Loan Servicing and Management of Delinquent Loans

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Abstract

In this paper, we explore the actions of servicers of loans guaranteed by Fannie Mae, a Government-Sponsored Enterprise (GSE). Fannie Mae agency servicers operate under master servicing agreements that, if followed, creates a servicing entity controlling roughly twenty-seven percent of all outstanding mortgage debt. The action or inaction of these servicers in managing severely delinquent loans may impact the housing market especially in light of a probable negative price externality associated with foreclosure. Our results show that agency servicers have a reduced probability of foreclosing on a loan in areas where they have high geographic concentration of loans. This is even true in the face of increased foreclosure activity by other small non-agency servicers. These actions are consistent with the idea that agency servicers are trying to internalize the negative price externality caused by foreclosure on their remaining servicing portfolio.

Keywords: Loan defaults, loan modifications, foreclosures, financial crisis, mortgages, securitization, mortgage servicing, principal agent, Fannie Mae, Government Sponsored Enterprise (GSE).

JEL Classifications G01, G21, R00, R31, R38.

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Introduction

During the most recent financial crisis and the resulting period of steep decline in house prices, the mortgage servicing industry emerged as a pivotal player in managing delinquent mortgage loans. Even before the crisis, the mortgage market had moved from portfolio lending with an 'originate-to-hold' approach to a securitized lending (an 'originate-to-distribute') model resulting in robust growth of the mortgage servicing industry.[1] This evolution in the mortgage servicing industry has garnered a lot of attention from lenders, investors, and regulators.

Under an 'originate-to-distribute' model, newly originated loans are sold in the secondary market and packaged into securities often guaranteed by Fannie Mae or Freddie Mac (government-sponsored enterprises or GSEs). In this model, the credit risk associated with the loan remains with the GSE due to the loan guarantee. Under this model, a third party mortgage servicer is used forming a principal-agent servicing arrangement between the GSEs and mortgage servicers. Since the agency issuing the MBS bears all of the credit risk, the agency monitors the terms of the pooling and the servicing agreements to minimize any credit loss. The current study explores the decisions of agency servicers to modify, foreclose, or take no action on delinquent loans. More importantly, it explores if agency mortgage servicers, as representative agents, internalize the potential negative price impact of foreclosure through their servicing actions, to minimize the impact on the remaining pooled assets. With a large portion of the $10 trillion in mortgage debt being managed under agency service arrangements, analyzing the role of the agency servicer is important to understand mortgage markets.

Within the context of portfolio lending, Favara and Giannetti (2017) provide evidence that lenders who hold a large share of outstanding mortgages in a geographic area on their balance sheet tend to avoid foreclosure and rather seek to modify loans. The authors conjecture these action are taken in order to minimize the decline in local house prices associated with foreclosure on their remaining portfolio.[2] They theorize that if lenders have a large concentration of loans in a geographical area, they will foreclose less often. In addition, when mortgages

[1] Federal Housing Finance Agency: Office of Inspector General, A Brief History of The Housing Government Sponsored Enterprises, available at https://www.fhfaoig.gov/LearnMore/History

[2] Foreclosures generate negative externalities, which could result in lower house prices in their immediate vicinity (negative spillover effect).

are held by many fragmented lenders (lenders with low concentrations), each lender disregards the effects of its foreclosure decisions on local house prices resulting in higher levels of foreclosure.

The negative spillovers associated with foreclosures are fundamental to the model theorized by Favara and Giannetti (2017) and have been examined by numerous studies. Shleifer and Vishny (1992) demonstrate that when markets are illiquid, forced sales of assets fetch prices below their fundamental values and distressed sales generate spillovers that reduce the market value of related assets held by the other players in the market. Other studies have shown that foreclosures generate price declines and have a propensity to spillover to adjoining and neighboring properties and endogenous housing illiquidity amplifies this drop in house prices (for example see Harding, Rosenblatt, and Yao (2009); Campbell, Giglio and Pathak (2011); Anenberg and Kung (2013); Hartley (2014); Garriga and Hedlund (2017)). Mian, Sufi and Trebbi (2015) showed during the recent crisis that foreclosures led to a widespread drop in house prices. This widespread decline resulted in further delinquencies as homeowners were upside down on their mortgages – they owed more than the value of their house. Guren and McQuade (2018) showed that during an economic downturn, lender equity is eroded, buyers are selective, and the number of buyers is reduced due to declining credit scores. When combined, these factors result in lower prices and transactions in the housing market. Foreclosure sales intensify price declines and cause additional defaults, which creates further price declines and generates a feedback loop.

Although the current study evaluates the behavior of the servicers of GSE loans with regard to delinquent loans, we believe the theoretical model developed by Favara and Giannetti (2017) provides a basis for our outcomes. In the securitized market (GSE), the guarantor holds the credit risk, as does the portfolio lender. The portfolio lender will act to minimize loss, as will the guarantor. Hence, we expect Fannie servicers to act in a manner consistent with portfolio lenders. The focus of our paper is similar to Favara and Giannetti (2017) but shifts the examination from the owner-servicer (portfolio lender) to a principal-agent relationship where numerous servicers act as agents for the GSE. The magnitude and complexity of the GSE market relative to the portfolio lending market provides for interesting setting for this study. We also explore how, and if, the decisions of Fannie Mae servicers are impacted by the actions of other, non-Fannie, loan servicers. Endogeneity issues are also explored.

To examine the mortgage servicers' behavior with respect to delinquent loans, we employ an extensive data set released by Fannie Mae which contains 22 million loans originated from 2000-2016. In addition to the acquisitions data, monthly loan-level performance information is also available for each loan. We restrict the data to 30-year fixed rate, fully amortizing, mortgage loans which are delinquent for more than 90 days. For tractability, we also focus our study on cities covered by S&P CoreLogic Case-Shiller 20-City Composite Home Price Index. These 20 metropolitan areas represent about one third of the 2010 U.S. population.

To mimic the servicers' decision behavior each month, the probability of a loan being modified or foreclosed upon is estimated using a loan hazard model based on monthly loan performance data. Specifically, we employ a discrete-time hazard model, estimated using a multinomial logit model, which addresses issues of left truncation and right censoring. Upon delinquency, each month the servicer has the option to foreclose on the delinquent mortgage and liquidate the asset, modify/renegotiate the delinquent mortgage such that the borrower resumes the repayment of the mortgage, or take no action on the delinquent loan. Given the three primary outcomes chosen by a servicer, each delinquent observation continues until either an event (foreclosure or modification) occurs or the observation is censored. It is important to note that a servicer's revenue stream is a function of the length of the mortgage (duration). When a mortgage becomes delinquent, choosing to foreclose on the mortgage will suspend servicing revenue while modifying it will preserve the revenue stream. During the delinquency period, servicers are contractually obligated to provide short term financing (the servicer has to advance the monthly principal and interest payments) to a delinquent mortgagor until the delinquency is resolved (execution of a modification or the sale of the foreclosed house). Upon resolution, the servicer is reimbursed all previously made advances on that delinquent mortgage loan irrespective of the terms of the modification or foreclosure proceeds.

The results indicate that Fannie Mae servicers act much like large private portfolio lenders/servicer. In areas with high concentration of loans, Fannie Mae servicers are less likely to foreclose as the concentration of Fannie Mae loans increases. In fact, if the concentration of loans in the area increases due to an increase in non-Fannie Mae loans, Fannie Mae servicers are also less likely to foreclose. Interestingly, Fannie Mae servicers act in unity, as other Fannie Mae servicers increase their foreclosure activity in a Metropolitan Statistical Area (MSA), the probability that a delinquent loan is foreclosed by the particular Fannie Mae servicer increases. In other

words, Fannie Mae servicers follow the action of the other Fannie Mae servicers and disregard the effects of its foreclosure decisions on local house prices resulting in higher levels of foreclosure. However, we find that as the foreclosure action of other servicers (non-FNMA) in an MSA increases, the probability a delinquent loan will be foreclosed by a Fannie Mae servicer decreases. This action that would be taken by a large lender/servicer to preserve the value of its remaining assets.

