

How Informed Were Non-Agency MBS Investors? Evidence from Mortgage Servicing Fees *

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Abstract

This paper examines the informativeness of servicing fees in the non-agency MBS market with regard to the quality of underlying mortgage collateral pools and, ultimately, the value of securities. In addition to reflecting observable mortgage characteristics, servicing fees capture some unobservable credit risk factor that differentially affects MBS bond classes. Interestingly, we find that bond spreads adequately account for this additional risk, which implies that non-agency MBS investors may have been more sophisticated than previously believed or that security issuers were to some extent more transparent about the risks associated with underlying mortgages than recognized in the literature.

JEL Classifications: G21, G24, R3

Keywords: Mortgage Credit Risk, Residential Private-Label Mortgage Securities, Mortgage Servicing, Information Asymmetry, MBS Security Pricing

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1 Introduction

As the devastating aftermaths of the 2008 financial crisis rolled through the U.S. economy and globally, questions were raised about the role of Wall Street given its dominant presence in the origination and securitization of non-agency home mortgages, the riskiest segment of the housing finance market where most of the mortgage credit expansion occurred. Wall Street firms that issue mortgage backed securities (MBS) have been accused of self-interestedly originating risky mortgages and peddling bonds backed by those mortgages to unsuspecting, less-informed investors. MBS Issuers certainly know more than security investors about the quality of collateral pools and could take advantage of their informational advantage. However, it is unclear how much of that information they can keep private, for servicing fees must reflect the true quality of mortgage pools since issuers are unlikely to enjoy substantial information advantage relative to servicers. Furthermore, it is somewhat unclear how truly uninformed investors were when considering MBS investments, even though studies have shown evidence of deceitful behavior by Wall Street firms.

This study explores how challenging it might have been for MBS investors to assess the quality of mortgage collateral pools by examining whether servicing fees carry any private information held by issuers and servicers about the quality of mortgage collateral pools. Diop and Zheng (2020) document that servicing fees capture observable credit risk associated with underlying mortgages. We extend their work by exploring whether servicing fees also capture MBS issuer' and servicers' appreciation of the quality mortgage that could have been used to inform security investment decisions

Many narratives have been proposed to explain the mortgage crisis that unfolded at the end of 2007 and the subsequent severe economic downturn commonly referred to as the Great Recession. The popular press and academic studies have overwhelmingly blamed mortgage securitization as a primary driver of the growth in risky mortgages that fueled the mortgage credit expansion and triggered the financial crisis. Proponents of this narrative argue that the development of the originate-to-distribute (OTD) mortgage lending business model due to securitization skewed the incentives of many mortgage lenders, particularly large banks and Wall Street firms, toward the origination of risky mortgages to the detriment of homeowners and

ultimate investors (Mian and Sufi, 2009; Demyanyk and Van Hemert, 2009; Keys et al., 2010, 2012; Nadauld and Sherlund, 2013; Elul, 2016). To address these perceived misaligned incentives in the OTD securitization process, policymakers enacted regulations targeting potential conflicts of interest in mortgage lending.¹ In addition to the documented deterioration in mortgage underwriting standards, MBS issuers and underwriters have been accused of intentionally misrepresenting and offuscating the quality of mortgages to security investors.²

The underlying assumption of the OTD narrative is that MBS investors were not as sophisticated as security issuers and underwriters, and did not have access to sufficient information on mortgages to adequately appreciate the risks associated with the securities they bought. Although this explanation seems appealing in light of unprecedented losses suffered by investors following the housing market crash, it is unclear why this group of investors composed mostly of large financial institutions (i.e., banks, pension fund asset managers, insurance companies), who are generally viewed as sophisticated and better informed relative to other categories of investors, would put themselves in such a “disadvantageous” position in the first place. Challenging this narrative, Foote et al. (2012) argue that the OTD model has been central to the U.S. mortgage market for decades before the financial crisis began, issuers supplied a great deal of information on collateral pools to potential investors, investors understood the risks associated with the securities they bought, and finally mortgage market insiders (i.e., Wall Street firms) were in fact the biggest losers. According to Foote et al. (2012), the issue may be less about rampant deliberate efforts on the part of financial institutions to mislead investors, but more about general hubris regarding the prospects of the house market, hence mortgage values.³ Furthermore, studies examining the performance of non-agency mortgage securitizations in the late 1990s and most of 2000s show that lenders securitized loans with

¹For example, to explicitly target incentives inherent in the OTD securitization model for financial intermediaries to collude with mortgage originators to lower underwriting standards during the housing boom prior to 2007, the Dodd-Frank Act requires that issuers of mortgage-backed securities retain a slice of the credit risk associated with issued securities unless the credit quality of the mortgages is strong enough to earn an exemption.

²Widespread misrepresentations in non-agency mortgage origination and securitization market have been documented. These misrepresentations were of various forms: borrower income misrepresentations (Jiang et al., 2014a; Mian and Sufi, 2017), inflated collateral values (Ben-David, 2011; Carrillo, 2013; Agarwal et al., 2015), personal asset misreporting (Garmaise, 2015), and undisclosed second mortgages (Piskorski et al., 2015; Griffin and Maturana, 2016).

³Foote et al. (2012) list twelve facts about the mortgage market to argue that the causes of the mortgage crisis lie in ex-post overly optimistic beliefs about house prices than institutional features of the mortgage market or financial innovation by Wall Street firms.

lower-default-risk (Ambrose et al., 2005; Agarwal et al., 2012) – Albertazzi et al. (2015) find a similar result using Italian securitization data. More specifically, Agarwal et al. (2012) find no evidence of adverse selection in subprime mortgage securitizations during the credit expansion. On the other hand, other studies have found evidence of information asymmetry with respect to the quality of collateral pool and adverse selection in private securitizations (Downing et al., 2008; Elul, 2016; Adelino et al., 2017). In conclusion, the level of asymmetric information and adverse selection in mortgage securitization remain an empirical question.

We contribute to the debate about the root causes of the Great Recession and the role of the OTD home finance model by examining the effect of securitization on information flow to mortgage security investors. More specifically, we explore the informativeness of mortgage servicing fees with respect to the quality of mortgage collateral pools. Finally, we test whether security prices truthfully reflect the credit risk priced in servicing fees as a way of assessing the extent to which issuers were able to take advantage of security investors.

Servicers play a central role in securitization by being in charge of mortgage payment processing and default resolution. Servicers’ main compensation consists of servicing fees charged on outstanding mortgage balances.⁴ As owners of mortgage servicing rights (MSRs), servicers, much like security investors, have a vested interest in mortgage pools, for servicing cash flows depend on the quality of mortgage pools and borrower behavior.⁵ Servicers must earn enough servicing cash flows to cover initial capital investment and ongoing operating expenses.⁶ Therefore, servicers must carefully assess the quality of mortgage pools because more default and foreclosure may have devastating financial consequences.⁷

Unlike security investors, servicers are likely to suffer less information asymmetry relative

⁴Servicing fees are applied on outstanding mortgage balances monthly. They are meant to compensate servicers for payment processing and account management. Loan renegotiation costs are normally borne by borrowers, any unpaid fees and foreclosure costs being recoverable from property sale proceeds. Servicing fees generally constitute the largest portion of servicing cash flows, which also include ancillary fees and interest rate float (Diop and Zheng, 2020).

⁵Faster prepayment speeds than initially expected also reduce servicing cash flows (Diop and Zheng, 2020). However, this study focuses on mortgage credit risk and its pricing into securities sold to investors.

⁶Technically, servicers acquire MSRs from deal issuers. These payments should be viewed though as a way for issuers to capture a share of future interest rate float earned by servicers. Since interest float cash flows also depend on the remaining balance on serviced mortgages, these initial payments exacerbate the effect of default on servicers’ financial standing.

⁷One could even argue that servicers have more incentives to assess the quality of mortgages. Unlike most MBS investors whose investments are subject to strict capital allocation rules, servicers are less diversified, thus more vulnerable to severe adverse mortgage market shocks.

to security issuers regarding the quality of collateral pools given their strategic role in mortgage securitization. Normally, servicers have access to detailed information on mortgage pools. In addition, they often originate a significant share of the mortgages they service or may be affiliated with the lenders, which may give them access to additional hard and soft information collected during underwriting. In conclusion, servicers have the incentive and the ability to assess proposed servicing fees given the quality of associated mortgage pools. Therefore, servicing fees should provide a window into the amount of credit risk associated with mortgage collateral pools. This study exploits this overlooked “*collateral certification*” role of servicers to examine incentive issues associated with the OTD model in the non-agency (private-label) mortgage market.⁸

This study covers the five-year period from 2002 to 2006 spanning most of the recent housing market bubble and accompanying mortgage credit expansion. We use mortgage origination, performance, and securitization data from ABSNet, a comprehensive non-agency mortgage database, and manually collected related MBS bond data from Bloomberg. Our sample includes 2,685 non-agency MBS deals consisting of roughly 6.2 million securitized mortgage loans, 62 issuers, and 75 servicers. These loans collateralize 51,679 securities of different credit risks and coupon structures. Given our focus on credit risk, and for other reasons discussed later, our security analysis focuses on the floating-rate securities.

First, we examine the relationship between servicing fee and the likelihood of mortgage default after securitization. After controlling for observable mortgage characteristics, we find that servicing fee still accounts of a significant portion of mortgage default. In relative terms, a one-standard deviation increase in servicing fee is associated with 5% and 6% increases in 60- and 90-day default within 24 months after securitization, respectively. This finding remains when we proxy for unobservable mortgage credit risk using the orthogonalized component of servicing fee following the model used by Diop and Zheng (2020). This evidence suggests that servicing fees also capture some private information about mortgage pools. Furthermore, we show that the residual effect of servicing fee on default remain after accounting for potential adverse selection in securitization.

⁸NOTE ON MISREPRESENTATIONS. However, this study is not about potential collateral misrepresentations by MBS issuers and underwriters to security investors. Most misrepresentations would not be necessarily captured by servicers and reflected in servicing fees.

