Mortgage Servicing Fees and Servicer Incentives During Loss Mitigation *

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Abstract

We study incentive problems associated with the compensation of servicers during default remediation. First, we fill a gap in the literature by identifying stylized facts about servicing fees. Next, we present evidence showing that servicing fees drive mortgage modifications and foreclosures, likely to the detriment of investors. Servicers modify loans paying high servicing fees and delay their foreclosure to protect servicing cash flows. These effects are causal. Voluntary mortgage renegotiation by servicers is unlikely to reduce foreclosures. In addition to ex-post government intervention, special servicing, and innovative mortgage contracts allowing for affordable modifications that benefit investors may improve renegotiation outcomes.

JEL Classifications: *G21, G23, G24, R3*

Keywords: *Real Estate, Securitization, Mortgage Servicing, Servicer Incentives, Mortgage Modification, Foreclosure*

*This paper was previously titled "*Mortgage Servicing Fees and Servicer Behavior*." We thank the editor, Tomasz Piskorski, and two anonymous referees for their insightful comments. We are also greatful to Brent W. Ambrose, Arnab Biswas, Michael LaCour-Little, Antonio de Melo, Seung-Hyun Hong, Brent C. Smith, Abdullah Yavas, and seminar audiences at the University of Southern California, the University of Illinois Chicago, the University of Wisconsin-Madison, the 2021 ASSA/AREUEA Conference, the 2020 FMA Conference, the 2019 AREUEA National Conference, and the 2019 ARES Conference.

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1 Introduction

With mortgage foreclosures surging nationally following the collapse of the housing market at the end of 2007, concerns over mounting associated economic and social costs reignited the debate about the need to curtail foreclosures during severe housing market downturns.[1] In addition to losses suffered by affected homeowners and mortgage investors, foreclosures depress house prices, thus adversely impacting local communities and the entire economy (Campbell et al., 2011; Anenberg and Kung, 2014; Gerardi et al., 2015; Fisher et al., 2015; Biswas et al., 2021; Makridis and Ohlrogge, 2022).[2] Mortgage servicers, who are also in charge of severely delinquent mortgages, had a crucial role in managing the unfolding crisis. Servicers have two options when dealing with prolonged payment delinquency, renegotiate loan terms with borrowers or initiate a forced sale of the property via foreclosure or a short sale.[3] Servicers are regularly blamed for choosing the foreclosure path, thus possibly adding impetus to downward spiraling house prices, rather than modifying mortgages to make them more affordable to borrowers.

Besides the rigidity characterizing most mortgage contracts (Piskorski and Tchistyi, 2010; Campbell, 2013; Piskorski and Seru, 2018) and restrictions imposed by securitization on servicers' ability to modify mortgages, which may be significant, servicers face trade-offs inherent to the current servicing model that may lead to more foreclosures.[4] For example, Aiello (2022) documents that financially-constrained servicers of private label (non-agency) securitization (PLS) deals aggressively pursued foreclosure during the mortgage crisis to the detriment of mortgage-backed security (MBS) investors due to their inability to make advances to investors to cover missed mortgage payments, as required under PLS servicing agreements. Furthermore, Kruger (2018) argues that servicers typically have broad discretion to modify loans but

[1] As average house prices fell by 27.4% from July 2006 to February 2012 based on the S&P/Case-Shiller U.S. National Home Price Index, the share of mortgages 90 days or more in default jumped from 1.5% in 2006Q3 to 9.5% in 2010Q1 before starting a slow decline (Federal Housing Finance Agency). Approximately, 5.3 million mortgages entered the foreclosure process between 2008 and 2012 (Emmons, 2020) – foreclosures peaked in 2009 before returning to pre-crisis levels at the end of 2012 (Dharmasankar et al., 2016).

[2] Fore example, Gabriel et al. (2021) estimate that the California Foreclosure Prevention Laws (CFPLs) created $300 billion in housing wealth by preventing 250,000 foreclosures.

[3] A short sale is a lender-approved sale of the property at a price that is lower than the mortgage balance. Servicers can also decide to do nothing with the hope that the loan will self-cure. However, prolonged delinquency ultimately leads to a modification or a forced sale.

[4] Foreclosure could also be optional for investors because few delinquent mortgages self-cure and delaying foreclosure may lower proceeds from the sale of the property due to worsening housing market conditions.

find foreclosure more beneficial because servicing agreements provide no incentives for loss mitigation whereas foreclosure costs are reimbursed. Our study contributes to this literature examining servicer behavior during default remediation by highlighting another trade-off that servicers face at this critical moment due to the current servicing compensation structure. We show that the economics of servicing causes servicers to selectively choose modifications that protect their own financial interests, leading to fewer loan renegotiations.[5]

The residential mortgage market serves millions of households and investors. Servicers, who are in charge of payment processing, account management, and default remediation, power this key sector of the economy. They even play a bigger role in the PLS market because securitization severs the link between lenders and borrowers. Servicers are selected by the deal sponsor (issuer) but are responsible to a trustee, hired by the issuer to monitor all aspects of the deal on behalf of investors.[6] Servicers receive a fixed servicing fee rate paid monthly on the outstanding balance of the mortgages under management as compensation for account management. Servicing contracts don't compensate loan renegotiation (Kruger, 2018), associated costs are normally charged to borrowers. Servicing fees are initially set by deal issuers but likely renegotiated with servicers – we only observe final servicing fees in our data.[7] Servicing fee payments, which represent the bulk of servicers' income, are highly sensitive to borrower behavior because mortgage termination due to default or prepayment reduces the loans under management used to compute these payments. Unlike with prepayments, servicers have an active role in notifying default to borrowers, renegotiating mortgage terms if they choose, and initiating foreclosure proceedings.

This study investigates whether the fixed servicing fee structure affects servicer behavior during default remediation given inherent agency problems plaguing the relationship between

[5]As the absence of widespread foreclosures during the COVID-19 pandemic shows, the incentive problem discussed in this paper is more acute in the private mortgage market where servicers unilaterally decide which mortgages get renegotiated and often deliver fewer modifications than socially desirable. In addition to providing substantial economic assistance during COVID-19, as the guarantor of most mortgages issued today, the government was able to effectively forestall massive foreclosures through temporary mortgage payment forbearance (Cherry et al., 2021).

[6]We use the terms "*issuer*" and "*sponsor*" interchangeably to refer to the entity that aggregates mortgages and issues mortgage-backed securities. In reality, the issuer is often a separate legal entity fully-owned by the sponsor.

[7]Servicers also earn additional interest income on collected mortgage payments and keep ancillary fees paid by borrowers. Based on our discussions with industry insiders, issuers auction mortgage servicing rights (MSRs) to capture a portion of these incomes that would be internalized if servicing is kept by the issuer. The auctioning of MSRs may also serve the purpose of fine-tuning servicing costs. Section 2.3 discusses servicer compensation.

servicers and investors in the PLS market. Contractually, servicers have a duty of care to security investors when addressing mortgage delinquencies.[8] However, servicers' interests to optimize their own cash flows may conflict with their obligation to investors. For example, it may be in the best interest of servicers to keep delinquent mortgages alive as long as possible and accrue unpaid servicing fees because their claims take precedence over investors' rights to foreclosure sale proceeds.[9] Absent incentive problems, servicing fees should normally be immaterial to servicers' loss mitigation efforts after controlling for mortgage characteristics, borrower attributes, and market conditions. However, self-interest may lead servicers to take advantage of the compensation structure to the detriment of security investors by modifying mortgages paying high servicing fees. At issue is the commingling of payment processing and default remediation in the home mortgage market.

Our sample consists of deals issued in the 5-year period from 2002 to 2006 inclusive, which encompasses most of the housing market boom and the underlying mortgage credit expansion spurred by a surge in non-conforming loans and the growth of the PLS market.[10] Our sample consists of jumbo, Alt-A, and subprime home mortgages collateralizing roughly 2,800 non-agency deals.[11] The average servicing fee in our sample is 36.6 basis points (bps). Even though we observe some clustering of servicing fees in the PLS market, in contrast to the conforming mortgage market, there is significant heterogeneity in servicing fees across deals and within deal asset types. We exploit these variations in servicing fees to assess the effects of the fixed fee structure on servicer behavior during loss remediation. But despite the crucial role servicing plays in housing finance, little is known about the determinants of servicing fees. To lie the foundations for our examination of servicer behavior and further motivate our analysis, we first test sensible predictions about possible factors affecting servicing fees, such as loan

[8] Servicers are agents of "absentee" investors. This principal-agent relationship is fraught with agency problems because investors and their representative, the trustee, cannot observe the efforts deployed by servicers during default remediation and do not know the best option to pursue given the borrower's circumstances.

[9] Even though servicers are required to make interest-free advances to investors for missed mortgage payments, they may still be better off delaying foreclosure.

[10] Non-conforming mortgages are mortgages that do not meet the underwriting requirements of the government-sponsored enterprises (GSEs), namely the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation and (Freddie Mac), for repurchase and are therefore securitized by private deal issuers.

[11] Jumbo loans are similar to (prime) loans purchased by GSEs, except that they exceed their loan guarantee limits. Alt-A stands for alternative income documentation. These are mortgages to relatively creditworthy borrowers who did not meet the GSEs' income documentation requirements. Subprime loans are loans to borrowers who did not meet the GSEs' credit and income requirements.

characteristics, deal conditions, and servicer and issuer attributes. However, this part of the study does not seek to establish causal relationships but rather explores correlations between servicing fees and potential determining factors.

As expected, we show that servicing fees are negatively related to mortgage quality, whether proxied by interest rate or borrower credit score, reflecting the lower probability of servicing termination. A one-standard-deviation increase in credit score corresponds to a 2.75-bp (7.5%) decrease in servicing fees. As a result, servicing fees are higher in non-recourse states due to a higher propensity for default in those states. In addition to reflecting expected default, servicing fees are also positively related to prepayment risk. Furthermore, longer maturity loans and larger loans are associated with lower servicing fees likely due to the fixed fee structure. We also find that servicing fees vary with the deal structure. They are lower when the issuer is the servicer, which could be due to issuers maximizing interest passed through to security investors, thus security prices. Servicing fees also seem to decrease with servicing allocation, suggesting that payment processing, which is subject to economies of scale, largely determines servicing fees. Finally, we find a positive correlation between servicing fees and the intensity of default in outstanding securitization pools.

Next, we examine whether incentive issues associated with the fixed compensation structure affect servicer behavior during default remediation. First, we show that servicers are more likely to modify mortgages paying higher servicing fees. On average, a one-standard-deviation increase in servicing fee is associated with a 9.5% increase in the likelihood of a 90-day delinquent loan getting modified. Servicers also tend to modify these loans sooner. Obviously, such modifications benefit servicers by extending the life of loans generating a large share of their servicing revenues. However, it is unclear whether these decisions are optimal from the investors' perspective because these modifications are not less likely to redefault. Furthermore, servicers are more prone to such behavior when they act as trustees and are therefore responsible to themselves rather than to an outside overseer.

In addition to enacting self-serving modifications, servicers also minimize the negative impact of foreclosures on operating cash flows by delaying the foreclosure of previously modified loans that become severely delinquent again. The likelihood of a previously modified loan that becomes 120-day delinquent getting foreclosed is 18% lower than that of a non-modified loan

with a similar default status. By delaying the foreclosure of modified loans, servicers buy themselves valuable time to recover modification costs because their claims against foreclosure sale proceeds take precedence over investors' rights to those proceeds. These delayed foreclosures could damage the interests of investors because distressed properties lose value over time.

Our analysis likely identifies causal effects of servicing fees on servicer behavior, rather than mere correlations, due to the significant time lag between when servicing fees are set and the observed servicer behavior and our saturated model specifications. However, we formally check that our findings do not suffer from endogeneity bias using three approaches. First, we match loans paying high servicing fees to those paying lower fees at the servicer level using propensity score matching (PSM) and show that servicers are more likely to modify loans in the high servicing fee sub-group and delay the foreclosure of modified loans that redefault. Since our PSM approach is not immune to unobservable factors affecting identification, we also use a fuzzy regression discontinuity approach and a quasi-experiment method as alternative identification strategies. After documenting a significant jump in servicing fees at the 80% LTV threshold, we construct buckets around that LTV threshold and use regression discontinuity to assess differences in modification between the two groups of loans. Our full and matched sample estimations show that servicers were more likely to modify loans in the higher servicing fee buckets. Our quasi-experiment focuses on changes in servicing. This is probably our cleanest identification strategy because the new servicers took over well after servicing fees were set. Again, we find that new servicers are also more likely to modify loans with high servicing fees. These identification tests confirm that our analysis identifies causal effects of servicing fees on modification and foreclosure decisions. The literature examining loan modifications and incentive problems in servicing has not considered the effects of the current servicing compensation structure on servicer behavior during default remediation (Maturana, 2017; Conklin et al., 2019; Kruger, 2018; Aiello, 2022).

The contribution of this study is threefold. We fill a gap in the literature by documenting key stylized facts of servicing fees paid on non-agency securitization deals. We also contribute to the mortgage termination literature by showing that servicing fees reflect observable mortgage termination risks (Campbell and Dietrich, 1983; Quercia and Stegman, 1992; Kang and

Zenios, 1992; Kau and Keenan, 1995; Deng et al., 2000; Pavlov, 2001).[12] Finally, the recent mortgage crisis has spawned numerous studies examining potential incentive problems during default remediation (Mayer et al., 2009; Quercia and Ding, 2009; Piskorski et al., 2010; Agarwal et al., 2011; Maturana, 2017; Conklin et al., 2019; Kruger, 2018; Aiello, 2022). We add to that literature by showing that servicing fees affect modification and foreclosure decisions by servicers. Understanding these incentive issues could be useful when designing mortgage renegotiation programs requiring broad servicer participation.

After remaining dormant since the 2007/8 housing crisis, the PLS market is slowly coming back with most new issuances consisting of jumbo loans because these mortgages do not qualify for repurchase by the GSEs. The incentive problem raised in this study still remains because the compensation structure of servicers in the PLS market has not changed. Servicers still combine payment processing and default management for a fixed fee, which could alter how much effort they spend on default management and which loans get renegotiated.[13] Competition in mortgage servicing and securitization have led to servicing being priced at the marginal cost of payment processing and account management. Non-agency servicing contracts include no incentives for loan renegotiation (Kruger, 2018). The Dodd-Frank Wall Street Reform and Consumer Protection Act requires that servicers invest in foreclosure prevention.[14] However, requiring that financially constrained delinquent borrowers reimburse servicers for modification costs is unlikely to produce socially-desirable levels of loan renegotiations as servicers concentrate on economically beneficial modifications, whereas foreclosure costs are borne by investors. Unless the existing servicing model is revamped, loan renegotiation programs such as the Home Affordable Modification Program (HAMP) will be needed to incentivize servicers to offer more modifications to deserving borrowers to avoid massive foreclosures in the PLS

[12] LaCour-Little (2008) presents a detailed review of that literature.

[13] Servicing fees on 27 PLS deals issued between 2010 and 2015 (the end of our ABSNet data) range from 24 to 37.5 bps. For example, the servicing of *Sequoia Mortgage Trust 2013-1*, a $390-million deal issued by RWT Holdings in 2013 and underwritten by Barclays, is identical to pre-Great Recession servicing agreements. The deal consists of 391 loans divided in two pools with different servicing fees. It is managed by four servicers who are in charge of collecting and remitting loan payments, administering escrow funds for the payment of real estate taxes and insurance premiums, contacting delinquent mortgagors, supervising foreclosures in the event of non-remedied defaults, and generally administering the loans. (https://www.sec.gov/Archives/edgar/data/1176320/000114420413002646/v332142_424b5.htm)

[14] The Dodd-Frank Wall act requires that servicers invest in foreclosure prevention by providing information about mortgage loss mitigation options to delinquent borrowers, establishing policies and procedures for providing delinquent borrowers with continuity of contact with servicer personnel capable of performing certain functions, and evaluating borrowers' applications for available loss mitigation options.

market.[15] However, such programs may have limited success because servicers may lack the organizational structure and capacity to offer more loan renegotiations when needed. As the federal government shrinks its footprint in housing finance, thus leaving more room for the private sector, the incentive issues examined in this study will need to be addressed.

