servicing Assets

5.1 Aggregate Facts

Figure 5 plots the share of outstanding loans that are serviced by non-banks in our data. By the end of 2015, non-banks serviced about 30% of total loans outstanding (Panel a). They serviced about 28% GSE loans (Panel b) and about 40% FHA loans (Panel c) in 2015, with progressively increasing servicing share since 2011. (Cherry et al., 2022) show that over the last decade, the market share of non-banks in servicing GSE and FHA loans has grown until it reached about half the market in 2019.

Table 1 Panel A describes the characteristics of the full sample of loans serviced by banks and non-banks in the 2011-2015 period. We observe 8,944 servicers, with just over half classified as banks. About 75% of the total stock of loans during 2011-2015, by both number and volume, are serviced by banks. Loans serviced by non-banks have similar loan amounts and terms, but have higher delinquency rates, lower credit scores and lower incomes. These differences reflect those in the origination market. The majority of our analysis is done on a 1% random sample of the full dataset, which has similar composition as reported in Panel B.

5.2 Baseline

We next examine the rise of non-banks by estimating the following specification using loan-level data:

$$NonBank_{i,j,t} = \beta_1 Middle_t + \beta_2 Post_t + \mu_i + \epsilon_{i,j,t}. \tag{15}$$

Where $NonBank_{i,j,t}$ is an indicator variable for whether a non-bank is the current servicer in quarter t of loan i. $Middle_t$ and $Post_t$ have been previously defined in Specification 12. μ_i is the loan fixed effect. By including loan fixed effects we exploit within-loan variation. Thus, the two coefficients of interest, β_1 and β_2, identify whether non-banks were more likely to be the buyers of the transferred servicing rights after the policy change. In addition to this fully saturated specification, we run less saturated specifications without loan fixed effects. In those, we include initial servicer fixed effects (ν_j) and zip code fixed effects (z_i). We cluster standard errors at the zip code level.

Table 4 presents the results. Column 3 corresponds to specification 15, while columns 1-2 estimate less saturated specifications. Column 1 shows that the share of total loans serviced by non-banks increased by about 12% after the final adoption of Basel III. Exploiting within servicer variation, column 2 shows that non-banks were 8.3% more likely to take over the servicing rights after the policy change in 2013Q2. The inclusion of loan fixed effects

in column 3 confirms that the increased likelihood of non-bank servicing was not merely driven by non-banks originating more loans following the policy change or by changes in the composition of loans or servicers over time.[12] Quantitatively, when the rule was finally adopted in 2013Q2, the likelihood of servicing rights being transferred to non-banks increased to 9.7% on average.

Figure 6 shows the evolution of MSR transfers to non-banks over time. It plots the estimated coefficients in a dynamic version of Equation 15. Prior to the initial proposal of Basel III, there was no pre-trend in non-bank servicing, alleviating the concern that the static DiD results are driven by a time series trend in banking activity migrating to the non-banking sector after the financial crisis. Non-banks' likelihood of receiving of the transferred MSRs began increasing in 2012Q2, grew rapidly in 2013Q2, when the regulation was finally adopted, and remained elevated thereafter.

5.3 Non-Bank MSR Holding by Loan Type

Finally, we examine non-banks' cumulative likelihood of holding the riskier MSRs that banks selectively sell. We examine this non-bank stock of MSR holdings across time, by the same borrower and loan categories used in the dynamic DiD transfer subgroup analysis in Section 4.2.3:

$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \ \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}, \tag{16}$$

where $NonBank_{i,j,t}$ is an indicator variable for whether a non-bank is the current servicer j (in quarter t) of loan i. μ_i are loan fixed effects. Standard errors are clustered at zip code level.

Figure 7 plots the estimated coefficients for each regression specification in each subgroup. Table 5 reports the average differences between each subgroup for a given category in the Middle (between 2012Q2-2013Q2) and Post (on or after 2013Q2) period, each relative to the pre-period. These differences are equivalent to the difference-in-differences coefficient.

We explain these results in detail below.

Income Panel (a) of Figure 7 depicts the results by borrower income. It shows that following the policy change, non-banks increase their cumulative likelihood of servicing loans for borrowers in below median income zip codes relative to those in above median income

[12] As Buchak et al. (2018b) argues, the higher regulatory risk weight on MSR assets lowered banks' incentives to originate mortgages, which led to an increase in non-bank loan origination. The inclusion of loan fixed effects absorbs the effect of MSR regulation on loan origination.

zip codes. Both of these figures exhibit pre-period parallel trends. Quantitatively, the final adoption of Basel III in 2013Q2 increases shadow banks' holdings of MSRs of loans held by below-median income borrowers by .4% more than that of MSRs of loans held by above-median income borrowers during 2013-2015 (Table 5 column 2).

Credit Score Panel (b) of Figure 7 depicts these results by borrower credit score. It shows that following the policy change, non-banks increase their cumulative likelihood of servicing loans for subprime borrowers relative to prime borrowers. The final adoption of Basel III in 2013Q2 increases shadow banks' holdings of subprime loans by 2% more than that of MSRs of prime loans during 2013-2015 (Table 5 column 3).

Delinquency Status Panel (c) of Figure 7 depicts the results by realized delinquency status. It shows that non-banks see a larger increase in their cumulative likelihood of servicing 60-90-120 or 120+ day delinquent loans rather than current or 30 day delinquent loans. The final adoption of Basel III in 2013Q2 increases shadow banks' holdings of delinquent loans by 2.3% more than that of MSRs of non-delinquent loans during 2013-2015 (Table 5 column 4).

The relative increase in non-banks' likelihood of servicing subprime loans, defaulted loans, and loans held by low-income borrowers is consistent with banks selling the MSRs associated with these characteristics to non-banks. Combining the results of the DiD in Figure 4 with the results of the event study in Figure 7 provides compelling evidence that non-banks were purchasing the riskier MSRs that banks sold following Basel III.

6 Impact on Borrower Financial Distress

The previous sections documented that Basel III's MSR regulation caused banks to sell MSRs and led to the rise of non-banks in holding MSRs. Now, we demonstrate the real impacts of this shift on borrowers and investors by estimating the net effect of the regulatory change on loan performance, measured by foreclosure, and household financial distress, measured by personal bankruptcy.

The expected welfare effects are ambiguous. On one hand, the shift in servicing may harm borrowers if transfers disrupt efficient communication with borrowers or if non-banks have less capacity or appetite for risk sharing due to their financing and contract structure. Negative welfare consequences may be amplified since transfer is more likely for loans of low

income and low credit score borrowers who are in greater need of communication and debt relief. On the other hand, transfers may benefit borrowers if non-banks are especially skilled in servicing the loans they are acquiring. Systemic considerations may also weigh in favor of servicing transfers to non-banks, if the systemic risk created by banks holding MSRs is more than the risk of non-banks holding those MSRs. We assess the impacts on borrowers below, and conclude with some broader implications.

6.1 Aggregate Evidence on Financial Outcomes by Servicer Type

We begin by analyzing the evolution of foreclosure and personal bankruptcy rates of borrowers whose loans were serviced by banks versus non-banks in 2011. We limit the data to loans originated prior to 2011 and classify loans as bank or non-bank servicer based on their servicer type in 2011. The sample limitations removes cohort effects arising from differences in new originations by each servicer type in the post-regulation period. This analysis allows us to examine loan performance outcomes for the entire portfolio of loans serviced by banks and those serviced by non-banks in 2011, combining the effect on both transferred and non-transferred loans. We rely on our previous result, that bank serviced loans will be more likely to experience transfers during 2012Q2-2013Q2. Differences in aggregate performance across the 2011 bank portfolio of loans and the 2011 non-bank portfolio of loans should be driven by the effects of Basel III on MSR transfers.

Figure 8 plots the foreclosure rates by servicer type over time. Panel (a) plots the foreclosure rates by servicer type for the entire portfolio of loans a servicer held in 2011. It shows that the foreclosure rate of loans serviced by banks in 2011 started rising in 2012Q2 and continued climbing until it peaked in 2015Q1. This timing coincides with the increased transfers in 2012Q2-2013Q2. In contrast, the foreclosure rate of loans serviced by non-banks in 2011 stayed low and experienced close to no fluctuation during the treatment period or after.

Figure 8 panels (b) and (c) plot the foreclosure rates of loans whose servicing rights were transferred (*transferred loans*) and never transferred (*non-transferred loans*), respectively. Comparing panels (b) and (c) reveals that the rising foreclosure rate among bank-serviced loans in panel (a) was mostly driven by transferred loans. Panel (b) shows that after Basel III, the foreclosure rate soared for loans serviced by banks in 2011, while the foreclosure rate of their counterpart – loans that experienced a transfer and were serviced by non-banks in 2011 – remained flat over time. Panel (c) limits to loans that never experienced transfer and shows that after Basel III, foreclosure rates remained relatively stable both pre and

post policy change for both loans serviced by banks and those serviced by non-banks in 2011. These plots suggest that post-Basel III, previously-bank-serviced loans experienced a disproportionate rise in foreclosure rates, and this effect was driven mainly by the loans whose MSRs were transferred.

Figure 9 plots the evolution of personal bankruptcy rates by servicer type. Panel (a) plots the personal bankruptcy rates by servicer type for the entire portfolio of loans a servicer held in 2011. It shows that the personal bankruptcy rates of borrowers serviced by both banks and non-banks in 2011 were increasing over time. However, the rate for bank-serviced borrowers increased slightly more than that for non-bank-serviced borrowers.

