The Rise of Non-Banks in Servicing Household Debt*

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Abstract

Servicing rights have become increasingly separated from the financing and origination of loans and are traded after being assigned to the initial servicers. Using a near universe of consumer credit records, we document novel facts about the allocation of mortgage servicing rights (MSRs) and identify the effect of MSR capital regulation on their allocation to servicers. We show that banks are more likely to allocate MSRs to non-banks following increased regulatory cost of holding MSRs, with more transfers of MSRs on subprime and delinquent loans. Our model rationalizes these findings and demonstrates how servicing rights traded in a private market can be allocated to servicers facing agency conflicts, causing welfare losses to borrowers and investors. Our empirical findings support this theoretical argument: loans impacted by the regulatory change have higher foreclosure rates, driven in part by re-allocation to non-banks who foreclose more aggressively than optimal for either borrowers or investors. The results suggest that Basel III's MSR rules decreased social welfare by re-allocating MSRs to conflicted servicers, with the largest negative effects on subprime borrowers.

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As the financial services industry has grown increasingly fragmented (Hanson et al., 2015; Egan et al., 2022), debt servicing has steadily become separated from funding and ownership. When loans are securitized, the right to service a loan, meaning collecting payments and dealing with financial distress, is stripped from ownership of the loan and traded as a standalone asset. In the residential mortgage context, these assets are called mortgage servicing rights (MSRs). MSRs can be *assigned* by an originator to a third party, or can be *transferred* across servicers later on during the life of a loan. While the fragmentation of mortgage ownership via securitization has been thoroughly explored,[1] little is known about the sale and retention of mortgage servicing rights.

Servicing can significantly impact borrowers and investors, since servicers have discretion in providing liquidity to borrowers in default (Cherry et al., 2021, 2022; Padi et al., 2023; Kim et al., 2022) and can impact realized returns to mortgage investors (Aiello, 2022). However, most servicers have conflicted incentives due to the structure of servicing contracts. Mortgage servicers must make payment advances on behalf of borrowers in default until a foreclosure occurs. Therefore, liquidity constrained servicers may foreclose when borrowers and investors would both prefer to delay or modify the loan (Aiello, 2022). Thus how MSRs are allocated across servicers can have profound impacts on the welfare of mortgage borrowers and investors.

Using a near-universe of credit bureau data, we document novel descriptive statistics about MSR holdings during the 2011-2015 time frame. First, MSRs are increasingly held by non-banks, which were excluded from post-crisis regulatory changes and were more liquidity constrained than deposit-taking banks. Second, most servicing rights were retained by or assigned to banks at origination before 2013, but banks are retaining fewer MSRs from their own originations and are assigned fewer MSRs by non-banks. Third, a spike in MSR transfers from banks to non-banks occurred when Basel III implemented regulations that made it more costly for banks to hold MSRs between 2012Q2 and 2013Q2. MSRs of more than three million loans were transferred in 2013Q2 alone, seven times the number of transfers in 2013Q1. Fourth, non-banks are taking a larger share of subprime mortgage servicing while banks are taking a smaller share. Fifth, loans serviced by non-banks face higher defaults and foreclosures than loans serviced by banks.

Based on these facts, we introduce a stylized model of servicer behavior in which the purchase of MSRs is endogenously determined. Both bank and non-bank servicers face agency conflicts, however they each have different discount rates driven by differences in their funding sources. In the final stage of game, servicers choose whether to be lenient

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

or strict in their foreclosure policy based on their expected private return. By backwards induction, banks and non-banks choose how many MSRs to hold. Banks are subject to a regulatory cost of carrying MSR assets. MSRs are priced to clear the market. Depending on how high the regulatory costs are for banks to hold MSRs, different allocations of MSRs and equilibrium foreclosure rates result.

Taking this to the data, we focus on the regulatory change between 2012Q2-2013Q2, when the Federal Reserve gradually adopted Basel III's stricter MSR regulations. The rule increased the capital required for banks to hold MSR assets on securitized loans, but did not affect non-banks. To identify the causal effect of this rule change, we use a difference-in-differences (DiD) design to examine whether banks are more likely to assign or transfer MSRs than non-banks after the regulatory change. We find that the final adoption of Basel III in 2013Q2 increased banks' likelihood of transferring 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.

In addition to a spike in transfers associated with Basel III, the rise of non-banks in mortgage servicing could be driven by shifts in the steady state probability of MSR assignment at origination or originations themselves around the implementation of Basel. We document that Basel III increased banks' likelihood of assigning MSRs to a third party at origination by .5% relative to non-banks. This increase in bank initial assignment of MSRs coincides with banks decreasing their originations, consistent with banks shedding their exposure to mortgage servicing rights at the assignment stage.

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. To categorize which of these two potential outcomes occurred, we 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. By adding fixed effects, we document that the increased likelihood of non-bank servicing is consistent with non-banks receiving MSRs from bank assignment or transfer rather than

from non-banks increasing originations or changing servicer composition over time.

We then study which loan characteristics were associated with transfer. Banks selectively transferred MSRs for below median income, subprime, and 60+ day delinquent loans to non-banks following Basel III. Following the policy change, non-banks increased their cumulative likelihood of servicing loans for subprime borrowers relative to prime borrowers, absorbing a majority of loans transferred away from banks. The re-allocation of MSRs after Basel III disproportionately impacted high risk loans held by disadvantaged borrowers, with lower credit scores and lower incomes.

In light of these results, we evaluate the welfare effects of MSRs being re-allocated to non-banks. Borrower welfare could increase if foreclosure rates decrease. There could also be distributional consequences to borrowers if high risk borrowers experience larger changes in foreclosure rates than low risk borrowers. Empirically, we first document aggregate statistics about loan performance post-regulation. In particular, the foreclosure rate of the portfolio 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. The timing of the diverging loan performance between the two groups coincides with the increased MSR transfers by banks.

To formally show that the diverging foreclosure rates were indeed driven by loans whose MSRs were transferred in response to Basel III, we estimate 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. Thus "serviced by bank in 2011Q1" is a proxy for re-allocation to non-banks and we capture the average effect on the entire portfolio of mortgages that bank servicers held prior to the shock. Given that the shock is during 2012Q2-2013Q2, this specification estimates the average change in foreclosure status following the shock, relative to prior to the shock, for the portfolio of loans held by banks versus those held by 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 of the 2011 bank-serviced portfolio of loans increased significantly relative to the 2011 non-bank-serviced portfolio of loans. The effect on foreclosure rates is heterogeneous for subprime and prime borrowers. MSR regulation worsened loan performance and financial distress disproportionately for subprime borrowers. Based on our model, this suggests that borrowers experienced welfare loss due to the Basel III MSR rules, and that the welfare losses were highest for subprime borrowers.

Finally, we investigate the effect of MSR allocation on investor welfare. Investors prefer foreclosure rates to be higher than zero, but their optimum depends on foreclosed asset value rather than on servicers' cost of funds. This agency conflict can mean that the servicer's privately optimal foreclosure rate is lower or higher than the investors' optimum.

Using our data, we sign the welfare effect on investors by finding a subsample of data that appears to have minimal conflicts of interest between investors and servicers - namely, portfolio loans. Portfolio loans are typically originated, financed, and serviced in-house by banks and are not sold to satisfy risk retention requirements. By comparing foreclosure rates on unconflicted portfolio loans to foreclosure rates by conflicted bank and non-bank servicers, we can estimate whether Basel III moved the allocation of servicing rights towards or farther away from the unconflicted optimum. We show that non-bank third party servicers have much higher foreclosure rates than both portfolio loans and bank-serviced loans, suggesting that re-allocating MSRs to non-banks results in welfare losses to investors.

Overall, our findings have several implications for the function and regulation of the servicing market. First, we establish that the allocation of mortgage servicing rights to banks and non-banks has important welfare implications. Second, we demonstrate that prudential regulation that is intended to decrease the fragility of the financial system can instead give incentives for MSR assets to be allocated to non-banks outside the oversight of bank regulators, potentially increasing systemic risk. Third, we show that transfers of MSRs to non-banks worsen borrower welfare, with a larger negative impact on subprime borrowers. 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. Fourth, 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. Fifth, and finally, we provide suggestive evidence that the Basel III MSR rule, as well as other rules that re-allocate MSRs to non-banks, causes welfare loss to investors, as well as borrowers. Investors would prefer less aggressive foreclosure policies that maximize recovery of asset value, rather than minimizing the cost of payment advances that servicers incur. A social planner putting weight on both investor and borrower welfare should ensure that foreclosure rates stay weakly below the investors' optimum, and regulation that pushes foreclosures above that level is Pareto-dominated. Our results suggest that policymakers have to trade off the efficacy of macroprudential regulation with the welfare of stakeholders in the market

for assets like MSRs.

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

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

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 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 pass-through 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. Using these results and some analysis of foreclosure rate by servicer type, we provide suggestive evidence of the welfare effects of MSR allocations on investor and borrower welfare.

[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

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 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.

Institutions can become the servicer of a loan in three ways: (1) originate the loan and never transfer the mortgage servicing right, (2) receive the mortgage servicing right immediately after the mortgage originated via what is called third-party assignment of the servicing rights from the originator to the servicer, (3) receive the mortgage servicing rights during the life of the loan via what we will call servicing right transfers. We will study both initial assignment of mortgage servicing rights and mortgage servicing right transfers in this paper.

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:

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

[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. Moreover, the term debt collector typically refers to a secondary buyer of unsecured debt, while a servicer specializes in repossession of collateral.

[5] See Jiang et al. (2023) for information about servicing fees.

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:

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

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 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

[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

a full timeline of the policy change in Appendix A.

2 Data and Servicer Classification

2.1 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 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) ratios for each bank in the publicly available Y9C data in 2011. We then merge this with the 1% sample of our credit registration data. We report summary statistics for this merged sample in Table 1. It is very similar to both the 1% and full samples.

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

[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.

3 Stylized Facts

3.1 Mortgage Servicing Market Share by Institution Type

Fact 1: The share of outstanding mortgage loans serviced by non-banks has been rising over time.

Figure 1 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% of GSE loans (Panel b) and about 40% of 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 to account for half the market in 2019.

This rise in non-bank servicing could be driven in part both by non-banks receiving a larger share of initial assignments of servicing rights at the time of mortgage origination, by originating more mortgages and maintaining the service rights, and by non-banks receiving transfers of mortgage servicing rights during the life of the loan.

3.2 Third-Party Assignment of Servicing Rights

Fact 2: Before 2013, most mortgage servicing rights were assigned to traditional banks at origination.

The servicing rights of the majority of non-bank originated loans were assigned to traditional banks, while the servicing rights of bank originated loans were almost completely kept by the originating banks or assigned to other banks.

Fact 3: Starting in 2013, the number of servicing rights assigned to traditional banks at origination declined significantly. Most loans originated by non-banks were either retained by the originating non-banks or assigned to other non-banks.

In Figure 2 we show that initial assignments to banks fall dramatically from 2011 to 2015.[10] This is driven both by loans that banks originate and never transfer falling and by initial assignments to other banks falling. Panel (a) shows that bank non-transferred loans fall from about 60% of loans in 2011Q1 to about 30% of loans in 2015Q4. Concurrently, initial assignments from banks to banks also fell from about 20% of loans in 2011Q1 to

[10] We are only able to analyze initial assignments for the subset of loans for which we can track both the originator and servicers. Thus our results understate total initial assignments.

about 10% of loans in 2015Q4 and loans originated by banks and transferred to non-banks remained flat and close to 0% of loans.

Conversely, initial assignments from non-banks to other non-banks increased dramatically from almost 0% of loans in 2011Q1 to over 20% in 2015Q4 and non-bank originated and non-transferred loans increased from less than 10% to almost 30% over this time period.

3.3 Servicing Right Transfers

Fact 4: Before 2012Q2, mortgage servicing rights were barely transferred in the secondary market, and there were no dominant sellers or buyers in terms of institutional types.

Fact 5: The MSR transfer volume started to rise in 2012Q2, spiked in 2013Q2, and remained at an elevated level thereafter. Traditional banks became the dominant sellers, while non-banks became the dominant buyers in the secondary market of MSRs.

Basel III's MSR rule, described in 1.2, should change banks' incentives to hold MSRs. The regulation both limited the amount of MSRs that could be included in tier 1 equity and increased the risk weighting of MSRs. Figure 3 documents a large spike in transfers of mortgage servicing rights around 2013Q2. The figure plots 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-banks to non-banks, 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, beginning in 2012Q2 and followed by a spike in 2013Q2, coincides with the Federal Reserve's gradual adoption of the Basel III regulations. The Federal Reserve proposed to adopt Basel III's MSR treatment in 2012Q2 and finally adopted it in 2013Q2.

Consistent with the spike being driven by bank regulation, about 82% of the transfers were from banks to non-banks. This large market shift likely had spillover effects on other MSR sales, which is supported by the slight increase in transfers from non-banks to non-

banks, non-banks to banks, and from banks to other banks at this time.

3.4 Composition of Loans Serviced by Banks vs Non-Banks

Fact 6: Non-banks service more delinquent loans, and loans of low-income borrowers or borrowers with lower credit score.

Fact 7: Non-banks have been servicing an increasing share of all subprime mortgage loans from 2011 to 2015. By the end of 2015 they serviced close to 50% of all subprime loans.

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 mirror those in the origination market.

The majority of our analysis is done on a 1% random sample of the full data set, which has similar composition as reported in Panel B of Table 1. Figure 4 plots average loan characteristics for bank versus non-bank serviced mortgage loans. Panel (a) plots the share of total outstanding subprime loans that were serviced by banks versus non-banks and finds that non-banks serviced an increasing share of the outstanding subprime mortgages. As of 2015Q4, non-banks serviced almost 50% of all subprime mortgages.

In Figure 4 panel (b), we see that 60-90-120 day delinquencies for banks were decreasing since 2011. The high number of delinquencies in 2011Q1 may in part be driven by the Financial Crisis of 2008. However, the decline in bank delinquencies is likely also driven in part by banks transferring riskier mortgage loans to non-banks during 2012Q2 to 2013Q2. Consistent with this hypothesis, non-bank delinquencies were relatively low and stable in 2011 and early 2012. Following 2012Q2, non-bank delinquencies began to increase while bank delinquencies continued to fall. By 2015Q4, non-banks' number of 60-90-120 day delinquent loans almost surpassed the number serviced by banks.

3.5 Foreclosure Rate by Servicer Type

Fact 8: Foreclosure rates are higher for non-bank servicers relative to bank servicers.

Fact 9: Foreclosure rates begin increasing in 2012Q2 and spike up following 2013Q2 for

non-banks relative to banks.