With the current compensation structure incentivizing servicers to expand payment processing capacity and minimally invest in default prevention and remediation, the continued commingling of these two functions should be questioned. Having servicers focus on payment processing and transferring severely delinquent mortgages to a special servicer as practiced in the commercial mortgage-backed security (CMBS) market could be a solution. However, special servicers and investors will need to be properly incentivized to produce socially-desirable levels of mortgage modifications, for example by using ex-post intervention programs calibrated to achieve those goals. Finally, the findings of this study are relevant to the debate about mortgage design. More flexible mortgage contracts, such as state-contingent mortgages allowing for automatic adjustment of contract terms (Piskorski and Seru, 2018), may reduce foreclosures and potentially lower the cost to taxpayers.

The rest of the paper proceeds as follows. Section 2 discusses mortgage servicing. Section 3 describes the data used in this study. Section 4 presents stylized facts about servicing fees. Section 5 investigates how servicing fees affect servicer behavior during default remediation and highlights inherent incentive problems. Section 6 concludes.

2 Mortgage Servicing

Private mortgage securitization is generally organized as follows. A deal *sponsor* (*issuer*), a large lender or a Wall Street firm, originates or purchases a pool of mortgages and then transfers them to a *depositor*, a fully owned legal entity specifically established for the sole purpose of issuing securities backed by the mortgages. Due to accounting and tax considerations, the depositor creates a bankruptcy-remote passive trust managed by an independent *trustee*

[15]The Home Affordable Modification Program was introduced by the federal government in 2009 to help homeowners who are at risk of foreclosure by providing affordable modifications that reduce monthly mortgage payments. The program, which expired at the end of 2016, relied on voluntary servicer participation, but it included incentives for participating servicers to encourage successful modifications – it also provided incentives to homeowners and mortgage investors. HAMP had specific eligibility requirements for homeowners and included strict guidelines for servicers.

who buys the mortgages from the depositor, issues the mortgage securities, and uses security proceeds to pay for the mortgages.[16] The issuer then hires a servicer(s), who will be responsible to the trustee, to manage the mortgages on behalf of the investors. As the overseer of the deal, the trustee has the power to replace servicers.

2.1 Servicer Role

Servicers have the responsibility to manage mortgage collateral pools as per the guidelines of the collateral pooling and servicing agreement (PSA).[17] Servicers perform two functions, payment processing and account maintenance, and default remediation.[18] Payment processing represents most servicers' bread-and-butter business. It includes sending out monthly statements to borrowers and processing mortgage payments, remitting funds to the trust, managing property tax and homeowner insurance escrow accounts, sending monthly account reports to credit bureaus, and providing customer support. This business line, which is subject to considerable economies of scale, is highly automated because it involves little interaction with borrowers, discretion, or expertise. In contrast, default management is less conducive to automation, for it often requires considerable servicer discretion and expertise, and direct personnel interactions with borrowers. However, it is the most critical servicing function for investors because servicer actions will affect how much cash is recovered from these loans, thus of the values of the securities.

As the above discussion shows, payment processing and default resolution are two distinct functions with little overlap in terms of operating requirements and economics. Generally, servicers heavily invest in payment processing to take advantage of existing economies of scale and only maintain minimal default remediation capacity due to the higher associated costs and the countercyclical nature of that business. Therefore, to adequately manage mounting mortgage defaults during housing market downturns, servicers have to ramp up default management,

[16] Generally, the depositor will hire an underwriter or a team of underwriters to assist with the structuring and marketing of the securities to investors.

[17] A PSA is a tripartite agreement signed by the issuer, the trustee, and the servicer. PSAs bind the actions of servicers by specifying their responsibilities and setting guidelines for permissible actions during default remediation (Eggert, 2007). Servicers are required to act in the best interest of security owners and must seek the trustee's approval for actions falling outside of their authority under the PSA. Some deals have one servicer, while others employ several servicers with a master servicer.

[18] In contrast, commercial mortgage securitizations use a servicer for payment processing and a special servicer who takes over the management of severely delinquent loans.

which could be a challenge during a deteriorating economic environment. Consequently, the economics of mortgage servicing puts a cap on the number of renegotiations that servicers can economically afford to undertake.

2.2 Servicer Compensation

Servicers have three sources of income: servicing fees, interest (float) income earned on mortgage payments before distribution to MBS investors and escrow account balances, and ancillary fees paid by borrowers. Technically, servicing fees only compensate servicers for payment processing and account management. They are fixed rates applied monthly on outstanding mortgage balances to determine servicing payments. For obvious reasons, issuers set servicing fees by pooling mortgages with similar characteristics rather than at the loan level.[19] Servicers deduct servicing fees from mortgage payments before remitting funds to trustees for distribution to investors. Unlike the other two servicer revenue sources, servicing fees are easily quantifiable, and generally represent a significant share of servicers' income (Cordell et al., 2008). For example, servicing fees represented 75% of Ocwen Financial Corporation's income in 2007 (Levitin and Twomey, 2011). We observe in our data a great deal of dispersion in servicing fees across deals and within deal asset types. The extant literature is largely silent on factors accounting for this heterogeneity in servicing fees. One goal of this study is to highlight key facts about servicing fees.

Servicers are also "entitled" to interest float earned on received payments. Homeowners typically make mortgage payments at the beginning of the month. However, servicers generally have until the 25^{th} of the month to transfer funds to the trustee. In the meantime, they deposit funds in interest-bearing accounts. Servicers also earn interest on property tax and homeowner insurance escrow accounts. The amount of float income depends on interest rates. Float income is generally much smaller and less predictable than income from servicing fees. For example, this income source only accounted for 9% of Ocwen's income in 2007 (Levitin and Twomey, 2011). As an integral part of cash flows generated by the mortgages, interest float technically

[19]For example, Merrill Lynch Mortgage Investors Trust Series 2206-A1 uses three servicers and pays two different servicing fees, whereas Washington Mutual's WaMu Mortgage Pass-Through Certificates Series 2006-AR16 employs one servicer but divides the collateral into three pools, each paying a different servicing fee (https://www.sec.gov/Archives/edgar/data/809940/000095012306003943/y18182e424b5.txt and https://www.sec.gov/Archives/edgar/data/1317069/000095011706004730/a45299.htm)

belongs to the deal issuer and is kept by the issuer if servicing is handled in-house. When servicing is outsourced, issuers typically recover a portion of this income by having servicers bid for the MSRs. We discuss this in the next section.

The third income source consists of ancillary fees charged on delinquent loans for expenses not incurred by the servicer in the normal course of business (e.g., late payment and bounced check fees), and mortgage renegotiation costs – these expenses are charged to borrowers, whereas foreclosure costs are deducted from foreclosure proceeds. PSAs typically allow servicers to collect these fees from borrowers. Typically, this income source represents a small share of servicers' net earnings.[20] However, its countercyclical nature helps smooth servicing cash flows and may therefore affect servicer behavior during market downturns.

2.3 Allocation of Mortgage Servicing Rights

PLS deal issuers face two choices regarding mortgage servicing. They can keep servicing in-house by handling it themselves or transfer it and any associated rights to an external (unaffiliated) servicer. In-house servicing has the potential advantage of improving deal profitability by allowing the issuer to capture interest float and ancillary income.[21] Based on our data, issuers prefer to keep servicing in-house. The main drawback of in-house servicing is that the issuer will be responsible to investors after securitization. Furthermore, the issuer may have to expand into servicing if it is not already one of its core businesses.[22] Consequently, issuers have to assess the net benefit from capturing servicing cash flows, taking into consideration operating costs, including potential exposure to liability, and their strategic business objectives.

Alternatively, an issuer can transfer servicing rights to an outside servicer, which removes it from having to manage the mortgages after securitization. Even though this may be appealing from a strategic perspective, it may be economically unattractive because of the potential loss

[20] For example, gross ancillary fee income represented nearly 15% of Ocwen's gross income in 2007 (Levitin and Twomey, 2011). Though unknown, the net amount after accounting for associated operating expenses would be much smaller.

[21] The following back-of-the-envelope calculation illustrates this point. Let us assume that a $500-million MBS deal is composed of 5%, 30-year fixed-rate mortgages. Let us further assume that the monthly payments of $2,684,108 are received on the 5^{th} of every month and transferred to investors at the end of the month and that the short-term risk-free rate is 2%. Under these assumptions, the present value of interest float alone discounted at 5%, assuming no default and a 15-year average life, amounts to $698,000, which represents 14 bps of the deal amount or 6% of the issuer's income if it earns a 25-bp spread from the deal.

[22] Issuers with no servicing capability may still elect to keep MSRs and hire a sub-servicer for a nominal fee, for example, $65 per loan annually.

of interest float and ancillary income. To capture a share of these incidental servicing revenues, issuers generally auction servicing rights using brokers, such as Mountain View Financial Solutions. How much a servicer is willing to pay for these rights will depend on its valuation of net servicing cash flows after operating expenses. However, servicer bids largely represent the share of incidental incomes they are willing to give back to issuers because servicing fees are set close to the marginal cost of servicing – servicer bids could also reflect adjustments to servicing fees. The auctioning of servicing rights reduces servicing profits, which may affect how much effort servicers are willing to spend on problem loans and which loans receive their attention.

3 Data

The mortgage data used in this study are from ABSNet Loan, a comprehensive non-agency mortgage origination, performance, and securitization database compiled by Lewtan, a Moody's Analytics company. ABSNet provides detailed loan-level information on loans packaged into PLS deals. It sources, normalizes, and analyzes non-agency mortgage data reported by servicers and trustees that provide granular information on a broad array of loan and deal attributes. The database covers approximately 90% of the private-label market. It contains millions of loans collateralizing roughly 7,000 deals.

Our initial sample consists of deals issued in the 5 years from 2002 to 2006 inclusive, a period of considerable expansion in mortgage lending and securitization, particularly in the non-agency mortgage finance space.[23] We apply the following filtering criteria to derive our study sample. First, we drop second liens; home equity lines of credits; loans with missing states; loans with a missing number of units or more than 4 units; loans originated in Puerto Rico, Guam, Hawaii, and the U.S. Virgin Islands; loans with an original balance of less than $25,000 or greater than $ 5 million; and loans originated before 2000.[24] out Next, we exclude loans with missing servicer or servicing fee information and servicers with less than 100 loans.

[23]The ABSNet database is sparsely populated prior to 2002 since the private MBS market was relatively small. The study ends in 2006 because PLS issuances stopped at end of 2007 and we need enough time to observe the performance of the mortgages in our sample and modification and foreclosure decisions by servicers before federal intervention programs aimed at reducing foreclosures.

[24]The loan amount thresholds are used to address potential data entry errors; they do not affect our findings.

After further cleaning the data of obvious reporting errors, we end up with 2,789 jumbo, alt-A, and subprime deals collateralized by 6,372,443 loans.[25] Our study sample includes 75 servicers, 1,687 non-missing lenders, 63 issuers, and 7 trustees. Table A.1 breaks our sample by loan origination year in panel A and by deal type in panel B. About 92% of our sample was originated in the 4-year period from 2003 to 2006 inclusive. Our sample reflects the considerable surge in non-agency mortgage originations during that period.

To construct our variables of interest in this study, we take advantage of ABSNet's loan performance data, which track the history of each loan from its securitization date by recording monthly payment, loan balance, current interest rate, and delinquency status (30/60/90/120/150$^+$ day delinquencies). Crucially, the performance data also capture servicer names and servicing fees at the loan level monthly. For the purposes of this study, we use servicing fees and servicer names recorded in the first monthly reports after securitization.[26]

Table 1 presents loan-level summary statistics. Servicing fees range from 12 to 54 bps with a mean of 36.6 bps and two peaks at 25 and 50 bps (Figure 1). The one at 25 bps corresponds to jumbo and Alt-A deals, whereas the 50-bp peak relates to subprime deals – this difference in fees is largely due to the average difference in mortgage quality between the two groups of loans.[27] More importantly, the observed heterogeneity in servicing fees goes beyond variations across deal asset types. For more than 25% of our sample, servicing is priced outside of these two modal values. Panel A of Table 2 reveals a significant increase in servicing fees over the study period as lenders relaxed lending standards to attract riskier borrowers entering the booming housing market. We exploit this heterogeneity in servicing fees in this paper.

[25]Our initial sample of first-lien loans secured by 1- to 4-unit properties in deals issued between 2002 and 2006 consisted of 7.1 million loans. After removing observations with missing values for the variables in Table 1 and servicers with less than 100 loans, we end up with a final sample of approximately 6.37 million loans. Our sample is evenly split between jumbo, Alt-A, and subprime deals. Asset classifications are assigned by ABSNet at the deal level, rather than loan level, to capture the general characteristics of mortgages collateralizing each deal.

[26]For the vast majority of our sample, this information is in the first monthly performance report after securitization.

[27]Figures A.1 in Appendix show the distribution of servicing fees by deal asset type.

4 Stylized Facts About Servicing Fees

4.1 Methodology

We expect servicing fees to vary with mortgage quality and deal features. Consequently, we estimate the following reduced-form model.

$$ServFee_{lisd} = \mathbf{X}_l'\beta + \mathbf{D}_d'\gamma + Location + OrigYear + Issuer + Vintage + \xi_{lisd}\ . \tag{1}$$

The dependent variable, $ServFee_{lisd}$, is the servicing fee agreed to between the issuer (i) and the servicer (s) for loan l of deal d, as reported in the first ABSNet monthly loan performance report following securitization. The vector $\mathbf{X}$ consists of loan characteristics at securitization that likely determine servicing fees. We use the loans' expected probabilities of default and prepayment in lieu of loan characteristics in alternative model specifications.[28] The vector $\mathbf{D}$ contains deal-level control variables, such as deal asset type, to account for differences in average servicing fees across various deal types. Our model also includes issuer fixed effects ($Issuer$) to account for time-invariant issuer attributes, such as issuer type or specialization, and turn off variations in servicing fees due to issuer heterogeneity.[29] We also include property location (CBSA) fixed effects ($Location$) to account for time-invariant local risk factors affecting mortgage termination risks. Location fixed effects also take care of variations in servicing fees across states, but we separately estimate the effect of differences in foreclosure laws on servicing fees, thus mortgage rates. We neutralize variations in mortgage underwriting stan-

[28] Following Adelino et al. (2017) and Ambrose et al. (2019), we use the mortgages' expected 6- and 12-month default and prepayment probabilities at securitization. We compute expected (ex-ante) default and prepayment probabilities for each loan using only information available at securitization. For each deal, we identity all loans that are in deals issued in the 12-month period ending 6 or 12 months prior to securitization – we refer to these loans as the prediction sample. Then, we estimate our default and prepayment models on the prediction sample using the following linear probability model (LPM):

$$Pr(Outcome_l = 1) = \mu + \mathbf{M}_l'\,\rho + \varepsilon_l \tag{2}$$

where $Outcome_l$ is either a default or prepayment binary variable indicating whether loan l of the prediction sample has defaulted or prepaid during the 6-month or 12-month period after the securitization month. $\mathbf{M}_l$ is a vector of loan and property characteristics at securitization that is similar to $\mathbf{X}$ of Equation (1). We calibrate our expected default and prepayment models and then calculate each loan's predicted probabilities of prepayment and default over 6 and 12 months following securitization. In addition to LPM estimates, we also compute non-linear estimates using probit.

[29] We do not include servicer fixed effects in our baseline model because servicing fees are technically set by issuers. But to accommodate potential servicer influence, we present regressions with servicer fixed effects in the appendix.

dards over time using mortgage origination-year fixed effects ($OrigYear$). Finally, our model includes deal issuance-year fixed effects ($Vintage$) to control for unobservable time-invariant factors affecting servicing fees at deal issuance. The last element of Equation (1), ξ, represents error terms.