The rest of the paper is organized as follows. In section II, we compile a comprehensive literature review and adjust Favara and Gianetti's portfolio lender model to reflect a mortgage servicer model. Section III describes the data and the empirical framework. Sections IV summarizes the results and section V concludes.

Literature Review and the Mortgage Servicer Model

Favara and Gianetti (2017) develop a cogent model that explains how foreclosures, house prices, and the concentration of mortgages are related. Rather than formally reiterating the Favara and Gianetti (2017) model here, we provide a summary of the model, with special attention to the portion of the model focused on the presence of a large portfolio lender, and a set of related testable hypotheses that can be drawn from the model.

In the Favara and Gianetti (2017) model, the incentive to foreclose is complicated by the impact of foreclosure on the price of the properties remaining in the servicer's portfolio. An underlying assumption of the model is that foreclosures results in an imbalance in housing supply resulting in a change in equilibrium neighboring house prices. In their model, an income shock causes a disequilibrium between supply and demand of housing. Prior to the income shock, the housing demand for a household is determined such that the utility from owning a house is greater than the price of housing. The equilibrium housing price is determined when the aggregate supply of housing is equal to the aggregate demand of housing. Under this equilibrium, all households repay their mortgage debt and there are no delinquencies.

When a segment of households is impacted by an economic shock, the affected households cannot repay their mortgage debt. When lenders foreclose on these delinquent mortgages, these households are excluded from the owned housing market and become renters and their foreclosed houses will re-enter the market. This imbalance results in a lower equilibrium house price after the shock.

In the model, the lender chooses to maximize their payoff from their portfolio of performing and delinquent mortgages. Consequently, when lenders hold a large share of mortgages in a specific geographic area, they are less likely to foreclose on delinquent mortgages in an effort to internalize the negative price externalities caused by foreclosures. However, lenders that hold a small share of mortgages disregard the negative externalities caused by foreclosures and act as first movers by foreclosing on delinquent mortgages. This implies that foreclosures are inversely related to the overall concentration of outstanding mortgages held by the lender. In addition, in the presence of a large lender, the foreclosure probability of the larger lender is decreasing in the foreclosure actions of other lenders. The large lender's internalization of its foreclosure policy on house prices implies house prices should be an increasing function of the overall concentration of outstanding mortgages of a larger lender's remaining assets.

While the Favara and Gianetti (2017) model does not explicitly consider loan modification, it is important to consider that a servicer's revenue stream is a function of the length of the mortgage (duration). When a mortgage becomes delinquent, choosing to foreclose on the mortgage will suspend servicing revenue while modifying it will preserve the revenue stream. Thus, we conjecture that as the dollar amount of outstanding mortgages in an MSA increases, while the probability that the delinquent loan will be foreclosed decreases, the probability that the delinquent loan will be modified increases.

A large number of papers have evaluated and offered explanations for the differences in the modification/loan renegotiation rates and foreclosure rates between portfolio lenders (bank loans) and securitized loans. Past research has presented three main theories that might explain the low rate of modifying delinquent (securitized) mortgage loans (i) "agency theory" (Cordell et al (2008) and Levitin and Twomey (2011)), (ii) "information asymmetry" (Foote et al (2009) and Adelino, Gerardi and Willen (2013)), and (iii) "institutional factors" (Piskorski et al (2010), Agrawal et al (2011), Been et al (2013) and Kruger (2016)). There isn't complete unanimity among researchers as to the underlying causes of the low rate of loan renegotiation among delinquent securitized loans.

The Favara and Giannetti (2017) model, while focused on portfolio lenders, provides some insight into the evaluation of modification and foreclosure rate differences based on the portion of their model related to large portfolio lender/servicers. As noted in the current study, Fannie Mae agency servicers operate under master servicing agreements that, if followed, create a servicing entity controlling roughly twenty-seven percent of all outstanding mortgage debt. This estimate is based on publicly available data in part provided by the Urban Land Institute. If Fannie Mae operates in a manner to preserve wealth of the investors, they would operate in-line with the actions of a large portfolio lender. Thus, applying the Favara and Giannetti (2017) model, one may conclude that agency servicers acting under a master servicing contract (acting as a very large lender would) may foreclose less even when other lenders/servicers are foreclosing more and are less likely to foreclose with a relatively large concentration of loans in a geographical area to internalized the negative price externality associated with foreclosure on the remaining assets managed on behalf of investors. While the primary goal of the current study is not related to the measurement of the differential in rates of modification and foreclosure between securitized loans and portfolio lenders, it may provide some additional insights.

Interestingly, Favara and Gianetti (2017) characterize investors in securitized mortgages as atomistic lenders (or one of many small lenders) with stronger incentives to foreclose defaulting mortgages and note that their theoretical model provides a "novel explanation for why securitization leads to more foreclosures." This ignores the fact that the agency issuing the MBS, such as Fannie Mae, bears all of the credit risk and service (oversee) the loans through a series of master servicing contracts. The agencies incentive is to monitor the servicing agreements to minimize any credit loss. This leads us to contend that Fannie Mae servicers should be viewed within the Favara and Gianetti (2017) framework as equivalent in the management of delinquent loans to large portfolio lenders. The master servicing contracts create a principal-agent relationship between the agency and the servicer. The mortgage servicers act as agents and may have a conflict between their fiduciary duty of maximizing the expected payoff for the principal and the revenue earned from mortgage servicing (Levitin and Twomey, 2011). If this behavior is present, we would expect the results of the current study to be inconsistent with the model's expectation of a large portfolio lender and more in-line with atomistic lenders.

An extensive literature exists supporting the idea that foreclosures generate negative price effects on neighboring properties. The link between foreclosure and neighborhood price effects is an underlying condition

of Favara and Giannetti (2017), as well as the current study. Homeowners with delinquent loans may lack the resources necessary to maintain their property leading to the deterioration of the property. Foreclosure may lead to vacant or abandoned properties, which may result in physical blight within a neighborhood. Abandoned homes could provide a safe haven for criminal activities and vandalism which may negatively impact neighborhood quality. Finally, an increase in foreclosures increases the inventory of available houses in the short term and given stable demand for housing, prices of all houses in that price point will be negatively affected.[3]

Data and Empirical Framework

The data for this study are drawn from Fannie Mae's single-family historical loan performance database. The data are available in two distinct sets of files: (i) acquisitions database which includes static mortgage loan data at the time of the mortgage loan's origination and delivery to Fannie Mae, and (ii) a performance database which provides monthly performance data for each loan, from the time of acquisition until its status as of the previous reporting quarter. The data for this study are restricted to include 30-year fixed rate, fully amortizing, mortgage loans. The original sample contains nearly 22 million loan origination records nationwide with nearly 10 million loans being originated within the 20 MSAs covered by the S&P CoreLogic Case-Shiller Home Price Indices.

Although the Fannie Mae data contain monthly loan-level performance data starting in 2000, the servicer information which is needed for this study is not consistently provided until the Q1 2002. We use a performance window from Q1 2003 through Q1 2016 with a loan origination window of Q1 of 2002 through Q4 of 2015[4]. Further, we restrict the sample to severely delinquent loans (90 days+). We also restrict our sample to

[3] Numerous studies have explored the negative price externality that foreclosures have on the value of nearby property (for example, see: Immergluck and Smith (2006); Lin, Rosenblatt and Yao (2009); Campbell et al (2011); Anenberg and Kung (2013)). Other studies have explored how the impact of foreclosure is transmitted through the economy (e.g., tightening credit, changes in consumption) and its impact on the housing market (for example see: Mian, Sufi and Trebbi (2015); Garriga and Hedlund (2017); Guren and McQuade (2018)).