In Table 1, the average foreclosure rate for non-banks is 0.07% while it is only 0.001% for banks in our sample from 2011 to 2015. Figure 5 panel (c) plots the number of foreclosure sales by banks versus non-banks from 2011 to 2015. Though the number of non-bank foreclosure sales remained above the number for banks, the two series moved in parallel from 2011 to 2012Q2. In 2012Q2 the number of non-bank foreclosure sales began increasing relative to banks, peaking in 2014, while the number of bank foreclosure sales remained flat and close to zero over this time period.

4 Model: Market Allocation of MSRs

Mortgage servicers have incentives that are misaligned with investors and borrowers due to the tradeoff between making payment advances on behalf of borrowers to preserve the possibility of receiving future servicing fee payments versus foreclosing to limit liquidity needs. In anticipation of this tradeoff, servicers optimize their MSR holdings conditional on the market price for these assets. Given heterogeneity in servicer type, for instance across banks and non-banks, some asset allocations may result in foreclosure behavior that is better aligned with investors or borrowers. We set up a stylized model to help identify what we can learn about optimal asset allocation from the observables in our empirical analysis.

Consider a three stage game. At time 0, the mortgage servicing rights of type l are priced at η_l. At time 1, servicers choose how many MSRs to hold of each type. Bank servicers must abide by capital requirements and a budget constraint, while non-bank servicers must satisfy only the latter. At time 2, servicers choose a foreclosure rule that maximizes their expected profit from each loan type.

4.1 Equilibrium

We solve for equilibrium foreclosure, profits, MSR holdings, and prices by backwards induction.

Time 2

Servicer of type s. Given MSR holdings of type l denoted as m_l, servicer chooses foreclosure rule f_{sl} to maximize expected profit on each loan type l

$$\Pi_{sl}(m) = (1 - d_l)\lambda m + (1 - f_{sl})[p_l(\delta_s \lambda m - C(m)(1 - \delta_s)) - (d_l - p_l)C(m)] \tag{3}$$

where d is the default rate, $C(m)$ is one period of advances and $\frac{C(m)}{1-\delta_s}$ is the NPV of advances. λ is the NPV of servicing fee. Default is recoverable with expected probability p_l but with probability q_l the default cannot be cured. By definition, default rate $d_l = p_l + q_l$. Servicers must pay one period of advances and delay recovery of the NPV of servicing fee by one period at the cost of $1 - \delta_s$ in order to salvage a recoverable default. Higher δ_s means that the servicer is more patient, for instance if the cost of funds is cheaper for the servicer. Return to the servicer from a foreclosed, defaulted loan is normalized to 0.

Foreclosure is optimal if $p_l(\delta_s \lambda m - C(m)(1 - \delta_s)) - (d_l - p_l)C(m) < 0$. Assuming that p_l is distributed uniformly in $[0, d_l]$, the probability that foreclosure will be profitable is the probability that

$$f_{sl} = \begin{cases} 1 & \text{if } p_l < \frac{d_l C(m)}{\delta_s(\lambda m + C(m))} \\ 0 & \text{if } p_l \geq \frac{d_l C(m)}{\delta_s(\lambda m + C(m))} \end{cases}. \tag{4}$$

Given the optimal foreclosure rule, the expected profit in equilibrium given the PDF of p_l is

$$E[\Pi_{sl}(m)] = (1 - d_l)\lambda m + \int_{\frac{d_l C(m)}{\delta_s(\lambda m + C(m))}}^{d_l} [p_l(\delta_s \lambda m - C(m)(1 - \delta_s)) - (d_l - p_l)C(m)] \frac{1}{d_l} dp_l. \tag{5}$$

Simplifying, we can write the return for servicer s from servicing loan type l as

$$E[\Pi_{sl}(m)] = (1 - d_l)\lambda m - d_l C(m) + \frac{\delta_s d_l(\lambda m + C(m))}{2} + \frac{C(m)^2}{\delta_s(\lambda m + C(m))} \tag{6}$$

The observed foreclosure rate associated with this will be $\frac{C(m)}{\delta_s(\lambda m + C(m))}$. Note that the foreclosure rate is monotonically decreasing as δ_s increases, following the intuition that more patient servicers can absorb more losses in return for higher future servicing fees. Profit is non-monotonic in δ_s, meaning that more patient servicers may be more or less profitable than less patient servicers.

Time 1

Bank and non-bank servicers choose how many MSRs to hold, given their expectations of future profit in Time 2. Banks are constrained by capital requirements, and both are constrained by budgets. The bank problem is:

$$\max_{m_l} \sum_l E[\Pi_{bank,l}(m_l)] - \eta_l m_l \tag{7}$$

$$\text{s.t.} \quad \sum_l \eta_l m_l < B \tag{8}$$

$$\frac{\sum_l m_l}{\xi} < \bar{m} \tag{9}$$

The non-bank problem is:

$$\max_{m_l} \sum_l E[\Pi_{nonbank,l}(m_l)] - \eta_l m_l \tag{10}$$

$$\text{s.t.} \quad \sum_l \eta_l m_l < B \tag{11}$$

To simplify calculations, we assume that the cost of making advances $C(m) = Cm$, meaning that it scales linearly with MSR holdings. We can then see that the servicers' profit varies linearly with MSR holdings, resulting in corner solutions. Banks will buy as many MSRs of type l as they can if the marginal revenue is higher than the marginal cost, with the optimal rule being:

$$m_{l,bank} = \begin{cases} \frac{B}{\eta_l} & \text{if } (1-d_l)\lambda - d_l C + \frac{\delta_{bank} d_l (\lambda + C)}{2} + \frac{C^2}{\delta_{bank}(\lambda + C)} > \eta_l + \frac{\gamma}{\xi} \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

$$m_{l,nonbank} = \begin{cases} \frac{B}{\eta_l} & \text{if } (1-d_l)\lambda - d_l C + \frac{\delta_{nonbank} d_l (\lambda + C)}{2} + \frac{C^2}{\delta_{nonbank}(\lambda + C)} > \eta_l \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

For ease of reference, we can label $E\Pi'_{sl} \equiv (1-d_l)\lambda - d_l C + \frac{\delta_s d_l (\lambda + C)}{2} + \frac{C^2}{\delta_s (\lambda + C)}$ to refer to marginal profit.

Time 0

The first stage requires setting a price η_l for each loan type. The price should be set to sell the full supply for MSRs to the highest bidder, whether bank or non-bank. Assuming that demand outstrips supply for MSRs, we can see that the equilibrium price is

$$\eta_l = \max\left\{E\Pi'_{bank,l} - \frac{\gamma}{\xi}, E\Pi'_{nonbank,l}\right\} \tag{14}$$

To interpret the implication of this price setting condition, non-banks will purchase all MSRs if their unconstrained marginal profit is higher than the constrained marginal profit of banks. Conversely, banks will purchase all MSRs if their constrained marginal profit is higher than the unconstrained non-bank marginal profit.

4.2 Pre-Treatment Equilibrium

Prior to the introduction of Basel III, we noticed four stylized facts. First, the majority of MSRs were held by banks. Second, few MSRs were transferred after origination. Third, non-banks specialized in high risk loans, including delinquent and subprime loans. Finally, non-banks had higher baseline foreclosure rates.

These facts are consistent with the model in a case where banks' marginal profit from holding MSRs are significantly higher than those for non-banks, even accounting for the regulatory cost that banks face but non-banks do not.

PROPOSITION 1. ***Assignment:*** *If bank servicers hold all MSRs of a particular loan type,* $E\Pi'_{bank,l} - \frac{\gamma}{\xi} > E\Pi'_{nonbank,l}$. *Conversely, if non-bank servicers hold all MSRs of a particular loan type,* $E\Pi'_{bank,l} - \frac{\gamma}{\xi} < E\Pi'_{nonbank,l}$.

Assignment as observed in the data is proxied by MSR holdings m in the model. If banks are holding non-zero MSRs of type l, the marginal benefit to them of holding MSRs less the marginal cost of regulation, must be high enough that their willingness to pay for MSRs is higher than that of non-banks for the same MSRs. The converse is true if non-banks hold MSRs.

Looking across loan types, the model and stylized facts together suggest that bank servicers receive higher marginal profit from a majority of loans, but non-banks receive higher marginal profits from servicing certain high risk loans. In the absence of regulatory contraints on banks, however, it is possible that non-banks would not be servicing even subprime or

delinquent loans.

The model is agnostic as to whether the allocation of MSRs in the pre-treatment period is efficient. That is, it could be that either an optimal, over-optimal, or under-optimal fraction of MSRs are held by servicers of any type. Instead, we try to make inferences about efficiency by comparing foreclosure rates before and after treatment.

The fact that non-banks have higher foreclosure rates prior to treatment suggests that they have lower δ_s than banks, meaning that they are less patient. This is consistent with banks having access to internal capital markets and easier sources of liquidity to cover servicing shortfalls when borrowers default. We then confirm this below by comparing foreclosure rates in the pre-treatment period to the post-treatment period.

4.3 Effect of Regulation

We observe equilibrium before and after the introduction of Basel III. We model the Basel III regulation as lowering ξ, tightening the capital constraint. Moreover, we can observe some cross-sectional heterogeneity in how binding the capital constraint will be across banks. The model gives some stylized predictions that will help us interpret the empirical findings.

PROPOSITION 2. ***Transfer:*** *If a decrease from ξ_1 to ξ_2 results in banks selling MSRs to non-banks, $E\Pi'_{bank,l} - \frac{\gamma}{\xi_1} > E\Pi'_{nonbank,l} > E\Pi'_{bank,l} - \frac{\gamma}{\xi_2}$. Similarly, if there is cross sectional variation in how binding capital requirements are across banks of type A and B, and type A banks hold a majority of MSRs before the tightening of the constraint while type B holds them after, $E\Pi'_{bankA,l} - \frac{\gamma}{\xi_{1A}} > E\Pi'_{bankB,l} - \frac{\gamma}{\xi_{1B}}$ while $E\Pi'_{bankA,l} - \frac{\gamma}{\xi_{2A}} < E\Pi'_{bankB,l} - \frac{\gamma}{\xi_{2B}}$*

Transfers in the stylized model are proxied as a difference between equilibrium holdings before and after a shifter such as Basel III. Banks must have had a high enough willingness to pay pre-Basel III to obtain MSRs, but the shift in capital regulation lowered their willingness to pay below that of non-banks. Market price was therefore set at non-banks' willingness to pay and they obtain all MSRs of that loan type. A similar phenomenon would occur within bank holdings of MSRs if there is heterogeneity in how binding capital constraints are.

PROPOSITION 3. ***Selective Transfer:*** *If a decrease from ξ_1 to ξ_2 results in banks selling loan type 1 MSRs to non-banks and not loan type 2, $E\Pi'_{bank,2} - E\Pi'_{nonbank,2} > E\Pi'_{bank,1} - E\Pi'_{nonbank,1}$. Intuitively, capital regulations give banks incentives to transfer assets from which they obtain the least profit advantage.*

Differential transfer by loan type follows directly from the previous proposition. To be precise, $E\Pi'_{bank,1} - \frac{\gamma}{\xi_1} > E\Pi'_{nonbank,1} > E\Pi'_{bank,1} - \frac{\gamma}{\xi_2}$ and $E\Pi'_{bank,2} - \frac{\gamma}{\xi_1} > E\Pi'_{bank,2} - \frac{\gamma}{\xi_2} >$

$E\Pi'_{nonbank,2}$ must both hold in order for banks to selectively transfer type 1 loans. Note that without this inequality holding, transfer may be homogeneous across types or not occur at all.

PROPOSITION 4. ***Foreclosure Rate:*** *If a decrease from ξ_1 to ξ_2 results in higher observed foreclosure rates, $\delta_s^2 < \delta_s^1$ meaning that the MSR holder after the regulatory change must be less patient than the prior MSR holder.*

In our simplified model above, observed foreclosure rates change only when MSRs change hands from a servicer with one δ_s to another.[11] Therefore, higher foreclosure rates after a regulatory change suggest that the market for MSRs shifted from more patient to less patient servicers. This shift is consistent with banks holding fewer MSRs and non-banks holding more MSRs, since banks have cheap access to internal capital while highly levered non-banks must borrow for liquidity.

Note that these propositions rely on an important simplification - it assumes that all non-banks and all banks are comparable. In reality, banks and non-banks are drawn from distributions of δ_s and face different levels of ξ depending on how close to the capital requirement their business model takes them. Outlier banks may act like non-banks, and vice versa. The propositions above still hold in expectation across the distribution of banks and non-banks, even if not all banks and non-banks have symmetric responses.

5 Casual Effect of Regulation on MSR Allocation

Proposition 1 rationalizes the stylized facts about the pre-Basel III allocation of MSRs. Most MSRs were assigned to traditional banks at origination, suggesting that banks derived more value from holding MSRs than non-banks before stricter bank capital regulation on holding MSRs was implimented. As Proposition 2 of the model suggests, MSR assets will be reallocated from banks to non-banks if the capital regulation lowers banks' willingness to pay below that of non-banks. In this section, we assess the causal effect of the Basel III MSR rule on the allocation of MSR assets.

[11] More complex functional forms for the cost of making advances $C(m)$ have more complex predictions.

5.1 MSR Regulation and Incentive to Transfer

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

$$Transfer_{i,j,t} = \beta_1 Middle_t \times Bank_{i,j,t-1} + \beta_2 Post_t \times Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}. \quad (15)$$

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 estimate less saturated specifications without loan fixed effects. In those, we include initial servicer fixed effects (ν_j) and zip code fixed effects (z_i).

Table 2 presents the results. Column 4 corresponds to Equation 15, which has loan and quarter fixed effects, while columns 1-3 estimate less saturated specifications with servicer, zip code, and quarter fixed effects. 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, relative to the pre-period, MSR sales increased 1.0% more for banks than they did for shadow 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, allow us to report the time-series evolution of overall transfer likelihood using the "Middle" and "Post" coefficients. They also show the baseline difference in the likelihoods of transfer between banks and non-banks before controlling for loan fixed effects. On average, banks were 0.6% more likely to sell MSRs in the interim period (i.e., 2012Q2-2013Q2) and 1.2% more likely to sell MSRs during the post-2013Q2 period, without controlling for loan fixed effects. 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 relative to 2012Q2 in Figure 7. The figure plots the estimated coefficients in a dynamic version of Specification 15. 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

the 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.

5.2 Robustness: Is It About MSR Regulation?

As Section 1.2 discussed, Basel III MSR regulation changes the treatment of MSRs in the calculation of banks' tier 1 capital ratio. This moves many banks closer to violating their capital requirement. Banks with higher pre-shock MSR-to-CET1 ratio are more exposed to the policy change. Facing a higher cost from the constraint tightening, such banks are more likely to sell MSRs, according to Proposition 2.