Figure 9 panels (b) and (c) plot the personal bankruptcy rates of loans whose servicing rights were transferred (*transferred loans*) and never transferred (*non-transferred loans*), respectively. Panel (b) shows the evolution of bankruptcy rates for borrowers that experienced MSR transfers. The bankruptcy rates diverged following the policy change for bank-serviced and non-bank serviced loans that ever experienced a transfer. The rate for non-bank-serviced borrowers declined over time, while the rate for bank-serviced borrowers rose significantly following the Basel III policy change in 2013Q2. Panel (c) shows that, in contrast, for borrowers that did not experience MSR transfers, the personal bankruptcy rates did not diverge based on previous servicer type. These plots suggest that post-Basel III, previously-bank-serviced loans that ever experienced a transfer saw a disproportionate rise in personal bankruptcy rates. An interesting feature that comes from comparing panel (b) and panel (c) is that bankruptcies rose disproportionately following the policy change for loans that were transferred by banks. If these loans were purchased by non-banks, then they could contribute to the rise in bankruptcies among non-transferred non-bank loans due to non-bank operational or funding capacity constraints.

6.2 Intent-to-Treat (ITT) Estimator

We causally estimate the effect of the regulatory change on foreclosure and personal bankruptcy rates with an intent-to-treat (ITT) estimator. The research design studies a single cohort of loans and defines loans as treated if they were serviced by a bank in 2011Q1, and control if they were serviced by a non-bank in 2011Q1. This definition is regardless of whether or not a loan was actually transferred. Thus we are using "serviced by bank in 2011Q1" as an instrument for transfer and we are capturing the average effect on the entire portfolio of mortgages that the servicer held prior to the shock. Given that the shock is during 2012Q2-2013Q2, this specification estimates the average change in all loans' bankruptcy and foreclosure status

following the shock, relative to prior to the shock, for banks versus non-banks.

$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \mathbb{1}_k Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan\ Age_{i,t} + \epsilon_{i,j,t}. \tag{17}$$

$Y_{i,j,t}$ for loan i, serviced by servicer j in 2011, is an indicator for whether a borrower experiences a foreclosure or personal bankruptcy in quarter t. $Bank_{i,j,2011}$ is an indicator variable for whether the 2011 servicer for loan i was a bank. μ_i, and θ_t are loan fixed effects and time fixed effects, respectively. $Loan\ Age_{i,t}$ corresponds to the time since origination, measured in years. We run the analysis with and without loan age fixed effects. Standard errors are clustered at zip code level.

Figure 10 panel (a) plots β_k, the estimated effect of being serviced by a bank in 2011 on foreclosure. Prior to the MSR regulation, we find no statistically significant difference in the foreclosure likelihoods for the portfolio of loans serviced by banks in 2011 relative to the portfolio serviced by non-banks in 2011 in most quarters. There is a small but noisy difference in 2011Q1 that make it seem, if anything, that there may have been a small downward trend in the first half of 2011. Following the policy change, the foreclosure likelihood of the 2011 bank-serviced portfolio of loans increased significantly relative to the 2011 non-bank-serviced portfolio of loans. Quantitatively, the foreclosure likelihood increased by 0.01% on average during the two years following the policy change (Table 6 Column (1)). This is relative to a sample average foreclosure likelihood of .025%. Given that the hazard rate of foreclosure varies heavily with loan age, we estimate an even more saturated model including loan age fixed effects in Column (2) of Table 6, and the effect is the same.

Figure 10 panel (b) plots β_k, the estimated effect of being serviced by a bank in 2011 on for personal bankruptcy. Prior to the MSR regulation, we find no statistically significant difference in the personal bankruptcy likelihoods for the portfolio of loans serviced by banks in 2011 and the portfolio serviced by non-banks in 2011. Following the policy change, the personal bankruptcy likelihood of the 2011 bank-serviced portfolio of borrowers increased significantly relative to their counterpart of 2011 non-bank-serviced borrowers. Quantitatively, borrowers who were serviced by banks in 2011 are statistically significantly .04% basis points more likely to file personal bankruptcies following the policy change, on average (Table 6 Column (3)). This is relative to a sample average bankruptcy likelihood of .03%. To test that this is not driven by loan age effects, we show that this result is robust to adding loan age fixed effects in Table 6 Column (4).

6.3 Heterogeneity in Performance Effects

We have shown that loans treated by the MSR regulation are more likely end in foreclosure. Finally, since high-risk MSRs are most likely to be transferred as a result of this regulation, we examine whether there was a disproportionately large effect of MSR regulation on high risk loans' performance.

We estimate the following dynamic DiD specification separately for prime and subprime credit score borrowers:

$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \mathbb{1}_k Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan\ Age_{i,t} + \epsilon_{i,j,t}. \tag{18}$$

$Y_{i,j,t}$ for loan i, serviced by servicer j in 2011, is an indicator for whether a borrower experiences a foreclosure or personal bankruptcy in quarter t. $Bank_{i,j,2011}$ is an indicator variable for whether the 2011 servicer for loan i was a bank. μ_i, and θ_t are loan fixed effects and time fixed effects, respectively. $Loan\ Age_{i,t}$ corresponds to the time since origination, measured in years. We run the analysis with and without loan age fixed effects. Standard errors are clustered at zip code level.

Figure 11 plots the estimated coefficients, β_k, on the interaction term that denotes whether a bank serviced the loan in each quarter pre and post transfer. Panel (a) plots the coefficients resulting from the DiD specification in Equation 18. It shows the performance of the portfolio of loans held by banks in 2011, relative to the performance of loans held by non-banks in 2011, for prime and subprime borrowers. The increase in foreclosure after the MSR regulation passed is driven by subprime loans only. The difference between bank and non-bank performance for prime credit score borrowers is statistically zero throughout the period.

Panel (b) shows that differences in bankruptcy rates between 2011 bank and non-bank portfolios grew more for subprime borrowers than prime borrowers. Differences in bankruptcy rates also increased for prime borrowers, rendering the difference statistically insignificant. These results confirm our hypothesis that the shift we document in previous sections has real distributional consequences.

6.4 Discussion

There are several mechanisms that could drive the performance effects we observe. The first mechanism is selection. We established in the previous section that high risk loans are

more likely to be transferred. If those loans are on a different long term trend than loans held by non-banks, selection could drive our results. The second is the detrimental effect of transfer itself. Servicing transfers are fraught with errors, such as loss of paperwork and typographical errors (Kaul et al., 2018). Our results could be driven in part by the transfer causing foreclosures and precipitating bankruptcy due to errors. The third mechanism is differential servicing quality. Non-banks provide less debt relief to borrowers than banks, on average in crisis times (Cherry et al., 2022) because they are liquidity constrained and may be under pressure to foreclosure aggressively.

Our results are consistent with MSR regulation amplifying existing disparities across borrowers. Risky borrowers now face additional risks through transfer, more assertive servicing by non-banks, and a larger probability of foreclosure and bankruptcy.

The welfare effect of MSR regulation is less clear. To assess the welfare effects of the regulation as a whole, more work is needed on two stakeholders - investors and financial stability regulators. Additional foreclosures and bankruptcies have an ambiguous welfare effect on investors. If foreclosures were inefficient, as they often were in the financial crisis (Mooradian and Pichler (2018)), investors may face losses from higher foreclosure rates, and the bankruptcies they cause. If, instead, foreclosures were insufficiently aggressive in the pre-period, MSR regulation may benefit investors by minimizing losses. Bank regulators also face an ambiguous welfare effect from MSR regulation. They may be worse off if the higher foreclosure and bankruptcy rates are significant enough to cause contagion, or if non-banks servicing high risk loans creates new systemic risks. Regulators may benefit from MSR regulation if the primary systemic risk MSRs posed arose from being held by banks.

Finally, our results raise questions about the design of the mortgage market. Regulations like the Basel III MSR regulation encourage more servicing transfers, further unbundling the structure of each mortgage. Servicing transfers can help servicers minimize costs and allow more money to flow into the lending sector. At the same time, this secondary market may cause inefficiencies that result in worse loan performance. Future work is needed to clarify mechanisms, study the implications for loan origination, and estimate broader welfare effects of MSR regulation.

7 Conclusion

This paper documents that more stringent regulation on mortgage servicing for banks increases the decoupling of the traditional bank model of deposit taking, lending, and servicing.

We show that traditional banks transferred a sizeable quantity of MSRs to non-banks in the wake of Basel III. Moreover, the selection of transferred loans was not random. We find that below median income, subprime, and 60+ day delinquent borrowers are more likely to experience transfer. The transferred loans do not perform equally well as loans retained by banks. Loans serviced by non-banks are more likely to face foreclosure and personal bankruptcy.

Our results raise the question of whether high risk borrowers are systematically more likely to experience less-integrated financial services in the non-bank sector. The results suggest that Basel III and the rise of non-bank servicing of household debt could exasperate disparities in financial risk for low income borrowers. This has important implications both for risk-sharing to borrowers in the primary market and returns to mortgage investors in the secondary market.