[4] For each loan, Fannie Mae reports the terms of originating of the loan, which include loan amount, contract rate, origination date, and originating lender. In addition, the following characteristics of the loan and borrower at origination are also provided: loan to value, debt to income ratio, number of borrowers, borrower credit score, location (MSA and 3-digit zip), loan purpose, and if the buyer is a first time homebuyer. After the loan is originated, Fannie Mae provides monthly performance data on each of these loans which includes the name of the servicer, the outstanding monthly balance, loan delinquency status, date the loan's balance was reduced to zero, reason the loan's balance was reduced to zero, date the loan was foreclosed upon, date the REO property was disposed, net sales proceeds from the disposition, holding costs of REO property, and the principal amount written off.

individually identifiable servicers who services more than one percent of the current actual total unpaid principal balance for the last month of a given quarter. Above this threshold, the Fannie Mae data identify the servicer by name; however, servicers falling under this threshold are recorded by the generic term "Other"[5]. Removing these loans results in the severely delinquent loan data set containing 359,388 loans of which 148,438 received no action from their servicers (they continue to stay delinquent), 67,651 were modified, and 143,129 were foreclosed. Table 1 provides the descriptive statistics for the full sample of severely delinquent loans, as well as for the sub-samples of foreclosed, modified, and no action (uncured), at origination and the point of delinquency.

There are some slight differences across the subsamples of severely delinquent loans, but they also share many similar traits. The average loan amount at origination is $211,225.78 with loan to value ratios at origination averaging 77.24%. Interestingly, loans that were modified had the largest loan balances at origination, but their loan to value ratios fall between uncured and foreclosed loans at origination. At origination, foreclosed loans had a higher loan LTV (just over 80%) than loans that were later modified and no action was taken (~75%). The debt-to-income ratio averaged around 0.40 for all loans at origination.

The reduction in borrowers' equity from origination to the loan becoming severely delinquent is reflected in the average 12.54 percentage point increase in the LTV. To estimate the current loan to value ratio (CLTV) for each property, the property value origination was adjusted by the appropriate S&P CoreLogic Case-Shiller Home Price Index and divided into the current outstanding balance of the loan. As expected, the increase in the LTV was greatest for loans that were ultimately foreclosed (80% to 100%) and least for loans left uncured (75% to 79%). On average, the loan balances in each subsample declined by 6.0% (approx.) from origination to delinquency and the loans were roughly the same loan age (time since delinquency). Thus, the increase in the LTV was driven by the decline in house prices.

The data also contain information related to the underlying property type of the land, as well as traits about the mortgage loan. The property types underlying the loans may impact the action taken by the servicer. A vast

[5] Changes that occur in the loan's servicing are reflected in the data.

majority, over 70%, of the loans in the sample are for single family home (1-4 unit) with planned urban development and condominium loans representing the remaining fraction of the loans.

Based on the reported averages, it appears that servicers were less likely to foreclose on homes used as a primary residence and more likely to foreclose on investor properties. Primary residences represent the highest percentage of properties underlying modified loans, with foreclosed loans having the lowest percentage of loans on primary residences. Loans for investment properties represent 7% of the loans in the delinquency sample. The share of loans on investment properties in the foreclosure subsample is over 10%.

The purpose (use) of the originated loans is divided between for purchase and for refinance – 31.9% of the delinquent loans were made to borrowers to purchase a property. The balance, 68.1% loans, were made to borrowers who were refinancing their mortgage loan. Of the loans for refinancing, two-thirds were part of a cash out refinancing, while the remaining refinanced loans did not draw on the home's equity. The channel by which loans are originated may reflect unobservable traits of the borrower or the underlying traits of the loan itself. Of the loans in the sample, over 45% are originated by a party other than a mortgage loan seller (correspondent) and then are sold to a mortgage loan seller. Only 31.76% of the mortgages are originated by the mortgage loan seller who takes the mortgage loan application and then processes, underwrites, funds, and delivers the mortgage loan to Fannie Mae. The remaining loans (22.97%) are originated through a mortgage broker.

We also construct variables to represent the total dollar amount of loans in each of the MSAs at each point in time using the Market Trends database obtained from CoreLogic. This data include information on the loans outstanding and the number of foreclosures each month across the 20 MSAs. We use information on the median LTV and house prices, along with loan counts, to construct the total dollar amount of loans outstanding. This information allows us to better control for the loans in an area and explore if Fannie Mae servicers are impacted differently by the concentrations of loans controlled by other servicers (non-Fannie Mae).

Geographic Concentration of Servicing Activity - To compute the monthly concentration/exposure of Fannie Mae servicers in a given geographical area, we need to know the current Unpaid Principal Balance (UPB) and the loan servicer each month, as well as the geographic location of the loan. Fannie Mae data contains the loan

amount at origination rounded to the nearest thousand. It also contains the monthly unpaid principal balance of the loan six months after acquiring the mortgage loan, as well as reporting the remaining loan term.[6] To populate the UPB for missing periods (the first 6 months), we estimate the monthly payment based on the first recorded monthly UPB, contract rate, and the remaining months to maturity. We then found the PV of payments over the term of the loan. If the PV of the payments is within +/- $500 of the loan amount at origination, we use the calculated payment to determine the unpaid balance for the first 6 months of the loan. If the balance does not fall within $500, we calculate a series of payments by adding and subtracting .05 (up to 0.5 months) to the remaining months to maturity term. Next we estimate the original balance for each of the payments. If more than one of the balances falls within $500 of the original balance, one payment was randomly selected to calculate the missing mortgage balances. We used this approach to populate the UPB for the first six months. Thereafter, we use the UPBs for each month, as provided by Fannie Mae in their database. Once we have the UPBs and the servicer's name, we are able to calculate the dollar magnitude of the loans in the servicer's portfolio across each servicer and for various geographic levels (e.g., national, MSA, three digit zip codes etc.). It is important to note that in these calculations we used all of the 30 yr fixed rate Fannie Mae loans in the original sample not just the severely delinquent loans. The dollar magnitudes estimated can easily be used to measure various monthly loan concentrations. For example, we can measure the geographic concentration of a particular Fannie Mae servicer's, servicer "s", portfolio as follows:

$$Loan\_Conc_{s,m,t}^{f,f} = \frac{Loans\ Serviced_{s,m,t}^{f}}{Loans\ Serviced_{m,t}^{f}} \quad (1)$$

where $Loans\ Serviced\ _{s,m,t}^{f}$ represents the dollar amount of all Fannie loans serviced by servicer *s* in geographic area *m* during the time period *t.* $Loans\ Serviced\ _{m,t}^{f}$ represents the dollar amount of all loans serviced by all servicers in geographic area *m* during the time period *t*. Or, using the Core-logic data, we could find the geographic concentration of Fannie loans across all loans in geographic area *m* as follows:

$$Loan\_Conc_{s,m,t}^{f,a} = \frac{Loans\ Serviced_{s,m,t}^{f}}{Loans\ Serviced_{m,t}^{a}} \quad (2)$$

where $Loans\ Serviced\ _{m,t}^{a}$ represents the dollar amount of all loans serviced in a geographic area *m* during the time period *t*.

[6] In addition, for a mortgage loan that has been liquidated within six months of acquisition, the current actual UPB displays the original UPB as a rounded value.