We estimate a treatment intensity research design that compares MSR sales for high MSR-to-CET1 banks relative to those for low MSR-to-CET1 banks:[12]

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \mathbb{1}_k \left(\frac{MSR}{CET1} \right)_{i,j,2011} + \mu_i + \theta_t + \epsilon_{i,j,t}, \tag{16}$$

where i denotes loan, j denotes the servicer of loan i in $t-1$, and 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 coefficient of interest, which captures the effect of the treatment intensity on MSR transfers.

Figure 8 plots the estimated β_k in Equation 16. The results indicate that banks with higher MSR-to-CET1 ratios increase their transfers of mortgage servicing rights by more than banks with lower MSR-to-CET1 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. Column 5 of Table 2 estimates the magnitude of the time-series average 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.

[12] 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.

5.3 Rise of Non-Bank Servicing

Banks selling MSRs could potentially lead to a reshuffling of mortgage servicing within the banking sector or a rise of non-bank servicing.[13] Like Proposition 2 of the model suggests, more exposed banks would choose to sell to non-banks if non-banks' willingness to pay exceeds that of other banks and otherwise they would sell to other banks. We next examine whether the MSRs sold by more exposed banks were transferred to non-banks by estimating the following specification using loan-level data:

$$NonBank_{i,j,t} = \beta_1 Middle_t + \beta_2 Post_t + \mu_i + \epsilon_{i,j,t}. \tag{17}$$

where $NonBank_{i,j,t}$ is an indicator for whether a non-bank is the current servicer in quarter t of loan i. $Middle_t$ and $Post_t$ are defined the same as in Specification 15. 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).

Table 3 presents the results. Column 3 corresponds to Specification 17, 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.[14] The inclusion of loan fixed effects absorbs the effect of MSR regulation on loan origination. Since we look at changes of transfer status within loan, it removes differential loan fixed effects resulting from origination. 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 9 shows the evolution of MSR transfers to non-banks over time. It plots the estimated coefficients in a dynamic version of Equation 17. Prior to the initial proposal of Basel III, there was no pre-trend in non-bank servicing, alleviating the concern that the

[13] For example, a report to Congress finds that more banks entered the servicing market after the MSR regulation: Report to the Congress on the Effect of Capital Rules on Mortgage Servicing Assets.

[14] 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.

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.

5.4 Other Possible Margins: Initial Assignment and Origination

Finally, we discuss two other possible margins of adjustment, which may contribute to the rise of non-banks, following the increased MSR capital regulation. First, banks may assign mortgage servicing rights to a third party at origination, which we call initial *assignment*. As banks' regulatory cost of holding MSRs increases, banks will assign the MSRs of their originated mortgages to non-banks when the value that banks derive from keeping the MSRs, net of the regulatory cost, declines to below the value of the MSRs for non-banks. Second, banks may choose to originate fewer mortgages if the combined value that they derive from both mortgage origination and servicing rights declines enough to impact their decision to originate mortgages.[15]

Initial Assignment We estimate a loan-level DiD specification and present the dynamic evolution of bank versus non-bank differences in initial assignments of MSRs relative to 2012Q2 in Figure 6. The final adoption of Basel III in 2013Q2 increases banks' likelihood of assigning MSRs to a third party different from themselves by 0.5% relative to that of non-banks. Banks' higher likelihood of MSR assignments persisted until the end of 2015. Importantly, prior to the initial proposal of the Basel III adoption, bank MSR assignments were not statistically more likely than those for non-banks. The lack of pre-trend alleviates the concern that different unobservable loan characteristics might drive different bank versus non-bank assignment likelihoods.

Origination We estimate a bank-level DiD specification and present the dynamic evolution of bank origination relative to non-bank origination in Figure D4. We find that bank origination drops relative to that of non-banks following the policy change. Relative to non-banks, banks are on average 5% less likely to originate mortgages post Basel III. Thus banks are both originating fewer mortgages after Basel III and simultaneously increasing the probability of transferring the mortgages that they do originate to a third party.

[15] This origination margin has been examined in Buchak et al. (2018b).

6 Changing Composition of MSRs Allocated to Banks and Non-Banks

Banks and non-banks need not have the same expected profit from servicing high risk loans as they do servicing low risk loans. As our model indicates, the difference between banks and non-banks in their costs of advancing payments and providing modification (δ) determines their relative advantages in servicing a mortgage. Patient servicers with higher δ find it less costly to make advance payments. These servicers are closer to indifferent between servicing a high risk and a low risk loan, since they can wait for loans to recover from defaults. In contrast, servicers with lower δ can cut costs on high risk loans by foreclosing more quickly and providing less liquidity to borrowers. This gives them a marginal profit benefit from holding risky loans that they do not receive from holding safer loans. Thus, the market allocation of MSRs may differ based on the default risk levels of underlying mortgages. To study this in the data, we examine heterogeneity in MSR transfers as guided by Proposition 3.

6.1 Selective Transfer of MSRs

Proposition 3 of our model predicts that banks sell more high-risk MSRs as the regulatory cost of holding MSRs increases if, relative to non-banks, banks' advantage in servicing these loans is smaller than their relative advantage servicing low-risk loans. Put differently, the Basel III rule change equally affected all loan types. Thus if banks' advantage in servicing high-risk loans, relative to non-banks, was lower than it was for servicing low-risk loans, then it would be easier for non-banks' profits on high-risk loans to surpass bank's profit after Basel III increased regulatory costs on MSRs. To empirically examine this proposition, we focus on two measures of default risk: credit score and realized delinquency status. We estimate the following dynamic DiD specification separately on subgroups by credit score and delinquency status, respectively:[16]

$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_{i,j,t-1} + \mu_i + \epsilon_{i,j,t}, \qquad (18)$$

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. $\mathbb{1}_k$ is an indicator for the quarter. μ_i are loan fixed

[16] The method is similar to that used in Curtis, Garrett, Ohrn, Roberts, and Serrato (2021).

effects. We cluster standard errors at the zip code level, to allow for neighborhood spatial correlation.

Figure 10 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. The differences between subgroups in each category shown in the figure are equivalent to the triple difference coefficient. Columns 1 and 2 of Table 4 report 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.

Panel (a) of Figure 10 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 loans held by prime borrowers during 2013-2015 (Table 4 column 1).

Panel (b) of Figure 10 shows banks' likelihood of MSR transfers relative to non-banks' for loans by delinquency status in the current quarter. The figure 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 and 120+ days delinquent at the time of the transfer relative to loans that were current. Since loans that are 120+ days delinquent may be foreclosed on, these results are consistent with our model's result that non-banks may have cost efficiencies in foreclosure, relative to banks. 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 60-90-120 days delinquent loans increased by 2.5% more than that of non-delinquent loans after the rule change (Table 4 column 2).

6.2 Non-Bank MSR Holding by Loan Type

Finally, we examine whether non-banks are buying the MSRs that banks are selectively selling by analyzing non-banks' cumulative likelihood of holding the riskier MSRs. Specifically, we examine non-bank dynamic MSR holdings by credit score and realized delinquency

status:

$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \ \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}, \tag{19}$$

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 11 plots the estimated coefficients for each regression specification in each subgroup. Table 4 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.

Panel (a) of Figure 11 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 non-banks' holdings of subprime MSRs by 2% more than their MSRs holdings of prime loans during 2013-2015 (Table 4 column 3).

Panel (b) of Figure 11 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 day delinquent loans relative to current loans. The final adoption of Basel III in 2013Q2 increases non-banks' holdings of delinquent MSRs by 2.3% more than their holdings of non-delinquent MSRs during 2013-2015 (Table 4 column 4).

The relative increase in non-banks' likelihood of servicing subprime loans and defaulted loans co-moves with banks selling the MSRs associated with these characteristics to non-banks. Combining the results of the DiD in Figure 10 with the results of the event study in Figure 11 provides compelling evidence that non-banks were purchasing the riskier MSRs that banks sold following Basel III.

7 Welfare Implications

An important welfare consideration in this setting is the potential misalignment in incentives between servicers, investors, and borrowers. In this section, we develop our model to characterize the welfare effects of different MSR allocations on borrowers and investors. To do so, we specify the foreclosure rates that are optimal for borrowers and investors, and compare them to the servicer optimum. Then, we take the model to the data to estimate the welfare

effects on borrowers and investors of moving from pre- to post-regulation allocations of MSR assets. We conclude with a discussion and policy implications.

7.1 Borrower's Welfare

In expectation between states of the world in which default is recoverable or non-recoverable, a borrower j receives:

$$\Pi_j = f_s d(-L_j) + (1 - f_s)pA_{nf} + (1 - f_s)q\delta(-L_j) + (1 - d)A_{nf}. \tag{20}$$

Where the borrower must pay foreclosure cost L_j in either this period or the next if default cannot be recovered. If foreclosure is avoided, the borrower may recover with probability p. With probability q the foreclosure is simply delayed.

The borrower's optimal foreclosure can be easily calculated by inspection - as long as foreclosure cost L_j is positive, foreclosure is never optimal for the borrower. This matches the intuition that borrower optimal foreclosure rates are 0 because borrowers do not internalize the externalities of the losses that their default causes to investors and servicers. Therefore, regulatory changes that lower foreclosure rates unequivocally increase borrower welfare. On the other hand, regulation that increases foreclosure rates lowers borrower welfare.

We can quantify the size of welfare loss to borrowers from foreclosure as $U(L_j((1-\delta)d + p\delta) + pA_{nf})$. Without specifying the utility function of the borrower, we can observe that borrowers who face higher foreclosure cost L_j have larger welfare losses than those with lower foreclosure costs. Higher foreclosure rates for populations with high foreclosure costs, such as subprime populations, cause larger welfare loss than higher foreclosure rates for populations with low foreclosure costs (Piskorski and Seru (2021)).

Taking this to the data, we demonstrate the real impacts of Basel III on borrower welfare by testing how regulation impacts foreclosure rates. We further compare the effect of regulation on foreclosure rates for low and high risk borrowers.

We limit the data to loans originated prior to 2011 and classify loans as serviced by bank or non-bank based on their servicer type in 2011. The sample restriction removes cohort effects arising from differences in new originations 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 12 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.[17] 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 12 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.

Intent-to-Treat (ITT) Estimator

We causally estimate the effect of the regulatory change on foreclosure 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

[17] Note we plot foreclosure sales. Foreclosure sales are likely more representative of servicer incentives than the foreclosure filings. The sale of the home in foreclosure is the point at which the servicer can be made whole for payments that it advanced while the borrower was in delinquency. Furthermore the speed to foreclosure sale is likely to reflect servicer efficiency in the foreclosure process. Therefore an increase in the number of foreclosure sales observed is consistent with more mortgage servicing rights moving to servicers who are more efficient at completing foreclosure sales.

estimates the average change in all loans' foreclosure status following the shock, relative to prior to the shock, for banks versus non-banks.

$$Y_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \mathbb{1}_k Bank_{i,j,2011} + \mu_i + \theta_t + \gamma Loan\ Age_{i,t} + \epsilon_{i,j,t}. \tag{21}$$

$Y_{i,j,t}$ for loan i, serviced by servicer j in 2011, is an indicator for whether a borrower experiences a foreclosure 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 13 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 makes 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 5 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 5, and the effect is the same.

We estimate Equation 21 separately for prime and subprime credit score borrowers and Figure 14 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) 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.

As a result, we can conclude that borrowers experienced welfare loss as a result of the regulation. The total loss is higher in magnitude than it may have been because it was concentrated among subprime borrowers, who face the highest foreclosure costs (Piskorski

and Seru (2021)).

7.2 Investor Welfare

The investor receives

$$\Pi_i = f_{sl} d_l A_f + (1 - f_{sl}) p_l I + (1 - f_{sl})(d_l - p_l)\delta A_f + (1 - d_l) I \tag{22}$$

where A_f is the asset value in foreclosure and I is the NPV of interest payments. Foreclosure is postponed at discount rate δ. Therefore, the investor's optimal foreclosure rule is to foreclose if:

$$p_l < d_l \frac{A_f(1+\delta)}{I + \delta A_f}. \tag{23}$$

Comparing the servicer's foreclsoure rule in Equation 4 to the investor's, we can see that the investor will prefer to foreclose if A_f is high relative I. This is because the investor is incentivised to foreclose in part to gain the value of the asset in foreclosure. In contrast, the servicer is incentivised to foreclose to avoid making advance payments while the loan is alive but delinquent. Thus the servicer and investor have conflicting incentives. A loan that is foreclosed according to the investor's optimal should have an observed foreclosure rate of $\frac{A_f(1+\delta)}{I+\delta A_f}$, while a loan that is foreclosed by a servicer should have an observed foreclosure rate of $\frac{C}{\delta_s(\lambda+C)}$, given by Equation 4 (setting $C(m) = Cm$ and simplifying).

Even assuming that the investor's NPV of interest payments (I) is approximately 20 times the NPV of servicing fees (λ) and that the servicer and investor have the same discount rate, the servicer's and investor's rates can still diverge due to a divergence between the servicer's cost of advances and the value of the home in foreclosure (A_f), which the investor receives. That is, the servicer does not internalize the asset's value and the investor does not consider the servicer's liqudity costs. The investor's optimal foreclosure rate could be lower or higher than the servicer's optimum. Theoretically, it is uncertain whether a regulation that shifts foreclosure rates for loans would improve or worsen investor welfare.

We turn to the data to sign the effect of regulation on investor welfare. To do so, we must find a subset of data for which we can observe the foreclosure rate that an investor would optimally choose. We can then compare that foreclosure rate with the foreclosure rate on a comparable group of loans that correspond to the pre-regulation equilibrium and the post-regulation equilibrium.

In our data, we create proxies for these three groups using a limited subsample. Group 1, the investor baseline foreclosure rate, is calculated from a group of loans that are largely portfolio loans held on the books by banks. We classify loans as portfolio loans if we can observe the loan's servicer and originator, and they the same. We exclude loans which are securitized by GSEs or classified as FHA loans. Then, we limit to loans that were originated in 2010 and 2011. During this time period, private label securitization was nearly 0 (Goodman (2016)). Therefore, we can conclude that the loans have not been securitized, and have likely been originated, funded, and serviced in-house. We assume that the majority of these loans are portfolio loans. The foreclosure rate on Group 1 loans are the best approximation we have to the investor's optimum.

Group 2, the pre-regulation benchmark of loans whose servicing rights were held by banks, is measured as the foreclosure rate among comparable loans to Group 1, but serviced by banks and securitized by the GSEs. Group 2 assesses the foreclosure rate for bank servicers facing agency conflicts. Group 3, is measured as the foreclosure rate among comparable loans to Group 1, but serviced by non-banks and securitized by the GSEs. We use Group 3's foreclosure rate as a proxy for non-bank servicers with agency conflicts. This approximates the benchmark that Basel III shifts the servicing market towards, as documented in our earlier results. To ensure that the loans in Group 2 and 3 are similar to those in Group 1, we restrict to the same time frame of originations (2010-2011).