Next, we explore whether this additional credit risk priced in servicing fees is properly reflected in security spreads and returns using Bloomberg security data. Our analysis reveals a positive relation between security spreads and servicing fees, after controlling for security characteristics, collateral pool characteristics, and market factors. Furthermore, we find that this risk primarily affects, as expected, lower security classes. Interestingly, unlike lower security classes, AAA securities experienced higher returns relative to this residual credit risk as the financial crisis worsened. AAA-security returns could be indicative of a possible underpricing of those securities with respect to this additional credit risk.

The contribution of this paper is threefold. First, we contribute to the mortgage termination literature (e.g. Campbell and Dietrich (1983); Pavlov (2001))⁹ by showing that servicing fees capture private information about mortgage pools that significantly explains mortgage default. Secondly, we extend the literature on information asymmetry in securitization (e.g., Agarwal et al. (2012); Ratnadiwakara (2016)) by providing evidence indicating that although issuers may enjoy some information advantage over security investors, the fact that servicers suffer less information asymmetry helps transparency in securitization by forcing servicing fees to reflect private information held by issuers. Finally, we present redeeming evidence regarding the OTD mortgage lending model showing that issuers have been more forthcoming to security investors or that investors were more informed than previously thought.

The next section discusses information asymmetry in mortgage securitization and further highlights our contribution to that literature. Section 3 is about the informativeness of servicing fees with respect to mortgage quality. Section 4 considers whether mortgage security prices adequately capture the amount of credit risk priced in servicing fees and how that risk differentially affects security investors. Section 5 concludes.

2 The Informativeness of Servicing Fees

2.1 Bridging Investors' Information Gap

Securitization has created a vibrant secondary market for home mortgages, which has increased mortgage liquidity by giving lenders the option to bundle and sell originated loans

⁹LaCour-Little (2008) presents a detailed review of this literature.

to investors and given rise to vertical dis-integration in housing finance. The development of this market has generated real economic benefits but also creates non-trivial drawbacks. On one hand, it creates business efficiencies by allowing firms to specialize and compete in areas where they enjoy comparative advantages, which ultimately benefits households. On the other hand, securitization introduces significant information frictions that are not present in the vertically-integrated mortgage financing model.¹⁰ Of particular interest to this study is the flow of information from security issuers to investors concerning mortgage pools. As such, the focus of this paper is on information transparency, rather than adverse selection in mortgage securitization.¹¹ As long as security investors do not suffer any information disadvantage relative to issuers, the cherry-picking of mortgages being securitized should not be an alarming matter because security prices would accurately reflect available information. The question addressed in this paper is whether MBS security issuers shared with outside parties all relevant information about the mortgages.

Securitized non-agency mortgages came from two channels. To secure the supply of mortgages for securitization and improve deal profitability by controlling the entire value chain, many investment banks integrated backward into mortgage origination.¹² In addition to the hard information collected during underwriting, security issuers may also have gathered soft information on originated loans. To complement their direct lending capacity, they also purchase loans from non-related lenders for securitization. As part of their due diligence, they evaluate those loans based on hard information supplied by lenders and also receive warranties from them that no material information was withheld. Obviously, issuers would know more about the quality of the mortgages they originate, in part by having access to soft information collected during underwriting.

Prior to marketing MBS securities, issuers have to meet stringent disclosure requirements.¹³

¹⁰Ashcraft and Schuermann (2008) list seven key informational frictions present in the dis-integrated housing finance model. LIST THE SEVEN INFORMATIONAL FRICTIONS

¹¹For example, Keys et al. (2010) show that securitization has led to lax borrower screening by lenders for loans destined for securitization, which suggests adverse selection in securitization.

¹²Starting in the early 2000s, Wall Street firms expanded into non-agency (subprime) lending. For example, HSBC acquired Household Finance, one of the largest subprime mortgage lenders, in 2003 to boost its mortgage origination and consumer finance business. Similarly, Lehman Brothers acquired BNC Mortgage in 2003 to become a major force in the subprime lending space. As our data show, Wall Street firms dominated non-agency mortgage lending over time.

¹³Issuers are required to register with the Securities and Exchange Commission (SEC) all securities marketed to the public and disclose all material information regarding the issues – disclosure requirements on private

As part of these requirements, security issuers have to provide investors with detailed information on securitized mortgages so that they can conduct their own independent analysis of proposed securities. Furthermore, issuers are required to hire a bond rating company to review the deal structure and underlying assets for the purposes of providing an independent assessment of the securities in the form of credit ratings. Bond rating agencies, security investors, and even servicers have to rely primarily on information from issuers, which will be mostly hard in nature because soft information is technically not transferable. Therefore, issuers may know more about securitized mortgages than outsiders and may take advantage of their privileged position when placing securities. However, that advantage should only be in relation to soft information on originated loans, provided that they invested in collecting that information in the first place.¹⁴

But does this mean that securitization inexorably limits information transparency due to the resulting business compartmentalization and information barriers, allowing issuers to take advantage of investors by withholding material information or offuscating the true risk associated with underlying mortgages? As many studies have shown, many MBS issuers have undoubtedly used their informational advantage to defraud investors (CITATIONS), which the new risk retention requirement under The Dodd-Frank Wall Street Reform and Consumer Protection Act is meant to address.¹⁵ In the case of non-agency securitization, we argue that servicing fees may have helped alleviate investors' information gap regarding the quality of mortgage pools.

Issuers have to finalize mortgage servicing arrangements before marketing securities to investors. A key consideration for issuers are servicing fees, which reduce interest rate spread

placements are less stringent since they are marketed to sophisticated investors . HOW MANY MBS DEALS WERE PRIVATE PLACEMENTS?

¹⁴It is unclear how much effort issuers were willing to spend on gathering soft information given that they intend to securitize all mortgages. Keys et al. (2010) note that lenders have no incentives to incur the cost of gathering soft information on mortgages destined for securitization because investors purchase loans based on hard information. However, this view fails to recognize that negative soft information may be priced at origination using fees such that investors may not know that the mortgage is riskier than the interest rate on loan indicates. THIS IS A POTENTIALLY INTERESTING QUESTION TO EXPLORE FURTHER. SO SOFT INFORMATION SHOULD ONLY MATTER ON PURCHASE MORTGAGES DUE TO ADVERSE SELECTION IN SECURITIZATION. IS IT SAFE TO ASSUME THAT NON-AGENCY ISSUERS TO NOT KEEP MORTGAGE IN PORTFOLIO.

¹⁵To be clear, our study is not about potential collateral misrepresentations by MBS issuers and underwriters to security investors (CITATIONS). Most misrepresentations would not be necessarily captured by servicers and reflected in servicing fees.

passed on to investors and security prices. Even though issuers need to keep servicing low in order to maximize deal profitability, they must make sure that servicing fees provide sufficient compensation to servicers, whomever it may be, throughout the life of the deal.¹⁶ Once set, servicing fees cannot be changed after deal closing if servicing is transferred due to the servicer going out of business, for example, or for whatever reason. Thus, it is in the best interest of issuers to ensure that servicing fees adequately pay for the administration of the mortgages, which forces them to consider all information at their disposal when setting the fees. Furthermore, the fact that issuers know that servicers will evaluate servicing fees limits ability to get away with setting incorrect fees.¹⁷

More than anybody else, servicers have vested interests in reducing the level of information asymmetry regarding the quality of mortgages. Even though servicers have access to the mortgage information available to security investors, which, according to (Foote et al., 2012), gives an accurate representation of mortgage pools, they are more likely to carefully dissect that information. Unlike security investors who can rely on security ratings, servicers must analyze the mortgages in order to evaluate proposed servicing fees. Unlike rating agencies who are paid fixed fees for reviewing the deal, servicer compensation directly depends on the quality of underlying mortgages. Furthermore, servicers are in the business of assessing collateral risks in order to accurately price mortgage servicing rights. Their central role in securitization and expertise give them a superior ability to assess collateral risks and appreciate whether servicing fees are appropriate given expected mortgage termination risks. Furthermore, servicers often originate a significant share of mortgages they service or may be affiliated with the originators of those mortgages. This gives them access to additional hard and soft information collected during underwriting. In summary, servicers have the incentive and ability to accurately assess the quality of collateral pools and do so when negotiating servicing conditions. Therefore, servicing fees should provide a window into the amount of credit risk associated with mortgage collateral pools. This study capitalizes on this overlooked “*collateral certification*” role of servicers. The information content of servicing fees has not been explored in the literature.

¹⁶Servicing fees are generally set by issuers prior to selecting servicers (Diop and Zheng, 2020). However, it is also possible that issuers negotiate servicing terms with selected servicers, rather than auction servicing after setting fees.

¹⁷Diop and Zheng (2020) give a detailed description of servicer compensation structure and discuss the determinants of mortgage servicing fees.

2.2 Empirical Analysis

This study builds on the finding by Diop and Zheng (2020) that non-agency mortgage servicing fees reflect observable mortgage quality by exploring whether servicing fees also capture private information held by MBS issuers regarding the quality of collateral pools. To answer this question, we first proxy for unobserved mortgage risk held by issuers and then examine whether it significantly explains observed mortgage default after securitization. Against mortgage and deal characteristics.¹⁸ We model mortgage default as follows:

$$\begin{aligned} Pr(Default_i = 1) = & \beta \times Unobserved Risk_i + \mathbf{X}_i' \gamma + \boldsymbol{\Theta}' \delta + Location_i \\ & + Origination Year_i + Servicer + \zeta_i. \end{aligned} \quad (1)$$

Our dependent variable, $Default_i$, is a binary variable indicating whether loan i has been in default during the selected performance observation window. We track the status of each loan monthly from securitization date to the first occurrence of default or until the end of our observation window for performing loans. $\mathbf{X}_i$ is a vector of observable borrower attributes and loan characteristics that are found to be the main predictors of mortgage default. We discuss its elements in the data section below. Our variable of interest is $Unobserved Risk$, which measures private information held by issuers that are priced in servicing fees. We propose two measures of unobservable credit risk. We use servicing fee as our first measure of unobservable credit risk because our default model also controls for observable mortgage characteristics. Consequently, servicing fee will only capture variation in mortgage default not explained by the elements of $\mathbf{X}$. Our second measure of unobserved risk are the orthogonalized values of servicing fees from a model similar to the one used by Diop and Zheng (2020).¹⁹

¹⁸We are aware that prepayment risk also affect servicing fees. However, as will become clear later, this paper focuses on whether private information regarding mortgage quality is appropriately priced in the secondary market.