The average concentration of Fannie Mae loans held by Fannie Mae servicers within each of the 20 MSA is surprisingly similar. Table 2 contains descriptive statistics of the concentration of loans held by Fannie Mae agency servicers as a share of all loans in MSA *m* at time *t*, averaged over the defined number of time periods. The average Fannie Mae servicer holds 15.83% of the loans in an MSA with a range being from 11.36% to 21.79%. Recall these percentages are based on only the amount of 30 year fixed rate loans serviced by agency servicer. If we considered other types of FNMA guaranteed mortgage loans (e.g., ARM), the percentage would be even higher. When the study period is divided into sub-periods, the data reveal the average percentage of loans held by Fannie Mae Servicer increases over the study period for all but three of the MSAs.

Empirical Framework - To model a Fannie Mae servicer's monthly decision related to the delinquency of a loan, a Cox discrete-time competing-risks loan hazard model is used. For each month of each loan subsequent to loan delinquency, loan performance data are used to determine whether a loan is continued, modified, or foreclosed. This discrete-time model solves the issue of left truncation and right censoring which are common issues in the mortgage literature. We implement the model by estimating a multinomial logit model using monthly mortgage observations of delinquent loans.[7] This framework mimics the servicer's monthly decision to modify, foreclose, or allow the delinquent loan to continue. Such a model can be written as:

$$\left(\Psi_{s,m,t}\middle|delinquency\right) = \alpha_0 + \beta_1 Loan\_Conc_{s,m,t}^{f,f} + \beta_2 \boldsymbol{X}_{i,m,t} + \delta_s + \gamma_m + \tau_t + \theta_t + \epsilon_{i,s,m,t} \qquad (3)$$

where $\Psi_{s,m,t}$ equals 1 if the delinquent loan i (this subscript is dropped) held by servicer s in geographic region *m* at time *t* is modified, 2 if the delinquent loan is foreclosed upon, and 0 otherwise (i.e. no action is taken by the servicer). The vector $\boldsymbol{X}_{i,m,t}$, includes loan–level and borrower characteristics, some are time varying (e.g., current LTV, months since delinquency) and others are observed at the time of mortgage origination (e.g., origination channel, property type). Variables representing if the borrower is a first time homebuyer, if the loan seller is equal to the loan servicer, the spread between the 10yr US Treasury and the 6 month lagged 10yr US

[7] The multinomial logit model embraces the independence of irrelevant alternatives (IIA) assumption that the odds ratio for any pair of choices is assumed to be independent of any third alternative (one event is not informative to the other conditional on all of the covariates in the model), and choices at any point in time are independent of those at any other point in time. We test this assumption and find it is an appropriate assumption for our model.

Treasury, and the spread between the current 10yr US Treasury and 10yr US Treasury at origination at included in the model. Several sets of fixed effects are also utilized including servicer idenfication fixed effects (δ_s), geographic location (MSA) fixed effects (γ_m), origination year fixed effects (τ_t), and year of delinquency fixed effects (θ_t). Note MSA fixed effects also proxy for state fixed effects as most MSAs are in a single state except for 3 in California and 2 in Florida.

In equation (3) it is not possible to disentangle the impacts of each of the variables making up the concentration variable, thus we tend toward estimating concentrations separating its two parts - the dollar amount of mortgages serviced by a Fannie Mae servicer *s* in geographic region *m* at time *t* and the dollar amount of loans serviced by all servicers in geographic region *m* at time *t*. Such a model can be written:

$$\begin{aligned}\left(\Psi_{i,s,m,t}\middle|delinquency\right) = \alpha_0 + \beta_1^n Loan\ Serviced_{s,m,t}^f + \beta_1^d Loan\ Serviced_{m,t}^f \\ +\beta_2 \boldsymbol{X}_{i,m,t} + \delta_s\ + \gamma_m + \tau_t + \theta_t + \epsilon_{i,s,m,t}\end{aligned} \quad (4)$$

where β_1^n and β_1^d represent the separate effects of the concentration of loans.

Results

To examine the influence of loan concentration on the Fannie Mae servicer's decision to modify, foreclose, or leave a delinquent loan uncured, we estimate multinomial logit models including variables representing the dollar amount of mortgages serviced by various categories of servicers and loan types in MSA *m* as measures of loan concentration. The concentration at the MSA level is the most localized geographic area used in the current study.

We look at the localized mortgage market as having one large servicer in Fannie Mae (i.e., all Fannie Mae servicers taking similar actions under similar serving agreements) and many smaller servicers, such as portfolio lenders. In this type of market, we hypothesize that as the dollar amount of mortgages serviced by a servicer in an MSA increases, the probability that the delinquent loan will be modified increases and the probability that the delinquent loan will be foreclosed decreases. This is based on the conjecture that large servicers will be less likely to foreclose on a delinquent loan to minimize the decline in local house prices associated with

foreclosures in their remaining portfolio. Further, as small servicers increase their level of foreclosure, large servicers will be less likely to foreclose on a delinquent loan. The estimates and marginal effects (evaluate at the mean) of this model are presented in Table 3.

The estimates indicate that the geographic concentration of loans impacts the individual Fannie Mae servicer's decision in managing severely delinquent loans. The results indicate that as the dollar amount of mortgages serviced by Fannie Mae servicers in an MSA increases, both the relative probability that the delinquent loan will be modified vs. no action and the relative probability that the delinquent loan will be foreclosed vs. no action will decrease. The corresponding estimated marginal effects show this increase leads to a decrease in the probability a Fannie Mae servicer will modify and foreclosure on a severely delinquent loan and increases the probability of no action being taken. Separately, the results also indicate that an increase in the dollar amount of *all* types of loans outstanding in MSA *m* will increase the relative probability that a severely delinquent Fannie Mae loan will be modified vs. no action and the decreases the relative probability that a severely delinquent Fannie Mae loan will be foreclosed vs. no action. The marginal effects indicate this increase will lead to an increase in the probability of no action being taken on the loan, as well as an increase in the probability of modification. Recall the relative probability is positive, indicating that the magnitude of these marginal effects is greater for no action being taken. The increase in the dollar amount of loans being serviced by all servicers in the MSA reduces the probability of foreclosure by a Fannie Mae servicer. The results seem to indicate that Fannie Mae is indeed playing the role of a relatively large servicer (holder of mortgage debt) and as its exposure in the area increases, it appears to be internalizing the potential price impact from foreclosure by reducing foreclosure of its loans. Even in the case where the relative magnitude of the large exposure is reduced, but not eroded (still a relatively large servicer operating with many small servicers), an increase in the total holdings of many small servicers does not lead to an increase in foreclosure.

As expected, some of the individual loan and property traits, as well as economic factors, impact the servicer's decision. Loans with greater age at the time of severe delinquency have a higher relative probability of action being taken (modified or foreclosed) relative to being left uncured. For traditional loans, more mature loans would represent a greater equity position for the homeowner due to the reduction in the mortgage balance. Becoming severely delinquent on a loan later in the life of the loan may indicate the severity of the

homeowner's situation. Loans with longer period of time since their first severe delinquency (90 days+) have a higher probability of foreclosure relative no action being taken and a lower probability of modification relative no action being taken; the longer a loan is delinquent the more likely it is to be foreclosed upon. As the current LTV ratio increases, the probability of foreclosure increases while the probability of modification and no action decreases, based on the marginal effects. In a market experiencing recent increases in interest rates, as measured by the change in the 10 year Treasury rate over the previous six months, the probabilities of modification and foreclosure decrease. However, an increase in interest rates since the time the loan was originated leads to a higher probability of modification and foreclosure. The marginal effect for the change in interest rates in the modification model is much larger than the marginal effect for the change in interest rates in the foreclosure model. This seems to imply servicers are attempting to negotiate new terms under the current market conditions. Loans with higher levels of mortgage insurance coverage have higher probabilities of foreclosure and modification. The modification marginal effect for mortgage insurance is over four times greater than for foreclosure marginal effect.