4.2 Empirical Results

Panel A of Table 1 reports the descriptive statistics of the elements of **X**. These variables are commonly used in the literature to model mortgage termination risks, which are key determinants of servicing cash flows. They include credit score (FICO), interest rate, original loan term, loan balance at securitization, combined loan-to-value (CLTV) ratio, occupancy status, seasoning (the time elapsed between origination and securitization), loan documentation type, loan purpose, interest rate type, debt-to-income (DTI) ratio, property type, and the presence of prepayment penalty, negative amortization, interest-only, or a final balloon payment. The composition of our sample is consistent with mortgages originated during that period, as evidenced by the large share of refinancing and adjustable-rate mortgage (ARM) loans. Our sample also contains a large share of interest-only, prepayment penalty, and low- and no-income documentation loans. Panel B reports expected 6- and 12-month linear (OLS) and nonlinear (probit) default and prepayment probabilities. The vector of deal control variables (**D**) used in some specifications includes the issuer-servicer relationship, servicer deal allocation (the share of loans allocated to each servicer), and servicing portfolio performance (average delinquency rates at the servicer level). Our model also includes asset-type fixed effects to account for differences in servicing fees across deal types. Consequently, our estimations rely on variations in servicing fees within, rather than across, deal asset types, which are of smaller magnitude.

4.2.1 Collateral Characteristics and Servicing Fees

First, we consider the relationship between servicing fees and certain mortgage characteristics. Lower quality mortgages should pay higher servicing fees because they are more likely to default and go into foreclosure, which leads to the termination of servicing, thus limiting the ability of servicers to recover fixed servicing costs and other expenses associated with the boarding

of loans onto their computer systems.[30] We use two measures of mortgage quality, interest rate and credit score (FICO), which together give the overall quality of a mortgage. Mortgage features associated with higher servicing cash flows may also affect servicing fees. Everything else the same, larger and longer-maturity mortgages will likely generate more servicing income because servicing costs are not necessarily increasing along those dimensions. Figure 2 and Panel B of Table 2 show that servicing fees decrease with credit score and are positively related to mortgage rates, which decrease with credit score. Panel B also indicates that servicing fees are negatively correlated with loan term but seem to have no significant relationship with loan amount, even though Figure 2 shows the predicted negative relationship. Figure 2 also suggests that servicing fees are positively related to CLTV. However, the preponderance of loans with CLTV between 80 and 100%, where the curve flattens, will likely affect the significance of the relationship in a regression setting. Overall, these unconditional results support our predictions.

Next, we explore these relationships using Equation (1) and report our results in Table 3. In Column (1), we abstract from issuer heterogeneity and differences across collateral asset types. These results confirm our unconditional results. Servicing fee is negatively related to credit score with a one-standard deviation increase in credit score corresponding to a 2.74-bp decrease in servicing fee or 7.5% relative to the mean servicing fee.[31] As predicted, servicing fee is also positively related to interest rate, which is a more comprehensive measure of mortgage quality. A one-standard deviation increase in interest rate by 1.69 percentage points (pp) corresponds to an increase in servicing fee of 2.4 bps or 6.6%.[32] Column (1) also shows that variables associated with higher servicing cash flows, loan amount and maturity, negatively affect servicing fees. Overall, these results confirm our predictions.[33]

Column (2) reproduces the specification in column (1), except for the inclusion of a dummy

[30] This largely explains why agency deals pay lower servicing fees. These deals securitize bundles of mortgages conforming to the GSE's strict underwriting requirements that are commonly referred to as prime mortgages. But lower servicing fees on agency mortgages could also partly reflect the greater bargaining power of the GSEs who securitize the bulk of those mortgages.

[31] 74 x 0.037 = 2.74 bps or 7.5% relative to the average servicing fee of 36.6 bps.

[32] 1.69 x 1.438 = 2.43 bps or 6.6% at the mean.

[33] The untabulated coefficients of the control variables also have intuitive interpretations. Variables indicating a higher likelihood of early mortgage termination (e.g., refinancing mortgage, ARM, prepayment penalty, balloon structure) are associated with higher servicing fees. Also, multi-unit residences, which tend to be investment properties, are associated with higher servicing fees as compared to single-family residences.

variable identifying recourse states in lieu of location fixed effects. Recourse increases the cost of default for borrowers, thus lowering their propensity to strategically default.[34] If this intuition is correct, loans from recourse states should command lower servicing fees, everything else the same. Column (2) shows that recourse is associated with 0.51-bp (1.4%) decrease in servicing fee. Since servicing fees are priced in mortgage rates, this result suggests that borrowers indirectly pay for non-recourse protection in the form of higher mortgage rates – Ghent and Kudlyak (2011), who the opposite result, also argue that recourse laws should negatively affect interest rates. The coefficients of the remaining variables are identical to the estimates in Column (1).

Column (3) adds issuer fixed effects in the model in Column (1) to control for time-invariant issuer characteristics. Thus, this estimation explains variations in servicing fees at the issuer level. Despite this restriction, our previous findings hold. Mortgage quality is still negatively correlated with servicing fees, with the coefficients of interest rate and credit score remaining largely unchanged. Furthermore, loan amount and maturity have the same effects as before. Our most restrictive specification in Column (4), which we adopt as our baseline model, includes both issuer and deal asset type fixed effects. Our variables of interest, credit score and interest rate, have the same relationships with servicing fees as before, but the associated coefficients are lower because we now capture variations within asset type. Our findings are unchanged when we finely control for issuer heterogeneity using issuer-location (CBSA) fixed effects in Column (5). In summary, the results in Table 3 establish that servicing fees decrease with mortgage quality, loan amount, and loan term.[35]

Loan quality determines servicing fees because default could cause the termination of servicing cash flows.[36] But default is not the only relevant risk factor; prepayment also terminates servicing, unless the loan is refinanced and reassigned to the same servicer.[37] Consequently, all else the same, servicing fees should be positively related to both expected mortgage default

[34]Recourse laws allow lenders to go after borrowers' assets for any remaining loan balance after foreclosure. Strategic default refers to a borrower choosing to default when the value of the property falls below the loan amount, even though he can afford the mortgage payments.

[35]Equation (1) is predicated on the assumption that issuers set servicing fees when structuring mortgage securities, taking into consideration the quality of the underlying mortgages. We use servicer fixed effects in Table A.2 to accommodate possible interaction between issuers and servicers. Our findings are unchanged.

[36]Servicing fees could therefore proxy for loan quality as Diop and Zheng (2022) argue.

[37]As the origination of mortgage products with high prepayment risk surged during the latter part of the mortgage credit boom, prepayment risk became a major concern in the PLS market (Agarwal et al., 2012).

and prepayment. We test this hypothesis in Table 4 – we compute the mortgages' expected 6-month probabilities of default and prepayment at securitization as described in Footnote 28. The first two columns show that servicing fee is positively related to expected 60- and 90-day expected defaults from linear (OLS) or nonlinear (probit) models in panels A and B, respectively. These results persist when we include expected prepayment risk in columns (3) and (4), which is also positively related to servicing fee.[38]

It is possible that the trend in servicing fees reported in Panel A of Table 2 stems from the types of mortgages originated during that period. It is widely documented that lenders issued riskier, exotic mortgages over time to meet growing mortgage security demand, fueling in the process the housing market boom (Keys et al. (2009); Agarwal et al. (2012); Krainer and Laderman (2014); Gartenberg (2014); Di Maggio et al. (2019)). Normally, the explanatory variables included in our servicing fee regressions should take care of differences in mortgage quality and changes in underwriting standards over time. But to dispel possible concerns that differences in mortgage products originated during that period drive our results, we divide our sample by mortgage types (i.e., FRM, ARM, purchase, refinancing, owner-occupied, and non-owner occupied mortgages) and re-estimate Equation (1) for each mortgage type separately. Panels A and B of Table 5 confirm that servicing fee is negatively correlated with mortgage quality, loan balance, and loan term, and increases with expected default and prepayment within each mortgage type – we omit asset type fixed effects because there is no variation in asset type within mortgage types.[39] Therefore, it is unlikely that the origination of riskier mortgages during the latter phase of the housing boom explains our findings from the pooled regressions in Table 3 and Table 4. We summarize these results with the following stylized facts.

Stylized Fact 1: *Mortgage servicing fees decrease with loan quality. More broadly, servicing fees are positively related to mortgage termination risks, including expected prepayment.*

Stylized Fact 2: *Due to the fixed-rate structure used, servicing fees decrease with loan amount*

[38]Our findings are unchanged when we include servicer fixed effects (Table A.3) or servicer-issuer pair fixed effects. Furthermore, untabulated results also show that servicing fee is positively related to expected 12-month default and prepayment at securitization.

[39]Our findings generally hold within deal asset type as well, but as expected, the effects are largest for subprime deals and smallest for jumbo deals.

and maturity.

4.2.2 Deal-Level Variations in Servicing Fees

Independent of loan characteristics, deal features may have contributed to the heterogeneity in servicing fees observed in the data. In this section, we explore the role of servicing allocation, the intensity of delinquency in servicing portfolios, and in-housing servicing.

The Effects of Servicer Allocation and Portfolio Performance

Mortgage payment processing and account management, the core business of most servicers, is subject to significant economies of scale, which may lead to servicing fees decreasing with servicing allocation. The performance of servicers' current servicing portfolios may also affect servicing fees for two reasons. First, higher than expected defaults may increase servicing costs, hence servicers' reservation fees.[40] Secondly, more delinquencies could be a sign of deteriorating mortgage market conditions. As a result, servicers may update their beliefs about future default rates when negotiating servicing contracts. Consequently, we predict that servicing fees should positively correlate with the intensity of default in servicing portfolios, all else the same.[41]

We empirically test these two predictions in Table 6. Column (1) shows that servicing fees decrease with servicing allocation, which is supportive of the existence of economies of scale in servicing.[42] A one-standard deviation increase in servicer deal allocation is associated with a 2.4% decrease in servicing fee.[43] Columns (2) and (3) indicate a positive relationship between servicing fee and servicing portfolio performance, proxied by 150^{+}-day delinquency rates.[44] As expected, the addition of issuer fixed effects in column (4) greatly reduces variations in

[40] Despite the resulting increase in ancillary income, rising delinquencies may become economically unsustainable in the long run.

[41] Servicing fees are normally set prior to the auctioning of servicing rights. Therefore, this is an ex-post test of the relation between servicing fees and portfolio performance, rather than an ex-ante examination of the effect of portfolio performance on servicing fees.

[42] We compute servicing allocation as the squared ratio of the dollar amount of loans allocated to each servicer to the total loan amount, in a manner similar to computing Herfindahl-Hirschman index (HHI). Our findings are unchanged if we use the number of loans instead.

[43] 0.42 x 2.131 = 0.84 bps or 2.4% of the average servicing fee of 36.6 bps.

[44] We use the entire ABSNet Loan database to compute monthly portfolio delinquency rates for each servicer as the ratio of delinquent to total loan balances. Our finding is unchanged when we use 60- or 90-day delinquencies in our estimations. Based on the coefficient estimate in column (3), a one-standard deviation increase in portfolio delinquency is associated with a 2.4%-increase in servicing fees (0.06 x 7.149 = 0.43 bps or 1.2%).

servicing fees, thus leading to servicing allocation becoming insignificant and servicing portfolio performance being marginally significant. Consequently, as servicers face more defaults than expected, as was the case during the recent housing market downturn, they are unable to satisfactorily address delinquencies without incurring massive losses – we explore in the next section whether servicers select which mortgages to modify based on servicing fees. The following stylized facts summarize these findings.

Stylized Fact 3: *Servicing fee appears to decrease with servicing allocation due to existing economies of scale in payment processing and account management.*

Stylized Fact 4: *Servicing fees are positively related to the intensity of default in securitization deals, possibly to account for increasing servicing costs as mortgage quality deteriorates.*

In-House vs. External Servicing

Whether to keep servicing in-house should be an important consideration for issuers. In-house servicing allows issuers to keep the entirety of interest float and other servicing income, that are rightly theirs, rather than receive a portion of those revenues through the auctioning of mortgage servicing rights. As an added benefit to in-housing servicing, issuers can keep servicing fees low in order to maximize interest spreads passed through to investors, thus security prices.[45] Given the impact of servicing fees on deal profitability, we expect issuers to have a preference for in-house servicing so that they can keep servicing fees low. But as Mayock and Shi (2019) argue, lower servicing fees on issuer-serviced loans could also be evidence of adverse selection in servicing whereby issuers cherry-pick quality loans for servicing and therefore pay themselves low servicing fees.

As hypothesized, issuers appear to prefer in-house servicing. Panel C of Table 1 shows that issuers are one of the servicers in 60% of the deals in our sample. Panel A of Table 7 indicates that issuers with in-house servicing capability pay themselves 9.2% (3.33 bps/36.3 bps) less on average when they handle servicing. Next, we explore the impact of in-house servicing on servicing fees by adding to our baseline model a dummy variable identifying issuer-serviced loans (*In-House Servicing*) and report our findings in Panel B of Table 7. These estimations are

[45]Issuers may also prefer high servicing cash flows. However, the securitization business dictates that issuers maximize security prices, which requires keeping securitization costs, including servicing fees, low. In-housing servicing only makes sense though if servicing costs can be kept low relative to the competition.

restricted to issuers with in-housing servicing. As predicted, Column (1) shows that issuers pay themselves lower servicing fees. After accounting for differences in mortgage characteristics, we find that servicing fees on mortgages serviced by issuers are on average 2 bps (5.5%) lower than fees paid on mortgages handled by outside servicers. The size of the effect persists when we add issuer fixed effects in Column (2), but its statistical significance decreases due to a larger standard error.

We have advanced two possible explanations that are not necessarily mutually exclusive for why servicing fees may be lower on mortgages serviced in-house. Issuers may want to maximize deal proceeds (the income motive); alternatively, issuers may cherry-pick loans to service (adverse selection in servicing). We explore the potential channel in Column (3) by including an indicator variable identifying mortgages originated by issuers (*Issuer-Lender Affiliation*) and its interaction with our in-house servicing indicator. The control group consists of loans originated and serviced by other parties. The coefficient of *In-House Servicing* now captures the difference in servicing fees between loans originated by other lenders (purchased loans) that are serviced by issuers and similar loans that are externally serviced. Since issuers are unlikely to enjoy any significant information advantage on purchased loans, the negative sign of in-house servicing is therefore supportive of the income motive. We also find that servicing fees are lower on loans originated by issuers that are externally serviced as compared to similarly serviced loans originated by outside lenders, which is neither supportive of adverse selection in servicing by issuers nor the income motive. In contrast, the coefficient of the interaction term is positive and economically significant, indicating that issuers are not taking lower servicing fees on their own loans they service, which does not support the adverse selection motive. Even though the evidence overall points to the income motive, there could be other explanations for why issuers take lower servicing fees on average but not on their own loans. Since our goal remains to document stylized facts about servicing fees, we leave this question to future research. The following stylized fact summarizes these results.

Stylized Fact 5:*. Servicing fees appear to be lower on loans serviced in-house, which is apparently due to issuers maximizing interest passed through to securities investors.*

These stylized facts suggest that non-agency mortgage servicing fees are not arbitrarily set

by security issuers. Next, we explore how the fixed servicing compensation structure affects the behavior of servicers during default remediation.

5 Servicing Fee Structure and Servicer Behavior

5.1 Hypothesis Development

Loss mitigation is the most crucial function of PLS servicers. When considering alternative options, servicers are required to act in the best interest of security investors by choosing a course of action that maximizes security values. It has been argued that servicers are more prone to foreclose than modify delinquent mortgages irrespective of the impact on investors and borrowers because modifications are generally more costly to servicers with no guarantee of success (Mayer et al., 2009; Thompson, 2009, 2011; Levitin and Twomey, 2011). Even well-intentioned servicers may have difficulty identifying the optimal actions from the investors' perspective because they face information asymmetry regarding borrower circumstances and a potential moral hazard problem depending on the options they choose (Foote et al., 2008).