¹⁹Following Diop and Zheng (2020), we model servicing fees as:

$$Servicing Fee_i = \mathbf{X}_i' \beta + Location + Origination Year + Vintage + Deal Type + Issuer + \xi_i. \quad (2)$$

$\mathbf{X}$ captures individual mortgage characteristics at securitization. The model also accounts for issuer heterogeneity using issuer fixed effects (*Issuer*) since issuers technically set servicing fees. We also include property location fixed effects (*Location*) in our model to account for time-invariant local risk factors affecting mortgage pricing, hence servicing services. Furthermore, we neutralize variations in mortgage underwriting standards over time using mortgage origination-year fixed effects (*Origination Year*). Finally, we include deal issuance year fixed effects (*Vintage*) and deal asset type fixed effects (*Deal Type*). We then use the explained components of

The vector Θ stands for time-varying housing market and macroeconomic factors affecting borrowers' propensity to default. Our model also includes origination-year fixed effects to control for changes in underwriting standards and location fixed effects to capture time-invariant local factors affecting mortgage performance. We also include servicer fixed effects in our model to control for unobservable deal attributes and servicer fixed effects to deal with heterogeneity in differences in servicing that might affect borrower performance. Following the literature, we estimate Equation (1) using a linear probability model due to the many fixed effects included in our model.

2.2.1 Mortgage Data

The mortgage data used in this study is from the ABSNet non-agency mortgage securitization databases collected by Lewtan, a Moody's Analytics company.²⁰ Our sample consists of 2,685 non-agency securitizations from 2002 to 2006. Consequently, our study covers most of the last housing market boom underpinned by a considerable expansion in non-agency mortgage lending and securitization. After dropping loans with missing servicing information and cleaning the data, our final sample consists of roughly 6.2 million loans with the relevant information in the ABSNet mortgage origination and performance data.²¹ Our sample contains 62 issuers and 75 servicers, with on average 41 issuers and 45 servicers annually over the 5-year period. Table 1 breaks our sample by deal vintage, loan origination year, and deal asset type. The last three years of the study account for at approximately 74% of our sample due to the surge in non-agency mortgage lending during that period. However, our sample is roughly evenly split between prime, alt-A, subprime deals.²²

To construct our main measures of mortgage default, we track the performance of mortgages over 24 months from securitization date using monthly performance updates from ABSNet and characterize default as the first occurrence of 60- or 90-day delinquency. We also estimate 12-

servicing fee, ξ_i , as a proxy of unobserved risk priced in servicing fees.

²⁰Lewtan sources, normalizes, and analyzes vast amounts of non-agency mortgage data reported by trustees and servicers to provide granular information on a broad array of mortgage loan and deal attributes.

²¹First, we drop second liens; home equity lines of credits; loans with missing states; loans with missing number of units or more than 4 units; loans originated in Puerto Rico, Guam, Hawaii and the U.S. Virgin Islands; and loans originated before 2000. To eliminate outliers and reporting errors, we keep loans with original balances less than \$25,000 or more than \$ 5 million.

²²Deal classifications (i.e., prime, Alt-A, or subprime) are assigned by ABSNet as a way of capturing the general characteristics of deal collateral pools.

month default models as a robustness check. As expected, Table 2 shows higher rates of 60- than 90-day defaults with 24-month default rates being 100% higher than 12-month defaults. Although 24-month 60- and 90-day default rates of 18.6% and 13.9% may seem high, they are symptomatic of the period of this study, particularly its second half. We measure servicing fees at securitization as reported in the ABSNet loan performance updates the month following securitization. As documented by Diop and Zheng (2020), our servicing fee data range from 12 and 54 bps, with an average of 36.6 bps, which will be useful for our analysis. Table 2 also reports orthogonalized values of servicing fees, “*Servicing Fee Residual 1*” and “*Servicing Fee Residual 2*”, estimated from our servicing fee regressions reported in columns (1) and (2) of Table A.1, respectively. As expected, our servicing fee residuals have means of zero.

Table 2 also describes the elements of our vector of loan characteristics ($\mathbf{X}$) included in our default model. These are default predictors commonly controlled for in models, namely, credit score, interest rate, loan balance, loan term, loan-to-value (LTV) ratio, debt-to-income (DTI), loan purpose, income documentation, loan seasoning (time elapsed between origination and securitization), prepayment penalty, interest type, and exotic mortgage features, such as interest only, negative amortization, and a balloon structure. Variable values are at loan origination, except for current LTV and current loan balance, whose values are measured at the time of default or at the end of our performance observation window for performing loans. The characteristics of our sample are reflective of non-agency loans originated during that period. The average credit score is higher than the GSE limit then since two-third of the deals are non-subprime. However, as was typical during that period, 58% are refinancing loans, 35% have prepayment penalties, 42% have deficient borrower income documentation, 20% allow income-only payments, and 5% include a balloon payment. As a result, the average interest rates range from 2.2% to 14.6%, averaging 7.2%. Our vector Θ of housing and macroeconomic control variables, summarized at the bottom of Table 2, consists of national inflation rates, 30-year fixed mortgage interest rates, state unemployment rates, house price index (HPI) at the three-digit ZIP code level, and volatility (20-period standard deviation) of **state quarterly HPI**. These variables of Θ take values at the time of default or at the end of the performance evaluation window for current loans. We use CBSA location dummies as our location effects

to capture time-invariant local credit risk factors.²³

2.2.2 Main Results

First, we explore the relationship between servicing fee and mortgage default while controlling for observable mortgage characteristics. Assuming as Diop and Zheng (2020) show that servicing fees also reflect observable mortgage characteristics, then the coefficient of servicing fee should capture variations in servicing fees not related to mortgage attributes included in our model and would therefore be an estimate of β , the coefficient of *Unobserved Risk* in Equation (1). Because servicing fees are set by MBS issuers, the estimated coefficient should then reflect private information known to issuers. Table 3 columns (1) and (2) report regression results for 60- and 90-day defaults within 24 months after securitization, respectively. These regressions yield predictable results for key determinants of mortgage default. Low credit score or high interest rate at origination is associated with a high probability of default. Higher LTV or loan balance after securitization is associated with a higher probability of default. Similarly, high DTI ratio, adjustable interest rate, seasoning, and exotic mortgage features, such as deficient income documentation, negative amortization, interest only, and a balloon structure increase the likelihood of a mortgage defaulting after securitization. On the other hand, loans on owner-occupied and single-family properties tend to default less often. In addition to mortgage attributes, macroeconomic and housing market variables have predictable effects on default. Mortgage default is negatively related to changes in house prices, house price volatility, and changes in interest rates, whereas unemployment positively contributes to mortgage defaults. The economic interpretation of each of these results is relatively intuitive. After accounting for these observable default factors, our regressions show that servicing fees still have a significant positive effect on mortgage default. A one-standard deviation increase in servicing fee is associated with an increase in 60- and 90-day defaults of 0.93 and 0.82 percentage points, respectively, corresponding to 5.01% and 5.89% in relative term.²⁴

Next, we proxy for unobservable mortgage risk using residuals from regressing servicing fee

²³Core-based statistical area (CBSAs) consist of one or more counties (or equivalents) anchored by an urban center of at least 10,000 people plus adjacent counties that are socioeconomically tied to the urban center by commuting.

²⁴From tables 2 and 3: $12.6 \times 0.00074 = 0.93\% \div 18.6\% = 5.01\%$ for 60-day default and $12.6 \times 0.00065 = 0.82\% \div 13.9\% = 5.89\%$ for 90-day default.

on observable mortgage loan characteristics following Equation (2). The elements of $\mathbf{X}$ in these first-stage estimations are the same as in Equation (1), except that the values of loan balance and combined LTV, which substitutes for LTV, are at loan securitization date. Residuals from these first-stage regressions in Appendix Table A.1, whose findings are identical to those documented by Diop and Zheng (2020), are summarized in Table 2. In columns (3) and (4) of Table 3, we proxy for unobservable risk using residuals from the servicing fee regression in Table A.1 column (1) omitting deal asset type fixed effects. These regressions suggest that a one-standard deviation in Unobserved Risk translates into 0.77% in 60- 90-day defaults or 4.16% and 5.57% relative to the means 60- and 90-day defaults. As Diop and Zheng (2020) show, prime and Alt-A mortgages have lower servicing fees than subprime mortgages, hence the need to control of deal asset types when modeling servicing fees. Consequently, our third measure of unobservable risk consists of regression residuals from a servicing fee model that controls for heterogeneity in deal asset types in Table A.1 column (2). We use this measure in our default regressions in the last two columns of Table 3. Using this measure, we find that a one-standard deviation increase in unobserved risk is associated with 0.84% (0.76%) increase in 60-day (90-day) default or 4.49% (5.47%) in relative term. Our findings are unchanged in relative terms when we examine 60- and 90-day defaults over 12 months after securitization in Table A.2. In conclusion, our default regression results are supportive additional risk being priced in servicing fees. Therefore, servicing fees are more informative than observable mortgage characteristics about the overall quality associated with collateral mortgage pools in the non-agency MBS market. We directly use servicing fees as a proxy for unobserved risk in our security analysis because we group mortgages by deal for that analysis and servicing fee regression residuals aggregate to zero. This is appropriate because the magnitude of the effect of servicing fee on mortgage default is similar to that of servicing fee residuals.