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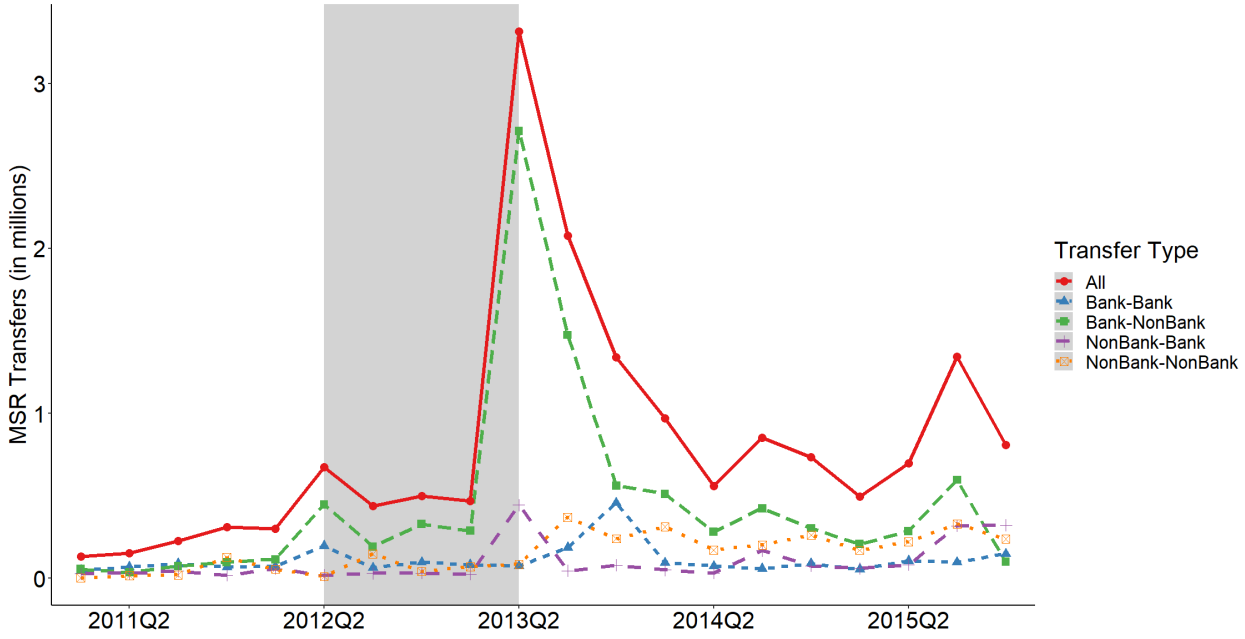
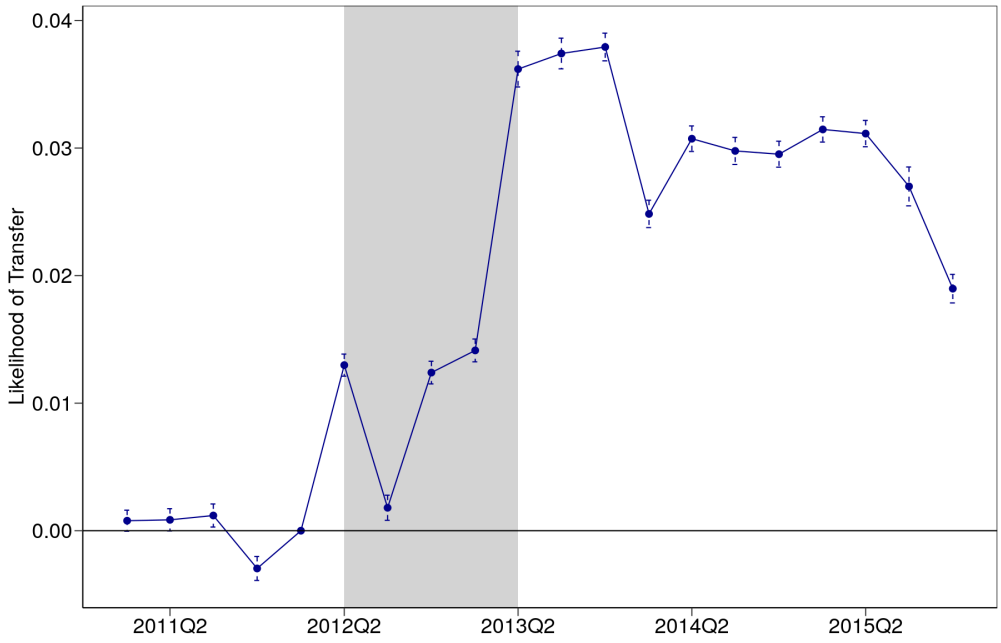
Figure 1. Aggregate MSR Tranfers Around Basel III MSR Rule Change



Notes: This figure presents quarterly time series for the total count of outstanding mortgages that underwent a transfer of mortgage servicing rights between 2011-2015. The bold red line denoted by '*All*' plots the count of outstanding loans whose servicing rights were sold in a given quarter. Bank-Bank (Bank-NonBank) corresponds to the number of outstanding mortgages whose servicing rights were held by a bank in the prior quarter and sold to a bank (non-bank) in the current quarter. NonBank-Bank (Non Bank-NonBank) counts the number of outstanding mortgages transferred to a bank (non bank) in a given quarter which were held by a non-bank in the prior quarter.

Figure 2. MSR Regulation and Bank Incentive to Transfer

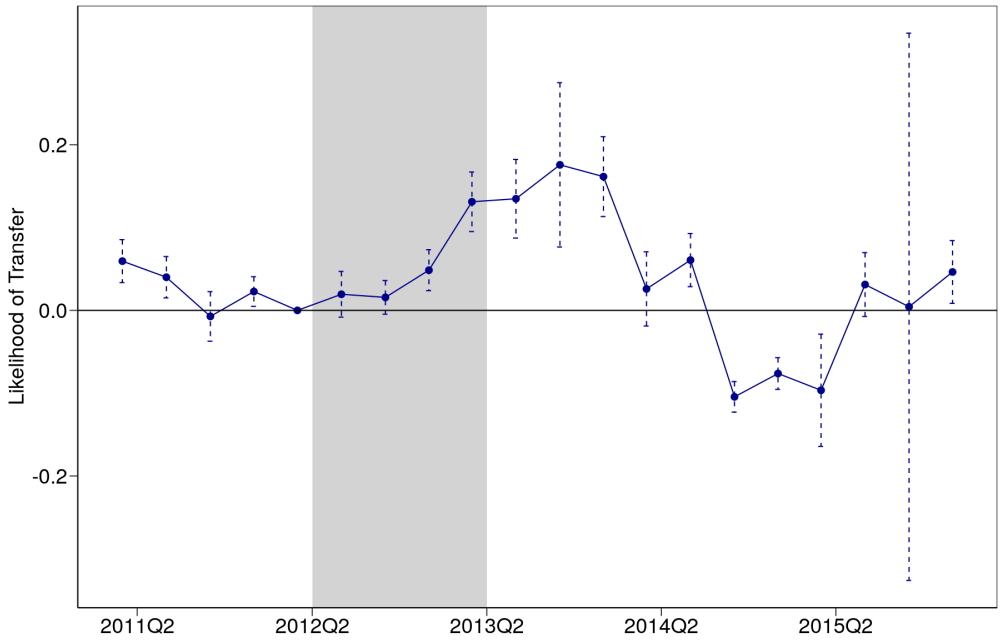


Notes: This figure plots the estimated coefficients β_k in the specification below:

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \gamma Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i was sold in quarter t. $Bank_{i,j,t-1}$ is an indicator for whether the servicer of loan i is a bank in the quarter before transfer. If a loan was not transferred during our sample period, we take the servicer type of the only servicer of the loan. μ_i and θ_t correspond to loan and quarter fixed effects respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Figure 3. Transfer Heterogeneity Across Banks

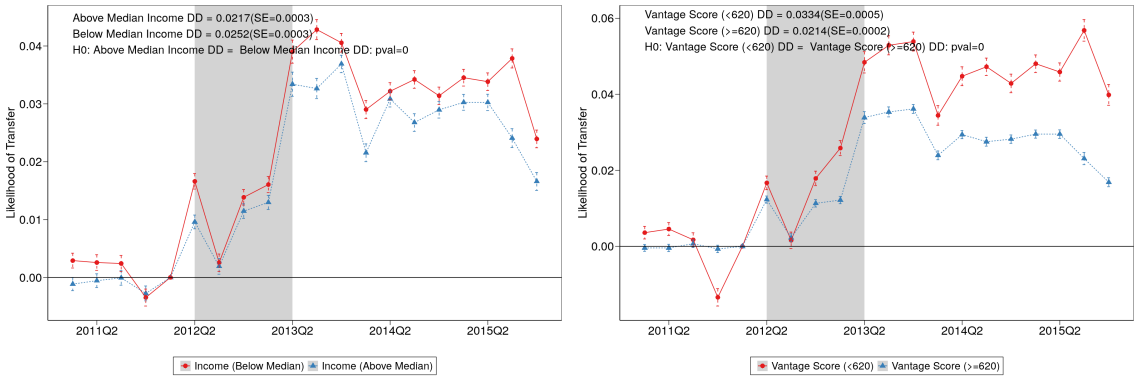


Notes: This figure plots the estimated β_k in the following specification:

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k \left(\frac{MSR}{CET1} \right)_{i,j,2011} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

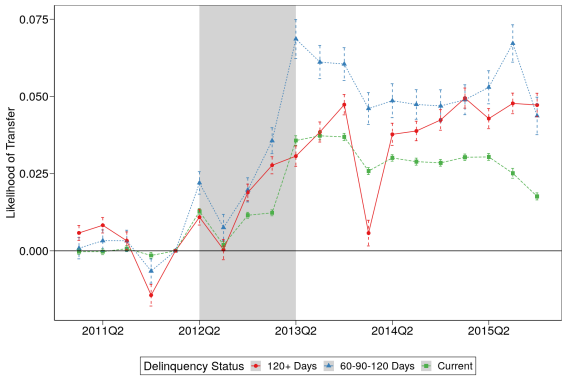
where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i was sold in quarter t. $(\frac{MSR}{CET1})_{i,j,2011}$ is the MSR to common equity tier 1 ratio measured as of 2011 for the entity servicing the loan in the quarter prior to transfer. μ_i and θ_t correspond to loan and quarter fixed effects respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Figure 4. Transfer Heterogeneity Across Loan Types