During loss mitigation, servicers have to decide between forbearance, modification, and immediate foreclosure, taking into consideration redefault risk, possible self-cure, housing market conditions, and PSA guidelines. Servicing fees should technically not factor into their decision.[46] However, self-interest on the part of servicers dictates that they consider servicing fees, along with loan renegotiation costs and the likelihood of recovering those costs.[47] From a servicer's perspective, modification only makes senses if the loan will remain current long enough afterward so that it can recover uncompensated modification costs, which could be substantial (Cordell et al., 2008). All else the same, servicing fees may therefore dictate which loans get modified because the higher the fee is, the shorter it takes to recover modification costs. This creates an incentive problem in loan renegotiation that has so far been overlooked in the literature. Investors may be worst off because loans with high servicing fees are riskier, thus more likely to redefault unless substantially modified and generate lower interest cash

[46] As showed, servicing fee is correlated with credit risk. But like original credit score, it would likely be a stale measure of credit risk because it would not reflect current borrower circumstances at default.

[47] Loan modification costs are charged to borrowers, not investors, which limits the ability of servicers to recover those costs, particularly if the loan redefaults soon after modification, which is often the case.

flows. Therefore, we make the following prediction:

H1: *All else the same, the current servicing structure incentivizes servicers to prioritize the modification of mortgages generating a large share of servicing income.*

For severely delinquent loans, foreclosure may be the only option, even though it often results in substantial losses for investors (Cordell et al., 2015). As with any action they undertake, servicers are likely to consider their own interests as well. Of importance to servicers when considering foreclosure are future servicing cash flows, any expenses incurred during loan renegotiation, and ongoing funding costs associated with advances made to investors for missed mortgage payments.[48] Servicing fees have two opposing effects on foreclosure. As we argue, servicers may try to extend the life of high-fee loans by offering modifications. For the same reason, they may also delay their foreclosure because it up to servicers to decide when to initiate foreclosure. This would lead to servicing fees being negatively related to foreclosure intensity. But the costs associated with such a strategy grows exponentially over time as servicers continue to make interest-free advances to investors. It will then come a point where net servicing earnings after accounting for the funding cost of advances will turn negative, thus forcing servicers to initiate foreclosure. Technically, the higher the servicing fee is, the longer the servicer can afford to delay foreclosure if their funding costs are low. Unlike large lenders, financially-constrained servicers may be forced to expedite foreclosures (Aiello, 2022). Therefore, the net effect of servicing fees on foreclosure becomes an empirical question.

Even though we cannot conclusively predict how servicing fee affects foreclosure, it is less problematic for modified mortgages that become delinquent again. One would expect that servicers, acting in the best interest of investors, would immediately foreclose on those loans. However, that view may be shortsighted, for it fails to consider previous modification costs incurred by servicers. Since these expenses are not reimbursed by investors, servicers may delay the foreclosure of modified loans in order to allow themselves sufficient time to recover those costs through servicing fees. Since modifications are likely to target high fee mortgages, as Hypothesis H1 predicts, servicers would therefore be more likely to delay the foreclosure of

[48]Servicers have to advance missed mortgage payments to investors as interest-free loans, provided that proceeds from the sale of the properties will be sufficient to repay advanced funds. Aiello (2022) shows that this was an important consideration during the foreclosure crisis.

those mortgages. Therefore, we make the following two predictions.

H2A: *All else the same, servicers will be less eager to foreclose modified loans that redefault soon after modification than mortgages with similar default status that were not modified.*

H2B: *Furthermore, the delayed foreclosure of modified mortgages that redefaulted will largely target those generating high servicing fees.*

5.2 Methodology

Following the mortgage termination literature (e.g., Conklin et al. (2019)), we adopt the models below to examine the behavior of servicers during loss mitigation.

$$\begin{aligned} Pr(Mod_{lsd}=1)/TMod_{lsd} &= \psi\, ServFee_{lsd} + \mathbf{X}_l'\gamma + \mathbf{\Theta}'\delta + OrigYear_l + Location_l \\ &\quad + Servicer_s + AssetType_d + \nu_l \qquad (3) \\ &\quad and \\ Pr(Fclos_{lsd}=1)/TFclos_{lsd} &= \phi\, ServFee_{lsd} + \eta\, Mod_{lsd} + \lambda\, Mod \times ServFee_{lsd} \\ &\quad + \mathbf{X}_l'\gamma + \mathbf{\Theta}'\delta + OrigYear_l + Location_l + Servicer_s \\ &\quad + AssetType_d + \zeta_l\,. \qquad (4) \end{aligned}$$

Equations (3) and (4) estimate the causal effects of servicing fees on modification and foreclosure decisions, respectively – the variable subscripts have the same meaning as previously. For each of these decisions, we analyze both the likelihood of servicers choosing that option using a linear probability approach and the timing of that decision.[49] Thus, the dependent variable of our modification model (Equation 3), takes two forms depending on the estimation: i) Mod_{lsd}, a dummy variable indicating whether a mortgage was modified during our observation window or ii) $TMod_{lsd}$, a right-censored variable measuring the time (number of months) elapsed between the first occurrence of default and modification or the end of the observation period. Similarly, in our foreclosure model (Equation 4), $Fclos_{lsd}$ is a dummy variable indicating foreclosure status and $TFclos_{lsd}$ measures the number of months from default to

[49] We model modification and foreclosure separately because servicers generally consider modification first and then resort to foreclosure after prolonged delinquency.

foreclosure.

As in Equation (1), $ServFee_{lsd}$ is the fee paid to the servicer and $\mathbf{X}$ is a vector of mortgage characteristics. The vector $\mathbf{\Theta}$ stands for housing market and macroeconomic conditions affecting modification and foreclosure decisions. Our foreclosure model is identical to the modification model, except for the inclusion of modification status (Mod_{lsd}) and its interaction with servicing fee ($Mod_{lsd} \times ServFee_{lsd}$) to test the predicted effects of modification on servicers' propensity to foreclose. Like our previous servicing fee model, both models include origination-year fixed effects ($OrigYear$), CBSA fixed effects ($Location$), servicer fixed effects, and deal asset type fixed effects ($AssetType$) to control for differences in deal characteristics, such as variations in PSA clauses affecting servicer behavior during loan renegotiation and unobservable deal features.[50] The servicer fixed effects allow us to precisely document how variations in servicing fees affect servicer behavior during this critical time.

5.3 Modification Decisions

Panel A of Table 8 tallies mortgage delinquencies within 12 months after securitization and related modifications 12 months after default. Roughly 623,000 loans (10% of our sample) were delinquent for 60 days or more, of which 388,000 (6% of our sample) were at least 90-day delinquent and 4.6% were severely (120 days or more) delinquent. On average, a mere 3% of delinquent mortgages were modified – Table A.4 shows that the rate of modification increases with default severity and then drops for loans that were 150-day plus delinquent. These low modification rates, which are similar to the findings of Conklin et al. (2019), confirms servicers' reluctance to renegotiate mortgages, which could be due to a number of reasons. Modifications are time-consuming and costly with no guarantee that borrowers will not redefault. Furthermore, servicers may be concerned about potential liability due to PSA restrictions on contract renegotiations. Panel B of Table 8 shows 24-month default and modification rates, which are almost twice as large as the rates observed over 12 months – this also transpires in Table A.4. These figures suggest that servicers, though timidly, increased the pace of modifications over time to address mounting delinquencies. This increased propensity to provide modifications

[50] Unlike in the servicing fee model (Equation 1), following the literature (Maturana, 2017; Aiello, 2022), we do not include issuer fixed effects in our modification and foreclosure regressions because issuer characteristics are unlikely to affect default.

also shows in the shorter average time elapsed between default and modification.

5.3.1 Likelihood of Modification

We test the impact of servicing fees on the likelihood of modification conditional on default using Equation (3). Table 9 reports 12-month modification regression results based on loans that defaulted within 24 months after securitization. The 60-day default results in Column (1) show that servicing fees had a positive effect on modification decisions. A one-standard deviation increase in servicing fee is associated with an increase in the likelihood of modification of 0.51 pp or 9.5%.[51] Furthermore, higher loan balance and longer remaining term are also associated with a higher likelihood of modification. The modification of loans with these characteristics certainly benefits servicers by extending servicing cash flows. As a validation of these findings, interest rate, LTV, DTI, prepayment penalty, and refinancing have the expected positive effect on the likelihood of modification, as documented in the literature (Conklin et al., 2019). Also, owner-occupied and single-family property loans, which tend to be less risky, are more likely to be modified, whereas balloon, ARM, and low documentation loans are modified less often. The insignificant effect of credit score at origination is not surprising because it is a stale measure of current borrower credit risk. As expected, loan modifications also respond to changes in housing and macroeconomic conditions. Modifications of 90-, 120-, and 150^{+}-day defaults in columns (2) to (4) confirm our 60-day default results. We find similar results when we restrict our sample to loans that defaulted within 12 after securitization (Table A.5).

Next, we explore whether securitization networks affect modifications. We focus this investigation on the servicer's affiliation with the trustee, who is in charge of monitoring servicing, and lenders, who may have private information on originated loans that could be useful for modifications (Conklin et al., 2019). To avoid unnecessary repetition, Table 10 only reports 90-day default results – the other default measures produce similar results. Column (1) confirms that servicing fees have a positive effect on servicers' propensity to modify delinquent loans after controlling for servicer-trustee and servicer-lender affiliations. It further shows that servicers are 69.5% (0.0454/6.53%) more likely to modify loans in deals where they act as trustees and 18.5% (0.0121/6.53%) more likely to modify loans they originated. The positive

[51] 12.63 x 0.0004 = 0.51% or 9.5% of the average modification rate of 5.37% (Table 8, Panel B).

effect of the servicer-trustee relationship on modifications may be due to servicers feeling less constrained when assuming trustee responsibilities, thus undertaking more modifications to extend servicing cash flows. As far as originated loans are concerned, servicers may have more information on those loans and therefore be in a better position to implement effective modifications as Conklin et al. (2019) show. But it is also possible that they modify these loans to avoid having to buy them back. However, the effect of servicer-lender affiliation is small as compared to that of servicer-trustee affiliation.

To shed more light on the motives behind these modifications, we interact servicing fee with our servicer-trustee and servicer-lender indicators in column (2). Now, the coefficient of servicing fee, which turns insignificant, applies to loans not originated by servicers in deals where they do not act as trustee. These results suggest that servicers are not solely focused on servicing fees when considering modifications; they also consider the affiliations highlighted in this section. The coefficient of the servicer-lender dummy is not statistically significant, indicating that servicers do not modify originated mortgages for the sole purpose of avoiding loan buybacks. Servicers concentrate their efforts on originated loans paying higher servicing fees. A one-standard deviation increase in servicing fee increases the likelihood of a servicer modifying a loan it originated by 11.6%.[52] Servicers also focus their modification efforts on high-fee loans when acting as trustee and the effect is relatively large. A one-standard deviation increase in servicing fee leads to 79.3% increase in the likelihood of modification.[53] These marginal effects seem large because the percentage of modifications undertaken by servicers is relatively small and a one-standard deviation change in servicing fees is relatively large (12.6/36.6=34.5%). For comparison purposes, a more modest 10% increase in servicing fee increases the probability of a servicer-originated loan being modified by 3.4% and that of a loan serviced by the trustee being modified by 23%. Thus, servicers acting as trustees are about 7 times more prone to take advantage of servicing fees when considering modifications.

The above results suggest that servicers use modifications to protect servicing cash flows. Even though it is difficult to evaluate whether investors benefited from these modifications, the much higher rate of modification when servicers act as trustee leaves no doubt about their

[52] 0.0006*12.63=0.76% and 0.76%/6.53%=11.6%
[53] 0.0041*12.63=5.18% and 5.18% /6.53=79.3%

intention. As Hypothesis H1 predicts, this evidence suggests that self-dealing by servicers, possibly to the detriment of security investors and borrowers.

5.3.2 Time to Modification

After showing that servicers modify loans that generate substantial servicing cash flows, we now consider whether the timing of these modifications reveals the servicers' true intention. If these modifications are driven by self-interest, servicers may expedite them for two reasons. First, the sooner the modifications are implemented, the higher future servicing cash flows. Furthermore, prompt action by servicers will reduce the negative effect of prolonged delinquency on borrowers' ability to remain current after modification.

To test this prediction, we estimate the time it takes servicers to modify defaulted loans. Table 11 summarizes our regression results for modified 60-, 90-, and 120- to 150^{+}-day defaults based on Equation (3) – we report the full results in Table A.6 of the appendix. Table 11 shows that time to modification is negatively related to servicing fee, the coefficient of servicing fee ranging in absolute terms from 0.005 to 0.014 depending on the estimation sample used. For example, a one-standard deviation increase in servicing fee corresponds to a 3.2% decrease in the time it takes to modify a loan that is 120 or more days in default.[54] The size of the effect is small because the economic value of receiving servicing payments a couple of weeks earlier is relatively small.

The above results, together with the positive effect of servicing fees on the likelihood of modification, suggest that servicers' default mitigation efforts are likely self-interested. The targeting of high servicing fees loans for modification appears suspicious, but we are unable to evaluate the full economic and social impact of these modifications. For economic and efficiency reasons, it may be unwise to advocate for the de-linking of mortgage origination and servicing after securitization.[55] But short of separating loan servicing and default management, not allowing the trustee to act as servicer would significantly limit potential agency problems in servicing during default mitigation.

[54] 0.0141 x 12.63 (Table 1) = 0.163/5.59 (Table 8) = 3.2% .

[55] Lenders may have an informational advantage in servicing their loans. Furthermore, lenders with servicing may sell their loans to mortgage aggregators without the servicing rights.

5.4 Foreclosure Decisions

Table 8 reports average foreclosure rates and time elapsed between default and foreclosure. As documented in the literature, servicers end up foreclosing the majority of loans that become severely delinquent. For example, about 70% of loans that were 90-day or more delinquent ended in foreclosure within 12 months, while only 3.2% were modified. It also appears that servicers quickly make up their minds about foreclosures. Servicers were on average at least twice as fast foreclosing than modifying loans that were 90 days or more delinquent. Borrowers were certainly negatively affected by this practice. However, it is unclear whether security investors are harmed by or benefit from the high foreclosure rate. Given the ruthlessness with which servicers decide foreclosures, one would expect that they would even be harsher on borrowers who have been given a second chance by having their loans modified but end up defaulting again.

Hypothesis H2A predicts that servicers may delay foreclosing on modified loans in order to buy time to recover modification costs. We identify the effect of servicing fee on foreclosure at the servicer level and account for mortgage origination year, location, and deal asset type. For the sake of brevity, we discuss the foreclosure of severely distressed loans since servicers are more likely to foreclose on those loans (Table 8). Table 12 reports the likelihood of foreclosure and the time to foreclosure of loans that were 120 days or more delinquent within 24 months after securitization.[56] Column (1) shows that loans with higher servicing fees are more likely to be foreclosed with a one-standard deviation increase in servicing fees corresponding to a 1.76-pp increase in the probability of foreclosure or 2.4% relative to the average foreclosure rate on that category of loans.[57] Though statistically significant, the effect of servicing fees on foreclosure is smaller than its effect on modifications. This is likely due to the two opposing effects of servicing fees on foreclosure discussed earlier.

As Hypothesis H2A predicts, column (1) also shows that the likelihood of modified loans that become 120-day delinquent getting foreclosed on is 13 pp or 17.7% (0.1303/0.7345) lower than that of non-modified loans. This large difference in foreclosure rates between modified and non-modified loans is unlikely to be a random occurrence or due to servicers selecting

[56] We report 150-day plus default results in Table A.7 of the appendix.
[57] 0.0014*12.6=1.76% and 1.76%/73.45%=2.4%

modifications resulting in more affordable payments (Ganong and Noel, 2020).[58] As discussed previously, it is puzzling why servicers would be more lenient toward borrowers who have already been given a second chance. One likely explanation is that servicers need time to recover modification costs, which are not reimbursed by investors. It is also possible that servicers were more informed about the circumstances of these borrowers during modification. However, information collected during modification may no longer be relevant, and conditional on the same default status, there should be no difference in foreclosure rate by modification status. This puzzling lower probability of servicers foreclosing on modified loans seems deliberate.