Turning our attention back to the concentration of loans, a servicer's decision with regard to delinquent loans may not only be impacted by the local geographical concentration but also by the servicer's other holdings. To account for the servicer's national portfolio concentration, we include the dollar amount of mortgages serviced by Fannie Mae servicers nationally and outstanding mortgage debt across the 20 MSAs in the model. The results are presented in Table 4. The coefficients of the variables in the base model are relatively stable in sign and significance with the exception of the coefficient on our loan concentration variable – the dollar amount of loans serviced by all servicers in an MSA *m*. In the modification model, the sign of this coefficient switched from positive to negative, indicating that an increase in the dollar amount of all loans serviced in an MSA leads to a decrease in the probability of modification this is opposite the prediction in the prior model. The current model's estimates indicate that an increase in local loan concentration of Fannie loans leads to a lower probability of modification and foreclosure. The reduction in the probabilities of modification and foreclosure and corresponding increase in the probability of no action is consistent with the idea that an increase in the number of loans serviced hinders the servicer's ability to manage delinquent loans potentially due to lack of adequate staff and technology (Cordell et al (2008)).

The coefficients on the non-local concentration variables are consistent in sign. As the dollar amount of loans serviced across 20 MSAs by All servicers and nationally by Fannie Mae servicers increases, the probabilities of modification and foreclosure increase. In the case of loans serviced nationally by Fannie Mae servicers, the probability of a locally delinquent loan being modified is significantly greater than the probability of a locally delinquent loan being foreclosed, while for loans serviced across 20 MSAs by All servicers the probability of a locally delinquent loan being foreclosed is significantly greater than the probability of a locally delinquent loan being modified.

The estimate on the age of the loan at delinquency also changes sign in the modification portion of the MNL. The sign shift from positive to negative impacts the sign of the marginal effects. Based on these estimates, as time since delinquency increases, the probability of a loan being modified decreases and the probability of no action increases. Thus, based on this results, the probability of no action and that of foreclosure increases as time since delinquency increases, a plausible result.

To consider the impact of foreclosures on a servicer's decision, we divide the number of total foreclosures in the MSA to exclude the foreclosures of the servicer holding the loan, servicer *s*, by introducing two variables. The first variable represents the number of Fannie Mae serviced loans foreclosed by *all other* (non-*s*) Fannie Mae servicers in MSA *m.* Next, we find the number of *other* serviced loans foreclosed in MSA *m*.[8] Based on the results presented in Table 5, the change to the model has no impact in sign or significance of the previously reported estimates. The results indicate that as the number of foreclosures by non-Fannie Mae serviced loans increases, the particular Fannie Mae servicer *s* is less likely to foreclose on the loan, while an increase in the number of foreclosures by non-s Fannie Mae servicers increases the probability of foreclosure. Once again, it seems like the Fannie Mae servicers are reserving action on delinquent loans in the face of other (non-Fannie Mae) servicers foreclosing in what the theory would say is an effort to internalize negative price impacts of the remaining assets. However, the foreclosure process will increase if all other Fannie Mae servicers increase foreclosure activity – action consistent with a master servicing contract.

[8] We find the number of *other* serviced foreclosures taking the total number of foreclosures reported in the CoreLogic data and subtracting the number of foreclosures by Fannie Mae servicers on 30yr fixed rate loans. Note that the *other* serviced foreclosures include non-30 year Fannie Mae serviced loans. This should bias the results against finding a variation in the results for what we coin as Fannie Mae servicers and *other* loan servicers. Thus, if we find a variation, it likely underrepresents the magnitude of the true impact.

To summarize, as the concentration of loans in an MSA increases, the probability a Fannie servicer forecloses on a loan decreases, as well as the probability of modification, this is true for the concentrations of Fannie Mae serviced loans or all loans outstanding. As foreclosures of *non-Fannie* servicers' loans increase in the MSA, servicer *s* is less likely to foreclose or modify a loan. As the dollar magnitude of foreclosures of *non-s* Fannie servicers' loans increases, servicer *s* is more likely to modify or foreclose on a loan. These results are consistent with Fannie servicers internalizing the price impact of their own foreclosure actions.

Issues of Endogeneity – The issues of endogeneity may be introduced into the analysis though the option upon the sale of the pool of loans by the lender/seller to Fannie Mae to retain the servicing rights. The lender/seller might retain the servicing on loans as they have an informational advantage of knowing the quality of the loans. While possible, it seems unlikely. Lenders/sellers originate and aggregate Fannie loans based upon the underwriting guideless of Fannie (uniform and consistent across lenders and markets). In addition, the loans are originated, on average, over three years prior to the loan going severely delinquent (the average age at delinquency is 40 months). The workout area within a mortgage servicing organization is functionally distant from the mortgage origination side (which creates market share) and the prediction of winners and losers between the groups is unlikely.

The manipulation of local market share by Fannie Mae servicers also seems unlikely. Lenders/sellers themselves, not servicers, determine the geographic concentration of loans extended under the Fannie Mae guarantee. That being said, servicing entities do have the ability to buy and sell mortgages from other servicing entities approved by Fannie in the secondary market (after securitization and servicer has on boarded the mortgage). These transactions (few and far between) typically occur to divest mortgages in markets wherein the servicer doesn't have the capacity or competence to service the mortgage or add mortgages to expand their portfolio.

The direct influence of the local market share (geographic concentration of loans) by Fannie Mae servicers does not seem meaningful. However, Fannie Mae itself, or through actions of others on its behalf, may be able to influence the geographic concentration of loans. Calomiris and Wallison (2009) note that Fannie and Freddie

provide political and substantial financial support to Congress. As companies, they lobbying and provide campaign contributions to federal candidates, parties, and committees as a general tactic and have been noted as giving more contributions to lawmakers who sit on committees that primarily regulate their industry including the powerful House Appropriations Committee. There is a large body of empirical literature, which has investigated the impact of government spending on consumption, investment, and output variables. Studies have also found evidence linking congressional seniority to government spending; they also find that senior members of the House were able to use their positions to improve their state's economic performance (Levitt and Poterba, 1999). Thus, political lobbying may have an impact on the amount of Fannie loans outstanding in an MSA. Hence, we believe that amount of loans serviced by Fannie servicers in an MSA might, although unlikely, be the source of endogeneity in our estimating equation.

Within the MNL framework, we employ a control function estimation method to minimize the endogeneity bias, as suggested by Terza, Basu & Rathouz (2008) and was first proposed by Hausman (1978). The technique is a two-stage residual inclusion (2SRI) estimation framework. In the first-stage, a regression is estimated by regressing the endogenous variable on the exogenous variable. In the second-stage regression, the first-stage residuals are included as additional regressors in the second-stage estimation.

To operationalize the control function approach, we regress the dollar amount of Fannie Mae mortgage loans outstanding in an MSA on all of the other explanatory variables contained in the MNL model in addition to a new variable representing the tenure of Congressional representative from the MSA on the House Appropriations Committee.

The control function approach has little overall impact on the estimates (in magnitude and significance) relative to the prior estimates. The estimates of the control function approach are presented in Table 6. In the first stage, the coefficient on the tenure of the House representative on the Appropriations Committee is positive and significant, as are a vast majority of the seller fixed effects. In the second stage, the coefficients and estimated marginal effects of the loan concentration variables remained consistent in sign, but increase substantially in magnitude.