(a) Income

(b) Credit Score



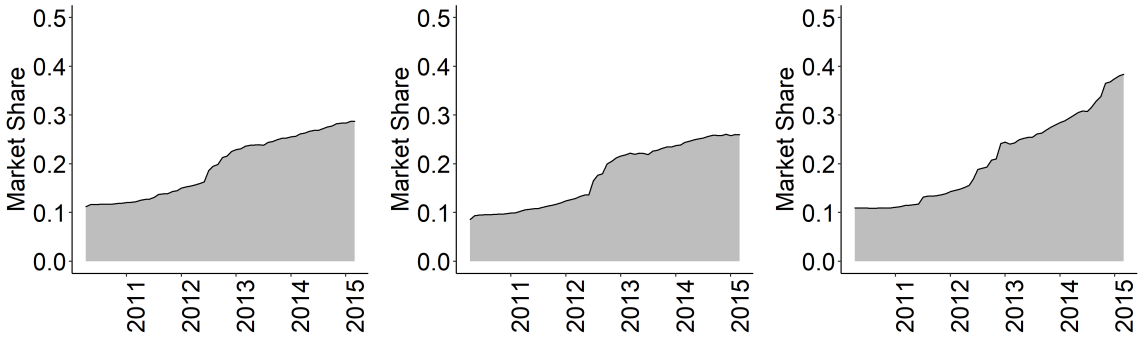
(c) Loan Performance

Notes: This figure plots the dynamic response of β_k from the specification below for subgroups based on loan and borrower characteristics.

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \gamma Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i was sold in quarter t. $Bank_{i,j,t-1}$ is an indicator for whether the servicer of loan i is a bank in the quarter before transfer. μ_i and θ_t correspond to loan and quarter fixed effects respectively. The sub-samples are based on income in panel (a), credit score in panel (b) and loan performance in panel (c) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level. Each panel reports the associated DiD estimates for each subgroup as well as the p-values from hypothesis tests comparing DiD estimates for different subgroups.

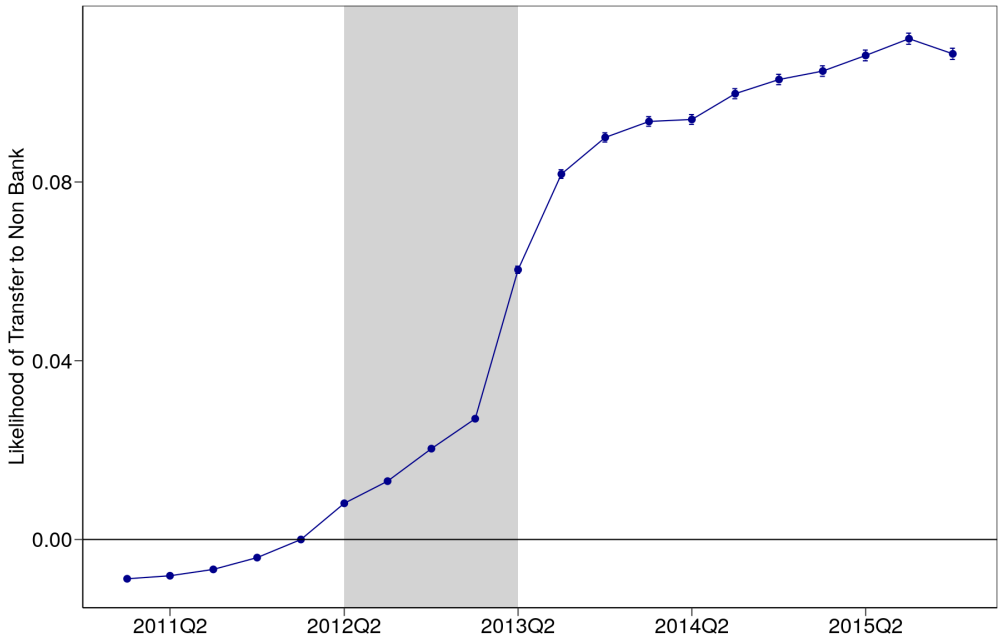
Figure 5. Rise of Non-Bank Servicers



(a) All Loans **(b)** GSE **(c)** FHA

Notes: This figure presents the time trends in market share of outstanding loans that are serviced by non-banks. Panel (a) plots the share of loans serviced by non-banks as a fraction of all the outstanding mortgages between 2011 and 2015. Panel (b) shows non-banks serviced shares among conforming mortgages. Panel (c) shows the non-bank serviced share among FHA mortgages.

Figure 6. Cumulative Servicing by Non-Banks

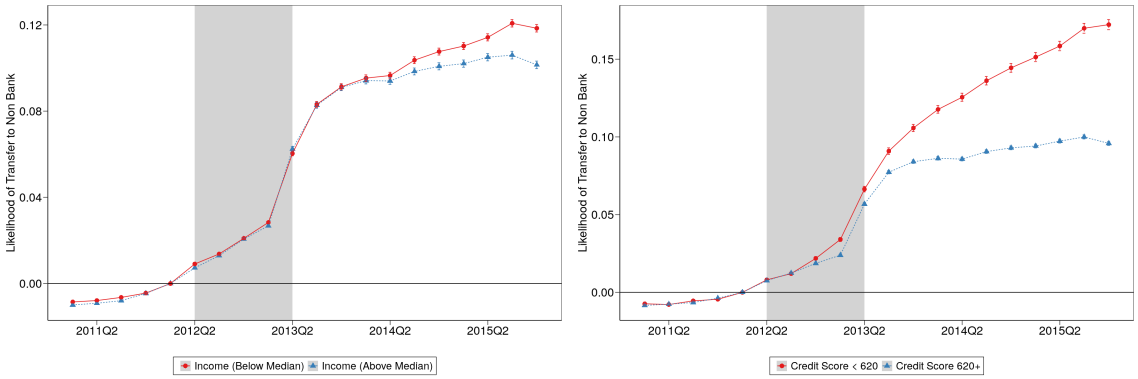


Notes: This figure plots the estimated coefficients β_k in the specification below:

$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}$$

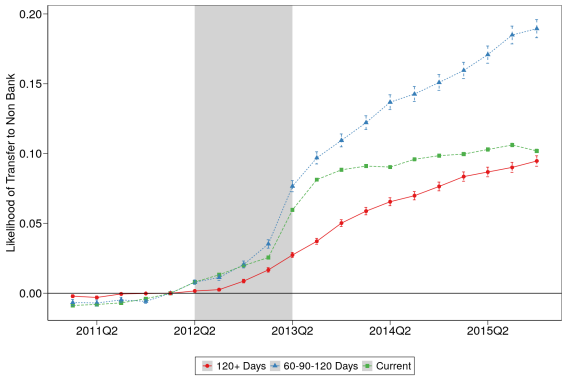
where $NonBank_{i,j,t}$ is an indicator variable for whether loan i is serviced by a non-bank servicer in quarter t. $\mathbb{1}_k$ is an indicator code as 1 for quarter k and 0 otherwise. μ_i represents loan fixed effects. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Figure 7. Non-Bank MSR Holdings by Income, Credit score & Loan performance



(a) Income

(b) Credit Score



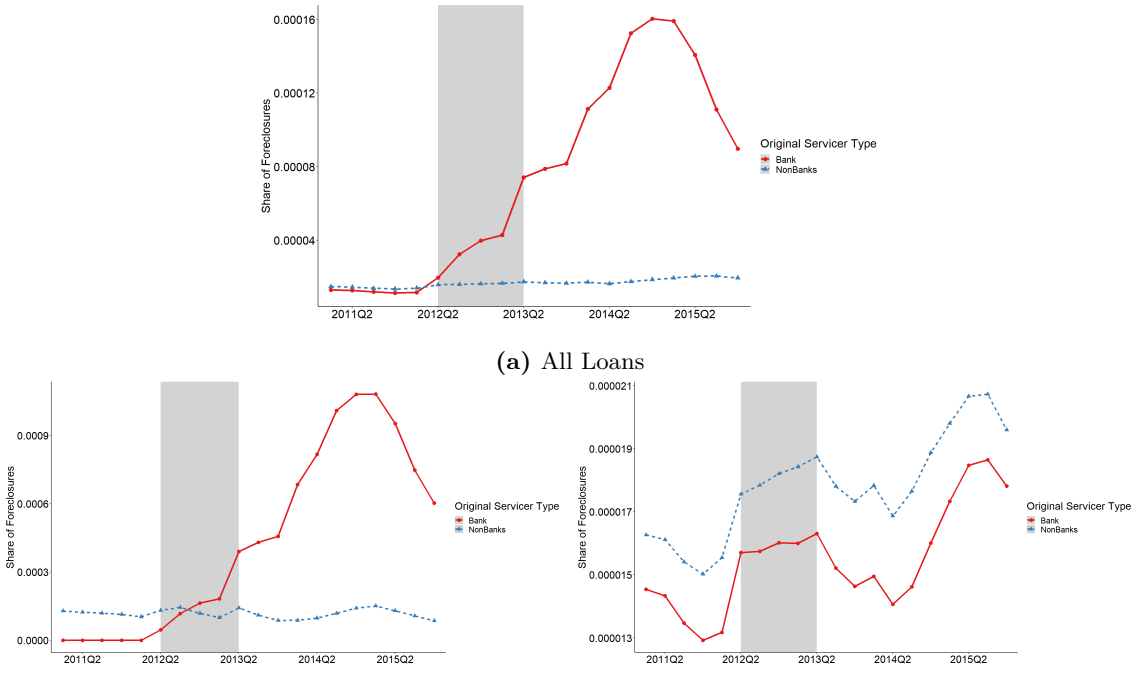
(c) Loan Performance

Notes: This figure plots the estimated coefficients β_k in the specification below for each sub-population listed:

$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}$$

where $NonBank_{i,j,t}$ is an indicator variable for whether loan i is serviced by a non-bank servicer in quarter t. $\mathbb{1}_k$ is an indicator code as 1 for quarter k and 0 otherwise. μ_i represents loan fixed effects. The sub-samples are based on income in panel (a), credit score in panel (b) and loan performance in panel (c) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Figure 8. Foreclosure by 2011 Servicer Type



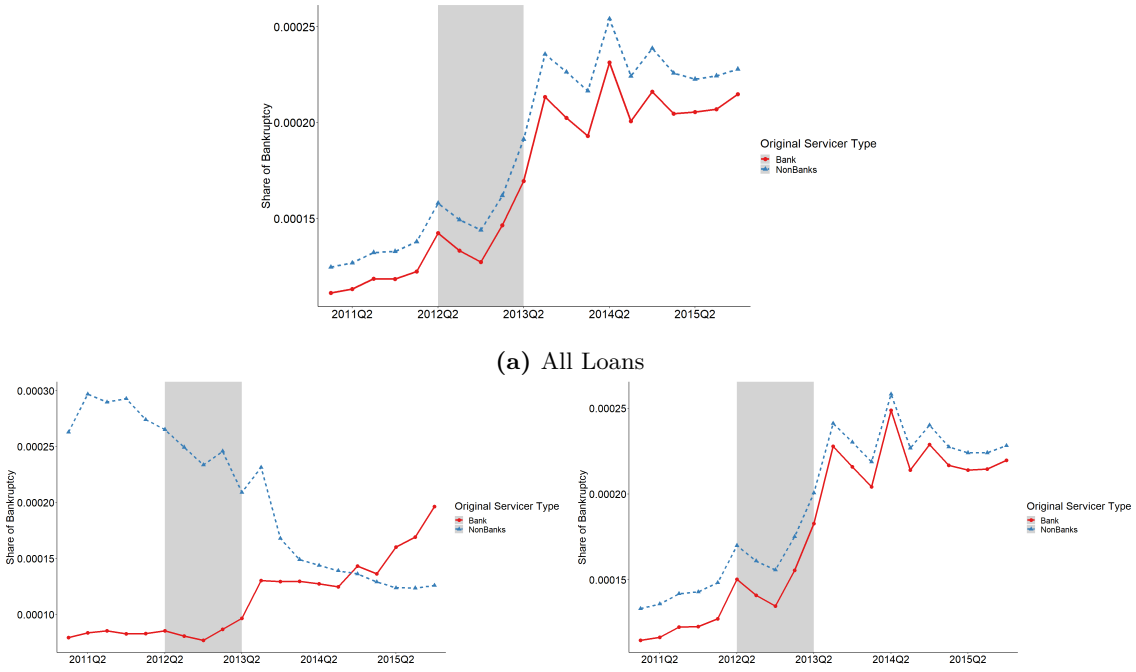
(a) All Loans

(b) Transferred Loans

(c) Non-Transferred Loans

Notes: This figure plots the monthly time-series for the share of foreclosures based on the type of entity servicing the loan. *Original Servicer Type* is identified based on the type of entity servicing the loan in the quarter prior to transfer for transferred loans and the servicer in any given quarter for the never transferred loans. Panel (a) shows the average likelihood of foreclosure for the entire sample of loans. Panel (b) restricts the sample to only loans that were transferred between 2011-2015 and Panel (c) to loans never transferred during the sample period.

Figure 9. Personal Bankruptcy Rate by 2011 Servicer Type



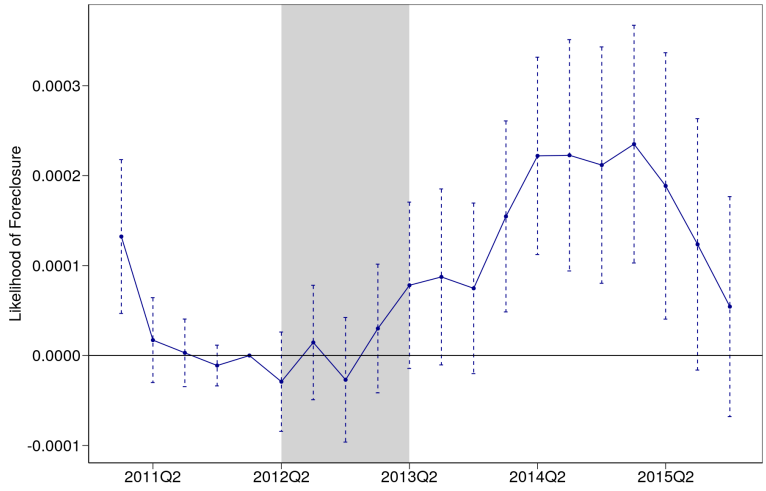
(a) All Loans

(b) Transferred Loans

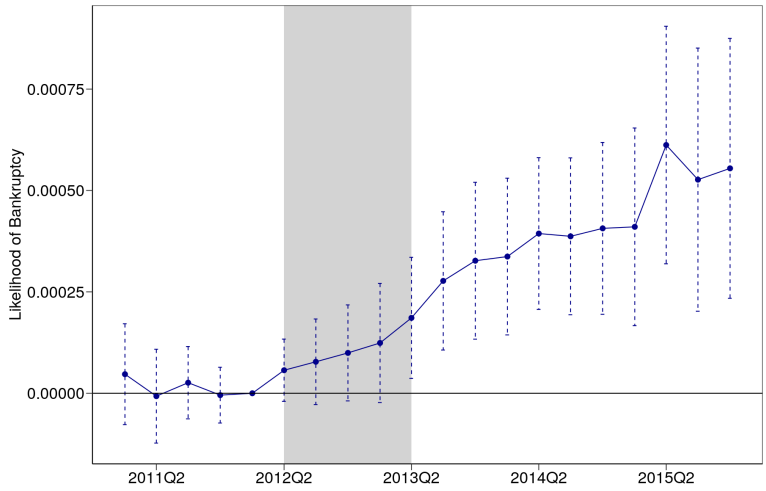
(c) Non-Transferred Loans

Notes: This figure plots the monthly time-series for the share of personal bankruptcy based on the type of entity servicing the loan. *Original Servicer Type* is identified based on the type of entity servicing the loan in the quarter prior to transfer for transferred loans and the servicer in any given quarter for the never transferred loans. Panel (a) shows the average likelihood of bankruptcy for the entire sample of loans. Panel (b) restricts the sample to only loans that were transferred between 2011-2015 and Panel (c) to loans never transferred during the sample period.

Figure 10. MSR Regulation and Consequences: Intent-to-Treat (ITT) Estimates



(a) Foreclosure



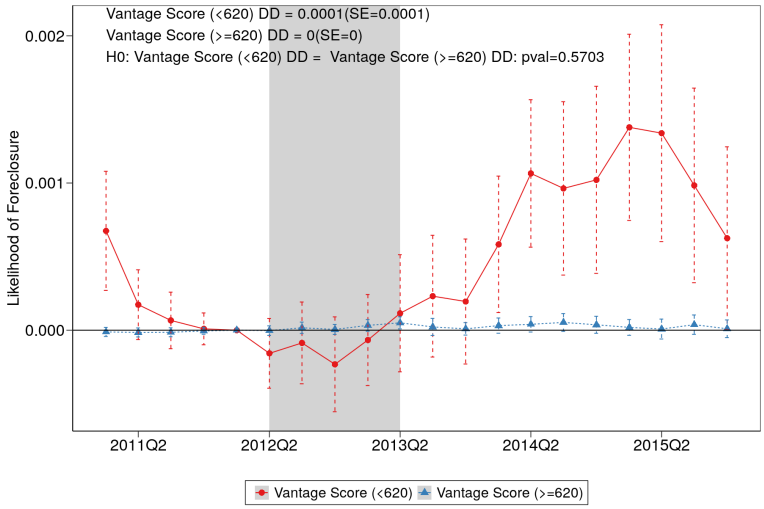
(b) Personal Bankruptcy

Notes: This figure plots the estimated β_k in the intent-to-treat (ITT) specification:

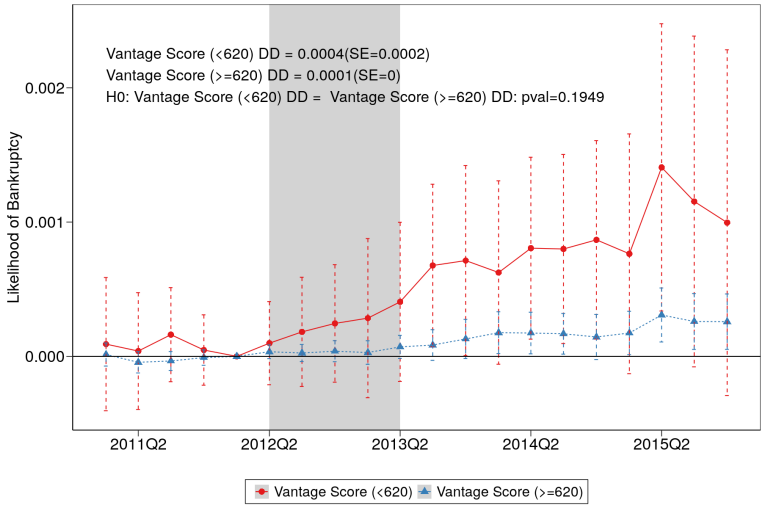
$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan \; Age_{i,t} + \epsilon_{i,j,t}$$

where $Y_{i,j,t}$ is an indicator for whether loan i is subject to foreclosure in Panel (a) or faces personal bankruptcy in Panel (b) in quarter t. $Bank_{i,j,2011}$ is an indicator for whether loan i is serviced by a bank in 2011Q1. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. $Loan \; Age_{i,t}$ corresponds to the time since origination, measured in years. The sample consists of loans originated before 2011. The 95% confidence intervals are included for each quarterly point estimate with standard errors clustered at zip code level.