2.2.3 Accounting for Adverse Selection in Securitization

As discussed, most MBS issuers maintain their own mortgage origination operations, but also purchase mortgages from other lenders for securitization. As they built up their mortgage lending capacities, Wall Street firms originated a large share of their securitization portfolios – about 74% of mortgages in our sample were originated by the issuers. With issuers purchasing

non-negligible shares of collateral pools from other lenders, does adverse selection in mortgage securitization, whereby lenders keep safer mortgages on their books and sell riskier mortgages to MBS issuers, explain observed variations in servicing fees?²⁵ Adverse selection in securitization would lead to mortgages originated by outside lenders being riskier along unobservable characteristics than those originated by issuers. Consequently, we expect mortgages that are not originated by MBS issuers to pay higher servicing fees after controlling for observable mortgage characteristics because both issuers and servicers are aware of the potential adverse selection. We want to make sure that the additional risk captured in servicing fees is not due adverse selection in securitization.

We present our findings in Table 4. We document in column (1) that mortgages sourced from outside lenders are more likely to default than mortgages with similar observable characteristics that are originated by MBS issuers or their affiliates – our issuer-originator dummy identifies mortgages originated by MBS issuers or their affiliates. On average, mortgages from outside lenders are 1.09%, or 7.84% in relative term, more likely to experience 90-day delinquency within 24 months after securitization – our estimation sample size is smaller due to missing originator identity. One potential explanation of higher default on sourced loans is adverse selection in securitization whereby lenders choose to keep safer mortgages and offload riskier ones into the secondary market for securitization. Assuming that issuers and servicers are aware of this possibility, servicing fees should price this risk as documented by Diop and Zheng (2020). Column (2) confirm this prediction, on average, servicing fees paid on mortgages originated by MBS issuers are 1.83 bps, or 5% relative to the mean, lower than on loans of similar observable characteristics that were purchased from other other lenders.²⁶ Next, we consider whether the identified additional risk priced in servicing fees remains once we control for the mortgages’ origins. Columns (3) to (5) shows that, whether we use servicing fees directly or servicing fee residuals from our first-stage regressions in Table A.1, servicing

²⁵The empirical evidence on the existence of adverse selection in securitization is mixed, depending on the data studied and the period covered. However, the evidence tilts more in favor of adverse selection in securitization. Although Ambrose et al. (2005) show that lenders may securitize less risky mortgages to take advantage of regulatory arbitrage or due to reputational concerns, rather than to take advantage of information asymmetry, more recent studies that cover the recent mortgage credit expansion find overwhelming evidence in support of adverse selection in securitization (Keys et al. (2010); Calem et al. (2010) ; Krainer and Laderman (2014); Jiang et al. (2014b); Elul (2016); Diop et al. (2020)).

²⁶Although we privilege the adverse selection explanation, we cannot affirmatively rule out explanations, such as specialization in mortgage lending, for example.

fees carries some unobservable risk independent that significantly affect mortgage performance after securitization.

In conclusion, we have shown that, in addition to reflecting observable mortgage characteristics, servicing fees also capture some additional risk factor from private information held by MBS issuers and servicers that is likely unobservable by information unobservable by outside parties, including MBS investors. Next, we explore whether this additional credit risk associated with collateral pools is properly reflected in security prices in order to assess how much information was available to MBS investors.

3 Security Analysis

3.1 Methodology

As discussed earlier, servicers play a central role in mortgage securitization, possibly giving them access to timely market information as compared to MBS investors. Having demonstrated that servicing fees capture servicers' assessment of the quality of mortgage collateral pools, we consider whether the additional credit risk captured in servicing fees is priced in securities sold to investors and its potential impact on the performance of various MBS security classes. To investigate these questions, we adopt the following security pricing and return models:

$$Pricing_b/Return_b = Credit\ Risk_p + \mathbf{X}_b' \beta + \mathbf{Z}_p' \gamma + \mathbf{D}_d' + Pricing\ YM_b + \xi_b . \quad (3)$$

We separately estimate our security pricing and return models using the data described in Section 3.2. Since security issuance prices are not publicly available, we use security spreads at placement under the restrictions specified in the data section to proxy for $Pricing_b$. To estimate our return model, we use the securities' internal rates of return (IRR) over various observation periods after issuance, which also require a number of assumptions. Our variable of interest is $Credit\ Risk_p$ represents the additional collateral credit risk captured in servicing fees. Our set of explanatory variables consists of bond characteristics ($\mathbf{X}_b$), collateral pool characteristics ($\mathbf{Z}_p$), and deal level controls ($\mathbf{D}_d$). In order to control for capital market conditions at security placement date, we include security pricing year-month fixed effects ($Pricing\ YM_b$). The last

term, ξ_b , represents error terms. Our vector of security level control variables, $\mathbf{X}_b$, includes servicing fee, tranche type, WAL, and subordination. Our collateral pool variables, $\mathbf{Z}_p$, include average credit score (FICO), LTV and seasoning, and share of low documentations, interest only, owner-occupied and negative amortization mortgages. Our vector of deal level control variables, $\mathbf{D}_d$, is limited to net coupon.

3.2 Security Data

For the purposes of this analysis, we put together a new dataset regrouping securities issued under our initial sample of 2,789 deals. We compile from ABSNet security identifiers (bond type, description, Bloomberg identifier, CUSIP, etc.) for all securities issued under these deals, which results in an initial sample of 51,679 securities. Then, we manually collect from Bloomberg all available relevant security information: interest rate type, spread, weighted average life (WAL), duration, subordination, and deal net coupon, i.e., weighted average coupon (WAC) minus average servicing fee. Table 5 provides a breakdown of our security sample by bond rating and coupon type. Next, we complement the Bloomberg data with average pool characteristics compiled from ABSNet’s loan-level data.

MBS security prices at issuance are not available since these are private transactions.²⁷ Following Adelino et al. (2017), we restrict our analysis to floating rate bonds, which reduces our sample to 16,206 securities. The reason behind this approach is twofold. First, it allows us to use spreads on floating rate bonds as a proxy for yield spreads at issuance, thus unobserved issuance prices, because spreads on floating rate securities are generally set at market required yield spreads at security issuance.²⁸ Therefore, we use the securities’ fixed spreads as our pricing variable in Equation (3). Another important reason for focusing on floating rate securities is that it allows us to abstract from interest rate risk and the negative convexity associated with fixed-rate, long-duration MBS securities, and concentrate on credit risk. After excluding bonds with missing information and those rated below BB that are generally less liquid, we

²⁷The Financial Industry Regulatory Authority (FINRA) now provides monthly MBS market activity statistics going back to May 2011 (<http://tps.finra.org/idc-index.html>). But these are aggregated market data and do not cover the period of this study.

²⁸Since these securities’ prices are set close to par at issuance, their spreads over short-term U.S. Treasury rates or LIBOR, which are fixed over the life of the securities, represent a good measure of the securities’ expected risk-adjusted returns, thus prices paid by investors. Although this assumption is likely true for liquid bonds, such as AAA rated securities, it may be less so for lower tranches that could sell at a discount.

are left with a final sample of 11,355 floating rate securities consisting of 36% (4,118) AAA, 24% AA, 21% A, 18% BBB, and 1% BB (Table 6).²⁹ This is the sample used for our security pricing (spread) analysis.

MBS security return data are not readily available. Following Chernenko (2017), we manually collect from Bloomberg monthly bond cashflows from issuance date in order to compute security returns. We calculate the securities' IRRs under the following conditions. First, we assume that the securities were bought at par. As result, we exclude non-investment-grade securities since they are less liquid and therefore more likely not to meet this condition. For monthly cashflows between a security's issuance date and the IRR calculation date, we use the actual payments received by security investors as reported on Bloomberg. For the final cash-flow at the end of the IRR calculation month, we use that month's distribution to investors, combined with any outstanding principal balance at that time. We then calculate four IRR series from security issuance date to December 2010, 2012, 2014 and 2016.³⁰

Table 6 reports the summary statistics of our security data. The statistics in Panel A are for the full sample, whereas Panel B is for AAA securities only. Since different tranches could be collateralized by the same mortgage pool, we have fewer unique observations of mortgage pool variables than security variables. Reported pool variables are average characteristics of individual loans contained in the pools. For example, servicing fees represent the average servicing fee for the pool of mortgages collateralizing the securities.³¹ Since the variables in Equation (3) are at the security pool level, we cannot use to previous measure of credit risk in our pricing and return estimations because it is likely to average to zero. Based on Table A.2 result, we directly use *Servicing Fee* to proxy for *Credit Risk* in our pricing and return models. The distributional characteristics of servicing fees for the whole sample and AAA bonds are identical with an average of 0.42 and similar to individual loan statistics in Table 2. We also take note of the similarity between other pool level variables in Panel A and Panel B.

²⁹Following Ghent et al. (2017), the AAA group combines AAA⁺, AAA, and AAA⁻ securities. We adopt the same rule for the other security classes.

³⁰Our IRR calculations assume that securities are bought at par at the beginning of the month of first cashflow available on Blomberg. This assumption is correct for about 90% of our sample. For the remaining 10% of our sample, first cashflows are more than 30 days after deal closing date. We attribute this to reporting errors and start our IRR calculation one month before first cash flow dates on Bloomberg.

³¹Most AAA securities are collateralized by specific loan pools, whereas lower tranche securities are generally backed by all mortgages.

AAA bond spreads vary from 3 to 200 bps with an average of 26.27 bps, compared to 3 to 500 bps with an average of 81.97 bps for the whole sample.³² Also, AAA IRRs remain relatively constant over time. The securities' WALs range from 0.49 to 13.44 years for the AAA sample and from 0.09 to 13.44 years for the whole sample. The maximum level of subordination in our sample is 71.56%.