To understand the effect of the regulation on welfare, we regress foreclosure rates on an indicator for portfolio loan (Group 1), bank serviced securitized loan (Group 2), and non-bank serviced securitized loan (Group 3). We estimate the following regression:

$$Y_i = Group1_i + Group3_i + \mathbf{X_i} + \gamma_z + \epsilon_i. \tag{24}$$

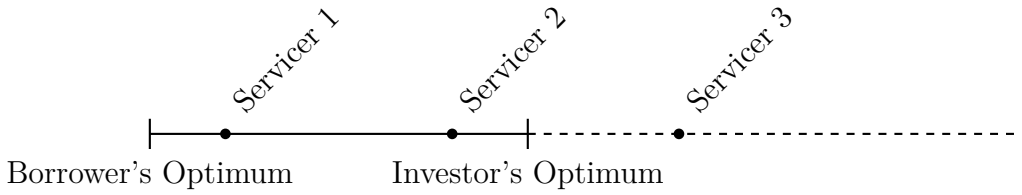
Where Y_i is an indicator for foreclosure. We estimate the specification using both foreclosure conditional on entering default one year before or less, and unconditional foreclosure. $Group1$ and $Group3$ are the indicators of interest and $Group2$ is the excluded category. We include a variety of controls $\mathbf{X_i}$, including credit score categories, loan amount, loan term, property value, and income, as well as zip code fixed effects (γ_z).

The results of this analysis are shown in Table 6. The coefficients of interest are labeled $Group1$ and $Group3$. We can see that foreclosure rates in Group 1 are significantly higher than those in Group 2. This suggests that the investor's optimal foreclosure rate is significantly higher than the bank servicer's optimum. The coefficient on Group 3 informs us

about whether the Basel III policy change moves the economy closer to or farther from the investor's optimal foreclosure rate. The coefficient is positive and statistically significant, and much larger than the coefficient in Group 1. Therefore, Group 3 loans have a foreclosure rate higher than the investor optimum in Group 1. In particular, the rate of foreclosure conditional on default, which is shown in columns (1) and (2), match the parameters in the model. They show that non-banks foreclose at rates three times higher than the investor's optimum. We conclude from these results that regulation re-allocating MSRs from banks to non-banks does not unequivocally improve investor welfare.

7.3 Discussion

The allocation of MSR assets impacts both borrower and investor welfare. It follows that there is an optimal allocation of MSR assets, depending on the weight placed on each stakeholder's utility. Social welfare, the sum of utilities of borrower and investor, is maximized when the servicer's optimum is aligned with the weighted average of the investor and borrower's optimum. Regulators with jurisdiction over servicers should target regulation to create this optimal allocation. This exercise may not be straightforward. We can see this graphically below, which depicts the range of foreclosure rates with the borrower's optimum and the investor's optimum marked.



Servicer 1 and 2 have optima in between the borrower and investor optima. Servicer 1 is optimal if the social welfare function weights borrowers more heavily than investors. Servicer 2 is optimal if investors are more heavily weighted than borrowers. The choice of social weights may depend on externalities created by low or high foreclosure rates. On the borrower side, the externalities include financial contagion and both pecuniary and non-pecuniary losses that borrowers' communities face when foreclosure rates are high. On the investor side, they includes the high costs created by low foreclosure rates, which can decrease credit access and lower overall liquidity in the market. Without additional evidence about externalities, both Servicer 1 and 2 lie on the frontier and can hold MSR assets.

Servicer 3, however, has the most highly misaligned incentive with both borrower and investor. This servicer has an optimal foreclosure rate higher than both the borrower and in-

vestor's optimum. Therefore, this servicer is outside the optimum allocation and should not hold MSR assets under any social welfare function. Our results suggest that non-banks buying servicing rights are, on average, of type 3. Such an MSR allocation is Pareto-dominated by a re-allocation towards type 1 and 2 servicers. Even if the social planner places no weight on borrower preferences, an allocation where foreclosure rates are equal to the investor's optimum would Pareto-dominate the type 3 allocation.[18] Regulations that re-allocate MSRs towards banks and other servicers with lower foreclosure rates would benefit overall social welfare, including both servicers and investors.[19]

Our setting provides suggestive evidence that raises new questions about the optimal design of financial regulation. Non-banks' exclusion from bank capital requirements has given them a regulatory arbitrage opportunity. Though higher risk weights such as those imposed by Basel III may be optimal from a macro-prudential perspective, the market response to the regulation may undo some of the rule's intended benefits. Stricter MSR regulations drove foreclosure rates higher than both the borrower and investor optimum. This can have negative externalities on borrowers' health (Downing (2016)) and neighborhoods (Lin et al. (2009)), in addition to the high costs directly caused by foreclosure (Diamond et al. (2020)). Moreover, MSR regulation may have increased investor losses, potentially harming the financial health of systemically important investors and worsening financial fragility (Bullard et al. (2009)). If non-banks had to comply with the same regulation as banks, financial stability, borrower, and even investor welfare may increase. Alternatively, as long as strict separation exists between regulating banks and non-banks, policymakers must acknowledge the conflict between appropriate risk weighting of assets and the creation of efficient incentives within the private market for those assets. Higher risk weights will inevitably result in some assets being re-allocated to non-banks. If re-allocation could generate significant welfare loss, macroprudential regulators may maximize welfare by prioritizing asset market efficiency over optimal risk weighting.

Finally, our results provide a new perspective on the distributional consequences of financial regulation. MSR regulation exacerbated existing disparities between high and low risk borrowers in two ways. First, high risk borrowers were more likely to have their loans transferred to non-banks. Second, transferred loans experienced disproportionately higher foreclosure rates. These results are consistent with subprime borrowers have their loans serviced by less patient servicers. Though this may be privately optimal within the market

[18] Note that the only way to justify allocating MSRs to type 3 servicers is if a policymaker places positive weight on the welfare of servicers for whom the equilibrium foreclosure rate is higher than the investor optimum.

[19] The zero lower bound on foreclosure means that the effect of regulations that lower foreclosure rates do not have a symmetric effect on borrowers and investors - they always improve borrower welfare, but foreclosure rates may get too low for investors.

for MSRs, the disproportionate re-allocation of high risk MSRs to non-banks raises concerns about higher financial risks being borne by households least able to absorb those risks. In future, policymakers may consider tailoring risk weighting policy across loan types to combat unintended distributional consequences of bank regulation.

8 Conclusion

This paper studies the relative servicing efficiency of different types of servicers and the implications for the optimal allocation of mortgage servicing rights. The paper first establishes several stylized facts about the rise of non-banks in the mortgage servicing industry. It then introduces a stylized model, which features an agency conflict between mortgage servicers and mortgage owners, embedded in a model with bank regulation. Consistent with the model predictions, we empirically document a causal increase in MSR transfers and assignments from banks to non-banks, heterogenous transfers among subprime borrowers, and elevated foreclosure rates in response to increased bank regulation. Our model and results suggest that the manner in which regulation of mortgage servicing rights is implemented has significant welfare implications for both borrowers and investors. Moreover, we observe distributional consequences of servicing regulation, with subprime borrowers facing more losses than prime borrowers.

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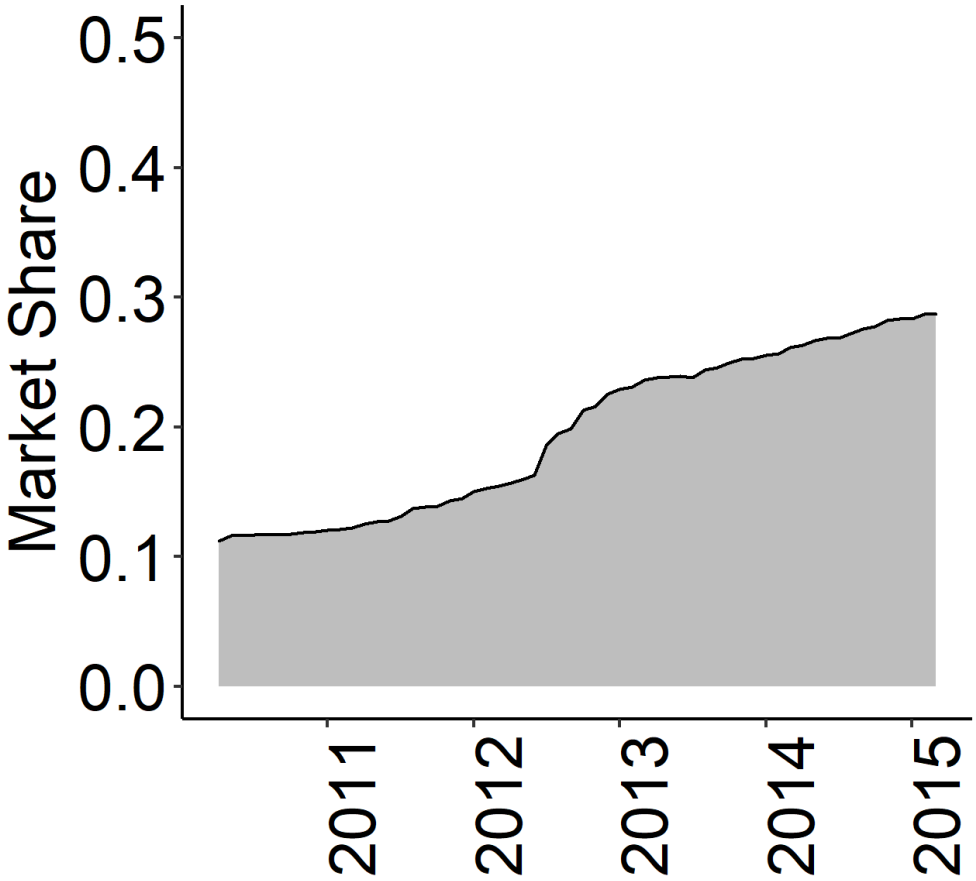
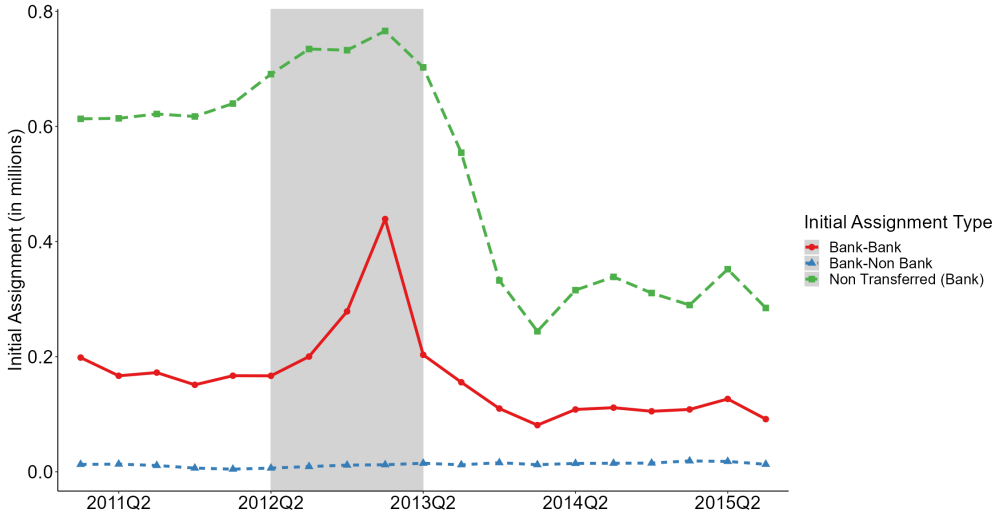
Figure 1. Rise of Non-Bank Servicers

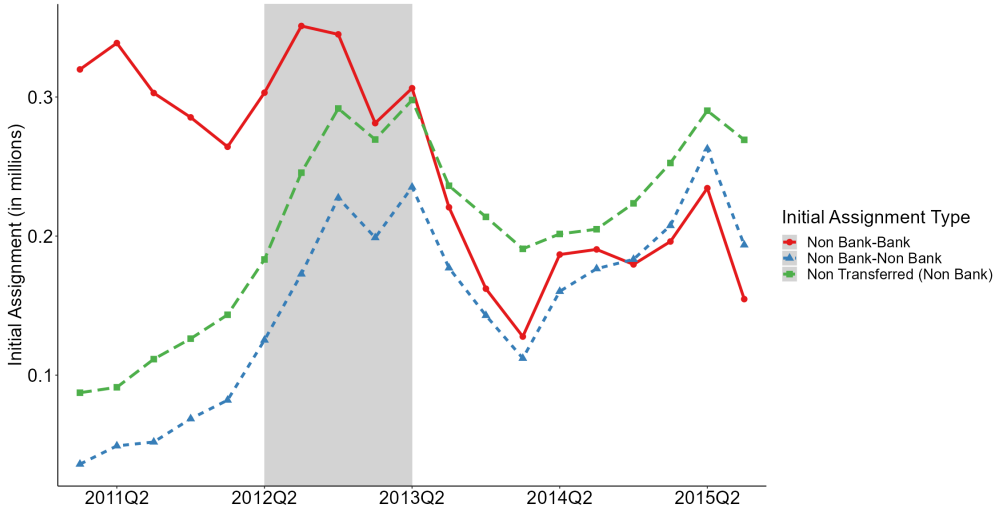


Notes: This figure presents the time trends in market share of outstanding loans that are serviced by non-banks. The shaded area indicates the share of loans serviced by non-banks as a fraction of all the outstanding mortgages between 2011 and 2015.