Figure 11. Heterogeneity in Intent-to-Treat (ITT) Estimates



(a) Foreclosure



(b) Personal Bankruptcy

Notes: This figure plots the estimated β_k in the intent-to-treat (ITT) specification, separately for subprime (< 620) and prime borrowers:

$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan \; Age_{i,t} + \epsilon_{i,j,t}$$

where $Y_{i,j,t}$ is an indicator for whether loan i is subject to foreclosure in Panel (a) or faces personal bankruptcy in Panel (b) in quarter t. $Bank_{i,j,2011}$ is an indicator for whether loan i is serviced by a bank in 2011Q1. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. $Loan \; Age_{i,t}$ corresponds to the time since origination, measured in years. The sample consists of loans originated before 2011. The 95% confidence intervals are included for each quarterly point estimate with standard errors clustered at zip code level.

Table 1: Summary Statistics

This table reports summary statistics for the two main datasets for outstanding mortgages between 2011-2015: the loan-level credit registration data and the loan-level MSR transfer data. Panel A presents the statistics for the loan-level credit registration data. Panel B (Panel C) presents the statistics of the loan-level MSR transfer data (Y9C matched sample), which constitutes a one percent sample of outstanding mortgages. Standard deviations are reported in brackets.

	All	Banks	Non Banks
	(1)	(2)	(3)
A. Full Sample			
Number of Servicers	8,944	5,030	1533
Number of Loan per Year (in Millions)	70	53	19
Dollar Volume per Year (in Trillions)	67.28	50.60	16.72
Loan Amount	192,615	193,860	188,970
	(131,732)	(133,490)	(126,371)
Loan Term	314	314	314
	(78)	(78)	(78)
Credit Score	715	718	707
	(108)	(107)	(109)
Income	54,921	55,310	53,669
.	(26,509)	(26,552)	(26,332)
% Delinquent	11.22	10.88	12.20
	(31.56)	(31.14)	(32.73)
% Foreclosure	0.03	0.002	0.07
	(1.34)	(0.39)	(2.58)
% Bankruptcy	0.03	0.02	0.06
	(1.68)	(1.32)	(2.45)
B. 1% Sample			
Number of Servicers	6,115	3,427	798
Number of Loan per Year (in Millions)	0.93	0.71	0.23
Dollar Volume per Year (in Trillions)	0.90	0.68	0.22
Loan Amount	192,473	193,732	188,779
	(131,662)	(133,393)	(126,371)
Loan Term	314	314	314
	(78)	(78)	(78)
Credit Score	715	718	707
	(107)	(107)	(109)
Income	57,149	57,767	55,284
	(34,029)	(34,820)	(31,451)
% Delinquent	10.99	10.66	11.97
	(31.28)	(30.86)	(32.46)
% Foreclosure	0.02	0.001	0.07
	(1.32)	(0.42)	(2.52)
% Bankruptcy	0.03	0.02	0.06
	(1.72)	(1.32)	(2.56)
C. Y9C Matched Sample			
Number of Servicers	905	799	131
Number of Loan per Year (in Millions)	0.55	0.54	0.05
Dollar Volume per Year (in Trillions)	0.494	0.492	0.002
Loan Amount	190,055	190,119	184,775
	(132,004)	(132,036)	(129,279)
Loan Term	314	314	325
	(78)	(78)	(71)
Credit Score	715	715	691
	(111)	(111)	(115)
Income	57,529	57,573	53,878
	(34,6618)	(34,617)	(34,459)
% Delinquent	12.09	12.05	15.90
	(32.61)	(32.55)	(36.57)
% Foreclosure	0.003	0.002	0.07
	(0.50)	(0.41)	(2.71)
% Bankruptcy	0.02	0.02	0.02
	(1.44)	(1.44)	(1.41)

Table 2
Are Banks More Likely to Sell MSRs After MSR Regulation

This table presents loan level difference-in-difference regression results from Equation 12. The underlying sample includes all loan-quarter observations in our random sample. The outcome variable $Transfer$ is an indicator for whether a loan's servicing right is transferred in a given quarter. The treatment indicator $Bank$ is coded as 1 for loans which were serviced by a bank in the quarter prior to transfer and 0 for non-banks. $Middle$ indicates whether the time is between 2012Q2 and 2013Q2, and $Post$ indicates whether the time is in or after 2013Q2. Servicer FE corresponds to initial servicer fixed effects. Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Transfer			
	(1)	(2)	(3)	(4)
Middle x Bank	0.006***	0.006***	0.006***	0.010***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Post x Bank	0.012***	0.012***	0.011***	0.031***
	(0.0002)	(0.0002)	(0.0002)	(0.0004)
Middle	-1.39×10^{-5}	-7.13×10^{-5}		
	(0.0001)	(0.0001)		
Post	0.005***	0.005***		
	(0.0001)	(0.0001)		
Bank	0.002***	0.002***	0.003***	0.016***
	(8.64×10^{-5})	(8.72×10^{-5})	(0.0001)	(0.0003)
Servicer FE	Yes	Yes	Yes	
Zip FE		Yes	Yes	
Quarter FE			Yes	Yes
Loan FE				Yes
N	14,384,063	14,384,063	14,384,063	14,384,063
R^2	0.036	0.038	0.043	0.139

Table 3
Selection in MSR Transfers

This table presents the heterogeneity in loan level difference-in-difference regression estimates from Equation 12 and from the static version of Equation 13 measuring the effect of MSR regulation under Basel III on the likelihood of transfer. For the MSR-to-CET1 regression: sample includes loans serviced by banks in the quarter prior to transfer. $\frac{MSR}{CET1}$ is the MSR to common equity tier 1 ratio measured as of 2011 for entity servicing the loan in the quarter prior to transfer. For heterogeneity by loan type: sample includes all loan-quarter observations in our random sample. The treatment indicator *Bank* is coded as 1 for loans which were serviced by a bank in the quarter prior to transfer and 0 for non-banks. *Middle* indicates whether the time is between 2012Q2 and 2013Q2, and *Post* indicates whether the time is in or after 2013Q2. *Category* is an indicator variable which takes a value of 1 if the loan corresponds to a below median income zipcode (column 2), has credit score lower than 620 (column 3), is in default (column 4). The outcome variable $Transfer$ is an indicator for whether a loan's servicing right is transferred in a given quarter. Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Transfer			
		$\text{Income}_{<Median}$	Subprime	Default
	(1)	(2)	(3)	(4)
Middle $\times \frac{MSR}{CET1}$	0.080***			
	(0.012)			
Post $\times \frac{MSR}{CET1}$	0.039**			
	(0.019)			
Middle × Bank × Category		0.002***	0.012***	0.017***
		(0.0004)	(0.0005)	(0.0009)
Post × Bank × Category		0.004***	0.021***	0.025***
		(0.0005)	(0.0005)	(0.0009)
Middle × Bank		0.010***	0.008***	0.009***
		(0.0003)	(0.0002)	(0.0002)
Post × Bank		0.030***	0.028***	0.030***
		(0.0004)	(0.0003)	(0.0003)
Middle × Category		-0.001***	-0.008***	-0.008***
		(0.0004)	(0.0004)	(0.0007)
Post × Category		-0.002***	-0.010***	-0.006***
		(0.0004)	(0.0004)	(0.0006)
Category × Bank		0.007***	-0.001***	-0.006***
		(0.0005)	(0.0002)	(0.0004)
Bank		0.011***	0.016***	0.014***
		(0.0003)	(0.0002)	(0.0002)
Loan FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
N	5,438,217	13,995,539	14,383,904	13,359,276
R^2	0.181	0.139	0.139	0.142

Table 4

Are Non Banks More Likely to hold MSRs After MSR Regulation

This table presents regression estimates from Equation 15 showing the likelihood of the non banks' holding of mortgage servicing rights. The underlying sample includes all loan-quarter observations in our random sample. The outcome variable *Non Bank* is an indicator for whether a loan is serviced by a non-bank in a given quarter. *Middle* indicates whether the time is between 2012Q2 and 2013Q2, and *Post* indicates whether the time is in or after 2013Q2. Servicer FE corresponds to initial servicer fixed effects. Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Non Bank		
	(1)	(2)	(3)
Middle	0.018***	0.018***	0.022***
	(0.0002)	(0.0002)	(0.0002)
Post	0.083***	0.083***	0.097***
	(0.0004)	(0.0004)	(0.0006)
Servicer FE	Yes	Yes	
Zip FE		Yes	
Loan FE			Yes
N	14,384,063	14,384,063	14,384,063
R^2	0.761	0.764	0.873