3.3 Security Pricing

Is the documented additional credit risk reflected in servicing fees properly priced by MBS bond investors? This is the question we address in this section. Non-agency MBS security prices are negotiated between bond issuers/underwriters and investors. Assuming no information asymmetry in securitization, security prices should reflect all pertinent information, including any additional insight regarding the quality of collateral mortgage pools gained from servicing fees. However, absence of information asymmetry may be a strong assumption that is difficult to reconcile with documented evidence of widespread frauds and misrepresentations in securitization (CITATIONS). Assuming that issuers and underwriters may shortsightedly focus on immediate financing gains when placing MBS bonds to investors, any pricing of the extra collateral credit risk captured in servicing fees would be indicative of investors being more informed than initially thought by not limiting themselves to information contained in deal prospectuses when valuing MBS securities. Such outcome should not come as a total surprise because fixed-income investors, including MBS investors, are generally large institutional investors who are not known to suffer from information asymmetry in financial markets.³³

Table 7 presents security yield spread estimation results following Equation (3). Our pooled regression not controlling for security type in column (1) shows that security spreads positively relate to servicing fees, our measure of credit risk in these estimations, which is indicative of security prices reflecting the additional collateral credit risk captured in servicing fees. An increase in servicing fees of 10 bps (one standard deviation in Panel A of Table 6) corresponds to an increase in spreads of 4.62 bps or 5.8% relative to a mean of 80 bps for our sample.

³²Most securities in our sample are priced against 1-month U.S. Treasury rates. We winsorize each tail of the spread distribution at 0.5%.

³³As noted earlier, this does not mean that MBS investors would be able to forestall frauds and misrepresentations by mortgage lenders, security issuer, or underwriters.

Additionally, our control variables generally shows the expected directional relations to security yield spreads. More importantly, subordination, a crucial measure of security credit risk, is negatively related to yield spreads. Also, yield spreads are higher on deals with higher net coupon (WAC). Even though the coefficient of WAL is statistically insignificant in this specification, it points to the expected relation to yield spread. Collateral control variables further confirm the validity of our model. All else the same, higher credit scores and owner occupancy, which are indicative of lower mortgage credit risk, translate into lower yield spreads. In contrast, higher LTVs and shares of low-doc loans lead to higher yield spreads to compensate investors for the higher level of credit risk. Even though ARMs are generally viewed from the borrowers' perspectives as higher-risk mortgage products, as compared to FRMs, our model shows that they are associated with lower security yield spreads. It is possible that the coefficient of our ARM variable may be capturing lower interest rates on ARM loans relative to FRM loans, which price expected inflation. Though puzzling, the negative relation between interest only and spreads in column (1) disappears as we fine-tune our model specification.

We significantly improve the explanatory power of our model specification controlling for security classes in column (2). We keep AAA securities as our control group by adding dummy variables for AA, A, and BBB securities. As expected, security yield spreads increase with expected default risk. Compared to AAA securities, average security yields increase monotonically from 22.2 bps on AA securities to 162.8 bps on BBB securities. The resulting average intensive effect of our credit risk measure (servicing fees) on yield spreads is significantly lower compared to column (1) because our model now captures the average effect within the four security classes. This specification also improves the estimated effects of some control variables. Now, WAL displays the expected positive relation to yield spreads indicating that investors are compensated for taking additional risks on longer-maturity securities. Furthermore, the surprising negative correlation between the share of interest-only loans to yield spreads in column (1) all but disappears. In summary, the results in column (2) that, on average, yield spreads within the four security classes making our sample positively reflect our additional credit risk factor.

We conduct our final pricing test at the security risk grade level. Non-agency MBS structures assign credit risk differently across security classes from bottom up with credit losses

applied to the most junior securities first and principal recoveries assigned top down to the most senior security first. We have already established that servicing fees price additional credit risk observed by servicers. The next important question is whether the risk is correctly allocated to security classes. If our story about additional credit risk priced in servicing fees is correct, top tranches should be relatively immune from the effect this risk factor, the blunt of which should concentrate on the most junior tranches. To test this prediction, we extend our previous model by adding servicing fee-security class interaction terms in column (3). This allows us to capture any differential effects of our credit risk measure on yield spreads within each security class.

We present the results from this analysis in column (3) of Table 7. First, we want to point out that differences in average yield spreads for various security classes relative to AAA securities are largely similar to our estimates in column (2). In this specification, the coefficient of servicing fee now applies to our control class, AAA securities. The coefficient estimates of our interaction terms show that servicing fee has no significant effect on the pricing of AAA, AA, A securities. In contrast, the effect of our credit risk measure on BBB yield spreads is both statistically and economically significant. A one standard deviation increase in servicing fee corresponds to an increase in spreads of 3.8 bps or 2.34% relative to an average spread of 163 bps for BBB securities. These results indicate that MBS security prices reflect the additional credit risk priced by servicers with junior-tranche investors rightfully receiving higher yield spreads as compensation for the additional risks they bear. Even though spreads on top tranches are not directly affected by our credit risk measure, defaults speed up principal repayments to those investors, which could affect security returns.

3.4 Security Performance

We complement of our analysis of the effects of this additional credit risk on securities investors by examining how it impacts returns to various security classes. As discussed in Section 3.2, we compute returns using the IRR approach under the assumption that the securities were sold at par. We use the end of December 2012 as cutoff for our return analysis because that date marks the beginning of the housing market recovery according to the Case-Shiller

Home Price Index.³⁴ Since our sample consists of non-agency MBS deals closed between 2002 and 2006, security returns cover up to 10 years. We separately estimate Equation (3) for each security class and report our findings in Table 8. It appears that the credit risk factor priced in servicing fees differentially affected security returns over our study period. This additional credit risk had a devastating effect on all MBS securities, except the most senior class. An increase in servicing fees of 10 bps (one standard deviation) decreased annual returns on BBB securities by 1.20%, on A securities by 1.04%, and on AA securities by 1.70%, which amount to 5.86, 5.09, and 8.22%, respectively, over the 5-year period from 2007 to 2012. In contrast, AAA security investors would experience a small gain of 0.92% over the same 5-year period for the same 10-bp change in servicing fees.

Next, we restrict our return analysis to AAA securities since they are more likely to be priced at par given their higher market liquidity and examine their performance at successive dates from January 2009 to the end of 2016. Table 9 shows that AAA securities collateralized by risky mortgages did not do well during that period. Collaterals composed of loans with high interest rates (net coupons), LTV, and shares of low-doc, interest-only, and negative amortization experienced significantly lower returns during that tumultuous period, in contrast to securities with higher subordination or backed by safer mortgages, such as more seasoned mortgage and higher shares of owner-occupied properties. After accounting for these risk factors, our model still yields a significant positive relation between servicing fees and returns on AAA securities during most of the period. Furthermore, the positive effect of this credit risk factor on AAA security returns increased monotonically over time as the economy recovers. Though positive but statistically insignificant at the beginning of 2009, the effect of servicing fees on AAA returns then turned significant and increased monotonically more than five times from 0.0045 at the end of 2009 to 0.0213 at the end of 2016. These estimates mean that a one standard deviation increase in servicing fees by 10 bps increased annual returns on AAA securities by 4.5 bps at the end of 2009 (9 bps for the two-year period from 2008 to 2009) and 21.3 bps at the end of 2016 (193 bps over the 9-year period from 2008 to 2016). Although these effects may appear small, they are important compared to average annual AAA security returns. For example, the 21.3-bp increase in AAA annual returns at the end of 2016 for a

³⁴S&P/Case-Shiller U.S. National Home Price Index (<https://fred.stlouisfed.org/series/csushpinsa>).

10-bp increase in servicing fees represents 7.1% relative to average AAA annual returns of 3%. Even this this positive of effect on the additional credit risk factor on senior security returns maybe somewhat puzzling, it is likely to defaults accelerating principal repayments to AAA tranche investors, which may have improved the performance of those securities during the Great Recession.

In conclusion, investors should be aware that higher servicing fees could be indicative of higher (lower) collateral risk (quality), which will differentially affect senior and junior tranche investors. We find that higher servicing fees are associated with higher spreads on lower tranches and higher returns on AAA tranches for the period covered by our study. Given this positive effect on AAA returns, we find the insensitivity of AAA yield spreads to variations in servicing fees surprising. Since security placement prices are not available, we were forced to limit our analysis to floating rate securities. However, our findings should also matter for other coupon structure. But in addition to credit risk, interest rate risk may become an important consideration in this case.

4 Conclusions

This paper addresses unexplored aspects of the pricing of mortgage servicing in private label securitizations. We show that servicing fees generally reflect default and prepayment risks associated with mortgage collateral pools. When deciding mortgage modifications, servicers appear to take advantage of the fixed servicing fee structure, possibly to the detriment of investors. After showing that servicing fees likely capture information available to servicers about the quality of collateral mortgage pools, we examine associated price and return implications. Our investigation indicates that spreads on lower tranche securities appropriately reflect the additional risk captured in higher servicing fees. Surprisingly, we find that returns on AAA securities were higher on deals with higher servicing fees during our study period, perhaps due to underpricing since default may accelerate cashflows to top tranche investors.

We broadly contribute to the securitization and mortgage servicing literature. More specifically, we extend the literature on mortgage pricing and information asymmetry and incentives in mortgage servicing. A fruitful avenue for future research would be to carefully study servicer

heterogeneity. Different types of servicer, for example, in terms of organizational structure, cost structure, or experience, may approach servicing differently due to differences in incentives. Although we place emphasis on servicer experience, more research is, however, needed in this area.

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Table 1: Sample Composition

	<i># Obs.</i>	<i>%</i>
<i>Panel A: Deal Vintage</i>		
2002	220	8.2%
2003	472	17.6%
2004	581	21.6%
2005	696	25.9%
2006	716	26.7%
<i>Total</i>	<i>2,685</i>	<i>100.0%</i>
<i>Panel B: Loan Origination Year</i>		
2000	16,880	0.3
2001	90,946	1.5
2002	400,086	6.4
2003	885,155	14.2
2004	1,322,688	21.3
2005	2,057,823	33.1
2006	1,448,207	23.3
<i>Total</i>	<i>6,221,785</i>	<i>100.0</i>
<i>Panel C: Deal Asset Type</i>		
Alt-A	876	32.6
Prime	870	32.4
Subprime	939	35.0
<i>Total</i>	<i>2,685</i>	<i>100.0</i>

This table breaks down the studied sample of 2,685 non-agency MBS deals, made up of 6,221,785 loans, by deal vintage year, loan origination year, and deal asset type.