Figure 2. Third-Party Assignment by Institution Type



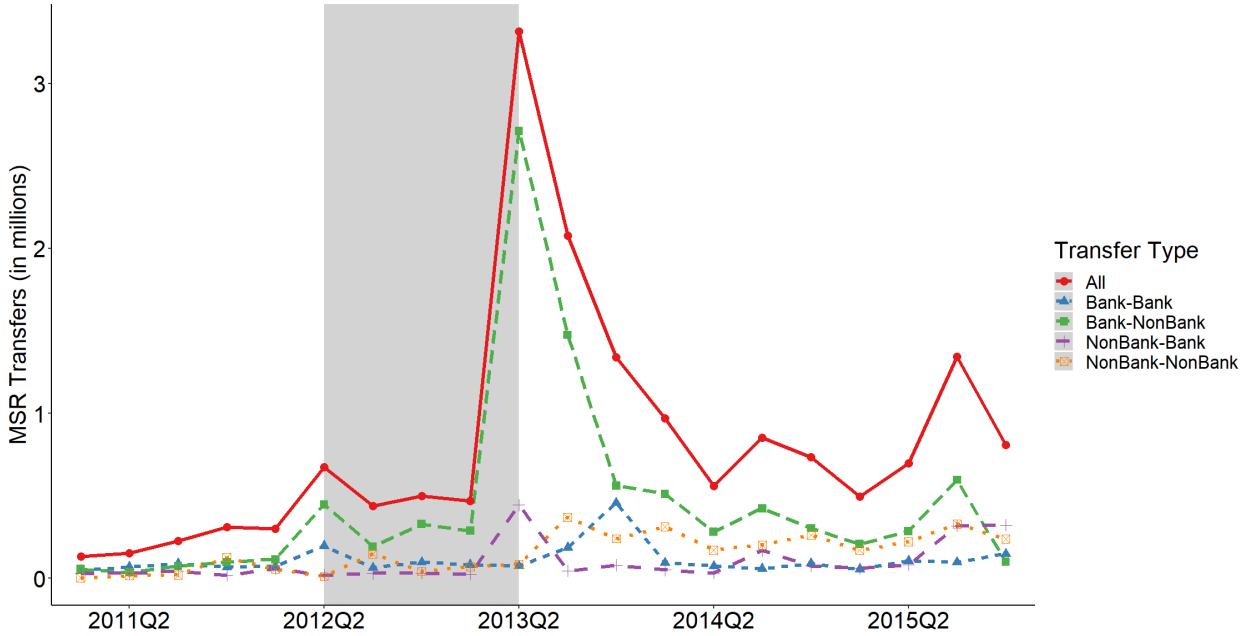
(a) Loans Originated by Banks



(b) Loans Originated by Non-Banks

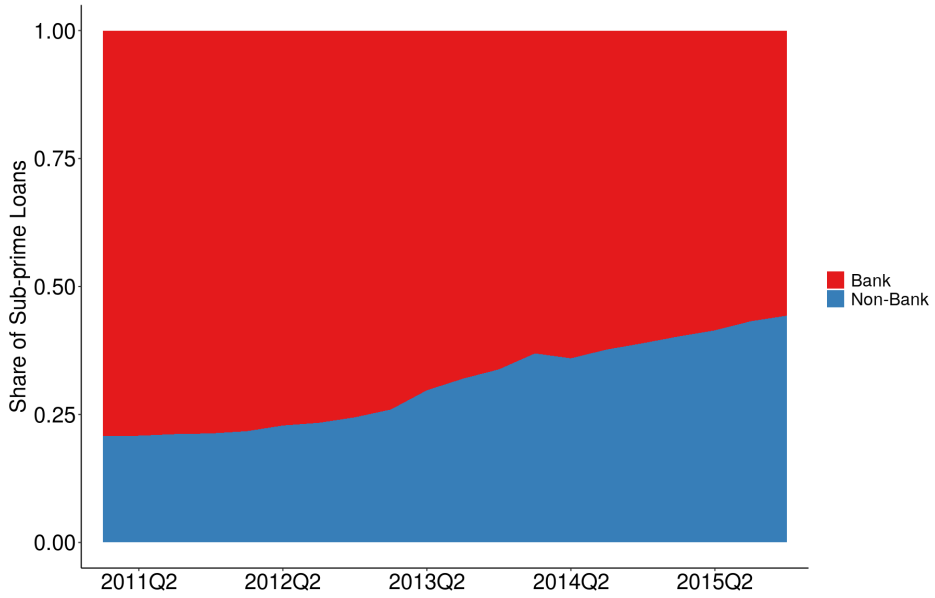
Notes: This figure presents quarterly time series for the total count of outstanding mortgages that underwent a third-party assignment of servicing rights between 2011-2015. Panel A presents the statistics about third-party assignments for loans originated by banks. Panel B presents the statistics about third-party assignments for loans originated by non-banks.

Figure 3. Aggregate MSR Tranfers Around Basel III MSR Rule Change

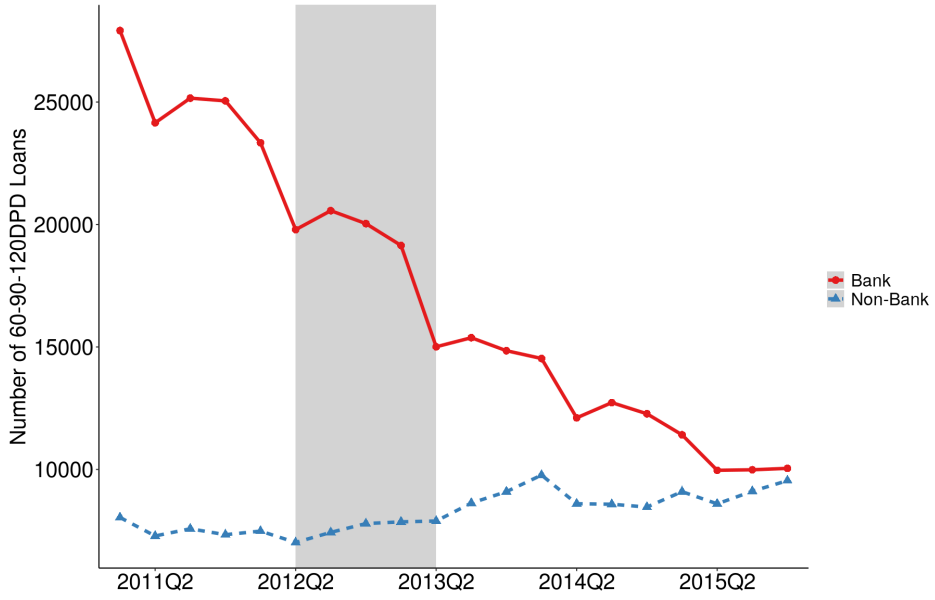


Notes: This figure presents quarterly time series for the total count of outstanding mortgages that underwent a transfer of mortgage servicing rights between 2011-2015. The bold red line denoted by '*All*' plots the count of outstanding loans whose servicing rights were sold in a given quarter. Bank-Bank (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 4. Loan Characteristics by Servicer Type Type



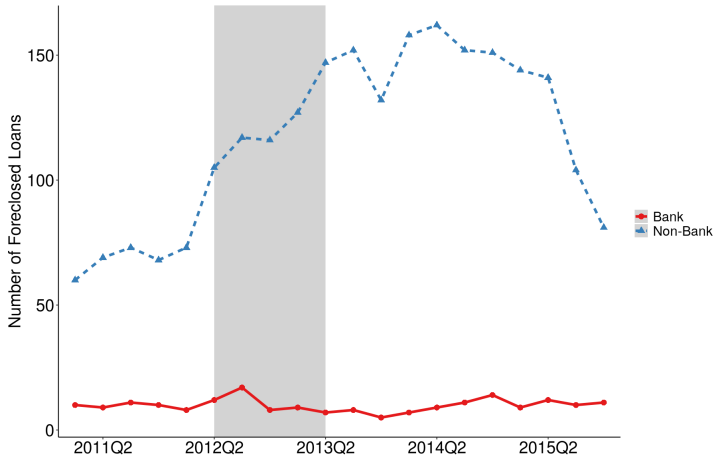
(a) Share of Subprime Mortgages



(b) 60-90-120 Day Delinquent Loans

Notes: Panel (a) presents quarterly time series of the share of total outstanding subprime loans that are serviced by banks versus non-banks. Panel (b) plots the number of delinquent loans serviced by banks and non-banks.

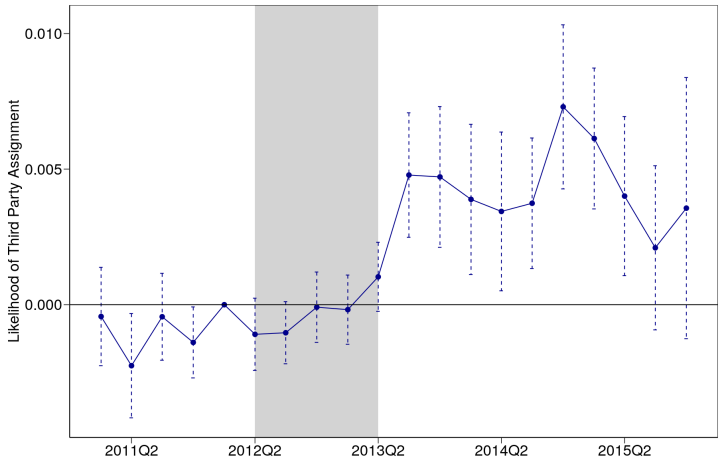
Figure 5. Bank versus Non-Bank Foreclosures



(a) Foreclosures

Notes: This figure plots the number of foreclosures on loans serviced by banks versus non-banks from 2011 to 2015.

Figure 6. MSR Regulation and Assignment

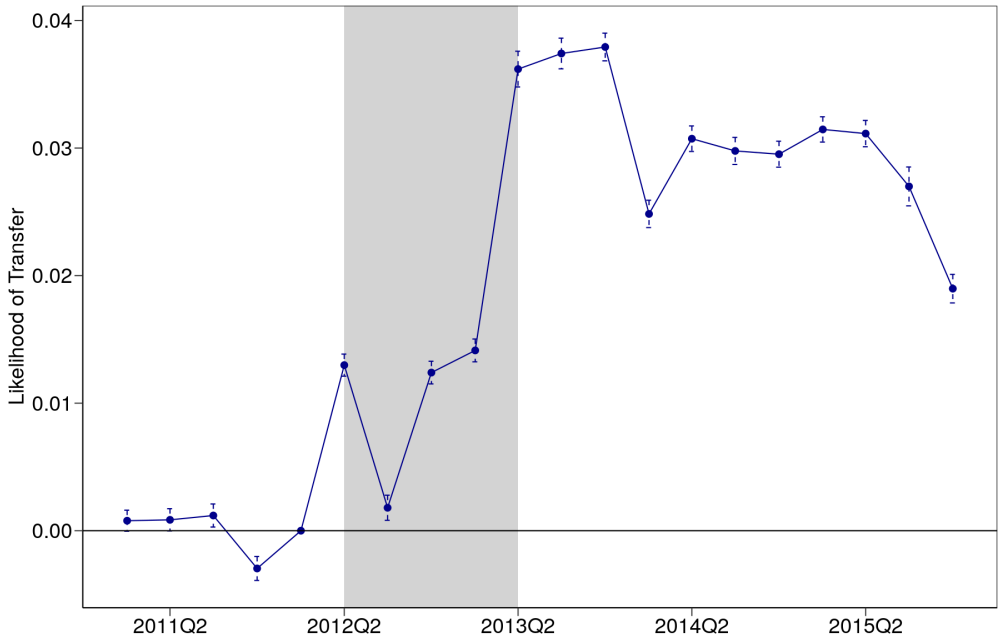


Notes: This figure plots the estimated coefficients β_k in the specification below:

$$Assignment_i = \sum_{k \neq 2012Q1} \beta_k \ \mathbb{1}_k \ Bank_o + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_o + \mathbf{X_i} + \eta_o + \nu_j + z_i + \epsilon_i, \qquad (25)$$

where $Assignment_i$ is an indicator for whether the first servicer observed in the performance data for loan i differs from its originator. $Bank_o$ is an indicator for whether the originator of loan i in the period before assignment is a bank. $\mathbb{1}_k$ is an indicator for the quarter. $\mathbf{X_i}$ includes controls for loan amount, credit score, loan term and type (FHA, GSE). We also include fixed effects for the originator of the loan (η_o), the servicer to whom the loan is assigned (ν_j), and zip code (z_i). We cluster standard errors at the zip code level, to allow for neighborhood spatial correlation.

Figure 7. MSR Regulation and Bank Incentive to Transfer

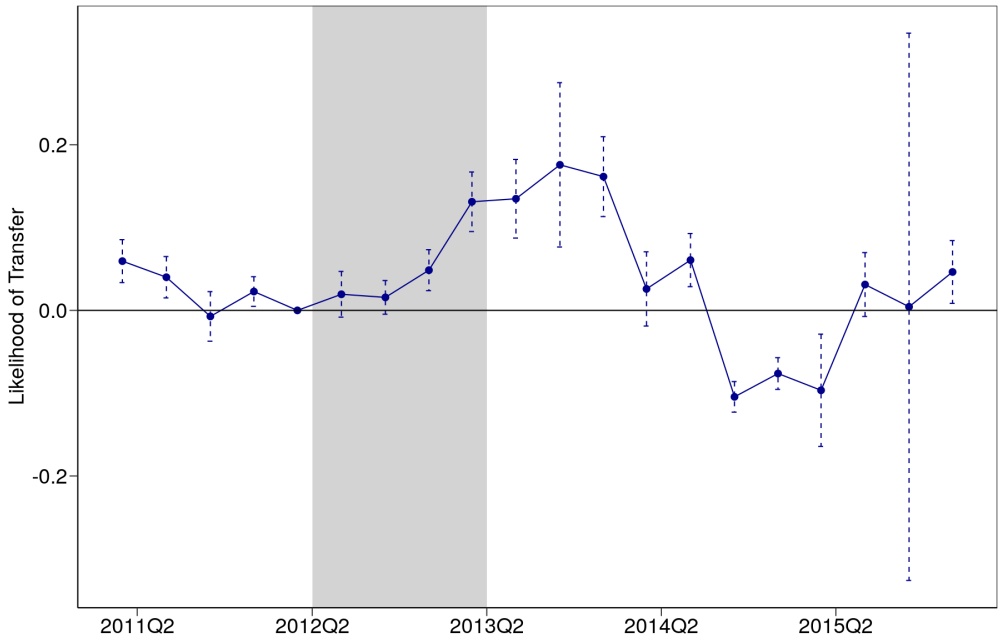


Notes: This figure plots the estimated coefficients β_k in the specification below:

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

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 8. Transfer Heterogeneity Across Banks

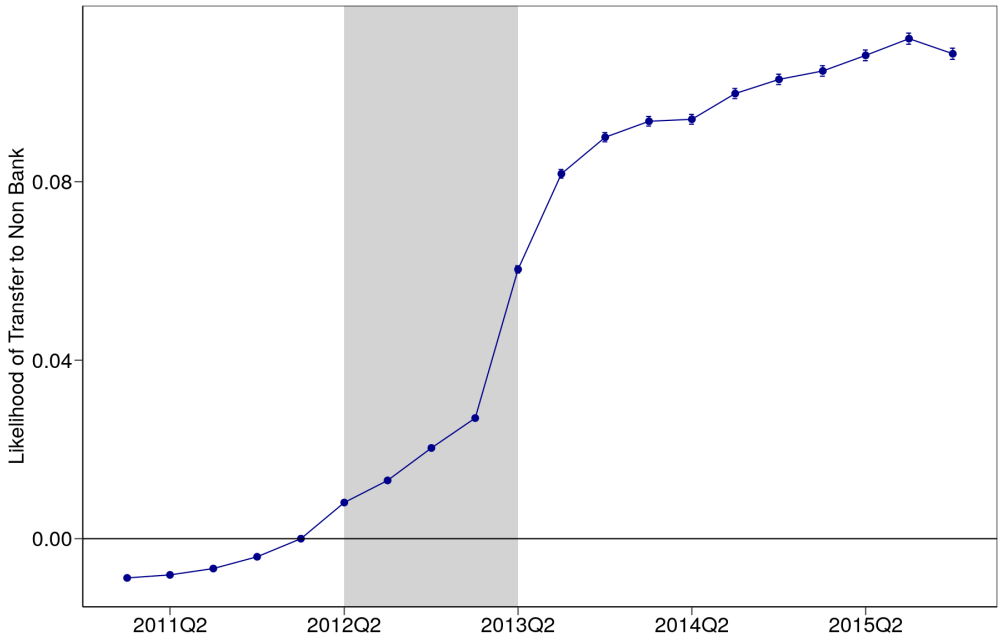


Notes: This figure plots the estimated β_k in the following specification:

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

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 9. Cumulative Servicing by Non-Banks

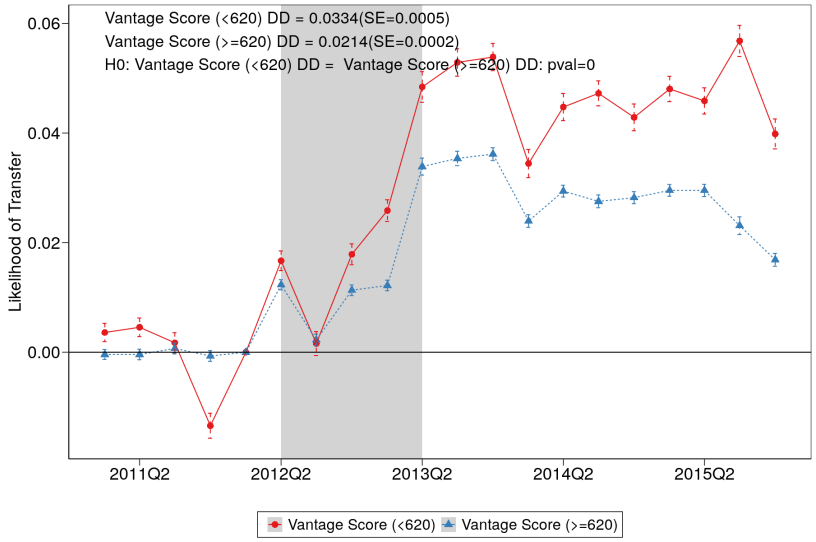


Notes: This figure plots the estimated coefficients β_k in the specification below:

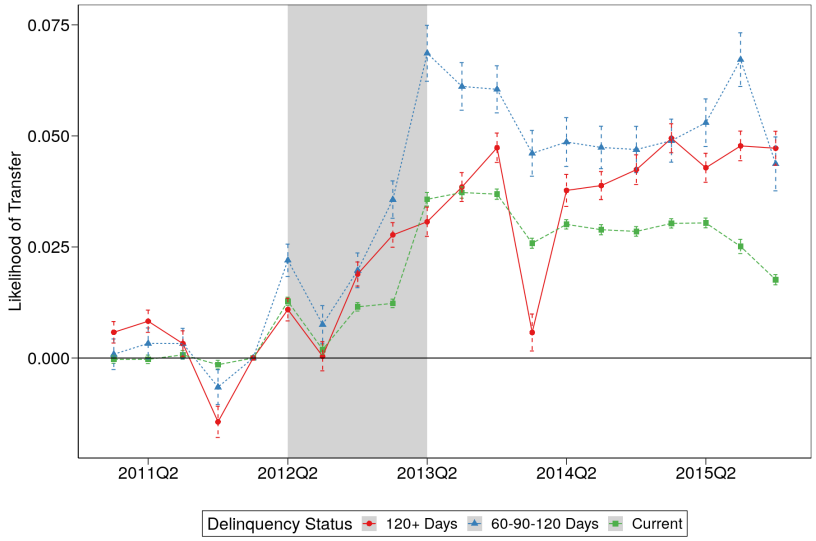
$$NonBank_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k + \mu_i + \epsilon_{i,j,t}$$

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 10. Transfer Heterogeneity Across Loan Types



(a) Credit Score — Transfer



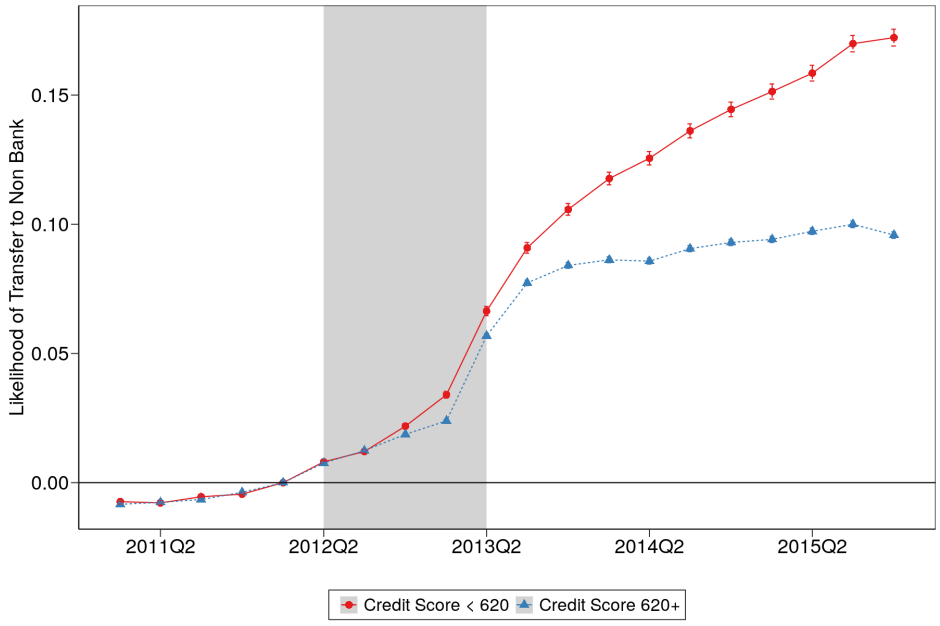
(b) Loan Performance

Notes: Panels (a) and (b) plot the dynamic response of β_k from the specification below for subgroups based on loan and borrower characteristics:

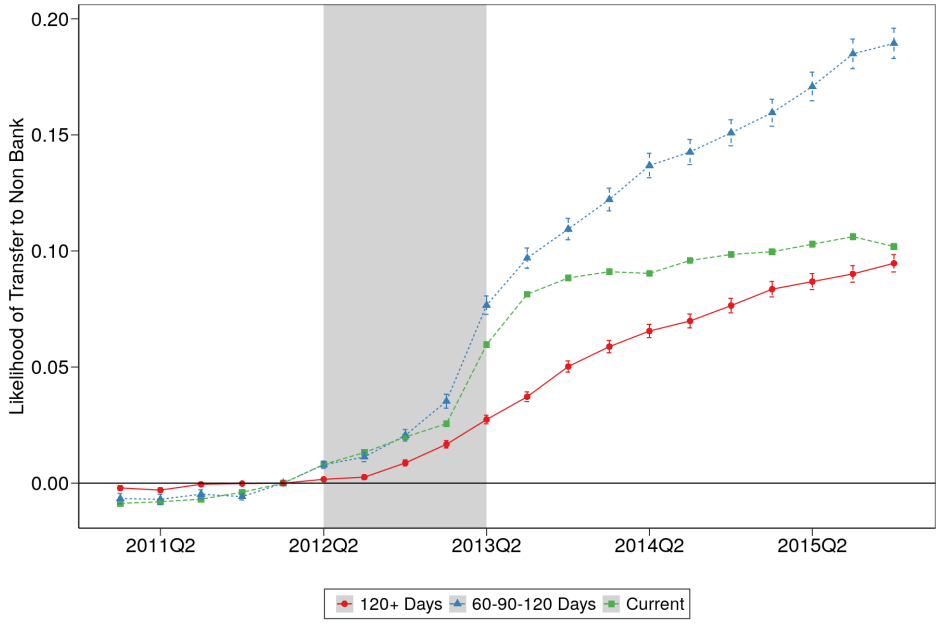
$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \gamma Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}.$$

$Transfer_{i,j,t}$ 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 credit score in panel (a) and on loan performance in panel (b). 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 11. Non-Bank MSR Holdings by Credit score & Loan performance



(a) Credit Score



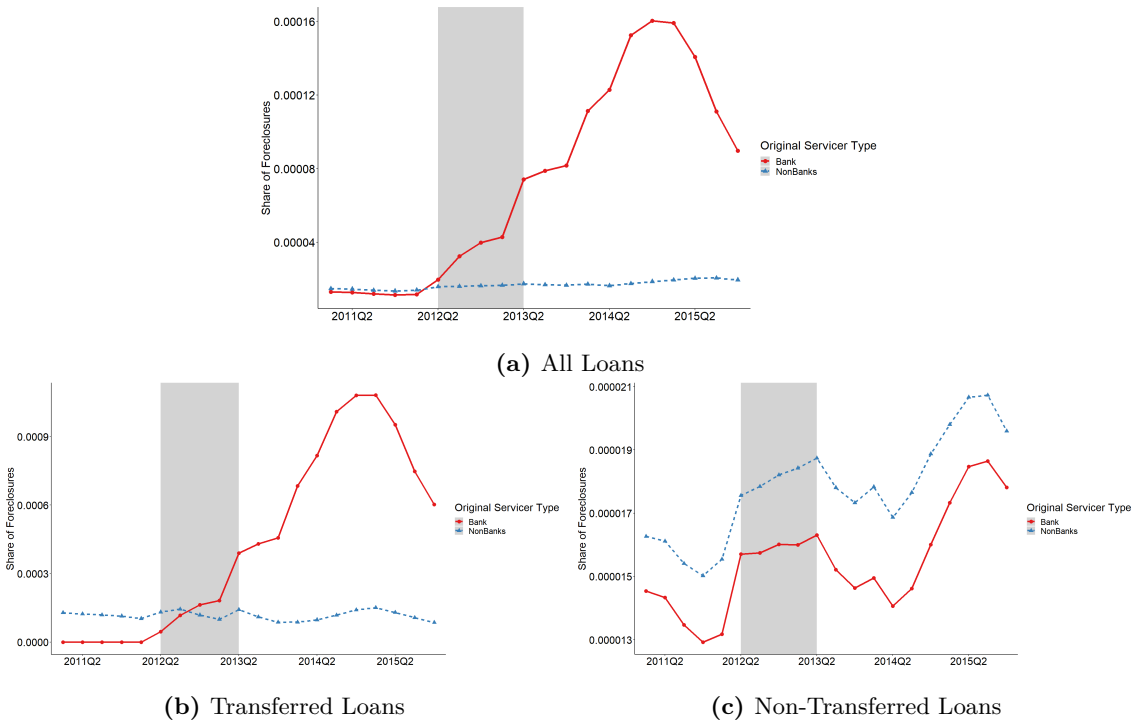
(b) Loan Performance

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 credit score in panel (a) and loan performance in panel (b) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

Figure 12. Foreclosure by 2011 Servicer Type



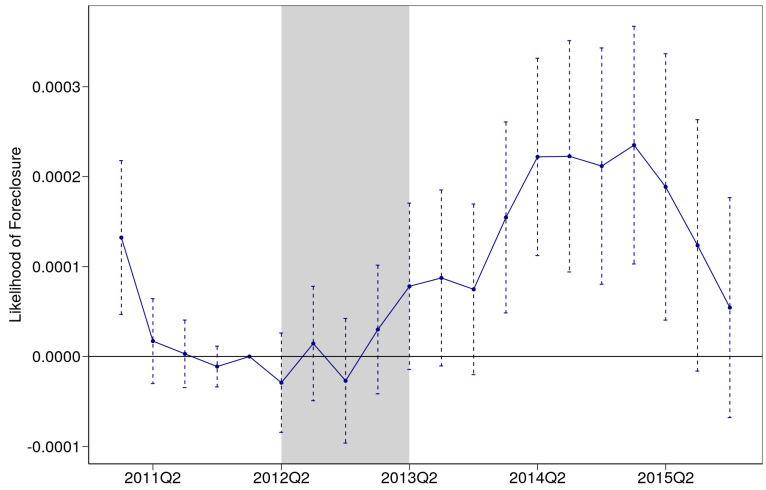
(a) All Loans

(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 13. Intent-to-Treat (ITT) Estimates and Heterogeneity

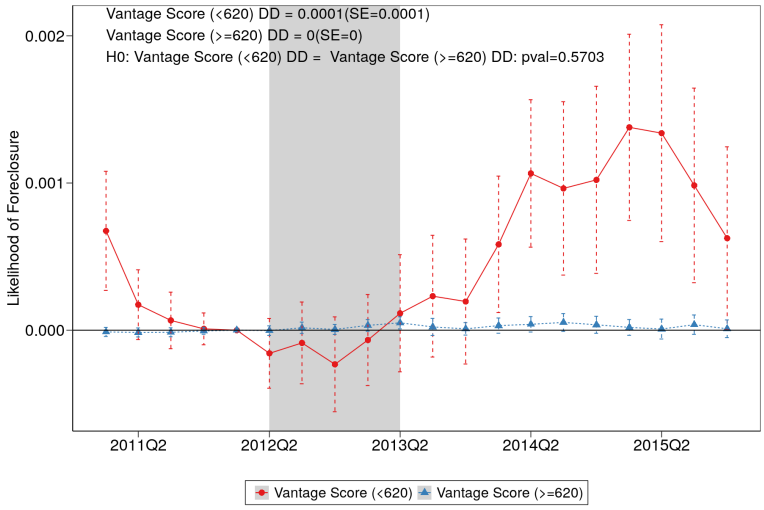


Notes: This figure plots the estimated β_k in the intent-to-treat (ITT) specification:

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

where $Y_{i,j,t}$ is an indicator for whether loan i is subject to foreclosure in 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 14. Heterogeneity in Intent-to-Treat (ITT) Estimates



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 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 15. 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. For the MSR-to-CET1 regression in column 5: 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. 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)	(5)
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 $\times \frac{MSR}{CET1}$					0.080***
					(0.012)
Post $\times \frac{MSR}{CET1}$					0.039**
					(0.019)
Servicer FE	Yes	Yes	Yes		
Zip FE		Yes	Yes		
Quarter FE			Yes	Yes	Yes
Loan FE				Yes	Yes
N	14,384,063	14,384,063	14,384,063	14,384,063	5,438,217
R^2	0.036	0.038	0.043	0.139	0.181

Table 3

Are Non Banks More Likely to hold MSRs After MSR Regulation

This table presents regression estimates from Equation 17 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 4
Selection in MSR Transfers

Columns 1 and 2 present the heterogeneity in loan level difference-in-difference regression estimates from Equation 15 and from the static version of Equation 16 measuring the effect of MSR regulation under Basel III on the likelihood of transfer. Columns 3 and 4 present heterogeneity in the likelihood of the non banks' holding of mortgage servicing rights from Equation 17.
In columns 1 and 2, the outcome variable is $Transfer$, which 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. In columns 3 and 4, the outcome variable is $Non\ Bank$, which is an indicator for whether a loan is serviced by a non-bank in a given quarter. In all columns, $Middle$ 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 has a credit score lower than 620 (columns 1, 3) or is in default (columns 2, 4). For all columns, the underlying sample includes all loan-quarter observations in our random sample. Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Transfer		Non Bank Servicer	
	Subprime	Default	Subprime	Default
	(1)	(2)	(3)	(4)
Middle × Bank × Category	0.012***	0.017***		
	(0.0005)	(0.0009)		
Post × Bank × Category	0.021***	0.025***		
	(0.0005)	(0.0009)		
Middle × Category	-0.008***	-0.008***	-0.008***	-0.018***
	(0.0004)	(0.0007)	(0.0005)	(0.0009)
Post × Category	-0.010***	-0.006***	0.021***	0.023***
	(0.0004)	(0.0006)	(0.0007)	(0.001)
Middle × Bank	0.008***	0.009***		
	(0.0002)	(0.0002)		
Post × Bank	0.028***	0.030***		
	(0.0003)	(0.0003)		
Category × Bank	-0.001***	-0.006***		
	(0.0002)	(0.0004)		
Bank	0.016***	0.014***		
	(0.0002)	(0.0002)		
Loan FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	No	No
N	14,383,904	13,359,276	14,383,904	13,359,276
R^2	0.139	0.142	0.873	0.872

Table 5

Intent-to-Treat

This table presents the regression estimates from the static version of our intent-to-treat (ITT) specification in Equation 21 showing the effects of MSR regulation under Basel III on foreclosure. 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.