Up to this point, we have evaluated the behavior of Fannie servicers as a group. In table 7, we divide the Fannie servicing of loans into loans serviced by Fannie Mae servicer *s*, loans serviced by non-*s* Fannie Mae servicers, and loans serviced by Fannie Mae servicers for MSA *m*, as well as the larger geographic areas. We once again use the control function approach, using the first stage residuals obtained using the specification in Table 6. The results, reported in Table 7, indicate that regardless of the servicer, an increase in the dollar amount of mortgages serviced by a servicer in an MSA decreases the relative probability that a loan will be foreclosed by servicer *s* vs. no action and decreases the relative probability that the delinquent loan will be modified vs. no action. Note that not all of the coefficients are statistically significant. The coefficients on the loans serviced nationally (portfolio concentration) are unchanged. Even with the substitution of variables, the overall results for the control variables stay the same.

In the two specifications using 2SRI, we find that servicers that service Fannie loans in an MSA, individually or collectively, behave in the same manner with regard to managing delinquent loans. As the Fannie loans serviced by servicers in an MSA increase, the decrease in the probability of foreclosure is greater than the decrease in the probability of modification. Therefore as the concentration of Fannie loans in an MSA increases, the probability of foreclosure decreases.

Estimates of the Fixed Effect Variables – The estimates of the fixed effect variables in the models estimated have been stable across the various models and contain some interesting insights outside of our primary hypotheses. The coefficients on the calendar time fixed effects (FE) variables are one such example. From 2002 - 2007, the FE variables (all significant) were positive in both the modification and foreclosure models. However, the coefficients in the foreclosure model were a minimum of two times the magnitude of those in the modification model. In 2008, the coefficient in the modification model turned negative (Figure 1). From 2010 onward, the calendar year FE coefficients in the modification model remain positive, but are now 1.3 to 5.4 times greater than the coefficient in the foreclosure models, where before they had been less. These results seem to show an impact of the GSE's 2008 decision to start paying servicers an incentive fee for each successful modification. Further, it indicates that servicers have some discretion in managing delinquent loans even when under a servicing contract with Fannie Mae.

The above results are in line with the timelines in other papers that have evaluated the numerous modification programs set in motion during and after the crisis. Scharlemann and Shore (2016) and Hembre (2014) have shown that the Home Affordable Modification Program (HAMP) reduced and prevented mortgage defaults. Maturana (2016) has studied the causal effect of loan modifications on loan losses and finds that losses on modified loans are one third less than the average loan loss (35.8% less). They have all provided evidence that the various modification programs enacted by the government have worked to a certain extent if not fully as intended.

Conklin et al (2018) find that seller-servicer affiliation increases the likelihood of modification. In the current study, loans originated through the seller's retail channel as opposed to the seller's correspondent channel are more (less) likely to be modified (foreclosed). Loans originated through the seller's retail channel are likely made to customers that have an existing relationship with the seller and, as a result, are more likely to be modified. Loans originated through the seller's broker channel, as opposed to the seller's correspondent channel, are more likely to be foreclosed. Interestingly, servicers are more likely to foreclose on loans in which they are identified as the seller than loans from other sellers.

Finally, given delinquency, loans underwritten by second homes and investment properties, as opposed to a primary residence, are less likely to undergo modification (more likely to be foreclosed upon) than a loan on a primary residence. This result is in line with S. Chan et al (2013). First-time homebuyers are also more likely to be foreclosed on than non-first-time homebuyers. Loans on single family properties are more (less) likely to modified (foreclosed upon) than other property types in the data.

Conclusion

The most recent financial crisis brought to the forefront the importance of mortgage servicing in managing delinquent loans. Previous studies concentrated on the difference in foreclosure and modification rates between securitized and non-securitized loans. The current study explores the decisions of agency (GSE) servicers to modify, foreclose, or take no action on delinquent loans. More importantly, it explores if agency mortgage servicers, as representative agents of investors/guarantor, internalize the potential negative price impact of

foreclosure, through their servicing actions, to minimize the impact on the remaining pooled assets (under the direction of Fannie Mae).

Favara and Gianetti (2017) show that portfolio lenders, who have a large concentration of loans in a geographical area, will foreclose less often to minimize the decline in local house prices associated with foreclosure on their remaining portfolio. Our results, with respect to agency (GSE) servicers, are in line with the actions of portfolio servicers. We find that conditional on delinquency, an increase in the dollar amount of mortgages serviced by a Fannie servicer in an MSA decreases the probability that the delinquent loan will be foreclosed. The larger the concentration of loans, the lower the probability of foreclosing; this is an indication that Fannie servicers may be internalizing the potential for a negative price effect. Foreclosures also play a role in the servicer's decision. As foreclosure activity of other loan servicers in the area increases, the probability of foreclosure decreases. If, however, other Fannie Mae servicers (*non-s*) foreclosure activity increases, servicer (*s*) will increase foreclosure activity – acting in line with other Fannie Mae servicers.

Our results from the calendar time fixed effects shed some interesting insights, although not directly related to our main hypothesis. During the period 2002-2007, the coefficients from modification and foreclosure are both positive with the relative probability for foreclosure being twice as large as modification. In 2008, after federal and state government intervention (moratorium on foreclosures) and the GSE's decision to start paying servicers an incentive fee for each successful modification, there was a sharp reduction in the probability of foreclosure and a relative increase in the probability of modification.

The servicer decision with regard to delinquent loans is also influenced by loan and property characteristics as well as prevailing economic factors. The probability of foreclosure increases as the current LTV increases or the length of the delinquency period increases. For loans that have purchased mortgage insurance, the modification probability is three times the foreclosure probability. With regard to interest rate changes, the marginal effect for the modification outcome is much larger than the marginal effect for the foreclosure outcome, which implies servicers make an attempt to renegotiate loans under current market conditions.

The origination channel of the loan also plays a role in the servicer's decision. Loans originated through the seller's retail channel are more likely to be modified, as they are likely made to customers who have an existing relationship with the seller. Surprisingly, GSE servicers are more likely to foreclose on loans in which they are identified as the seller than loans from other sellers. Finally, given delinquency, loans to finance second homes and investment properties, as opposed to a primary residence, are more likely to be foreclosed upon. First time homebuyers are also more likely to be foreclosed on than non-first-time homebuyers.

Overall, the results indicate that agency (GSE) mortgage servicers behave in a manner consistent with prior research on portfolio servicers. The concentration of loans in a geographic area influences the decision to modify or foreclose on loans and the decisions are likely driven by the negative impact foreclosure has on the value of the remaining portfolio due to neighborhood price declines.

References

Adelino, M., Gerardi, K., & Willen, P. S. (2013). Why don't Lenders renegotiate more home mortgages? Redefaults, self-cures and securitization. *Journal of Monetary Economics*, *60*, 835–853.

Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., Piskorski, T., & Seru, A. (2017). Policy Intervention in Debt Renegotiation: Evidence from the Home Affordable Modification Program. *Journal of Political Economy*, *125*(3), 654–712.

Agarwal, S., Amromin, G., Ben-David, I., Chomsisengphet, S., & Evanoff, D. D. (2011). The role of securitization in mortgage renegotiation. *Journal of Financial Economics*, *102*, 559–578.

Anenberg, Elliot Kung, Edward. (2014). Estimates of the Size and Source of Price Declines Due to Nearby Foreclosures. *The American Economic Review, 104 (8),* 2527–51.

Been, V., Weselcouch, M., Voicu, I., & Murff, S. (2013). Determinants of the incidence of U.S. Mortgage Loan Modifications. *Journal of Banking and Finance*, *37*, 3951–3973.

Calomiris, C. W., & Wallison, P. J. (2009). The Last Trillion-Dollar Commitment: The Destruction of Fannie Mae and Freddie Mac. JOURNAL OF STRUCTURED FINANCE, (1), 71.

Campbell, J., Giglio, S., & Pathak, P. (2011). Forced Sales and House Prices. *The American Economic Review, 101*(5), 2108–2131.