We further explore this question by interacting modification status with servicing fee in Column (2). These results confirm that servicing fees had a minimal effect on the foreclosure of non-modified loans. Servicers' propensity to delay the foreclosure of modified loans targeted loans paying high servicing fees. The time to foreclosure regression in Column (3) confirms these results. Servicers take longer to foreclose modified mortgages in general, with time to foreclosure increasing with servicing fees. Our foreclosure regressions based on 150-day defaults reported in Table A.7 in the appendix confirm these findings. In conclusion, these delayed foreclosures likely serve the interests of servicers since they lead to more servicing cash flows being claimed against foreclosure proceeds. Therefore, it is doubtful that they benefit investors.

5.5 Identification

The fact that default remediation takes place long after servicing is finalized should alleviate identification concerns. However, omitted variables bias could cause endogeneity between servicing fees and default remediation.[59] To address this problem, our models include a rich set of mortgage characteristics (captured at origination or updated), and relevant time-varying local

[58] ABSNet classifies modifications as capitalization (of past dues), multiple attributes modified, principal forgiveness, rate/payment change, or other. We find similar shares of types of modification among modified loans that were foreclosed, which tend to have higher servicing fees, and those that were not foreclosed. In fact, the share of rate or payment reduction modifications, which are more impactful according to Ganong and Noel (2020), is slightly higher on foreclosed modified loans.

[59] Simultaneity and reverse causality should not be a major concern. Servicing is finalized prior to securitization, while the servicer behavior examined in this study takes place many months later because only performing mortgages can be securitized and lenders are generally required to repurchase mortgages that default soon after securitization (Diop et al., 2022). We observe modifications and foreclosures over 12 months after default, which occurs on average 12 to 15 months after securitization depending on the default measure used. Furthermore, borrowers, not servicers, decide whether to default.

housing market and economic factors commonly included in default models since redefault is a major concern of servicers during loss mitigation. Furthermore, we employ a battery of fixed effects to improve identification. The asset type and servicer fixed effects partially control for PSA features restraining servicer action during default remediation. Affiliations between the servicer and the other parties, particularly the issuer and lenders, could also explain both servicing fees and actions taken by servicers during default remediation.[60] We observe and control for issuer and lender affiliations in Table 10. To further alleviate endogeneity concerns, we next test the robustness of our findings using propensity score matching (PSM), fuzzy regression discontinuity, and a quasi-experiment based on changes in servicing after securitization (Conklin et al., 2019).

5.5.1 Propensity Score Matching

For this exercise, we identify loans paying high servicing fees (50 bps or more) and match them with the remaining loans in our sample along several dimensions using propensity scores and examine differences in modification and foreclosure rates between the two groups of loans.[61] Table A.8 reports our first-stage probit estimation of the likelihood of treatment (being in the high servicing fee group) for our modification and foreclosure samples.[62] Our model includes the same set of explanatory variables and fixed effects used in our servicing fee regressions. We match loans at the servicer level using probability estimates derived from the first stage.

Panel A of Table 13 reports modifications of 90-day default loans. The top section shows that high servicing fee loans experienced a much higher modification rate. To control for small differences in loan characteristics after matching and time-invariant unobservables, we re-estimate our modification and time to modification models on our PSM sample using the specifications in Table 9 and Table 11 and report our findings in the bottom section of Panel A of Table 13. These estimations confirm that servicing fee is associated with a higher likelihood of modification and a shorter time to modification. Next, we examine the foreclosure of 120-defaults in Panel B. The top section shows no difference in foreclosure rates between treated

[60] As discussed, servicer-issuer affiliation may affect servicing fees and servicing, for servicers may be tempted to mitigate issuer liability to security investors. By servicing their own loans, lenders could use modifications to limit the risk of having to buy back loans that did not meet warranties and representations made to issuers.

[61] We use the Stata command *psmatch2* (Leuven and Sianesi, 2018) for our propensity score matching.

[62] For sake of space, we only report modification of 90-day defaults and foreclosure of 120-day defaults.

and control loans. However, previously modified loans with the same default status as non-modified loans were less likely to be foreclosed. Our re-estimation of the likelihood of and time to foreclosure on the matched sample in the bottom section produces similar results as the full-sample regressions reported in Table 12. Servicing fee increases the probability of a loan being foreclosed but is associated with a lower likelihood of foreclosure for modified loans.

5.5.2 Fuzzy Regression Discontinuity

Even though our matched sample analysis confirms the results from our full sample analysis, it is not immune from endogeneity due to unobservables. To address this potential concern, we adopt a fuzzy regression discontinuity approach at the 80%-LTV threshold.[63] For this exercise, we construct five narrow (2%) LTV buckets on the left and right of the 80%-LTV threshold and compute the average servicing fees for each bucket.[64] Figure 3 graphs average servicing fees in bps for the LTV buckets on the right and left of the 80%-LTV threshold. It reveals a significant jump in servicing fees from 34 to 43 bps at that LTV threshold. Next, we explore whether this discontinuity in servicing fees is associated with a higher rate of modification in the buckets on the right.

Table 14 reports our fuzzy regression discontinuity results. The variable *"Treated"* identifies loans in the high servicing fee buckets. The regressions in columns (1) to (3) only control for heterogeneity in servicing – we compare the first three buckets on either side of the discontinuity in Column (1) and then narrow our estimation sample to two buckets and then one bucket on either side. All three columns confirm that the likelihood of modification increases with servicing fee at the servicer level. To improve identification, the regressions in columns (1') to (3') reproduce the previous three regressions on matched samples based on the same PSM procedure as in Section 5.5.1.[65] Again, they confirm our previous findings – the estimate in column (3') is significant at 10%. Finally, we repeat the same exercise using our saturated model in Table 9, except for substituting *Treated* for *Servicing Fee*, on the matched samples. The effect of servicing fee on modification remains positive and stable as we narrow our es-

[63] We thank the editor and one of the referees for this great suggestion.

[64] The LTV buckets numbered 1 to 10 consist of 70<LTV≤72, 72<LTV≤74, 74<LTV≤76, 76<LTV≤78, and 78<LTV≤80 on the left and 80<LTV≤82, 82<LTV≤84, 84<LTV≤86, 86<LTV≤88, and 88<LTV≤90 on the right of the 80% LTV threshold.

[65] Except for credit score, we have a balanced sample on both sides of the LTV cutoff after matching.

timation window from three buckets to one bucket on either side of the LTV discontinuity – the estimate in column (3") becomes insignificant due to the small sample size and the large number of fixed effects used.[66]

5.5.3 Quasi-Experiment

The main identification concern in this study is that there may be unobservables affecting both servicing fees and how servicers handle default remediation later. Our third identification strategy directly addresses this concern by severing the link between servicer and servicing fee. To that end, following Conklin et al. (2019), we examine how changes in servicing fees affect loan modification by new servicers who took over servicing after securitization. This identification strategy relies on the fact that servicing fees are originally set for the life of the deal and that new servicers are selected by the trustee who represents the interests of investors, whereas original servicers are selected by the issuer.

To implement this strategy, we track the performance of each loan in our sample from its securitization date and identify changes in servicing. For the purposes of this robustness check, we focus our analysis on the 867,000 loans that became 90-day delinquently within 12 months after securitization that are examined in Column (2) of Table 9. The servicing of about 223,500 of those loans was transferred to new servicers. To improve identification, we match these loans at the servicer level using the same PSM approach as before. This produces roughly 117,500 loans involving 17 new servicers. We examine the effect of servicing fees on the likelihood of modification of these loans in Table 15 using the same specification as in Table 9. Column (1) reports regressions using current (new) servicer fixed effects only. The coefficient of servicing fee is positive but is twice as large as in Column (2) of Table 9 due to fewer fixed effects. Column (2) uses our saturated model specification. Again, servicing fees positively affect modifications by new servicers with the effect being one and half times larger than the estimate in Table 9. The final column of Table 15 restricts our estimation to changes in servicing with no change in servicing fee, which technically represents the ideal sample for identification purposes.[67] Not only does the positive effect of servicing on modifications

[66] Our fuzzy regression discontinuity methodology also confirms that time to modification decreases with servicing fees and that servicers are less likely to foreclose on previously modified loans.

[67] As noted earlier, servicing fees are relatively sticky due to a number of reasons; 96% of transferred loans

remain, but it is now twice as large as our previous full-sample estimate reported in Table 9. This result, which is based on a much small sample, suggests that our main findings are likely underestimated and not due to endogeneity.[68]

In summary, we recognize that it is difficult to firmly establish causality in non-experimental studies. The structure of the data used in this study reduces potential sources of endogeneity. Furthermore, the fact that all three identification strategies presented above confirm our findings suggests that we are identifying causal effects of servicing fees on servicer behavior during default remediation.

6 Conclusion

This study reviews the current servicing compensation structure in the PLS market. After documenting the key characteristics of servicing fees, the most important of which being that they increase with mortgage termination risks, we present disturbing evidence indicating that servicing fees partly drive mortgage modifications and foreclosures, likely to the detriment of mortgage security investors. Servicers benefit themselves by modifying loans paying high servicing fees and tend to delay their foreclosure to protect servicing cash flows. We present numerous tests confirming that the identified effects of servicing fees on servicer behavior are causal.

With mortgage servicing being primarily focused on payment processing and account management, servicers have the incentive to cherry-pick which loans to modify given their limited default management capacity, with servicing fees playing a major role in that decision. The PLS market is slowly regaining activity. As the government reduces its footprint in housing finance, thus leaving more room for the private market, the incentive issues highlighted in this study will need to be addressed. Despite the Dodd-Frank provisions aimed at reducing foreclosures, achieving high modification rates will remain a challenge under the current servicing system. Modifications will only work if they make the mortgages more affordable, which generally results in substantial losses for investors. Special servicing and targeted ex-post

involved no change in servicing fee.

[68] Untabulated results based on the same approach show that time to modification decreases with servicing fees and servicers delay the foreclosure of previously modified loans.

government interventions will certainly improve renegotiation outcomes. However, innovative mortgage designs whereby investors benefit from future house price recovery may be needed.

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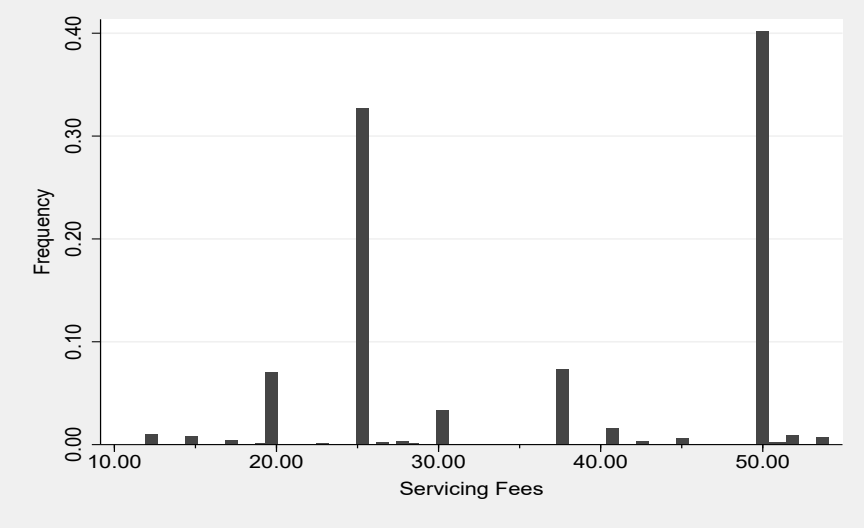

Figure 1: Distribution of servicing fees in basis points (bps)

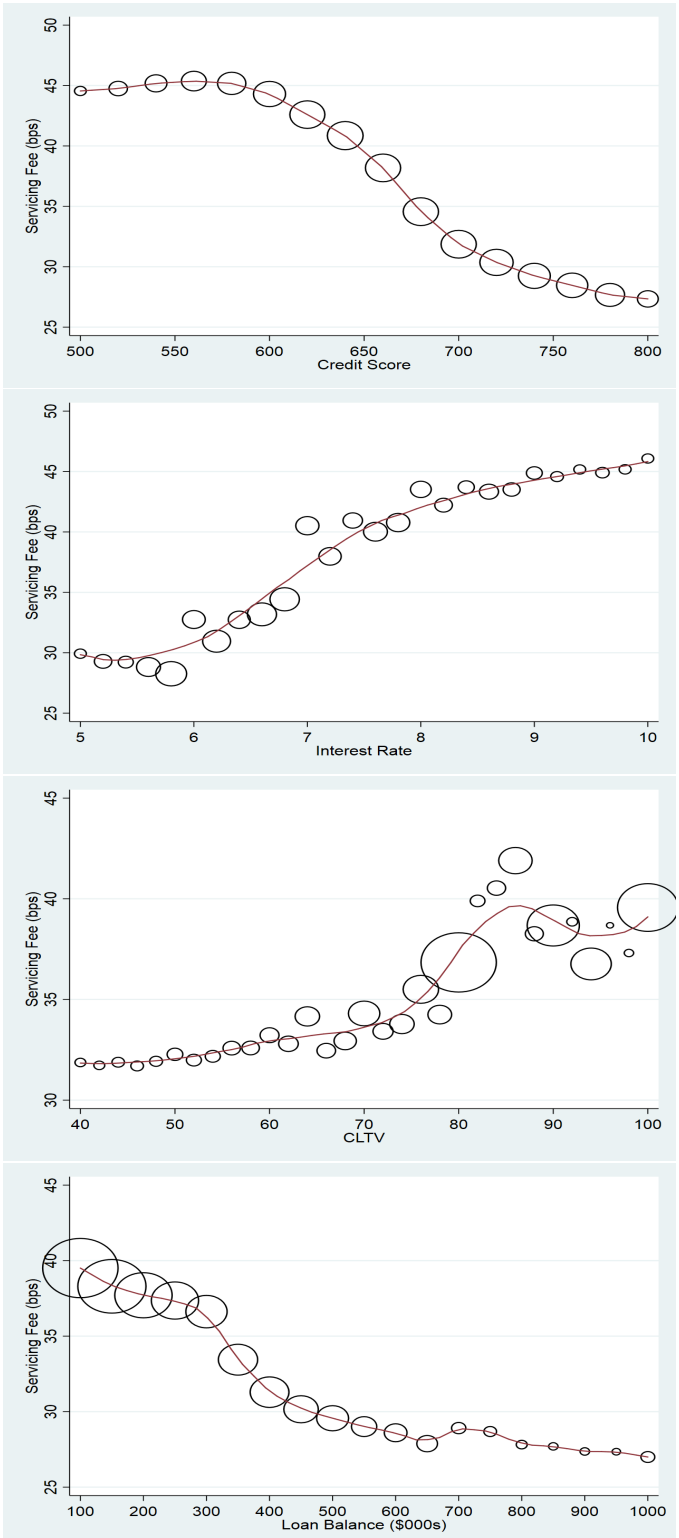

Figure 2: Servicing fees in basis points (bps) relative to credit score, interest rate (%), combined LTV (%), and loan balance ($000s)

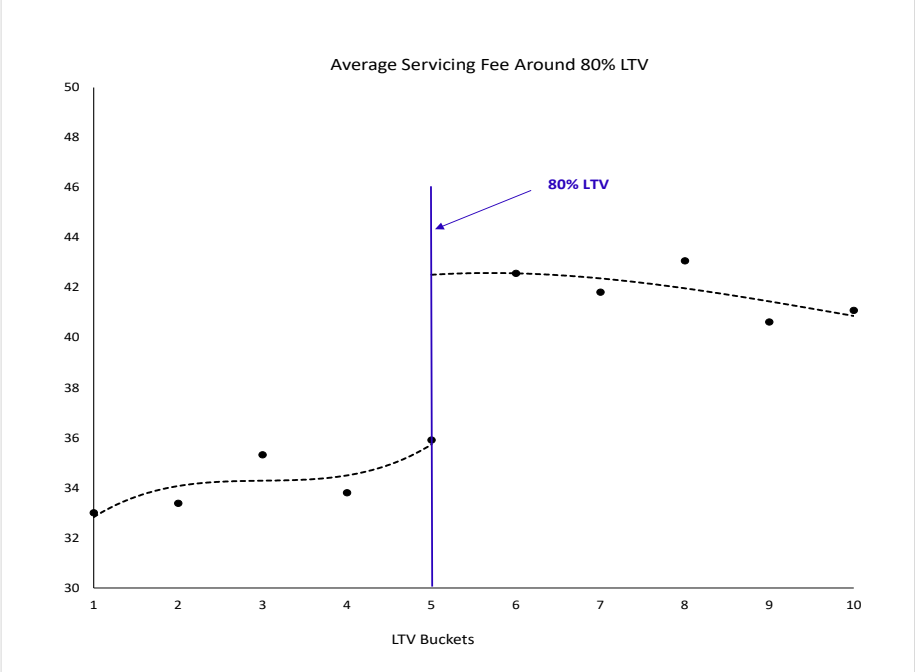

Figure 3: This graph shows average servicing fees in basis points (bps) for 10 LTV buckets constructed around the 80% LTV threshold. The LTV buckets, numbered 1 to 10, include loans between 70<LTV≤72, 72<LTV≤74, 74<LTV≤76, 76<LTV≤78, 78<LTV≤80, 80<LTV≤82, 82<LTV≤84, 84<LTV≤86, 86<LTV≤88, and 88<LTV≤90, respectively.