Table 2: Loan Descriptive Statistics

<i>Variable</i>	<i>Description</i>	<i># Obs.</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min.</i>	<i>Max</i>
60-Day Default 24 Months	Binary variable identify first time loan in 60-day delinquency with 24 after securitization	6,221,785	0.186		0	1
90-Day Default 24 Months	Binary variable identify first time loan in 90-day delinquency with 24 after securitization	6,221,785	0.139		0	1
60-Day Default 12 Months	Binary variable identify first time loan in 60-day delinquency with 12 after securitization	6,221,785	0.099		0	1
90-Day Default 12 Months	Binary variable identify first time loan in 90-day delinquency with 12 after securitization	6,221,785	0.062		0	1
Servicing Fee	Servicing fee paid to servicer in basis points	6,221,785	36.6	12.6	12.0	54.0
Servicing Fee Residual 1	Residuals from servicing fee estimation	6,221,785	0.0	8.6	-52.7	40.6
Servicing Fee Residual 2	Residuals from servicing fee estimation	6,221,785	0.0	7.6	-44.6	35.8
Credit Score	Borrower FICO score at loan origination	6,221,785	666	74	300	850
Interest Rate	Original loan interest rate	6,221,785	7.16	1.69	2.20	14.55
Current LTV	Estimated loan LTV at default or period end	6,221,785	0.65	0.22	0.00	1.25
Loan Term	Original loan term in years	6,221,785	29.0	3.9	15.0	50.0
Seasoning	Number of months elapsed between loan origination and securitization	6,221,785	3.4	3.5	0.0	25.0
Current Balance	Log outstanding loan balance at default or end of observation period	6,221,785	11.7	2.3	0.0	15.5
Owner Occupied	Binary variable identifying owner occupied properties	6,221,785	0.82		0	1
Refinancing	Binary variable identifying refinancing loans	6,221,785	0.58		0	1
Prepayment Penalty	Binary variable identifying loans with prepayment penalty	6,221,785	0.35		0	1
Low-No Doc	Binary variable identifying loan and no income documentaton loans	6,221,785	0.42		0	1
Negative Amortization	Binary variable identifying negative amortization loans	6,221,785	0.00		0	1
ARM	Binary variable identifying adjustable-rate mortgage loans	6,221,785	0.57		0	1
Single Family	Binary variable identifying single family properties	6,221,785	0.94		0	1
Interest Only	Binary variable identifying interest-only loans	6,221,785	0.22		0	1
Balloon	Binary variable identifying balloon loans	6,221,785	0.05		0	1
DTI	Debt-to-income ratio; set to zero if missing	1,189,867	37.5	11.8	0.0	100.0
Inflation	Lag monthly national inflation rate at default or end of period	6,221,785	3.23	1.00	1.10	5.50
Mortgage Rate	Monthly national 30-year fixed mortgage rate at default or end of period	6,221,785	6.18	0.32	5.23	7.01
Unemployment	Lag monthly national unemployment rate at default or end of period	6,221,785	5.05	1.11	2.10	10.90
HPI	Log lag house price index in 3-digit Zip code at default or end of period	6,221,785	5.40	0.26	4.71	5.95
HPI Volatility	Lag standard deviation of change in 3-digit Zip code HPI at default or period end	6,221,785	1.83	1.19	0.35	6.03

A Appendix

Table 3: Unobserved Credit Risk Priced in Servicing Fees and Mortgage Default

<i>Dep. Variable:</i>	(1)	(2)	(3)	(4)	(5)	(6)
<i>Mortgage Default</i>	<i>60 Default</i>	<i>90 Default</i>	<i>60 Default</i>	<i>90 Default</i>	<i>60 Default</i>	<i>90 Default</i>
Servicing Fee	0.00074*** (0.0002)	0.00065*** (0.0002)				
Unobserved Risk (Serv. Fee Resid. 1)			0.0009*** (0.0002)	0.0009*** (0.0002)		
Unobserved Risk (Serv. Fee Resid. 2)					0.0011*** (0.0002)	0.0010*** (0.0002)
Credit Score	-0.0008*** (0.0000)	-0.0005*** (0.0000)	-0.0008*** (0.0000)	-0.0005*** (0.0000)	-0.0008*** (0.0000)	-0.0005*** (0.0000)
Interest Rate	0.0424*** (0.0010)	0.0367*** (0.0009)	0.0435*** (0.0009)	0.0377*** (0.0009)	0.0433*** (0.0009)	0.0375*** (0.0009)
Current LTV	0.2573*** (0.0092)	0.2028*** (0.0075)	0.2579*** (0.0092)	0.2035*** (0.0075)	0.2586*** (0.0093)	0.2040*** (0.0075)
Loan Term	-0.0024*** (0.0003)	-0.0021*** (0.0002)	-0.0025*** (0.0003)	-0.0022*** (0.0002)	-0.0025*** (0.0003)	-0.0022*** (0.0002)
Seasoning	0.0056*** (0.0005)	0.0045*** (0.0004)	0.0056*** (0.0005)	0.0046*** (0.0004)	0.0056*** (0.0005)	0.0046*** (0.0004)
Current Balance	0.0066*** (0.0011)	0.0053*** (0.0009)	0.0065*** (0.0011)	0.0052*** (0.0009)	0.0065*** (0.0011)	0.0051*** (0.0009)
Owner Occupied	-0.0119*** (0.0025)	-0.0129*** (0.0022)	-0.0114*** (0.0025)	-0.0125*** (0.0022)	-0.0111*** (0.0025)	-0.0121*** (0.0023)
Refinancing	-0.0215*** (0.0019)	-0.0262*** (0.0018)	-0.0210*** (0.0019)	-0.0257*** (0.0018)	-0.0211*** (0.0019)	-0.0258*** (0.0018)
Low-No Doc	0.0305*** (0.0018)	0.0265*** (0.0016)	0.0294*** (0.0018)	0.0255*** (0.0016)	0.0296*** (0.0018)	0.0256*** (0.0016)
Prepayment Penalty	0.0332*** (0.0031)	0.0260*** (0.0027)	0.0357*** (0.0031)	0.0281*** (0.0026)	0.0357*** (0.0030)	0.0282*** (0.0026)
Negative Amortization	0.0893*** (0.0097)	0.0746*** (0.0081)	0.0908*** (0.0097)	0.0759*** (0.0080)	0.0906*** (0.0096)	0.0757*** (0.0080)
ARM	0.0431*** (0.0022)	0.0398*** (0.0019)	0.0465*** (0.0020)	0.0428*** (0.0018)	0.0463*** (0.0020)	0.0425*** (0.0018)
Single Family	-0.0079*** (0.0013)	-0.0100*** (0.0012)	-0.0079*** (0.0013)	-0.0100*** (0.0012)	-0.0079*** (0.0013)	-0.0101*** (0.0012)
Interest Only	0.0116*** (0.0024)	0.0067*** (0.0021)	0.0102*** (0.0025)	0.0055*** (0.0022)	0.0103*** (0.0025)	0.0056*** (0.0022)
Balloon	0.0823*** (0.0056)	0.0848*** (0.0049)	0.0840*** (0.0056)	0.0863*** (0.0049)	0.0837*** (0.0056)	0.0860*** (0.0049)
DTI	0.0003*** (0.0001)	0.0002*** (0.0001)	0.0003*** (0.0001)	0.0002*** (0.0001)	0.0003*** (0.0001)	0.0002*** (0.0001)
Inflation	-0.0126*** (0.0035)	-0.0117*** (0.0032)	-0.0126*** (0.0035)	-0.0118*** (0.0032)	-0.0126*** (0.0035)	-0.0117*** (0.0031)
Mortgage Rate	0.0325*** (0.0110)	0.0483*** (0.0084)	0.0328*** (0.0110)	0.0486*** (0.0084)	0.0325*** (0.0109)	0.0483*** (0.0084)
Unemployment	-0.0100*** (0.0034)	-0.0085*** (0.0030)	-0.0101*** (0.0034)	-0.0086*** (0.0030)	-0.0102*** (0.0033)	-0.0086*** (0.0030)
HPI (log)	-0.0841*** (0.0081)	-0.0108*** (0.0063)	-0.0842*** (0.0081)	-0.0111*** (0.0063)	-0.0838*** (0.0080)	-0.0107*** (0.0063)
HPI Volatility	-0.0717*** (0.0035)	-0.0480*** (0.0028)	-0.0717*** (0.0035)	-0.0480*** (0.0028)	-0.0718*** (0.0035)	-0.0481*** (0.0028)
Origination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes	Yes	Yes
Location (CBSA) FE	Yes	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>
<i>Adjusted R2</i>	<i>0.215</i>	<i>0.177</i>	<i>0.215</i>	<i>0.177</i>	<i>0.215</i>	<i>0.177</i>

OLS estimation of mortgage default (60- and 90-day delinquencies) within 24 months following securitization. Our dependent variables are binaries set equal to 1 if a mortgage is in default during the 24-month observation window. We measure unobserved credit risk (*Unobserved Risk*) by *Serv. Fee Resid. 1* and *Serv. Fee Resid. 2*, servicing fee residuals extracted from our servicing fee regressions in columns (1) and (2) of Table A.1, respectively. We show in parenthesis our regression standard errors clustered at the deal level with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.