Cordell, L., Dynan, K., Lehnert, A., Liang, N., & Mauskopf, E. (2008). Incentives of Mortgage Servicers: Myths and Realities. *Uniform Commercial Code Law Journal*, (4), 347–374.

Favara, G., & Giannetti, M. (2017). Forced Asset Sales and the Concentration of Outstanding Debt: Evidence from the Mortgage Market. *Journal of Finance, 72(3),* 1081–1118.

Foote, C., Gerardi, K., Goette, L., & Willen, P. (2010). Reducing Foreclosures: No Easy Answers. *NBER Macroeconomics Annual, 24*(1), 89–138.

Garriga, Carlos and Hedlund, Aaron, Mortgage Debt, Consumption, and Illiquid Housing Markets in the Great Recession (2017-10-01). FRB St. Louis Working Paper No. 2017–30.

Ghent, A. C. (2011). Securitization and Mortgage Renegotiation: Evidence from the Great Depression. *Review of Financial Studies*, *24*(6), 1814–1847.

Harding, J. P., Rosenblatt, E., & Yao, V. W. (2009). The contagion effect of foreclosed properties. *Journal of Urban Economics*, *66*, 164–178.

Hartley, D. (2014). The effect of foreclosures on nearby housing prices: Supply or dis-amenity? *Regional Science and Urban Economics*, *49,* 108–117.

Hembre, E. (2014, August). *Essays in Housing and Public Economics* (Ph.D.). University of Wisconsin.

Immergluck, D., & Smith, G. (2006). The External Costs of Foreclosure: The Impact of Single-Family Mortgage Foreclosures on Property Values. *Housing Policy Debate*, *17*(1), 57–79.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*, 305–360.

Samuel Kruger, The effect of mortgage securitization on foreclosure and modification, *Journal of Financial Economics*, 129, 586–607.

Levitin, A. J., & Twomey, T. (2011). Mortgage Servicing. *Yale Journal on Regulation*, *28*(1), 1–90.

Levitt, S., & Snyder, J. (1995). Political Parties and the Distribution of Federal Outlays. *American Journal of Political Science, 39*(4), 958-980.

Lin, Z., Rosenblatt, E., & Yao, V. (2009). Spillover Effects of Foreclosures on Neighborhood Property Values. *Journal of Real Estate Finance & Economics*, *38*(4), 387–407.

Maturana, G. (2017). When Are Modifications of Securitized Loans Beneficial to Investors? *Review of Financial Studies*, *30*(11), 3824–3857.

McQuade, Timothy and Guren, Adam, (2018), How Do Foreclosures Exacerbate Housing Downturns? *R&R, Review of Economic Studies*.

Mian, A., Sufi, A. and Trebbi, F. (2015), Foreclosures, House Prices, and the Real Economy. *The Journal of Finance, 70: 2587–2634.*

Piskorski, T., Seru, A., & Vig, V. (2010). Securitization and distressed loan renegotiation: Evidence from the subprime mortgage crisis. *Journal of Financial Economics*, *97*(The 2007-8 financial crisis: Lessons from corporate finance), 369–397.

Posner, E. A. and L. Zingales. 2009. A loan modification approach to the housing crisis. *American Law and Economics Review* 11:575–607.

Ronel, E., Nicholas S., S., Souphala, C., Dennis, G., & Robert, H. (2010). What "Triggers" Mortgage Default? *The American Economic Review*, (2), 490–494.

Scharlemann, T. C., & Shore, S. H. (2016). The Effect of Negative Equity on Mortgage Default: Evidence From HAMP's Principal Reduction Alternative. *Review of Financial Studies*, *29*(10), 2850–2883.

Shleifer, A., & Vishny, R. (1992). Liquidation Values and Debt Capacity: A Market Equilibrium Approach. The Journal of Finance, 47(4), 1343–1366.

Zhu, J., Janowiak, J., Ji, L., Karamon, K., & McManus, D. (2015). The Effect of Mortgage Payment Reduction on Default: Evidence from the Home Affordable Refinance Program. *Real Estate Economics*, *43*(4), 1035–1054.

Figure 1: The Log Odds estimates of Foreclosure and Modification (vs. no action) for Calendar Time Fixed Effects

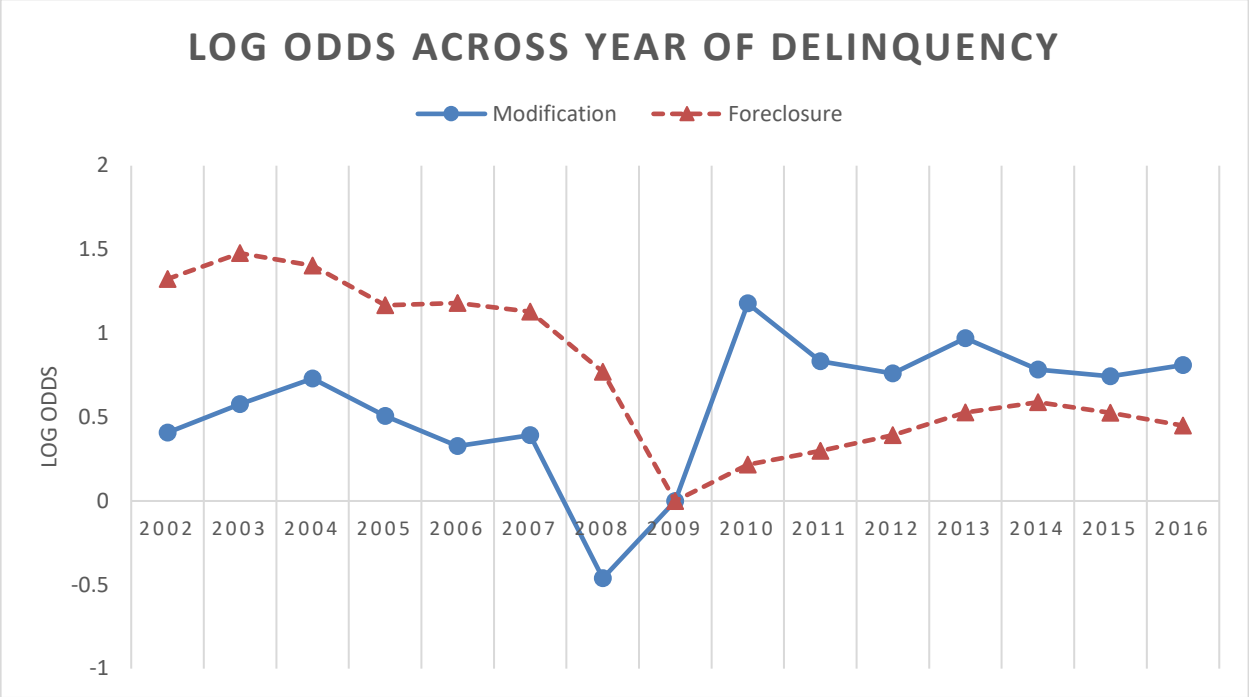

Table 1: Descriptive Statistics for the Pool of Delinquent Mortgage Loans

This table outlines the descriptive statistics of delinquent loans and the three categories based upon the loan outcomes – uncured, modified, and foreclosed. The sample in this study consists of securitized first-lien agency mortgage loans that were at least 90-days delinquent. Mean values of the variables have been reported and the standard deviations are in parentheses below. The (0, 1) *denote a variable coded as 1=yes and 0=no.*