Table 1: Mortgage Characteristics

	# Obs.	Mean	Std Dev	Min.	Max.
Panel A: Loan Characteristics					
Servicing Fee	6,372,443	36.60	12.63	12.00	54.00
Seasoning (months)	6,372,443	3.4	3.5	0.0	25.0
Credit Score	6,372,443	667	74	300	850
Interest Rate	6,372,443	7.15	1.69	2.12	14.50
Combined LTV	6,372,443	80.0	16.0	18.3	103.0
Loan Term (months)	6,372,443	347	47	180	600
Loan Balance ($000s)	6,372,443	$248	$209	$25	$5,000
Owner Occupied	6,372,443	0.82		0	1
Refinancing	6,372,443	0.58		0	1
Low/No Doc	6,372,443	0.41		0	1
Prepayment Penalty	6,372,443	0.35		0	1
Negative Amortization	6,372,443	0.00		0	1
ARM	6,372,443	0.57		0	1
Single Family	6,372,443	0.94		0	1
Interest Only	6,372,443	0.22		0	1
Balloon Loan	6,372,443	0.05		0	1
DTI	1,175,384	38.9	9.5	10.0	100.0
Panel B: Expected Default and Prepayment					
I. Linear Probability Model (LPM) Estimates					
60-Day Default (6 months)	6,372,443	0.040	0.042	-0.13	0.30
90-Day Default (6 month)	6,372,443	0.017	0.021	-0.08	0.17
Prepayment (6 months)	6,372,443	0.019	0.021	-0.14	0.24
60-Day Default (12 months)	6,372,443	0.072	0.075	-0.24	0.53
90-Day Default (12 months)	6,372,443	0.040	0.046	-0.17	0.33
Prepayment (12 months)	6,372,443	0.049	0.054	-0.25	0.48
II. Probit Probability Estimates					
60-Day Default (6 months)	6,372,443	0.040	0.048	0.00	0.81
90-Day Default (6 months)	6,372,443	0.018	0.024	0.00	0.66
Prepayment (6 months)	6,372,443	0.018	0.023	0.00	0.87
60-Day Default (12 months)	6,372,443	0.072	0.081	0.00	0.93
90-Day Default (12 months)	6,372,443	0.042	0.051	0.00	0.79
Prepayment (12 months)	6,372,443	0.049	0.056	0.00	0.96
Panel C: Servicer Variables					
Servicer Deal Allocation	3,739	0.617	0.420	0.000	1.000
Portfolio Performance (60-day delinquency)	1,274	0.043	0.067	0.000	0.997
Portfolio Performance (90-day delinquency)	1,274	0.034	0.062	0.000	0.997
Portfolio Performance (150-day delinquency)	1,274	0.029	0.060	0.000	0.997
Issuer - Servicer Dummy	2,789	0.60		0	1
Servicer - Lender Dummy	6,372,443	0.56		0	1

Table 2: Trend in Servicing Fees and Correlations with Mortgage Characteristics

Panel A: Vintage Year	*Mean*	*Change*	*t-statistic*		
2002	34.55				
2003	32.11	-2.43	-92		
2004	34.67	2.55	140		
2005	37.80	3.13	220		
2006	38.68	0.89	73		
Panel B: Correlations	*Servicing Fee*	*Credit Score*	*Interest Rate*	*Loan Amount*	*Loan Term*
Servicing Fee	1.00				
Credit Score	-0.50	1.00			
Interest Rate	0.43	-0.55	1.00		
Loan Term	-0.30	0.37	-0.40	1.00	
Loan Balance	0.03	-0.07	-0.07	0.07	1.00

Table 3: Mortgage Characteristics and Servicing Fees

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Credit Score	-0.037***	-0.038***	-0.033***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Interest Rate	1.438***	1.460***	1.255***	0.328***	0.336***
	(0.075)	(0.076)	(0.074)	(0.059)	(0.059)
Loan Term	-0.008***	-0.009***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Loan Balance	-2.216***	-1.826***	-1.853***	-0.563***	-0.601***
	(0.115)	(0.112)	(0.113)	(0.089)	(0.090)
State Recourse Law Dummy		-0.508***			
		(0.095)			
Control Variables	Yes	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes	Yes
Asset-Type FE	No	No	No	Yes	Yes
Location FE	Yes	No	Yes	Yes	No
Issuer FE	No	No	Yes	Yes	No
Issuer-Location FE	No	No	No	No	Yes
Observations	*6,372,443*	*6,372,443*	*6,372,443*	*6,372,443*	6,367,015
Adjusted R-squared	*0.382*	*0.378*	*0.534*	*0.637*	0.645

Notes: This table reports results from OLS regressions of servicing fees in basis points (bps) on mortgage credit risk and expected servicing cash flow variables. The control variables include CLTV, seasoning, owner occupancy, purpose, income documentation, prepayment penalty, negative amortization, interest rate type, property type, interest only, balloon, and DTI. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 4: Expected Mortgage Termination Risks and Servicing Fees

	(1)	*(2)*	*(3)*	*(4)*
Panel A: Linear Probability Estimates				
Expected Default (60-Day Delinquency)	24.321***		19.562***	
	(2.797)		(2.972)	
Expected Default (90-Day Delinquency)		38.647***		28.521***
		(5.428)		(5.891)
Expected Prepayment			33.680***	35.000***
			(5.864)	(5.940)
Asset-Type FE	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Adjusted R-Squared	*0.614*	*0.613*	*0.616*	*0.615*
Panel B: Nonlinear Probability Estimates				
Expected Default (60-Day Delinquency)	17.787***		14.842***	
	(1.899)		(1.972)	
Expected Default (90-Day Delinquency)		27.824***		21.218***
		(3.326)		(3.559)
Expected Prepayment			18.583***	19.671***
			(3.924)	(4.013)
Asset-Type FE	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Adjusted R-Squared	*0.613*	*0.612*	*0.614*	*0.613*
Observations	*6,372,443*	*6,372,443*	*6,372,443*	*6,372,443*

Notes: This table reports results from OLS estimations of servicing fees in basis points (bps) on linear (OLS) and nonlinear (probit) expected default (using 60- and 90-day delinquency) and prepayment probabilities over 6 months at securitization in Panel A and Panel B, respectively. We compute the mortgages' expected 6-month default and prepayment probabilities as explained in Footnote 28 – expected 12-month default and prepayment produce similar results. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 5: Mortgage Product Bucket Estimations

	(1) *FRM*	*(2)* *ARM*	*(3)* *PURCHASE*	*(4)* *REFI*	*(5)* *OWN-OCC*	*(6)* *NON-OWN*
Panel A:						
Credit Score	-0.025***	-0.039***	-0.028***	-0.035***	-0.032***	-0.024***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interest Rate	1.844***	0.773***	1.548***	0.931***	1.088***	1.664***
	(0.114)	(0.066)	(0.089)	(0.068)	(0.072)	(0.153)
Loan Balance	-1.497***	-1.779***	-1.891***	-1.857***	-2.214***	-0.668***
	(0.167)	(0.125)	(0.120)	(0.122)	(0.120)	(0.152)
Loan Term	-0.004***	0.040***	-0.011***	-0.001	-0.005***	-0.003
	(0.001)	(0.006)	(0.003)	(0.001)	(0.001)	(0.002)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	*0.595*	*0.456*	*0.560*	*0.532*	*0.536*	*0.600*
Panel B:						
Expected Default	46.358***	27.672	54.041***	32.151*	50.051***	-6.805
	(13.119)	(15.412)	(12.441)	(12.653)	(12.620)	(18.771)
Expected Prepayment	44.470***	91.440***	50.060***	62.231***	59.420***	26.534**
	(9.767)	(11.811)	(10.936)	(9.965)	(10.364)	(10.270)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	*0.599*	*0.463*	*0.564*	*0.537*	*0.541*	*0.600*
Observations	*2,746,912*	*3,625,531*	*2,651,338*	*3,721,105*	*5,227,890*	*1,144,553*

Notes: This table presents results of OLS regressions of servicing fees in basis points (bps) on mortgage characteristics by mortgage product types: FRM, ARM, Purchase, Refinancing (*REFI*), Owner Occupied (*OWN*), and Non-Owner-Occupied (*NON-OWN*) mortgages in columns 1 to 6, respectively. In addition to the variables listed, we control for seasoning, owner occupancy, purpose, income documentation, prepayment penalty, negative amortization, interest rate type, property type, interest only, balloon, and DTI. Panel B reports the effects of expected 6-month default (60-day delinquency) and prepayment computed at the time of securitization using linear probability models. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 6: Effects of Economies of Scale and Portfolio Performance on Servicing Fees

	(1)	*(2)*	*(3)*	*(4)*
Servicing Allocation	-2.131**		-2.113**	0.676
	(0.716)		(0.716)	(0.532)
Servicing Portfolio Performance		7.057*	7.149*	5.479
		(3.230)	(3.198)	(3.390)
Credit Score	-0.008***	-0.008***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
Interest Rate	0.336***	0.331***	0.333***	0.356***
	(0.063)	(0.063)	(0.064)	(0.058)
Loan Term	-0.005***	-0.006***	-0.005***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Loan Balance	-0.596***	-0.624***	-0.596***	-0.545***
	(0.087)	(0.086)	(0.087)	(0.082)
Control Variables	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Issuer FE	No	No	No	Yes
Observations	*6,218,091*	*6,201,308*	*6,201,308*	*6,201,308*
Adjusted R-squared	*0.645*	*0.643*	*0.645*	*0.680*

Notes: This table reports results from OLS regressions of servicing fees in basis points (bps) on *Servicing Allocation* and current *Servicing Portfolio Performance*. *Servicing Allocation* is the share of loans allocated to each servicer, computed as the squared ratio of the dollar amount of allocated loans to the total deal collateral amount, in a manner similar to computing Herfindahl-Hirschman index (HHI). *Servicing Portfolio Performance* is the share of loans that are 150^{+}-day delinquent. For each servicer, we use the entire ABSNet Loan database to compute monthly 150^{+}-day portfolio delinquency rates as the ratio of delinquent loan balance to total loan balance – our finding is unchanged when we use 60- or 90-day delinquencies in our estimations. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 7: In-House Servicing and Servicing Fees

Panel A: Average Servicing Fees	*# Obs*	*Mean*	*Std. Err.*
Loans Serviced In-House	1,857,971	33.00	0.010
Externally Serviced Loans	2,808,787	36.33	0.007
Difference	*4,666,758*	*3.33****	*0.012*
Panel B:Servicing Fee Regressions	*(1)*	*(2)*	*(3)*
In-House Servicing	-1.950***	-1.785	-2.804**
	(0.708)	(1.213)	(1.337)
Issuer-Lender Affiliation			-5.854***
			(1.622)
Issuer-Lender Affiliation x In-House Servicing			7.203***
			(1.761)
Credit Score	-0.010***	-0.010***	-0.010***
	(0.002)	(0.002)	(0.002)
Interest Rate	0.401***	0.430***	0.398***
	(0.084)	(0.080)	(0.079)
Loan Term	-0.007***	-0.006***	-0.006***
	(0.001)	(0.002)	(0.001)
Loan Balance	-0.595***	-0.593***	-0.599***
	(0.109)	(0.109)	(0.109)
Control Variables	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes
Issuer FE	No	Yes	Yes
Observations	*4,666,758*	*4,666,758*	*4,666,758*
Adjusted R-Squared	*0.646*	*0.664*	*0.666*

Notes: Panel A reports average servicing fees in basis points (bps) for in-house and externally serviced loans. Panel B presents OLS regressions of servicing fee in basis points (bps) on *In-House Servicing* measured by a binary variable taking the value of 1 if a loan is serviced by the issuer or 0 otherwise. *Issuer-Lender Affiliation* is a binary variable identifying loans originated by the issuer. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1

Table 8: Average Default, Modification, and Foreclosure Rates

	Defaults		*Modifications*			*Foreclosures*		
	# Loans	*%*	*# Loans*	*%*	*TMod*	*# Loans*	*%*	*TFclos*
Panel A: 12 Months								
60-day Defaults	622,958	9.78	17,098	2.74	7.69	333,338	53.51	4.03
90-day Defaults	388,484	6.10	12,530	3.23	6.79	270,944	69.74	2.51
120-day Defaults	291,941	4.58	8,751	3.00	6.33	212,777	72.88	2.04
150^{+}-day Defaults	226,390	3.55	5,675	2.51	6.18	160,335	70.82	1.85
Panel B: 24 Months								
60-day Defaults	1,166,233	18.30	62,668	5.37	6.92	644,899	55.30	3.91
90-day Defaults	871,356	13.67	56,900	6.53	6.05	614,589	70.53	2.47
120-day Defaults	732,009	11.49	45,825	6.26	5.59	537,649	73.45	2.03
150^{+}-day Defaults	630,883	9.90	34,590	5.48	5.40	454,315	72.01	1.85

Notes: This table reports 60-, 90-, 120-, and 150-day delinquencies within 12 and 24 months after securitization, along with modifications within 12 months after initial default. Default rates are relative to our initial sample of 6,372,443 loans. *TMod* is the number of months elapsed between the first occurrence of default and the modification date. *TFclos* is the number of months elapsed between default and foreclosure.