Table 4: Accounting for Adverse Selection in Securitization

	(1) Default	(2) Servicing Fee	(3) Default	(4) Default	(5) Default
Issuer-Originator Dummy	-0.0109** (0.0050)	-1.8307** (0.8443)	-0.0091* (0.0051)	-0.0096* (0.0051)	-0.0096* (0.0050)
Servicing Fee			0.0007*** (0.0002)		
Unobserved Risk (Serv. Fee Resid. 1)				0.0009*** (0.0002)	
Unobserved Risk (Serv. Fee Resid. 2)					0.0013*** (0.0002)
Credit Score	-0.0005*** (0.0000)	-0.0089*** (0.0016)	-0.0005*** (0.0000)	-0.0005*** (0.0000)	-0.0005*** (0.0000)
Interest Rate	0.0363*** (0.0011)	0.3095*** (0.0653)	0.0355*** (0.0010)	0.0364*** (0.0010)	0.0363*** (0.0010)
Control Variables	Yes	Yes	Yes	Yes	Yes
Servicer FE	No	Yes	Yes	Yes	Yes
Issuer FE	Yes	No	No	No	No
Vintage-Year FE	Yes	No	No	No	No
Asset-Type FE	Yes	No	No	No	No
Originator-Year FE	Yes	Yes	Yes	Yes	Yes
Location (CBSA) FE	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	<i>4,755,840</i>	<i>4,755,840</i>	<i>4,755,840</i>	<i>4,755,840</i>	<i>4,755,840</i>
<i>Adjusted R2</i>	<i>0.174</i>	<i>0.665</i>	<i>0.174</i>	<i>0.174</i>	<i>0.175</i>

This table reports OLS regression results of servicing fees in column (1) and mortgage default (90-day delinquency over 24 months) in columns (2) and (5). *Issuer-Originator Dummy* identifies mortgages that are originated by deal issuers. We measure unobserved credit risk (*Unobserved Risk*) by *Serv. Fee Resid. 1* and *Serv. Fee Resid. 2*, servicing fee residuals extracted from our servicing fee regressions in columns (1) and (2) of Table A.1, respectively. The control variables in columns (1) and (2) (i.e., default estimations) are the same as in Table 3. Those in the servicing fee estimations in columns (3) and (4) are the same as in Table A.1. We use deal-clustered standard errors with one, two and three stars indicate statistical significance at 10%, 5% and 1%, respectively.

Table 5: Sample's Securities by Rating and Coupon Type

	<i>Fixed</i>	<i>Floating</i>	<i>STEP</i>	<i>Variable</i>	<i>Zero</i>	<i>Missing</i>	<i>Total</i>
AAA	11,556	7,136	692	6,088	1,238	3	26,713
AA	632	3,061	201	1,206	0	0	5,100
A	606	2,744	207	1,132	0	0	4,689
BBB	618	2,655	216	1,227	3	0	4,719
BB	546	537	54	1,150	1	0	2,288
CCC and below	4,663	73	9	2,823	5	597	8,170
Total	18,621	16,206	1,379	13,626	1,247	600	51,679

Table 6: Security Sample Descriptive Statistics

	<i># Obs.</i>	<i>Mean</i>	<i>SD</i>	<i>Min.</i>	<i>Max.</i>
Panel A: All Securities					
AAA	11,248	36.6%			
AA	11,248	24.1%			
A	11,248	21.1%			
BBB	11,248	18.1%			
Spread (bps)	11,248	80.25	78.73	3	500
IRR Dec. 2010	11,221	-0.17	0.40	-0.99	0.07
IRR Dec. 2012	11,218	-0.22	0.42	-0.99	0.07
IRR Dec. 2014	11,219	-0.23	0.42	-0.99	0.07
IRR Dec. 2016	11,219	-0.23	0.42	-0.99	0.07
WAL	11,248	4.39	1.72	0.09	13.44
Subordination	11,248	12.60	11.48	0	71.56
Servicing Fee	2,525	0.42	0.10	0.15	0.53
Credit Score	2,525	642.27	41.33	527.67	754.50
ARM	2,525	0.74	0.24	0	1
LTV	2,525	77.53	6.11	18.50	102.02
Interest Only	2,525	0.25	0.31	0	1
Negative Amortization	2,525	0.01	0.07	0	1
Owner Occupied	2,525	0.81	0.25	0	1
Low Doc	2,525	0.35	0.24	0	1
Seasoning	2,525	3.55	2.11	0.60	17.01
Net Coupon	1,148	4.49	0.88	2.63	9.56
Panel B: AAA Securities					
Spread (bps)	4,118	26.27	16.57	3	200
IRR Dec. 2009	4,118	0.04	0.01	-0.03	0.05
IRR Dec. 2010	4,118	0.03	0.02	-0.15	0.05
IRR Dec. 2012	4,118	0.03	0.03	-0.23	0.05
IRR Dec. 2014	4,118	0.03	0.04	-0.26	0.05
IRR Dec. 2016	4,118	0.03	0.04	-0.26	0.05
WAL	4,118	3.47	2.37	0.49	13.44
Subordination	4,118	21.62	12.37	0	71.56
Servicing Fee	1,930	0.42	0.10	0.15	0.53
Credit Score	1,930	643.48	42.13	527.67	754.50
ARM	1,930	0.74	0.25	0	1
LTV	1,930	77.42	6.49	18.37	102.02
Interest Only	1,930	0.26	0.32	0	1
Negative Amortization	1,930	0.01	0.08	0	1
Owner Occupied	1,930	0.81	0.25	0	1
Low Doc	1,930	0.35	0.24	0	1
Seasoning	1,930	3.54	2.12	0.60	17.07
Net Coupon	1,103	4.48	0.88	2.63	9.56

Table 7: Servicing Fees and Security Yield Spreads

	(1)	(2)	(3)
AA Tranche	22.231*** (0.776)	18.527*** (3.085)	
A Tranche	66.446*** (1.215)	68.747*** (4.313)	
BBB Tranche	162.755*** (1.743)	146.808*** (6.358)	
Servicing Fee	46.229*** (7.614)	10.444** (4.526)	2.374 (5.341)
Servicing Fee x AA Tranche			9.114 (6.618)
Servicing Fee x A Tranche			-4.812 (9.711)
Servicing Fee x BBB Tranche			38.099** (14.824)
WAL	0.179 (0.300)	1.239*** (0.155)	1.237*** (0.155)
Subordination	-3.569*** (0.097)	-0.474*** (0.049)	-0.462*** (0.049)
Net Coupon	4.006*** (0.866)	1.009* (0.527)	0.981* (0.525)
Low Docs	15.001*** (2.826)	7.683*** (1.757)	7.753*** (1.750)
Seasoning	-0.272 (0.289)	0.469** (0.186)	0.461** (0.186)
FICO	-0.188*** (0.029)	-0.060*** (0.018)	-0.060*** (0.018)
ARM	-20.258*** (3.726)	-8.930*** (2.260)	-9.314*** (2.260)
LTV	0.244*** (0.088)	0.117** (0.053)	0.120** (0.053)
Interest Only	-17.187*** (3.623)	-0.096 (2.215)	-0.025 (2.208)
Owner Occupied	-12.864*** (2.276)	-3.673** (1.478)	-3.670** (1.479)
Negative Amortization	-11.204 (10.263)	5.655 (4.500)	5.060 (4.480)
Pricing Year-Month FE	Yes	Yes	Yes
<i># Observations</i>	<i>11,248</i>	<i>11,248</i>	<i>11,248</i>
<i>Adjusted R2</i>	<i>0.404</i>	<i>0.772</i>	<i>0.773</i>

OLS estimation of PLS security spreads in bps on servicing fees in bps and relevant control variables. Our sample comprises floating-rate securities of deals . The figures in parenthesis are White-robust standard errors with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.

Table 8: Security Returns as of 2012-12 by Security Class

	(1) AAA	(2) AA	(3) A	(4) BBB
Servicing Fee	0.0183*** (0.0056)	-0.1695*** (0.0577)	-0.1036* (0.0531)	-0.1203** (0.0525)
WAL	-0.0012*** (0.0002)	0.0042 (0.0070)	0.0213*** (0.0072)	-0.0022 (0.0094)
Subordination	0.0002*** (0.0000)	0.0093*** (0.0010)	0.0054*** (0.0015)	0.0060*** (0.0016)
Net Coupon	-0.0013*** (0.0005)	0.0340*** (0.0086)	0.0135** (0.0058)	0.0087 (0.0056)
Low Docs	-0.0057* (0.0033)	-0.0611** (0.0276)	-0.0635** (0.0264)	-0.0778*** (0.0224)
Seasoning	0.0004** (0.0002)	0.0151*** (0.0033)	0.0152*** (0.0035)	0.0157*** (0.0033)
FICO	0.0000 (0.0000)	-0.0011*** (0.0002)	-0.0004 (0.0002)	-0.0002 (0.0002)
ARM	-0.0000 (0.0024)	0.0949*** (0.0283)	-0.0301 (0.0270)	-0.1039*** (0.0271)
LTV	-0.0001* (0.0000)	0.0038*** (0.0009)	0.0018*** (0.0007)	0.0013** (0.0006)
Interest Only	-0.0199*** (0.0026)	-0.0569 (0.0358)	-0.0627* (0.0338)	-0.0267 (0.0315)
Owner Occupied	0.0045** (0.0020)	0.0939*** (0.0273)	0.0005 (0.0233)	0.0265 (0.0178)
Negative Amortization	-0.0300** (0.0124)	-0.0849 (0.0929)	-0.1228* (0.0636)	-0.1005 (0.0697)
Pricing Year-Month FE	Yes	Yes	Yes	Yes
Observations	4,118	2,709	2,363	2,028
Adjusted R2	0.167	0.585	0.767	0.811

OLS estimation of returns (IRR) on floating non-agency MBS security classes at the end of December 2012. The figures in parenthesis are White-robust standard errors with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.