Table 5

What Loans are More Likely to be Held by Non Banks

This table presents heterogeneity in the likelihood of the non banks' holding of mortgage servicing rights from Equation 15. The underlying sample includes all loan-quarter observations in our random sample. The outcome variable *Non Bank* is an indicator for whether a loan is serviced by a non-bank in a given quarter. *Middle* indicates whether the time is between 2012Q2 and 2013Q2, and *Post* indicates whether the time is in or after 2013Q2. *Category* is an indicator variable which takes a value of 1 if the loan corresponds to a below median income zipcode (column 1), has credit score lower than 620 (column 2), is in default (column 3). Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Non Bank		
	$\text{Income}_{<Median}$	Subprime	Default
	(1)	(2)	(3)
Middle × Category	0.0003	-0.008***	-0.018***
	(0.0004)	(0.0005)	(0.0009)
Post × Category	0.004***	0.021***	0.023***
	(0.001)	(0.0007)	(0.001)
Loan FE	Yes	Yes	Yes
N	13,995,539	14,383,904	13,359,276
R^2	0.870	0.873	0.872

Table 6

MSR Regulation and Consequences: Foreclosure and Personal Bankruptcy

This table presents the regression estimates from the static version of our intent-to-treat (ITT) specification in Equation 18 showing the effects of MSR regulation under Basel III on foreclosure Columns (1-2) and personal bankruptcies Columns (3-4). The sample is restricted to loans originated before 2011. *Middle* indicates whether the time is between 2012Q2 and 2013Q2, and *Post* indicates whether the time is in or after 2013Q2. *Bank* is an indicator variable equal to 1 if the loan was serviced by a bank in 2011Q1. Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Foreclosure		Bankruptcy	
	(1)	(2)	(3)	(4)
Middle × Bank	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Post × Bank	0.0001**	0.0001**	0.0004***	0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
N	8,724,868	8,724,868	8,724,868	8,724,868
R^2	0.628	0.628	0.765	0.765
Loan FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Loan Age FE	No	Yes	No	Yes

Internet Appendix

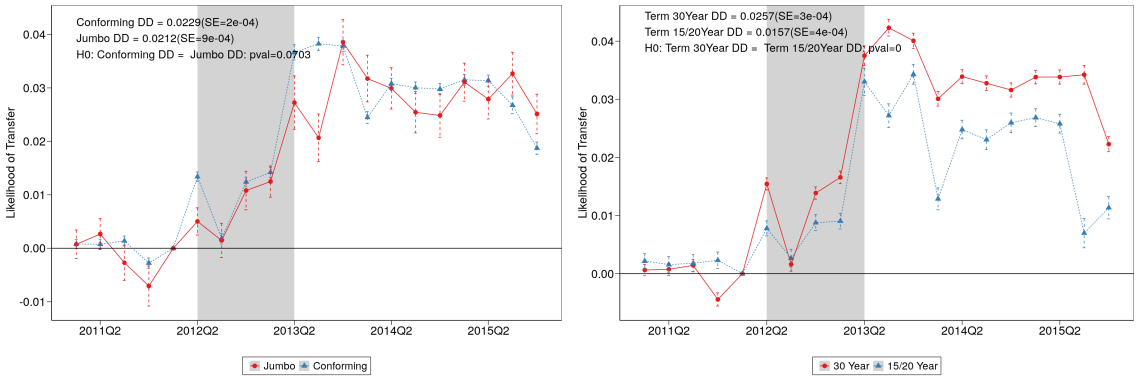
A Basel III Timeline

A full timeline of Basel III's regulatory changes follows, adapted from Hendricks, Neilson, Shakespeare, and Williams (2016).

- Dec 2009 – Basel Committee proposes that intangible assets (e.g., MSRs) be deducted from the equity component of Tier 1 capital. Comments invited by April 16, 2010.
- Jul 2010 – Basel Committee modifies the initial proposal so that MSRs are allowed to comprise 10% of Tier 1 Equity, rather than being fully deducted.
- Dec 2010 - Basel Committee increases the risk weighting on MSRs included in Tier 1 capital from 100% to 250% and releases timeline for banks to comply by 2015.
- Apr 2012 – Basel Committee issues a member progress report and classifies the US as "1-Draft regulation not published. This status corresponds to cases where no draft law, regulation, or other official document has been made public to detail the planned content of the domestic regulatory rules."
- Jun 2012 – Fed Board issues a proposal to adopt the Basel III's treatment of MSRs. The Fed Board proposes that this treatment of MSRs be in addition to the current rules that only allow 90% of MSRs to be counted in the common equity component of Tier 1. The Fed Board invites comments by Sep 2012.
- Oct 2012 – Basel Committee issues a member progress report and classifies the US as "2-Draft regulation published."
- Apr 2013 – Basel Committee issues a member progress report and still classifies the US as "2. draft regulation published."
- July 2013 – The Fed Board approves the Basel III rule with only minimal changes to the proposed treatment of MSRs. Specifically, the previous requirement that only 90% of MSRs could be included in the common equity component of Tier 1 capital was removed in favor of the Basel Committee's more stringent requirements. Implementation to begin on Jan 1, 2014 (Jan 1, 2015) for Advanced Approaches (non-Advanced Approaches) institutions.
- Oct 2013 - Basel Committee issues a member progress report and classifies the US as "3 - Final rule published."
- Apr 2014 - Basel Committee classifies US as "4 - Final rule in force."

B Additional Tables and Figures

Figure B1. Transfer DiD by Loan Size & Term



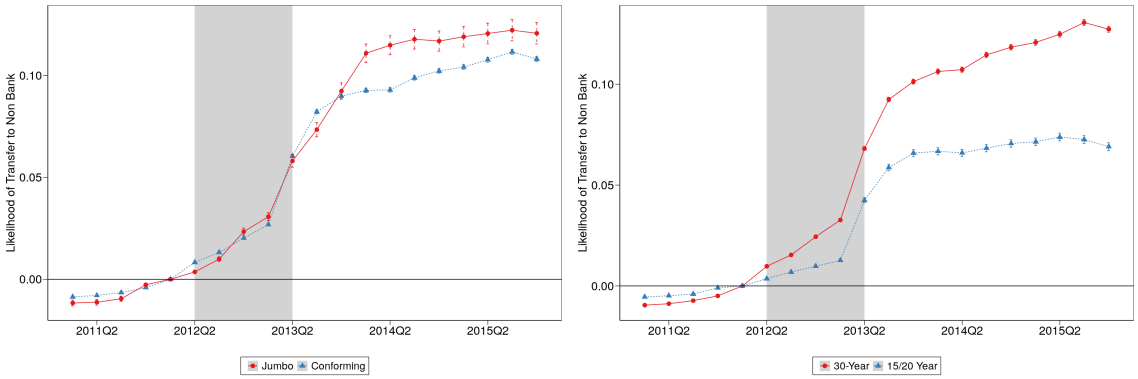
(a) Loan Size **(b)** Loan Term

Notes: This figure plots the dynamic response of β_k from the specification below for subgroups based on loan and borrower characteristics.

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \ \mathbb{1}_k \ Bank_{i,j,t-1} + \gamma Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

where $Transfer_{i,j,t}$ is an indicator for whether the servicing right on loan i was sold in quarter t. $Bank_{i,j,t-1}$ is an indicator for whether the servicer of loan i is a bank in the quarter before transfer. μ_i and θ_t correspond to loan and quarter fixed effects respectively. The sub-samples are based on loan size in panel (a) and loan term in panel (b) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level. Each panel reports the associated DiD estimates for each subgroup as well as the p-values from hypothesis tests comparing DiD estimates for different subgroups.

Figure B2. Non Bank MSR Holdings by Loan Size & Term



(a) Loan Size **(b)** Loan Term

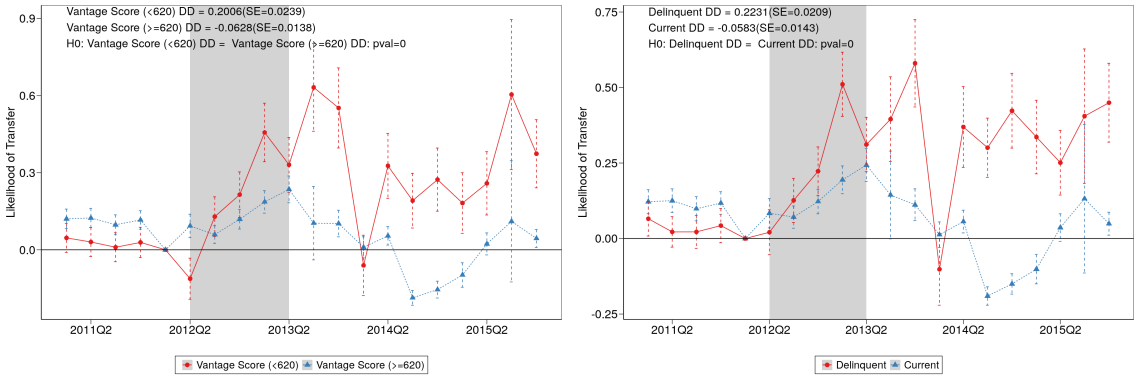
Notes: This figure plots the estimated coefficients β_k in the specification below for each sub-population listed:

$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}$$

where $NonBank_{i,j,t}$ is an indicator variable for whether loan i is serviced by a non-bank servicer in quarter t. $\mathbb{1}_k$ is an indicator code as 1 for quarter k and 0 otherwise. μ_i represents loan fixed effects. The sub-samples are based on loan size in panel (a) and loan term in panel (b) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Loan Term and Size Figure B1 plots the coefficients resulting from the DiD specification in Equation 14. Panel (a) shows that banks' likelihood of transferring MSRs relative to non-banks' for conforming versus jumbo loan sizes. Panel (b) shows transfer likelihood for loans with a 360 month loan term versus a 180/240 month loan term. Panel (a) provides evidence that banks transferred more MSRs associated with conforming loans initially following the policy change and then increased their transfers of MSRs associated with jumbo loans. Panel (b) shows that banks transferred more 360 month term relative to 180/240 month term loans. In order to study whether these MSRs were transferred to non-banks, we estimate the event study in Equation 16. Figure B2 depicts the results. It shows that following the policy change, non-banks see a larger increase in their cumulative likelihood of servicing conforming loans before jumbo loans catch up and eventually overtake the likelihood of conforming loans. Panel (c) shows that non-banks see a larger increase in servicing 360 month relative to 180/240 month term loans, following the policy change. All 4 of these figures exhibit pre period parallel trends. Table B1 reports the average difference between sub-groups for each category in the Middle and Post period. Combining the results of the DiD in Figure B1 with the results of the event study in Figure B2 provides compelling

Figure B3. Selective Transfer DiD



(a) Credit Score **(b)** Loan Performance

Notes: This figure plots the dynamic response of β_k from the specification below

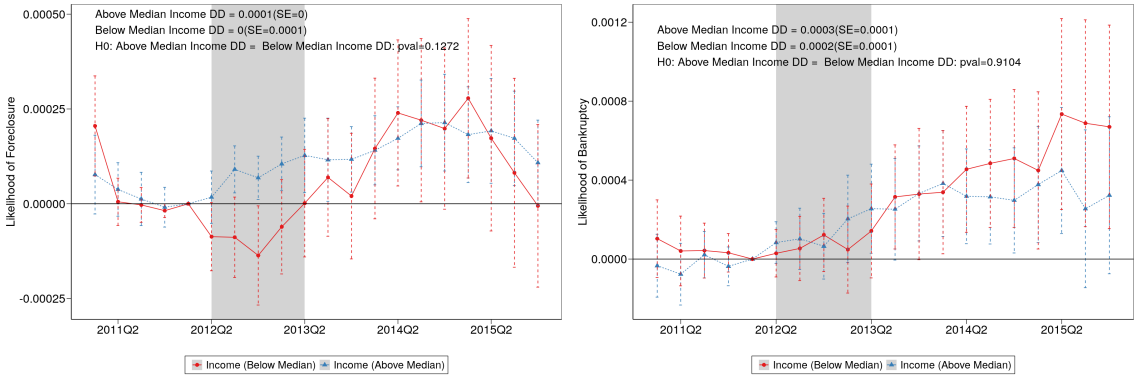
$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k \left(\frac{MSR}{CET1} \right)_{i,j,2011} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

for subgroups based on credit score and loan performance. Panel (a) shows effects separately for above and below 620 credit score, Panel (b) for current and delinquent loans. 95% confidence intervals are included for each quarterly point estimate with standard errors clustered at zip code level. The text in each panel reports the associated DiD estimates for each subgroup as well as the p-values from hypothesis tests comparing DiD estimates for different subgroups.

evidence that non-banks were purchasing the MSRs that banks sold following Basel III.

Together the above results indicate that banks were more likely to transfer MSRs associated with lower income, higher delinquency, 360 month term, and conforming loan amounts.

Figure B4. Intent to Treat: Heterogeneity



(a) Foreclosure: Income **(b)** Bankruptcy: Income

Notes: This figure plots the estimated β_k in the intent-to-treat (ITT) specification, separately by sub-category:

$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan\ Age_{i,t} + \epsilon_{i,j,t}$$

where $Y_{i,j,t}$ is an indicator for whether loan i is subject to foreclosure in Panel (a) or faces personal bankruptcy in Panel (b) in quarter t. $Bank_{i,j,2011}$ is an indicator for whether loan i is serviced by a bank in 2011Q1. μ_i and θ_t are loan fixed effects and quarter fixed effects, respectively. $Loan\ Age_{i,t}$ corresponds to the time since origination, measured in years. The sample consists of loans originated before 2011. The 95% confidence intervals are included for each quarterly point estimate with standard errors clustered at zip code level. The text in each panel reports the associated DiD estimates for each subgroup as well as the p-values from hypothesis tests comparing DiD estimates for different subgroups.

Table B1
Selection in MSR Transfers

This table presents the heterogeneity in loan level difference-in-difference regression estimates from Equation 12. The underlying sample includes all loan-quarter observations in our random sample. The outcome variable $Transfer$ is an indicator for whether a loan's servicing right is transferred in a given quarter. The treatment indicator $Bank$ is coded as 1 for loans which were serviced by a bank in the quarter prior to transfer and 0 for non-banks. $Middle$ indicates whether the time is between 2012Q2 and 2013Q2, and $Post$ indicates whether the time is in or after 2013Q2. $Category$ is an indicator variable which takes a value of 1 if the loan is jumbo (column 1) and has a 30-year loan term (column 2). Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Transfer		Non Bank	
	Jumbo	30 Year	Jumbo	30 Year
	(1)	(2)	(3)	(4)
Middle × Bank × Category	-0.002**	0.007***		
	(0.0009)	(0.0004)		
Post × Bank × Category	-0.002**	0.012***		
	(0.001)	(0.0005)		
Middle × Bank	0.011***	0.006***		
	(0.0002)	(0.0003)		
Post × Bank	0.031***	0.022***		
	(0.0003)	(0.0005)		
Middle × Category	0.0007	-0.001***	0.001	0.015***
	(0.0008)	(0.0003)	(0.0008)	(0.0004)
Post × Category	2.07×10^{-5}	-0.003***	0.044***	0.033***
	(0.0009)	(0.0004)	(0.002)	(0.001)
Category × Bank	-0.010***	0.005***		
	(0.0009)	(0.0004)		
Bank	0.016***	0.011***		
	(0.0002)	(0.0004)		
Loan FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes		
N	14,384,063	13,504,541	14,384,063	13,504,541
R^2	0.139	0.139	0.873	0.869

Table B2

ITT: Heterogeneity

This table presents heterogeneity in the regression estimates from the dynamic version of our intent-to-treat (ITT) specification in Equation 18 showing the effects of MSR regulation under Basel III on foreclosure Columns (1-2) and personal bankruptcies Columns (3-4). The sample is restricted to loans originated before 2011. *Bank* is an indicator variable equal to 1 if the loan was serviced by a bank in 2011Q1. *Middle* indicates whether the time is between 2012Q2 and 2013Q2, and *Post* indicates whether the time is in or after 2013Q2. *Category* is an indicator variable which takes a value of 1 if the loan belongs to below median zipcode (column 1 & 3) and has credit score below 620 (column 2 & 4). Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Foreclosure		Bankruptcy	
	$\text{Income}_{<Median}$	Subprime	$\text{Income}_{<Median}$	Subprime
	(1)	(2)	(3)	(4)
Middle × Bank × Category	-0.0002**	-6.96×10^{-5}	-0.0001	-9.34×10^{-5}
	(6.28×10^{-5})	(0.0001)	(0.0001)	(0.0002)
Post × Bank × Category	-2.29×10^{-5}	0.0007***	5.71×10^{-5}	0.0003
	(8.67×10^{-5})	(0.0001)	(0.0002)	(0.0002)
Loan FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
N	8,477,621	8,724,784	8,477,621	8,724,784
R^2	0.618	0.628	0.769	0.765

Table B3: Servicer Level Summary Statistics

This table reports summary statistics for servicer level portfolio between 2011-2015. Panel A presents the statistics for all years, Panel B and C summarize years 2011 and 2015 respectively. The servicer-year panel is constructed from a one percent sample of outstanding mortgages. Standard deviations are reported in brackets.

	All	Banks	Non Banks
	(1)	(2)	(3)
A. All Years			
Credit Score	717	717	716
	(30)	(30)	(30)
Income	51,125	51,568	50,593
.	(7,705)	(8,490)	(6,612)
% FHA	2.70	1.71	3.89
	(4.56)	(4.75)	(4.33)
% Foreclosure (if 60+Dpd)	15.96	17.29	14.62
	(6.97)	(6.54)	(8.34)
% Foreclosure (if 90+Dpd)	20.96	21.20	20.69
	(8.69)	(7.97)	(10.18)
% Foreclosure (if 120+Dpd)	26.12	22.57	30.02
	(8.16)	(7.28)	(10.08)
B. 2011			
Credit Score	716	718	714
	(72)	(69)	(76)
Income	50,511	50,740	50,225
.	(20,467)	(23,103)	(16,604)
% FHA	1.91	1.25	2.72
	(10.10)	(7.31)	(12.68)
% Foreclosure (if 60+Dpd)	19.70	13.06	23.68
	(34.14)	(17.56)	(42.80)
% Foreclosure (if 90+Dpd)	27.25	19.78	31.73
	(33.81)	(26.20)	(39.88)
% Foreclosure (if 120+Dpd)	28.15	20.63	32.65
	(33.25)	(25.54)	(39.25)
C. 2015			
Credit Score	722	723	722
	(66)	(65)	(67)
Income	50,898	51,197	50,542
.	(18,967)	(20,722)	(16,640)
% FHA	2.84	1.66	4.23
	(12.38)	(8.98)	(15.35)
% Foreclosure (if 60+Dpd)	20.18	30.00	0.55
	(19.72)	(14.14)	(-)
% Foreclosure (if 90+Dpd)	22.36	33.08	0.92
	(22.71)	(18.49)	(-)
% Foreclosure (if 120+Dpd)	22.43	33.08	1.15
	(22.60)	(18.49)	(-)