Table 9: Servicing Fees and Modifications Conditional on Default

Estimation Sample:	*(1)* *60-day Defaults*	*(2)* *90-day Defaults*	*(3)* *120-day Defaults*	*(4)* *150-day Defaults*
Servicing Fee	0.0004**	0.0004**	0.0003**	0.00024*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Credit Score	-0.0000	-0.0001***	-0.0001***	-0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Interest Rate	0.0149***	0.0201***	0.0216***	0.0205***
	(0.0017)	(0.0022)	(0.0023)	(0.0022)
Current Loan Balance	0.0178***	0.0243***	0.0258***	0.0245***
	(0.0015)	(0.0020)	(0.0021)	(0.0020)
Loan Term	0.0018***	0.0026***	0.0028***	0.0027***
	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Seasoning	0.0012**	0.0015***	0.0012**	0.0012**
	(0.0004)	(0.0005)	(0.0005)	(0.0004)
Current LTV	0.0236***	0.0268***	0.0242**	0.0182*
	(0.0056)	(0.0075)	(0.0081)	(0.0078)
Owner Occupied	0.0230***	0.0275***	0.0266***	0.0238***
	(0.0024)	(0.0030)	(0.0028)	(0.0025)
Refinancing	0.0128***	0.0185***	0.0180***	0.0165***
	(0.0011)	(0.0013)	(0.0013)	(0.0012)
Low/No Doc	-0.0161***	-0.0227***	-0.0234***	-0.0203***
	(0.0016)	(0.0020)	(0.0020)	(0.0019)
Prepayment Penalty	0.0145***	0.0163***	0.0151***	0.0122***
	(0.0016)	(0.0019)	(0.0019)	(0.0017)
Negative Amortization	0.0106	0.0200*	0.0286**	0.0380***
	(0.0080)	(0.0097)	(0.0087)	(0.0088)
ARM	-0.0021	-0.0089***	-0.0094**	-0.0059*
	(0.0019)	(0.0026)	(0.0029)	(0.0027)
Single Family	0.0080***	0.0140***	0.0156***	0.0157***
	(0.0012)	(0.0014)	(0.0014)	(0.0014)
Interest Only	-0.0010	-0.0054**	-0.0055***	-0.0051**
	(0.0015)	(0.0017)	(0.0017)	(0.0016)
Balloon	-0.0085**	-0.0108**	-0.0110**	-0.0111***
	(0.0033)	(0.0036)	(0.0034)	(0.0029)
DTI	0.0005***	0.0006***	0.0006***	0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Inflation	0.0112***	0.0147***	0.0154***	0.0153***
	(0.0012)	(0.0014)	(0.0012)	(0.0011)
Mortgage Rate	-0.0196***	-0.0246***	-0.0255***	-0.0266***
	(0.0024)	(0.0027)	(0.0027)	(0.0028)
Unemployment	0.0037***	0.0016	0.0003	-0.0007
	(0.0009)	(0.0010)	(0.0010)	(0.0010)
HPI	-0.0011	0.0081	0.0170***	0.0182***
	(0.0039)	(0.0046)	(0.0046)	(0.0042)
HPI Volatility	0.0291***	0.0253***	0.0193***	0.0135***
	(0.0017)	(0.0016)	(0.0014)	(0.0013)
Location FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes	Yes
Observations	*1,160,346*	*867,000*	*728,596*	*628,106*
Adjusted R-Squared	*0.071*	*0.084*	*0.082*	*0.073*

Notes: This table reports OLS estimation results of the likelihood of modification over 12 months conditional on 60-, 90-, 120 and 150^{+}-day default within 24 months after securitization. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 10: Servicer Affiliations and Modifications

Estimation Sample	*(1)* *90-day Defaults*	*(2)* *90-day Defaults*
Servicing Fee	0.0004*	0.0001
	(0.0001)	(0.0002)
Servicer-Trustee Affiliation	0.0454**	-0.0730
	(0.0154)	(0.0417)
Servicer-Trustee Affiliation x Servicing Fee		0.0041***
		(0.0011)
Servicer-Lender Affiliation	0.0121*	-0.0130
	(0.0054)	(0.0098)
Servicer-Lender Affiliation x Servicing Fee		0.0006**
		(0.0002)
Servicer-Issuer Affiliation	-0.0085	-0.0084
	(0.0061)	(0.0061)
Servicer-Master Servicer Affiliation	0.0067	0.0073
	(0.0051)	(0.0051)
Control Variables	Yes	Yes
Origination-Year FE	Yes	Yes
Location FE	Yes	Yes
Servicer FE	Yes	Yes
Asset-Type FE	Yes	Yes
Observations	*867,000*	*867,000*
Adjusted R-Squared	*0.084*	*0.084*

Notes: This table reports OLS results of the likelihood of modification within 12 months conditional on 90-day default within 24 months following securitization on servicer affiliations. The control variables used in these regressions are those in Table 9. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 11: Servicing Fees and Time to Modification

	(1) *60-day Defaults*	*(2)* *90-day Defaults*	*(3)* *120-day Defaults*	*(4)* *150-day Defaults*
Servicing Fee	-0.0046*	-0.0053*	-0.0141***	-0.0129***
	(0.0020)	(0.0021)	(0.0024)	(0.0028)
Credit Score	-0.0036***	-0.0019***	-0.0009*	-0.0007
	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Interest Rate	0.0147*	-0.0014	-0.0208**	-0.0088
	(0.0064)	(0.0068)	(0.0077)	(0.0089)
Current Loan Balance	0.0073	0.0131	0.0103	-0.0046
	(0.0307)	(0.0330)	(0.0374)	(0.0437)
Loan Term	0.0099*	-0.0004	0.0074	0.0100
	(0.0047)	(0.0051)	(0.0058)	(0.0069)
Control Variables	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes	Yes
Observations	*62,647*	*56,880*	*45,806*	*34,570*
Adjusted R-Squared	*0.096*	*0.085*	*0.098*	*0.093*

Notes: This table reports OLS estimation results of time to modification within 12 months conditional on default within 24 months following securitization and being in modified within 12-months following defaults. We measure default as 60-. 90-. 120-, and 150^{+}-day delinquency. The control variables used in these regressions are those in Table 9. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 12: The Effects of Servicing Fees on Foreclosure

	(1)	(2)	(3)
Dep. Variable:	*Foreclosure Dummy*	*Foreclosure Dummy*	*Time to Foreclosure*
Estimation Sample:	*120-Day Defaults*	*120-Day Defaults*	*Foreclosed Loans*
Servicing Fee	0.0019***	0.0020***	-0.0066***
	(0.0005)	(0.0005)	(0.0018)
Modified	-0.1326***	-0.0069	0.2983**
	(0.0088)	(0.0231)	(0.1135)
Modified x Servicing Fee		-0.0028***	0.0106***
		(0.0006)	(0.0026)
Credit Score	-0.0004***	-0.0004***	-0.0021***
	(0.0000)	(0.0000)	(0.0001)
Interest Rate	-0.0275***	-0.0273***	0.0251***
	(0.0015)	(0.0015)	(0.0057)
Current Loan Balance	0.0618***	0.0618***	0.1305***
	(0.0066)	(0.0066)	(0.0095)
Loan Term	0.0093***	0.0094***	-0.0029
	(0.0011)	(0.0011)	(0.0021)
Control Variables	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Observations	*724,130*	*724,130*	*537,479*
Adjusted R-Squared	*0.241*	*0.241*	*0.057*

Notes: This table reports OLS estimations of the probability of and time to foreclosure, conditional on 120-day default over 12 months following default within 24 months after securitization, on servicing fees (in bps), mortgage characteristics, and local housing market and macroeconomic variables. Columns (1) and (2) explore the effects of servicing fees and modification on the likelihood of foreclosure, whereas column (3) examines time to foreclosure from default. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 13: Propensity Score Matched Modification and Foreclosure Results

Panel A: Modification			
I. Average Treatment Effect	*Treated*	*Control*	*Difference*
Modification (ATT)	0.0763	0.0618	0.0145***
			(0.0046)
II. Matched-Sample Regressions		*Modification*	*Time to Mod.*
Servicing Fee		0.0002***	-0.0046*
		(0.0000)	(0.0023)
Control Variables		Yes	Yes
Servicer FE		Yes	Yes
Location (CBSA) FE		Yes	Yes
Vintage-Year FE		Yes	Yes
Origination-Year FE		Yes	Yes
Observations		*561,837*	*38,031*
Adjusted R-Squared		*0.088*	*0.090*
Panel B: Foreclosure			
I. Average Treatment Effect	*Treated*	*Control*	*Difference*
Foreclosure (ATT, Full Sample)	0.7173	0.7054	0.0119
			(0.0195)
Foreclosure of Modified Loans (ATT)	0.5605	0.6596	-0.0991**
			(0.0345)
II. Matched-Sample Regressions	*Foreclosure*	*Foreclosure*	*Time to Forecl.*
Servicing Fee	0.0014***	0.0015***	-0.0056***
	(0.0001)	(0.0001)	(0.0005)
Modified	-0.1411***	0.0104	0.4687***
	(0.0028)	(0.0166)	(0.1420)
Modified x Servicing Fee		-0.0032***	0.0077**
		(0.0003)	(0.0030)
Control Variables	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes
Location (CBSA) FE	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes
Observations	*471,137*	*471,137*	*340,076*
Adjusted R-Squared	*0.264*	*0.264*	*0.061*

Notes: This table reports modification and foreclosure estimation results from matched samples in Panel A and Panel B, respectively. Our treatment group consists of loans with servicing fees of 50 bps or higher and loans with servicing fees lower than 50 bps constitute our control group. Loans are matched by servicer using the Stata command *psmatch2* (Leuven and Sianesi, 2018) – the first stage probit estimation of likelihood of treatment for the modification and foreclosure samples are in Table A.8. In each panel, we first present the average treatment effect (of servicing fee) on the treated (ATT), followed by OLS regression results of the likelihood of modification or foreclosure and time to modification or foreclose. We consider modifications of loans that are 90-day delinquent within 24 months following securitization and the foreclosure of loans that are 120-day delinquency within the same time frame. In parentheses are heteroskedasticity robust standard errors. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 14: Likelihood of Modification of High-Servicing Fee Mortgages Estimated Using Fuzzy Regression Discontinuity Around the 80% LTV Threshold

	Unmatched Sample			*Matched Sample*			*Matched Sample*		
	(1)	*(2)*	*(3)*	*(1')*	*(2')*	*(3')*	*(1")*	*(2")*	*(3")*
Estimation Window	*74<LTV≤86*	*76<LTV≤84*	*78<LTV≤82*	*74<LTV≤86*	*76<LTV≤84*	*78<LTV≤82*	*74<LTV≤86*	*76<LTV≤84*	*78<LTV≤82*
Treated	0.0083***	0.0182***	0.0130***	0.0042**	0.0150***	0.0106	0.0108***	0.0108*	0.0110
	(0.0010)	(0.0024)	(0.0039)	(0.0014)	(0.0036)	(0.0060)	(0.0021)	(0.0044)	(0.0076)
Control Variables	No	No	No	No	No	No	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	No	No	No	No	No	No	Yes	Yes	Yes
Origination-Year FE	No	No	No	No	No	No	Yes	Yes	Yes
Vintage-Year FE	No	No	No	No	No	No	Yes	Yes	Yes
Observations	*487,618*	*376,854*	*357,342*	*131,390*	*22,330*	*7,793*	*131,371*	*22,190*	*7,600*
Adjusted R-Squared	*0.027*	*0.025*	*0.024*	*0.033*	*0.039*	*0.037*	*0.102*	*0.105*	*0.107*

Notes: This table reports results of our fuzzy regression discontinuity estimations of likelihood of modification within 12 months of high-servicing fee mortgages that became 90-day delinquent within 24 months after securitization. Based on the discontinuity in servicing fees at the 80% LTV threshold observed in Figure 3, we create five LTV buckets on the right and left of that border to estimate the difference in likelihood of modification of higher servicing fee loans located at the right of border as compared to loans with lower servicing fees in the left side LTV buckets – the LTV buckets numbered 1 to 10 on Figure 3 consist of 70<LTV≤72, 72<LTV≤74, 74<LTV≤76, 76<LTV≤78, and 78<LTV≤80 on the left and 80<LTV≤82, 82<LTV≤84, 84<LTV≤86, 86<LTV≤88, and 88<LTV≤90 on the right. We report regression results for loans in the six buckets (i.e., 74<LTV≤86), four buckets (i.e., 76<LTV≤84), and two buckets (i.e., 78<LTV≤82) around the 80% LTV threshold. The variable *"Treated"* identifies loans on the right of the border (i.e., higher servicing fee loans). Columns (1) to (3) report results from unmatched sample, whereas columns (1') to (3') and (1") to (3") report results from matched samples using propensity score matching at the servicer level using the Stata command *psmatch2* (Leuven and Sianesi, 2018). In parentheses are heteroskedasticity robust standard errors. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table 15: Changes in Servicing and Modifications

	(1)	*(2)*	*(3)*
Servicing Fee	0.0009***	0.0006**	0.0008***
	(0.0002)	(0.0002)	(0.0002)
Credit Score	-0.0004***	-0.0004***	-0.0004***
	(0.0000)	(0.0000)	(0.0000)
Interest Rate	0.0064***	0.0039***	0.0043***
	(0.0010)	(0.0011)	(0.0011)
Current Loan Balance	0.0091***	0.0033	0.0042
	(0.0022)	(0.0024)	(0.0025)
Loan Term	0.0031***	0.0024***	0.0023***
	(0.0004)	(0.0004)	(0.0004)
Control Variables	Yes	Yes	Yes
Current Servicer FE	Yes	Yes	Yes
Origination-Year FE	No	Yes	Yes
Location (CBSA) FE	No	Yes	Yes
Vintage-Year FE	No	Yes	Yes
No Change in Servicing Fee			Yes
Observations	*117,548*	*117,514*	*110,451*
Adjusted R-Squared	*0.077*	*0.085*	*0.083*

Notes: This table reports OLS estimations of likelihood of modification of 90-day delinquent loans after securitization. To mitigate potential endogeneity issues, our sample is restricted to loans transferred to a servicer different from the servicer who initially managed the loan after securitization. We further match high servicing fee loans (servicing greater or equal to 50 bps) to low servicing fee loans by current servicer using the Stata command *psmatch2* (Leuven and Sianesi, 2018) – the probit estimation of likelihood of treatment used in our matching is similar to the one presented in Table A.8. To save space, we only report modifications within 12 months after default of loans that are 90-day delinquent within 24 months following securitization. In parentheses are heteroskedasticity robust standard errors. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

A Appendix

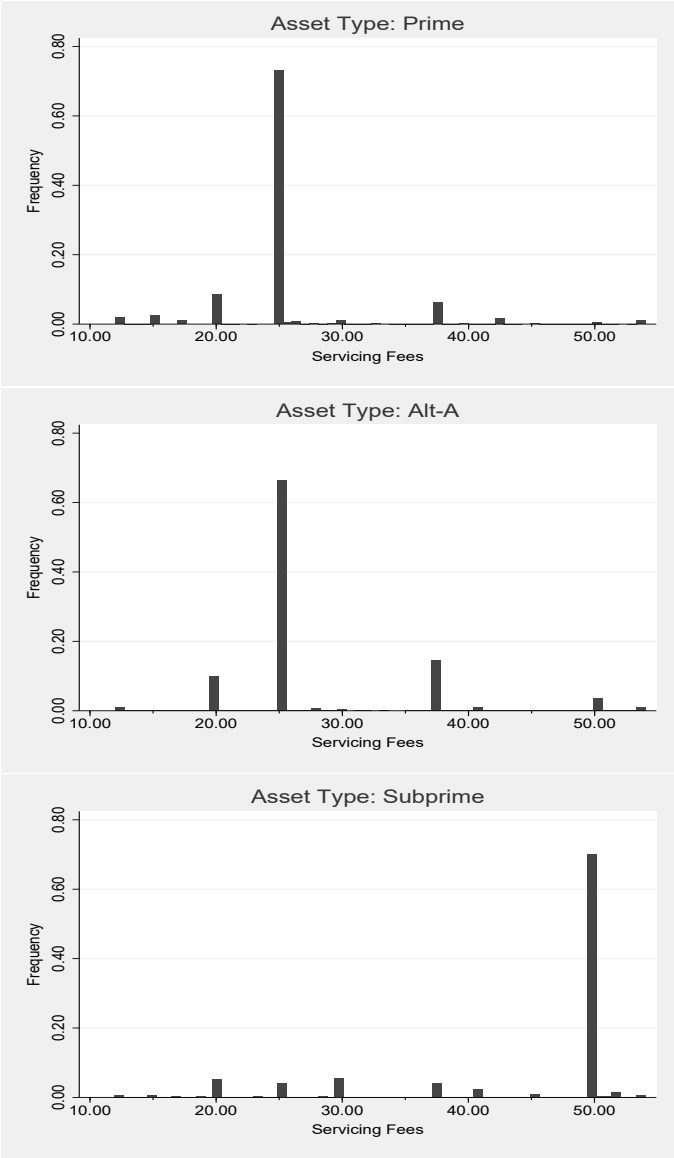

Figure A.1: Servicing fees in basis points (bps) by deal asset type (jumbo, alt-A and subprime deals)