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

Table 6

Foreclosure by Investor versus Servicer

Table reports the results of Equation 24 which estimates the response of foreclosure and foreclosure conditional on default to whether the loan is both serviced and owned by the same entity (Group1 - portfolio loans), securitized and serviced by a bank (Group2), or securitized and serviced by a non-bank (Group3). The additional covariates are included as controls. The sample consists of loans originated in 2010 with information on origination entity. For each loan, the sample is restricted to calendar year-month within two years of origination. Standard errors are clustered at the zip code level in the regressions where zip code level fixed effects are included. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Foreclosure|Default		Foreclosure	
	(1)	(2)	(3)	(4)
Constant	-0.108***		0.004***	
	(0.020)		(0.0006)	
Group 1 - Portfolio	0.008**	0.012*	0.0006***	0.0008**
	(0.004)	(0.007)	(0.0001)	(0.0003)
Group3 - Non Bank Serviced	0.041***	0.039***	0.0009***	0.001***
	(0.002)	(0.009)	(5.79×10^{-5})	(0.0003)
Score 580-669	0.005*	-0.003	-0.003***	-0.003
	(0.003)	(0.007)	(0.0003)	(0.002)
Score 670-739	0.004	-0.0007	-0.006***	-0.006***
	(0.003)	(0.007)	(0.0003)	(0.002)
Score 740-799	-0.004	-0.007	-0.007***	-0.006***
	(0.004)	(0.011)	(0.0003)	(0.002)
Score800-850	0.003	0.004	-0.007***	-0.006***
	(0.007)	(0.024)	(0.0003)	(0.002)
Log (Loan Balance)	0.010***	0.020**	0.0002***	0.001***
	(0.002)	(0.009)	(4.92×10^{-5})	(0.0003)
Log (Origination Amount)		-0.013		-0.001***
		(0.011)		(0.0003)
Log (Loan Term)		0.013		0.0008***
		(0.013)		(0.0002)
Log (Income)		-0.015		-0.0005**
		(0.010)		(0.0002)
Zip FE	No	Yes	No	Yes
N	42,788	41,757	1,352,266	1,331,529
R^2	0.013	0.175	0.002	0.022

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 Other Margin of Adjustment: Initial Assignment

To understand whether banks are more likely than non-banks to assign mortgage servicing rights to a third party at origination, which we refer to as initial *assignment*, we estimate the following difference-in-differences (DiD) specification:

$$Assignment_i = \sum_{k \neq 2012Q1} \beta_k \, \mathbb{1}_k \, Bank_o + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_o + \mathbf{X_i} + \eta_o + \nu_j + z_i + \epsilon_i, \quad \text{(A1)}$$

where $Assignment_i$ is an indicator for whether the first servicer observed in the performance data for loan i differs from its originator. $Bank_o$ is an indicator for whether the originator of loan i in the period before assignment is a bank. $\mathbb{1}_k$ is an indicator for the quarter. $\mathbf{X_i}$ includes controls for loan amount, credit score, loan term and type (FHA, GSE). We also include fixed effects for the originator of the loan (η_o) and zip code (z_i). We cluster standard errors at the zip code level, to allow for neighborhood spatial correlation.

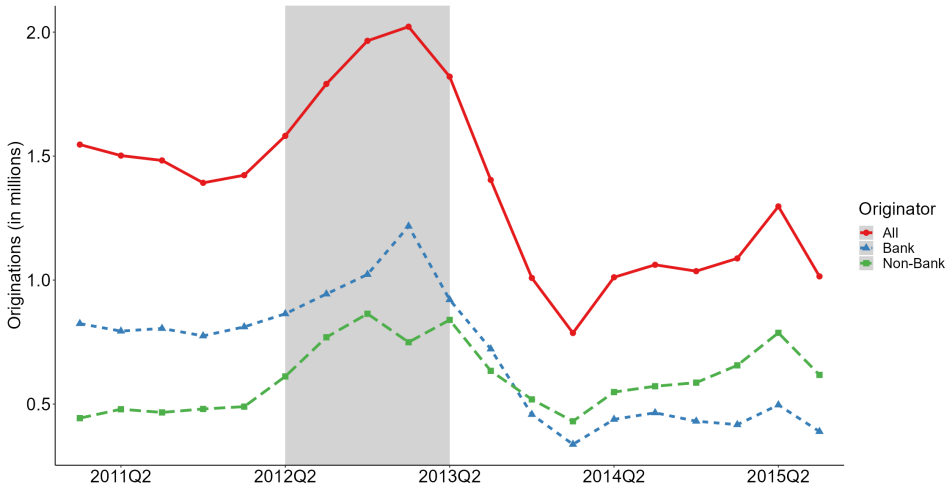
We show the dynamic evolution of bank versus non-bank differences in initial assignments of MSRs relative to 2012Q2 in Figure 6. The figure plots the estimated coefficients of the β_k in Equation A1. The final adoption of Basel III in 2013Q2 increases banks' likelihood of assigning MSRs to a third party different from themselves by 0.5% relative to that of non-banks. Banks' higher likelihood of MSR assignments persisted until the end of 2015. Importantly, prior to the initial proposal of the Basel III adoption, bank MSR assignments were not statistically more likely than those for non-banks. The lack of pre-trend alleviates the concern that different unobservable loan characteristics might drive different bank versus non-bank assignment likelihoods.

The result that the likelihood of bank initial placements is higher than that of non-banks following the policy change, is striking. This is because Figure 2 shows that the level of bank initial assignments fell dramatically following the policy change, while the level of non-bank initial assignments increased following the policy change, as discussed in subsection 3.2. Bank originations, plotted in appendix Figure A1, help us reconcile the results shown in Figure 2 and Figure 6. Bank originations drop following the policy change. Relative to non-banks, Figure D4 indicates that banks are on average 5% less likely to originate mortgages post Basel III. Thus banks are both originating fewer mortgages after Basel III and simultaneously increasing the probability of transferring the mortgages that they do originate to a third party. This results in the level of bank assignments falling while the probability of assignment increases, and increases at a faster rate than that of non-bank initial assignments despite their growth over this time period.

C Other Margin of Adjustment: Origination

For a subsample of loans, we are able to see the originator. To classify originators as banks versus non-banks, we utilize the same algorithm that we use to classify servicers. Figure A1 plots the originations by banks versus non-banks from 2011 to 2015. The figure shows that bank and non-bank originations moved in parallel from 2011Q1 to 2012Q1. In 2012Q2, non-bank originations begin increasing and almost double during the treatment period. Bank originations also increase slightly during the treatment period and then fall sharply from nearly 1.25 million originations in 2013Q1 to close to 0.25 million in 2013Q2. Bank originations remain steady at this level throughout the duration of our sample, while non-bank originations rise, ending 2015 with almost double the originations that they made in 2011.

Figure A1. Originations



Notes: This figure presents the quarterly time series the total count of mortgages originated between 2011-2015 for a subset of the loans for whom we are able to observe the originator.

To rigorously interpret the results that we show in Figure A1, we estimate the following difference-in-differences (DiD) regression:

$$Origination_o = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_o + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_o + \mathbf{X_i} + \eta_o + z_i + \epsilon_o, \quad \text{(A2)}$$

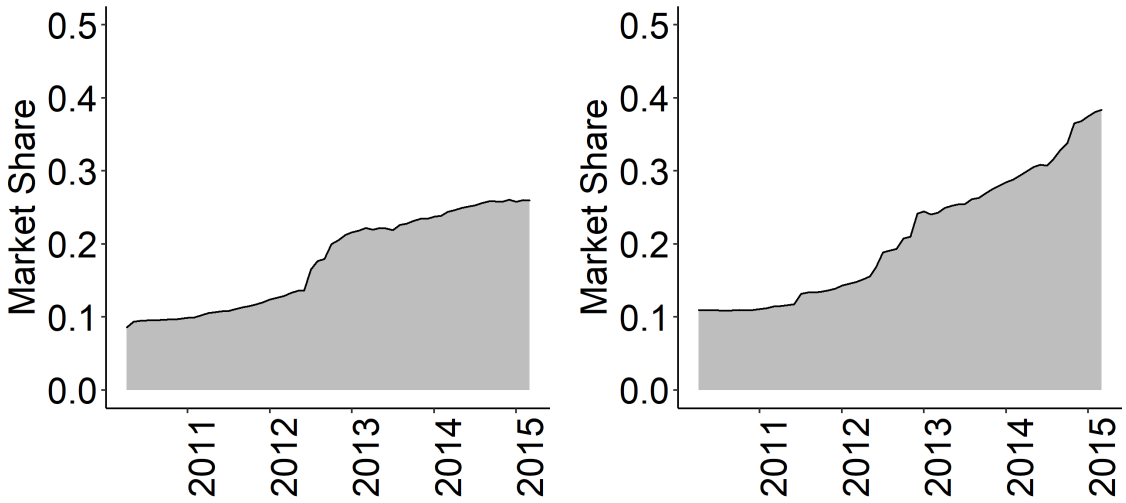
where $Origination_o$ is the number of originations by originator o. $Bank_o$ is an indicator for whether an originator in the quarter of origination is a bank. $\mathbb{1}_k$ is an indicator for the quarter. $\mathbf{X_i}$ includes controls for loan amount, credit score, loan term and type (FHA, GSE).

We also include fixed effects for the originator of the loan (η_o) and zip code (z_i). We cluster standard errors at the zip code level (z_i), to allow for neighborhood spatial correlation.

We show the dynamic evolution of bank versus non-bank differences in mortgage originations relative to 2012Q2 in Figure D4. The figure plots the estimated coefficients of the β_k in Equation A2. The final adoption of Basel III in 2013Q2 appears to decrease banks' likelihood of originating mortgages by 5% relative to non-banks. Banks' likelihood of originating mortgages increasingly declined until they were almost 10% less likely to originate mortgages relative to non-banks. Importantly, prior to Basel III's adoption in 2013Q2, bank and non-bank originations moved on a parallel trend. The pre-treatment parallel trend alleviates the concern that different unobservable loan characteristics might drive different bank versus non-bank origination likelihoods.

D Additional Tables and Figures

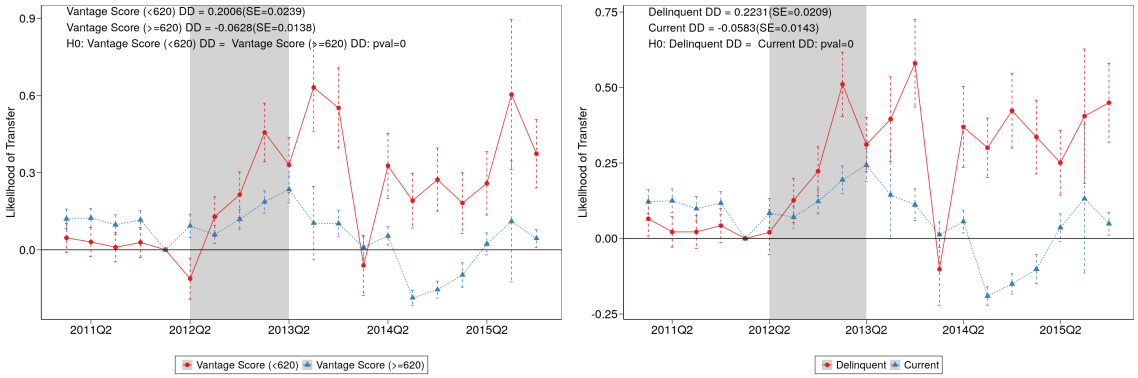
Figure D1. Rise of Non-Bank Servicers



(a) GSE **(b)** 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 D2. Transfer Heterogeneity Across Banks–Selective Transfer DiD



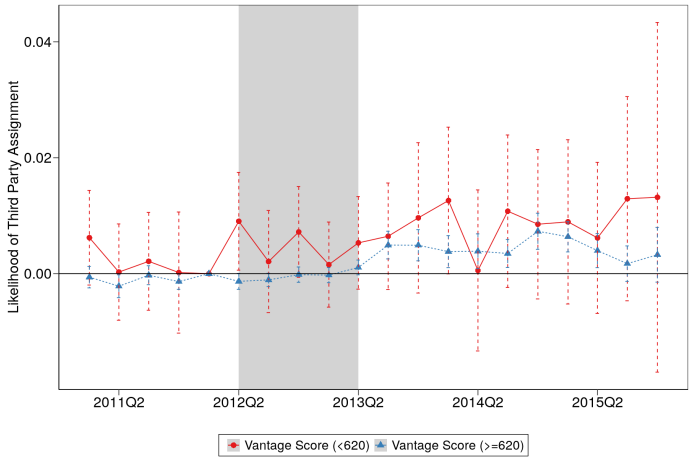
(a) Credit Score **(b)** Loan Performance

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.