Table 9: Servicing Fees and AAA Security Returns from 2009 to 2016

	(1) IRR 2009:1	(2) IRR 2009:12	(3) IRR 2010:12	(4) IRR 2012:12	(5) IRR 2014:12	(6) IRR 2016:12
Servicing Fee	0.0010 (0.0009)	0.0045*** (0.0015)	0.0108*** (0.0037)	0.0183*** (0.0056)	0.0199*** (0.0061)	0.0213*** (0.0059)
WAL	0.0002*** (0.0000)	-0.0004*** (0.0000)	-0.0008*** (0.0001)	-0.0012*** (0.0002)	-0.0014*** (0.0002)	-0.0015*** (0.0002)
Subordination	-0.0001*** (0.0000)	-0.0000*** (0.0000)	0.0000 (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)
Net Coupon	0.0000 (0.0001)	-0.0001 (0.0001)	-0.0007** (0.0003)	-0.0013*** (0.0005)	-0.0015*** (0.0005)	-0.0015*** (0.0005)
Low Docs	-0.0011*** (0.0003)	-0.0025*** (0.0007)	-0.0041* (0.0022)	-0.0057* (0.0033)	-0.0060* (0.0035)	-0.0063* (0.0035)
Seasoning	-0.0001*** (0.0000)	-0.0000 (0.0001)	0.0001 (0.0001)	0.0004** (0.0002)	0.0005*** (0.0002)	0.0005*** (0.0002)
FICO	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
ARM	0.0006 (0.0004)	0.0003 (0.0007)	0.0005 (0.0015)	-0.0000 (0.0024)	-0.0000 (0.0027)	-0.0010 (0.0026)
LTV	-0.0000*** (0.0000)	-0.0000** (0.0000)	-0.0001 (0.0000)	-0.0001* (0.0000)	-0.0001** (0.0001)	-0.0001* (0.0001)
Interest Only	-0.0014*** (0.0004)	-0.0038*** (0.0006)	-0.0106*** (0.0016)	-0.0199*** (0.0026)	-0.0227*** (0.0029)	-0.0221*** (0.0028)
Owner Occupied	0.0002 (0.0003)	0.0013** (0.0005)	0.0029** (0.0012)	0.0045** (0.0020)	0.0054** (0.0022)	0.0060*** (0.0021)
Negative Amortization	-0.0006 (0.0010)	-0.0024** (0.0011)	-0.0248** (0.0103)	-0.0300** (0.0124)	-0.0396*** (0.0132)	-0.0439*** (0.0132)
Pricing Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,118	4,118	4,118	4,118	4,118	4,118
Adjusted R2	0.820	0.475	0.179	0.167	0.179	0.190

OLS estimation of returns (IRR) on AAA floating non-agency securities from January 2009 to December 2016. Our sample consists of AAA floating securities. The figures in parenthesis are White-robust standard errors with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.

Table A.1: First-Stage Estimation of Unobservable Credit Risk Reflected in Servicing Fees

<i>Dep. Var.: Servicing Fee</i>	<i>(1)</i>	<i>(2)</i>
Credit Score	-0.0330*** (0.0016)	-0.0069*** (0.0014)
Interest Rate	1.2241*** (0.0729)	0.3189*** (0.0590)
Loan Term	-0.0050*** (0.0013)	-0.0051*** (0.0013)
Loan Balance	-1.8296*** (0.1141)	-0.5561*** (0.0902)
Combined LTV	0.0081* (0.0047)	-0.0286*** (0.0041)
Seasoning	0.1012 (0.0617)	0.0414 (0.0509)
Owner Occupied	1.4210*** (0.2594)	1.2510*** (0.2379)
Refinancing	0.8413*** (0.1230)	-0.1161 (0.0946)
Low-No Doc	-1.6620*** (0.1676)	-0.5479*** (0.1396)
Prepayment Penalty	3.2879*** (0.3354)	-0.2713 (0.2571)
Negative Amortization	0.8920 (1.4872)	1.8613 (1.2393)
ARM	4.1721*** (0.2641)	1.6744*** (0.2227)
Single Family	0.0154 (0.1451)	0.2318** (0.1158)
Interest Only	-2.3173*** (0.2273)	-0.2566 (0.1840)
Balloon	2.3111*** (0.4895)	0.6472 (0.4606)
DTI	0.1692*** (0.0188)	0.1498*** (0.0197)
Origination-Year FE	Yes	Yes
Vintage-Year FE	Yes	Yes
Issuer FE	Yes	Yes
Location FE	Yes	Yes
Asset-Type FE	No	Yes
<i>Observations</i>	<i>6,221,785</i>	<i>6,221,785</i>
<i>Adjusted R2</i>	<i>0.534</i>	<i>0.635</i>

This table reports loan-level OLS estimation of servicing fees measured in basis points (bps). Our list of mortgage-level control variables includes CLTV, seasoning, owner occupancy, refinancing, prepayment penalty, negative amortization, ARM, single family, interest only, balloon, and DTI. Standard errors are clustered at the deal level with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.

Table A.2: Unobserved Credit Risk Priced in Servicing Fees and Mortgage Default

<i>Dep. Variable:</i>	(1)	(2)	(3)	(4)	(5)	(6)
<i>Mortgage Default</i>	<i>60 Default</i>	<i>90 Default</i>	<i>60 Default</i>	<i>90 Default</i>	<i>60 Default</i>	<i>90 Default</i>
Servicing Fee	0.0003** (0.0001)	0.0002** (0.0001)				
Unobserved Risk (Serv. Fee Resid. 1)			0.0004*** (0.0001)	0.0003*** (0.0001)		
Unobserved Risk (Serv. Fee Resid. 2)					0.0006*** (0.0002)	0.0004*** (0.0001)
Credit Score	-0.0006*** (0.0000)	-0.0003*** (0.0000)	-0.0006*** (0.0000)	-0.0003*** (0.0000)	-0.0006*** (0.0000)	-0.0003*** (0.0000)
Interest Rate	0.0285*** (0.0006)	0.0203*** (0.0005)	0.0289*** (0.0006)	0.0207*** (0.0005)	0.0288*** (0.0006)	0.0206*** (0.0005)
Current LTV	0.1114*** (0.0068)	0.0695*** (0.0037)	0.1118*** (0.0068)	0.0699*** (0.0037)	0.1125*** (0.0068)	0.0701*** (0.0037)
Loan Term	-0.0006*** (0.0002)	-0.0005*** (0.0001)	-0.0007*** (0.0002)	-0.0005*** (0.0001)	-0.0007*** (0.0002)	-0.0005*** (0.0001)
Seasoning	0.0048*** (0.0005)	0.0035*** (0.0003)	0.0048*** (0.0005)	0.0035*** (0.0003)	0.0048*** (0.0005)	0.0035*** (0.0003)
Current Balance	0.0052*** (0.0006)	0.0039*** (0.0004)	0.0052*** (0.0006)	0.0039*** (0.0004)	0.0051*** (0.0006)	0.0039*** (0.0004)
Owner Occupied	-0.0022 (0.0014)	-0.0033*** (0.0010)	-0.0020 (0.0014)	-0.0031*** (0.0010)	-0.0020 (0.0014)	-0.0030*** (0.0010)
Refinancing	-0.0164*** (0.0012)	-0.0166*** (0.0009)	-0.0162*** (0.0012)	-0.0164*** (0.0009)	-0.0162*** (0.0012)	-0.0164*** (0.0009)
Low-No Doc	0.0182*** (0.0012)	0.0138*** (0.0009)	0.0178*** (0.0012)	0.0134*** (0.0009)	0.0179*** (0.0012)	0.0135*** (0.0009)
Prepayment Penalty	0.0048** (0.0019)	0.0023* (0.0013)	0.0056*** (0.0018)	0.0031** (0.0012)	0.0056*** (0.0018)	0.0031** (0.0012)
Negative Amortization	0.0640*** (0.0062)	0.0466*** (0.0049)	0.0646*** (0.0061)	0.0465*** (0.0050)	0.0645*** (0.0061)	0.0464*** (0.0050)
ARM	0.0374*** (0.0015)	0.0275*** (0.0010)	0.0386*** (0.0013)	0.0286*** (0.0010)	0.0385*** (0.0013)	0.0285*** (0.0010)
Single Family	-0.0046*** (0.0009)	-0.0071*** (0.0007)	-0.0046*** (0.0009)	-0.0071*** (0.0007)	-0.0046*** (0.0009)	-0.0071*** (0.0007)
Interest Only	-0.0065*** (0.0014)	-0.0065*** (0.0011)	-0.0070*** (0.0014)	-0.0069*** (0.0011)	-0.0069*** (0.0014)	-0.0069*** (0.0011)
Balloon	0.0372*** (0.0045)	0.0351*** (0.0027)	0.0378*** (0.0044)	0.0356*** (0.0027)	0.0378*** (0.0044)	0.0355*** (0.0027)
DTI	0.0002*** (0.0001)	0.0001** (0.0001)	0.0003*** (0.0001)	0.0002*** (0.0001)	0.0003*** (0.0001)	0.0002*** (0.0001)
Inflation	0.0031 (0.0042)	-0.0006 (0.0028)	0.0032 (0.0042)	-0.0006 (0.0028)	0.0032 (0.0042)	-0.0005 (0.0028)
Mortgage Rate	-0.0371*** (0.0133)	-0.0158* (0.0088)	-0.0368*** (0.0133)	-0.0155* (0.0088)	-0.0369*** (0.0133)	-0.0156* (0.0088)
Unemployment	0.0203*** (0.0030)	0.0202*** (0.0020)	0.0203*** (0.0030)	0.0202*** (0.0020)	0.0203*** (0.0030)	0.0202*** (0.0020)
HPI	-0.0228*** (0.0068)	0.0191*** (0.0047)	-0.0229*** (0.0068)	0.0190*** (0.0047)	-0.0229*** (0.0068)	0.0191*** (0.0047)
HPI Volatility	-0.0692*** (0.0033)	-0.0452*** (0.0024)	-0.0693*** (0.0033)	-0.0453*** (0.0024)	-0.0694*** (0.0033)	-0.0453*** (0.0024)
Origination-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Servicer FE	Yes	Yes	Yes	Yes	Yes	Yes
Location (CBSA) FE	Yes	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>	<i>6,221,785</i>
<i>Adjusted R2</i>	<i>0.125</i>	<i>0.087</i>	<i>0.125</i>	<i>0.087</i>	<i>0.125</i>	<i>0.087</i>

OLS estimation of mortgage default (60- and 90-day delinquencies) within 12 months following securitization. Our dependent variables are binaries set equal to 1 if a mortgage is in default during the 24-month observation window. We measure unobserved credit risk (*Unobserved Risk*) by *Serv. Fee Resid. 1* and *Serv. Fee Resid. 2*, servicing fee residuals extracted from our servicing fee regressions in columns (1) and (2) of Table A.1, respectively. We show in parenthesis our regression standard errors clustered at the deal level with 1, 2 and 3 stars indicating statistical significance at 10%, 5% and 1%, respectively.