Table A.1: Mortgages by Origination Year and Deal Type

	Observations	*Percents*
Panel A: Loans by Origination Year		
2000	16,948	0.3
2001	92,643	1.5
2002	411,140	6.5
2003	914,813	14.4
2004	1,366,631	21.4
2005	2,105,179	33.0
2006	1,465,089	23.0
Total	*6,372,443*	*100.0*
Panel B: Deal Types		
Alt-A	910	32.6
Jumbo	906	32.5
Subprime	973	34.9
Total	*2,789*	*100.0*

Table A.2: Servicing Fee Regressions with Servicer Fixed Effects

	(1)	*(2)*	*(3)*	*(4)*
Credit Score	-0.031***	-0.031***	-0.030***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.001)
Interest Rate	1.145***	1.165***	1.127***	0.360***
	(0.075)	(0.076)	(0.073)	(0.057)
Loan Term	-0.006***	-0.006***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Loan Balance	-1.867***	-1.582***	-1.772***	-0.584***
	(0.105)	(0.094)	(0.118)	(0.085)
State Recourse Law Dummy		-0.188*		
		(0.074)		
Control Variables	Yes	Yes	Yes	Yes
Asset-Type FE	No	No	No	Yes
Issuer FE	No	No	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	No	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Observations	*6,372,443*	*6,372,443*	*6,372,443*	*6,372,443*
Adjusted R-squared	*0.552*	*0.550*	*0.591*	*0.677*

Notes: This table reproduces the regressions in Table 3 with servicer fixed effects. It reports results from OLS regressions of servicing fees in basis points (bps) on mortgage credit risk and expected servicing cash flow variables. The control variables include CLTV, seasoning, owner occupancy, purpose, income documentation, prepayment penalty, negative amortization, interest rate type, property type, interest only, balloon, and DTI. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table A.3: Expected Mortgage Termination Risks and Servicing Fees (With Servicer Fixed Effects)

	(1)	*(2)*	*(3)*	*(4)*
Panel A: Linear Probability Estimates				
Expected Default (60-Day Delinquency)	26.733***		22.523***	
	(2.720)		(2.899)	
Expected Default (90-Day Delinquency)		43.379***		34.494***
		(5.284)		(5.757)
Expected Prepayment			29.596***	30.945***
			(5.768)	(5.852)
Asset-Type FE	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Adjusted R-squared	*0.653*	*0.652*	*0.655*	*0.654*
Panel B: Nonlinear Probability Estimates				
Expected Default (60-Day Delinquency)	19.061***		16.738***	
	(1.783)		(1.860)	
Expected Default (90-Day Delinquency)		29.329***		24.007***
		(3.094)		(3.358)
Expected Prepayment			14.634***	15.910***
			(3.874)	(3.981)
Asset-Type FE	Yes	Yes	Yes	Yes
Issuer FE	Yes	Yes	Yes	Yes
Vintage-Year FE	Yes	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes
Adjusted R-squared	*0.652*	*0.651*	*0.653*	*0.652*
Observations	*6,372,443*	*6,372,443*	*6,372,443*	*6,372,443*

Notes: This table reproduces the regressions in Table 4 with servicer fixed effects. It reports results from OLS estimations of servicing fees in basis points (bps) on linear (OLS) and nonlinear (probit) expected default (using 60- and 90-day delinquency) and prepayment probabilities over 6 months at securitization in Panel A and Panel B, respectively. We compute the mortgages' expected 6-month default and prepayment probabilities as explained in Footnote 28 – expected 12-month default and prepayment produce similar results. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table A.4: Default Status and Modification

	Defaults	*Modifications*	%
Panel A: 12 Months			
60-day Defaults	234,474	4,568	1.95
90-day Defaults	96,543	3,779	3.91
120-day Defaults	65,551	3,076	4.69
150+-day Defaults	226,390	5,675	2.51
Panel A: 24 Months			
60-day Defaults	294,877	5,768	1.96
90-day Defaults	139,347	11,075	7.95
120-day Defaults	101,126	11,235	11.11
150+-day Defaults	630,883	34,590	5.48

Notes: This table tallies loan modifications according to default status within 12 and 24 months after securitization and related modifications with 12 months after initial default.

Table A.5: Servicing Fees and Modification Conditional on Default within 12 Months

Estimation Sample:	*(1)* *60-day Defaults*	*(2)* *90-day Defaults*	*(3)* *120-day Defaults*	*(4)* *150-day Defaults*
Servicing Fee	0.0004***	0.0004***	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Interest Rate	0.0082***	0.0101***	0.0104***	0.0096***
	(0.0015)	(0.0018)	(0.0019)	(0.0018)
Current Loan Balance	0.0094***	0.0118***	0.0118***	0.0107***
	(0.0012)	(0.0015)	(0.0015)	(0.0015)
Loan Term	0.0011***	0.0014***	0.0013***	0.0014***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Current LTV	0.0172***	0.0186***	0.0173***	0.0117**
	(0.0037)	(0.0049)	(0.0051)	(0.0048)
Credit Score	-0.0000	-0.0001***	-0.0001***	-0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Seasoning	0.0003	0.0008**	0.0010***	0.0013***
	(0.0003)	(0.0004)	(0.0004)	(0.0004)
Owner Occupied	0.0103***	0.0110***	0.0111***	0.0088***
	(0.0020)	(0.0023)	(0.0020)	(0.0017)
Refinancing	0.0069***	0.0090***	0.0087***	0.0072***
	(0.0009)	(0.0011)	(0.0011)	(0.0010)
Low-No Doc	-0.0114***	-0.0147***	-0.0150***	-0.0118***
	(0.0013)	(0.0016)	(0.0016)	(0.0015)
Prepayment Penalty	0.0063***	0.0062***	0.0056***	0.0046***
	(0.0012)	(0.0014)	(0.0014)	(0.0013)
Negative Amortization	0.0019	0.0013	0.0045	0.0069
	(0.0066)	(0.0070)	(0.0065)	(0.0064)
ARM	-0.0085***	-0.0114***	-0.0089***	-0.0062***
	(0.0016)	(0.0023)	(0.0024)	(0.0022)
Single Family	0.0065***	0.0088***	0.0089***	0.0085***
	(0.0011)	(0.0013)	(0.0014)	(0.0013)
Interest Only	-0.0011	-0.0032**	-0.0025**	-0.0016
	(0.0011)	(0.0013)	(0.0013)	(0.0013)
Balloon	-0.0071***	-0.0072***	-0.0063***	-0.0047**
	(0.0024)	(0.0025)	(0.0023)	(0.0020)
DTI	0.0002***	0.0003***	0.0003***	0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Inflation	0.0002	0.0010	0.0024*	0.0043***
	(0.0009)	(0.0012)	(0.0013)	(0.0014)
Mortgage Rate	0.0101***	0.0116***	0.0089**	0.0035
	(0.0025)	(0.0036)	(0.0039)	(0.0042)
Unemployment	0.0023***	0.0006	-0.0019**	-0.0027***
	(0.0007)	(0.0009)	(0.0008)	(0.0009)
HPI	-0.0163***	-0.0177***	-0.0139***	-0.0102**
	(0.0033)	(0.0039)	(0.0041)	(0.0041)
HPI Volatility	0.0198***	0.0190***	0.0149***	0.0103***
	(0.0020)	(0.0021)	(0.0019)	(0.0016)
Observations	*619,088*	*385,152*	*289,206*	*224,204*
Adjusted R-squared	*0.042*	*0.049*	*0.047*	*0.041*

Notes: This table reports OLS estimation results of the likelihood of modification over 12 months conditional on 60-, 90-, 120 and 150^{+}-day default within 12 months after securitization. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table A.6: Servicing Fees and Time to Modification

	(1) *60-day Defaults*	*(2)* *90-day Defaults*	*(3)* *120-day Defaults*	*(4)* *150-day Defaults*
Servicing Fee	-0.0046*	-0.0053*	-0.0141***	-0.0129***
	(0.0020)	(0.0021)	(0.0024)	(0.0028)
Credit Score	-0.0036***	-0.0019***	-0.0009*	-0.0007
	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Interest Rate	0.0147*	-0.0014	-0.0208**	-0.0088
	(0.0064)	(0.0068)	(0.0077)	(0.0089)
Current Loan Balance	0.0073	0.0131	0.0103	-0.0046
	(0.0307)	(0.0330)	(0.0374)	(0.0437)
Loan Term	0.0099*	-0.0004	0.0074	0.0100
	(0.0047)	(0.0051)	(0.0058)	(0.0069)
Seasoning	-0.0633***	-0.0378***	-0.0216**	-0.0147
	(0.0056)	(0.0059)	(0.0067)	(0.0076)
Current LTV	-0.0210	-0.2368*	-0.3642**	-0.1095
	(0.0922)	(0.1008)	(0.1141)	(0.1341)
Owner Occupied	-0.1610**	-0.1194*	-0.1388*	-0.1622*
	(0.0529)	(0.0578)	(0.0649)	(0.0762)
Refinancing	0.0186	-0.0430	-0.0442	-0.0538
	(0.0282)	(0.0309)	(0.0351)	(0.0406)
Low/No Doc	0.1333***	0.1719***	0.1666***	0.1282**
	(0.0291)	(0.0318)	(0.0358)	(0.0414)
Prepayment Penalty	-0.0292	-0.0372	-0.0903*	-0.0998*
	(0.0338)	(0.0362)	(0.0408)	(0.0472)
Negative Amortization	1.3087*	0.8587	1.2609	0.3068
	(0.6204)	(0.6742)	(0.7154)	(0.7623)
ARM	-0.1287***	0.1708***	0.3684***	0.3799***
	(0.0336)	(0.0359)	(0.0400)	(0.0466)
Single Family	0.0840	-0.0549	-0.0326	-0.1670
	(0.0624)	(0.0693)	(0.0781)	(0.0901)
Interest Only	-0.1859***	-0.0734	0.0367	0.0376
	(0.0386)	(0.0433)	(0.0497)	(0.0579)
Balloon	-0.0424	-0.1419**	-0.0956	-0.0331
	(0.0431)	(0.0468)	(0.0527)	(0.0609)
DTI	0.0048***	0.0004	-0.0029*	-0.0006
	(0.0010)	(0.0011)	(0.0013)	(0.0015)
Inflation	-0.3294***	-0.3657***	-0.3655***	-0.3432***
	(0.0145)	(0.0155)	(0.0177)	(0.0211)
Mortgage Rate	0.4251***	0.0808	0.1478*	0.1939**
	(0.0478)	(0.0509)	(0.0590)	(0.0701)
Unemployment	-0.3451***	-0.2282***	-0.2318***	-0.1822***
	(0.0185)	(0.0200)	(0.0246)	(0.0299)
HPI (log)	-0.0433	-0.0222	-0.0577	-0.2636
	(0.1477)	(0.1622)	(0.1840)	(0.2125)
HPI Volatility	-0.4261***	-0.4669***	-0.3160***	-0.3414***
	(0.0265)	(0.0296)	(0.0347)	(0.0418)
Servicer FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes	Yes
Observations	*62,647*	*56,880*	*45,806*	*34,570*
Adjusted R-Squared	*0.096*	*0.085*	*0.098*	*0.093*

Notes: This table reports OLS estimation results of time to modification within 12 months conditional on default within 24 months following securitization and being in modified within 12-months following defaults. We measure default as 60-. 90-. 120-, and 150^{+}-day delinquency. The control variables used in these regressions are those in Table 9. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table A.7: The Effects of Servicing Fees on Foreclosure of 150-day Defaults

	(1)	(2)	(3)
Dep. Variable:	*Foreclosure Dummy*	*Foreclosure Dummy*	*Time to Foreclosure*
Estimation Sample:	*150-Day Defaults*	*150-Day Defaults*	*Foreclosed Loans*
Servicing Fee	0.0017***	0.0018***	-0.0069***
	(0.0005)	(0.0005)	(0.0018)
Modified	-0.0800***	0.0183	0.4779***
	(0.0086)	(0.0239)	(0.1304)
Modified x Servicing Fee		-0.0022***	0.0069*
		(0.0006)	(0.0030)
Credit Score	-0.0005***	-0.0005***	-0.0017***
	(0.0000)	(0.0000)	(0.0001)
Interest Rate	-0.0284***	-0.0283***	0.0248***
	(0.0016)	(0.0016)	(0.0054)
Current Loan Balance	0.0703***	0.0703***	0.1105***
	(0.0065)	(0.0065)	(0.0089)
Loan Term	0.0096***	0.0096***	-0.0031
	(0.0011)	(0.0011)	(0.0020)
Control Variables	Yes	Yes	Yes
Origination-Year FE	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes
Asset-Type FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Observations	*624,038*	*624,038*	*454,155*
Adjusted R-squared	*0.266*	*0.266*	*0.075*

Notes: This table reports OLS estimations of the probability of and time to foreclosure, conditional on 150-day default over 12 months following default within 24 months after securitization, on servicing fees (in bps), mortgage characteristics, and local housing market and macroeconomic variables. Columns (1) and (2) explore the effects of servicing fees and modification on the likelihood of foreclosure, whereas column (3) examines time to foreclosure from default. In parentheses are standard errors clustered at the deal level. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.

Table A.8: First Stage Probit Estimations of Treatment

	(1) *Treatment (Modification)*	*(2)* *Treatment (Foreclosure)*
Credit Score	-0.0039***	-0.0038***
	(0.0000)	(0.0000)
Interest Rate	0.1206***	0.1222***
	(0.0014)	(0.0016)
Current Loan Balance	-0.1808***	-0.1759***
	(0.0039)	(0.0042)
Loan Term	-0.0221***	-0.0224***
	(0.0007)	(0.0007)
Seasoning	0.0395***	0.0434***
	(0.0009)	(0.0010)
Current LTV	-0.4018***	-0.4192***
	(0.0131)	(0.0143)
Owner Occupied	0.2458***	0.2517***
	(0.0053)	(0.0057)
Refinancing	0.0345***	0.0320***
	(0.0038)	(0.0041)
Low/No Doc	-0.2935***	-0.2898***
	(0.0039)	(0.0042)
Prepayment Penalty	0.1120***	0.1118***
	(0.0041)	(0.0045)
Negative Amortization	-0.1972**	0.0181
	(0.0688)	(0.0791)
ARM	0.4434***	0.4576***
	(0.0046)	(0.0050)
Single Family	0.0145*	0.0135
	(0.0073)	(0.0079)
Interest Only	-0.4764***	-0.4895***
	(0.0051)	(0.0056)
Balloon	0.2863***	0.2882***
	(0.0066)	(0.0071)
DTI	0.0171***	0.0165***
	(0.0002)	(0.0002)
Inflation	0.0060**	0.0043
	(0.0020)	(0.0023)
Mortgage Rate	-0.0362***	-0.0323***
	(0.0066)	(0.0075)
Unemployment	0.0113***	0.0152***
	(0.0028)	(0.0032)
HPI	0.2758***	0.2590***
	(0.0181)	(0.0200)
HPI Volatility	0.0225***	0.0195***
	(0.0033)	(0.0037)
Origination-Year FE	Yes	Yes
Location FE	Yes	Yes
Vintage FE	Yes	Yes
Issuer FE	Yes	Yes
Observations	*820,492*	*691,135*
Pseudo R-Squared	*0.305*	*0.305*

Notes: This table reports probit estimations of the likelihood of treatment (servicing fee greater or equal to 50 bps) for our propensity score matched modification and foreclosure estimations of 90-day and 120-day defaults within 24 months after securitization reported in Table 13. Statistical significance: *** p<0.001, ** p<0.01, * p<0.05.