Figure D3. Initial Assignment Heterogeneity Across Loan Types



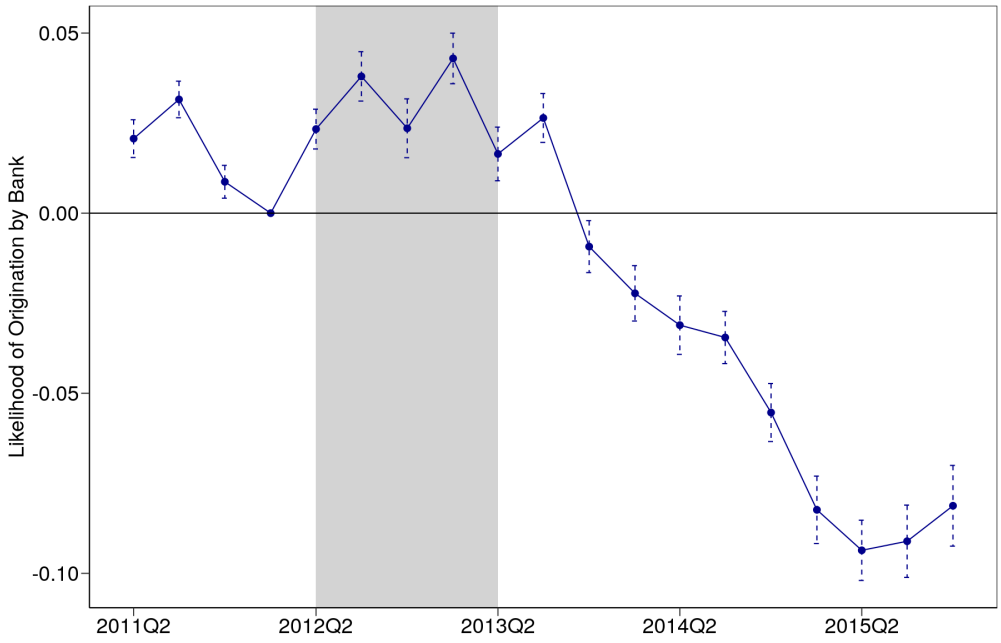
(a) Credit Score — Initial Assignment

Notes: Panel (a) plots the dynamic response of β_k from the specification below for subgroups based on borrower characteristics:

$$Assignment_i = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_o + \sum_{k \neq 2012Q1} \mathbb{1}_k + \mathbf{X_i} + \gamma Bank_o + \mu_i + \epsilon_i,$$

$Assignment_i$ is an indicator for whether the servicing right on loan i originated by originator o was assigned to a third party at origination. $Bank_o$ is an indicator for whether the originator of loan i is a bank. The sub-samples are based on credit score.

Figure D4. MSR Regulation and Origination

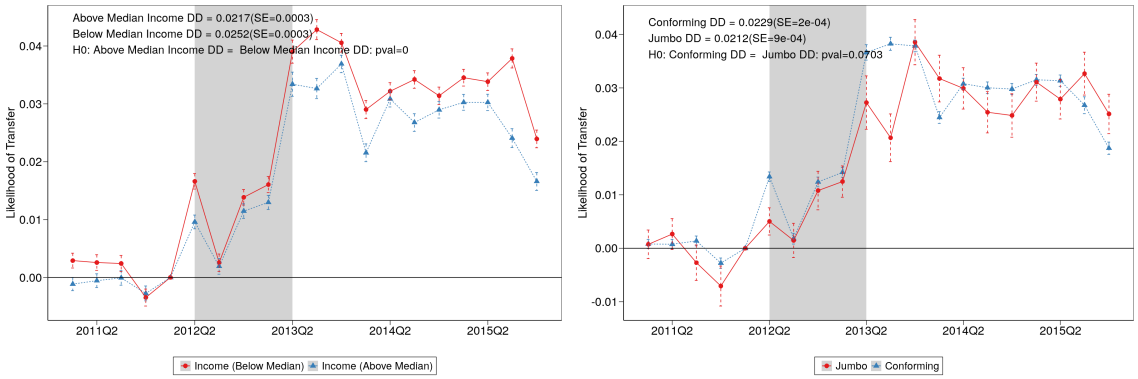


Notes: This figure plots the estimated coefficients β_k in the specification below:

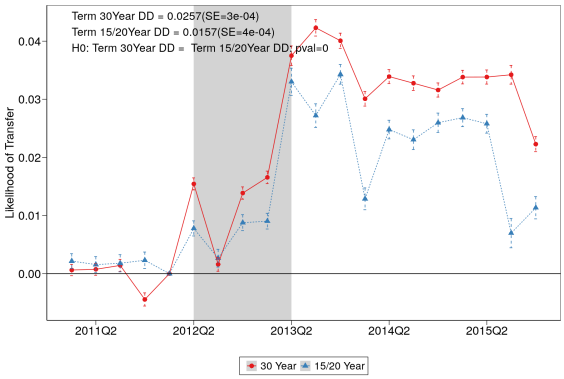
$$Origination_i = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_o + \sum_{k \neq 2012Q1} \mathbb{1}_k + \gamma Bank_o + \mathbf{X_i} + \eta_o + \nu_j + z_i + \epsilon_i, \qquad \text{(A3)}$$

where $Origination_i$ is an indicator for whether loan i is originated. $Bank_o$ is an indicator for whether the originator of loan i in the quarter of origination is a bank. $\mathbb{1}_k$ is an indicator for the quarter. $\mathbf{X_i}$ includes controls for loan amount, credit score, loan term and type (FHA, GSE). We also include fixed effects for the originator of the loan (η_o), the servicer to whom the loan is assigned (ν_j), and zip code (z_i). We cluster standard errors at the zip code level (z_i), to allow for neighborhood spatial correlation.

Figure D5. Transfer DiD by Income, Loan Size & Term



(a) Income **(b)** Loan Size



(c) Loan Term

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

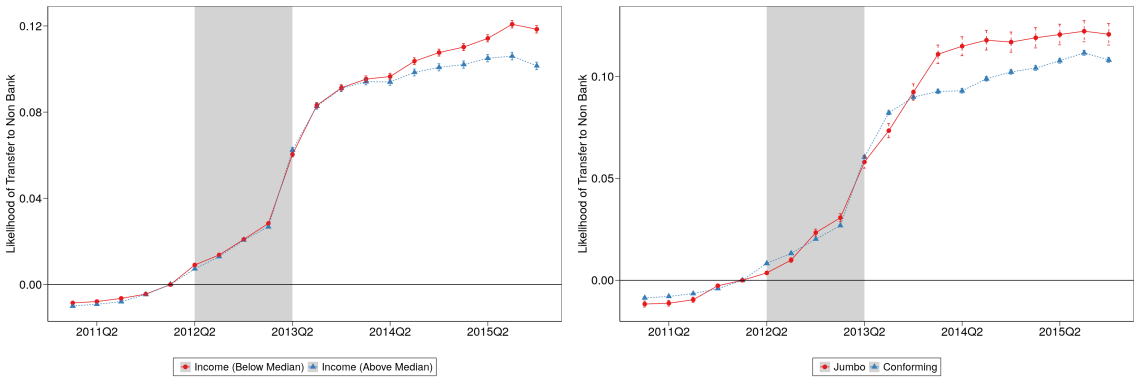
$$Transfer_{i,j,t} = \sum_{k \neq 2012Q1} \beta_k \; \mathbb{1}_k \; Bank_{i,j,t-1} + \gamma Bank_{i,j,t-1} + \mu_i + \theta_t + \epsilon_{i,j,t}$$

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 median income in a zip code in panel (a), loan size in panel (b), and loan term 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.

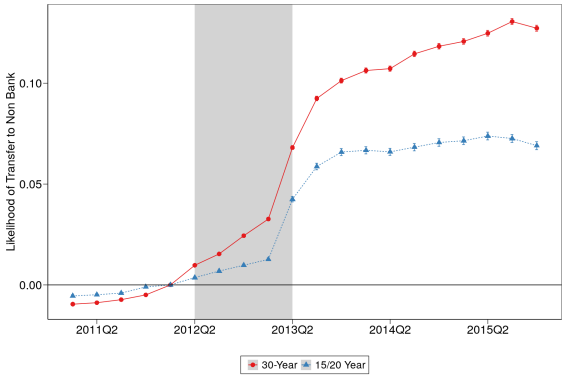
Changing Composition of MSRs Allocated to Banks and Non-Banks (Additional Results)

Income, Loan Term, and Size Panel (a) of Figure D5 shows banks' likelihood of transferring MSRs relative to non-banks' likelihood for two subgroups: loans held by borrowers

Figure D6. Non Bank MSR Holdings by Income, Loan Size & Term



(a) Income **(b)** Loan Size



(c) 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 median income in a zip code in panel (a), loan size in panel (b), and loan term in panel (c) respectively. 95% confidence intervals are included for each quarterly point estimate. Standard errors are clustered at the zip code level.

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 D1 column 1).

Figure D5 plots the coefficients resulting from the DiD specification in Equation 18. Panel (b) shows that banks' likelihood of transferring MSRs relative to non-banks' for conforming versus jumbo loan sizes. Panel (c) shows transfer likelihood for loans with a 360 month loan term versus a 180/240 month loan term. Panel (b) 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 (c) shows that banks transferred more 360 month term relative to 180/240 month term loans. We plot the static version of the results in Table D1 in columns 2 and 3.

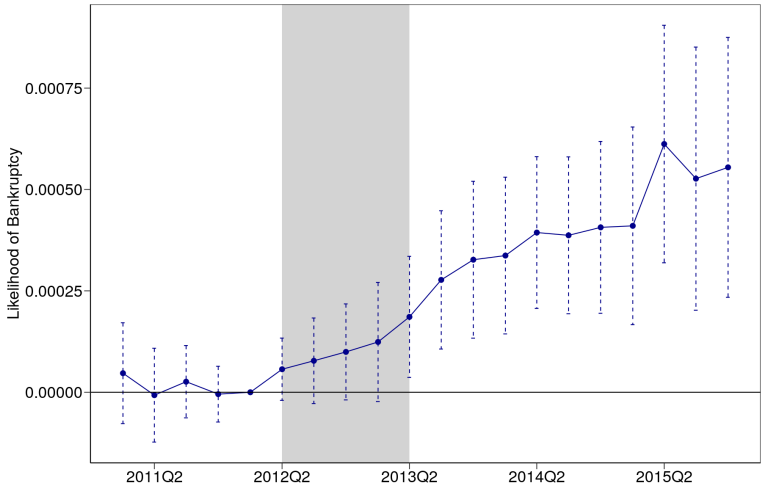
In order to study whether these MSRs were transferred to non-banks, we estimate the event study in Equation 19. Figure D6 depicts the results.

Panel (a) of Figure D6 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 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 D1 column 2).

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 D1 reports the average difference between sub-groups for each category in the Middle and Post period. Combining the results of the DiD in Figure D5 with the results of the event study in Figure D6 provides compelling evidence that non-banks were purchasing the MSRs that banks sold following Basel III. We plot the static version of the results in Table D1 in columns 5 and 6.

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 D7. Intent-to-Treat (ITT) Estimates and Heterogeneity

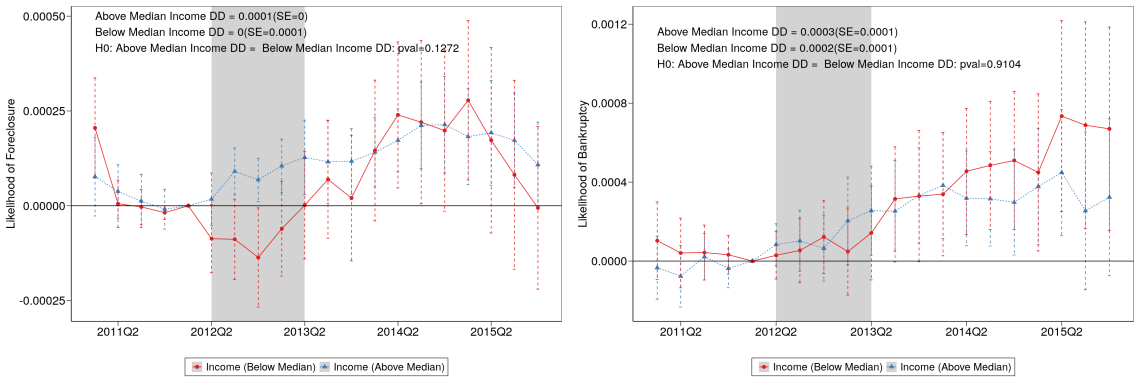


Notes: This figure plots the estimated β_k in the intent-to-treat (ITT) specification:

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

where $Y_{i,j,t}$ is an indicator for whether loan i is subject to bankruptcy 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 D8. Intent-to-Treat (ITT): 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 D1
Selection in MSR Transfers

This table presents the heterogeneity in loan level difference-in-difference regression estimates from Equation 15. 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 below-median income (column 1, 4), jumbo (column 2, 5), and has a 30-year loan term (column 3, 6). Standard errors are clustered at zip code level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	Transfer			Non Bank		
	$\text{Income}_{<Median}$	Jumbo	30 Year	$\text{Income}_{<Median}$	Jumbo	30 Year
	(1)	(2)	(3)	(4)	(5)	(6)
Middle × Bank × Category	0.002***	-0.002**	0.007***			
	(0.0004)	(0.0009)	(0.0004)			
Post × Bank × Category	0.004***	-0.002**	0.012***			
	(0.0005)	(0.001)	(0.0005)			
Middle × Bank	0.010***	0.011***	0.006***			
	(0.0003)	(0.0002)	(0.0003)			
Post × Bank	0.030***	0.031***	0.022***			
	(0.0004)	(0.0003)	(0.0005)			
Middle × Category	-0.001***	0.0007	-0.001***	0.0003	0.001	0.015***
	(0.0004)	(0.0008)	(0.0003)	(0.0004)	(0.0008)	(0.0004)
Post × Category	-0.002***	2.07×10^{-5}	-0.003***	0.004***	0.044***	0.033***
	(0.0004)	(0.0009)	(0.0004)	(0.001)	(0.002)	(0.001)
Category × Bank	0.007***	-0.010***	0.005***			
	(0.0005)	(0.0009)	(0.0004)			
Bank	0.011***	0.016***	0.011***			
	(0.0003)	(0.0002)	(0.0004)			
Loan FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes			
N	13,995,539	14,384,063	13,504,541	13,995,539	14,384,063	13,504,541
R^2	0.139	0.139	0.139	0.870	0.873	0.869

Table D2

ITT: Heterogeneity

This table presents heterogeneity in the regression estimates from the dynamic version of our intent-to-treat (ITT) specification in Equation 21 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 D3: 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)	(-)