Variable	Delinquent Loans	Uncured Loans	Modified Loans	Foreclosed Loans
At Origination				
Contract Rate	0.0615	0.0607	0.0611	0.0625
	(0.0061)	(0.0066)	(0.0057)	(0.0056)
Loan Amount	$211,225.78	$215,955.60	$235,908.52	$194,673.71
	($96,781.89)	($98,821.42)	($95,911.68)	($91,913.08)
Loan-to-value	0.7724	0.7464	0.7625	0.8042
	(0.1312)	(0.1412)	(0.1291)	(0.1136)
Debt to income ratio	0.4067	0.4036	0.4214	0.4029
	(0.1163)	(0.1177)	(0.1113)	(0.1166)
Mortgage Insurance (if required)	0.2414	0.2413	0.2384	0.2425
	(0.0644)	(0.0652)	(0.0661)	(0.0633)
At Delinquency				
Loan amount outstanding	$199,316.16	$202,990.75	$222,344.73	$184,495.68
	($93,860.33)	($95,808.69)	($93,544.75)	($89,268.84)
Current Loan-to-Value (CLTV)	0.8978	0.7917	0.9078	1.0030
	(0.2943)	(0.2664)	(0.2753)	(0.2917)
Loan age (in months)	49.69	51.39	51.55	47.06
	(30.21)	(33.43)	(28.41)	(27.19)
Occupancy (0,1):				
Primary Home	0.9066	0.9238	0.9595	0.8639
Secondary Home	0.0214	0.0179	0.0133	0.0288
Investor	0.0720	0.0582	0.0273	0.1073
Property Type (0,1):				
Condominium	0.1260	0.1081	0.0978	0.1579
Co-operative	0.0055	0.0081	0.0041	0.0033
Mfd. Housing	0.0038	0.0034	0.0025	0.0048
PUD	0.1577	0.1343	0.1525	0.1844
Single Family	0.7070	0.7460	0.7431	0.6496
Origination Channel (0,1)*:*				
Correspondent	0.4526	0.4305	0.4587	0.4727
Retail	0.3176	0.3396	0.3142	0.2966
Broker	0.2297	0.2300	0.2271	0.2307
Purpose (0,1)*:*				
Purchase	0.3189	0.3035	0.2803	0.3531
Refinance with Cash Out	0.4378	0.4600	0.4844	0.3928
Refinance with No Cash Out	0.2433	0.2365	0.2353	0.2540
Observations	359,388	148,438	67,651	143,129

Table 2: The average concentration of loans by Fannie Mae servicer across time by MSA

The averages in the table are found by calculating the concentration of loans serviced by all Fannie Mae servicers relative to all outstanding loans in an MSA at each point in time. These concentrations are then average across the time periods noted in the table.

			2002-06		2007-11		2012-15	
MSA	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev
Atlanta	0.1346	0.0114	0.1245	0.0081	0.1404	0.0108	0.1369	0.0086
Boston	0.2179	0.0229	0.1900	0.0096	0.2216	0.0153	0.2376	0.0117
Charlotte	0.1136	0.0228	0.0899	0.0020	0.1138	0.0114	0.1335	0.0222
Chicago	0.1427	0.0185	0.1179	0.0036	0.1534	0.0139	0.1522	0.0069
Cleveland	0.1389	0.0249	0.1029	0.0062	0.1532	0.0123	0.1540	0.0075
Dallas	0.1262	0.0328	0.0905	0.0027	0.1201	0.0143	0.1629	0.0207
Denver	0.1933	0.0386	0.1588	0.0121	0.1816	0.0156	0.2347	0.0328
Detroit	0.1462	0.0188	0.1245	0.0036	0.1608	0.0168	0.1490	0.0093
Las Vegas	0.1386	0.0200	0.1283	0.0145	0.1291	0.0152	0.1574	0.0143
Los Angeles	0.1743	0.0528	0.1233	0.0078	0.1555	0.0302	0.2371	0.0225
Miami	0.1353	0.0162	0.1219	0.0085	0.1314	0.0126	0.1507	0.0113
Minneapolis	0.1414	0.0213	0.1139	0.0023	0.1484	0.0140	0.1571	0.0131
New York	0.1561	0.0339	0.1152	0.0055	0.1555	0.0213	0.1914	0.0130
Phoenix	0.1719	0.0213	0.1505	0.0086	0.1697	0.0141	0.1921	0.0158
Portland	0.1931	0.0236	0.1673	0.0069	0.1945	0.0137	0.2132	0.0202
San Diego	0.1892	0.0425	0.1573	0.0173	0.1683	0.0267	0.2382	0.0225
San Francisco	0.1700	0.0593	0.1137	0.0095	0.1474	0.0359	0.2412	0.0206
Seattle	0.1953	0.0242	0.1717	0.0082	0.1925	0.0172	0.2182	0.0181
Tampa	0.1346	0.0150	0.1172	0.0033	0.1370	0.0108	0.1468	0.0103
Washington	0.1520	0.0234	0.1241	0.0081	0.1540	0.0175	0.1735	0.0091
AVG	0.1583		0.1302		0.1564		0.1839	

Table 3: Estimate of the Fannie Servicer's Decision with Local Loan Concentrations

*The estimates below are based on the estimation of a multinomial logit and the marginal effect (at means) using a sample of mortgages that are 90+ days delinquent (359,388 loans and 5,613,437 monthly observations).The dependent variable is defined by the Fannie Mae servicer's decision to modify, foreclose, or take no action (the base category) on an individual loan. Estimates followed by * and ** are statistically different from zero with 0.01 and 0.05 significance levels, respectively. The t-values are reported in parentheses below the estimates and are based on robust (clustered) standard errors.*

	Multinomial Logit		**Marginal Effect (at means)**		
Variable	**Modify**	**Foreclose**	**No Action**	**Modify**	**Foreclose**
All Loans in MSA *m* ($, trillions)	0.29100 (1.25)	-2.85600* (4.50)	0.04530* (4.07)	0.00632 (1.45)	-0.05160* (20.19)
FNMA Loans in MSA *m* ($, trillions)	-2.70700* (8.66)	-16.34000* (8.49)	0.33800* (9.93)	-0.04400* (8.35)	-0.29400* (39.12)
All Loans across 20 MSAs ($, trillions)	X	X	X	X	X
FNMA Loans Nationally ($, trillions)	X	X	X	X	X
FNMA Loans foreclosed in MSA *m* (#, thousands)	X	X	X	X	X
Other Loans foreclosed in MSA *m* (#, thousands)	X	X	X	X	X
Loan Age at Delinquency *(in months)*	0.00156 (1.92)	0.00569* (3.34)	-0.00013* (3.39)	0.00003 (1.81)	0.00012* (4.52)
Current Loan-to-Value (CLTV)	-0.40400* (9.77)	0.86700* (6.73)	-0.00808* (3.02)	-0.00770* (10.43)	0.01580* (8.94)
Change in treasury rate over last 6 mos. ($y_t - y_{t-6}$)	-0.09340* (11.89)	-0.01040 (0.60)	0.00186* (6.61)	-0.00171* (11.35)	-0.00016 (0.49)
Change in treasury rate from Origination ($y_t - y_0$)	0.10500* (8.34)	0.03920* (2.49)	-0.00258* (6.35)	0.00191* (8.10)	0.00067** (2.37)
Months Since Delinquency	-0.02500* (10.78)	0.00619* (4.44)	0.00034* (9.10)	-0.00046* (12.35)	0.00012* (4.96)
Mortgage Insurance Percentage	0.00249* (3.44)	0.00066 (0.55)	-0.00006 (1.94)	0.00005* (3.43)	0.00001* (0.51)
Intercept	-4.02800* (21.66)	-3.80500* (7.72)			
MSA Fixed Effects	Yes	Yes			
Property Type Fixed Effects	Yes	Yes			
Loan Type Fixed Effects	Yes	Yes			
Origination Year Fixed Effects	Yes	Yes			
Delinquency Year Fixed Effects	Yes	Yes			
Servicer Fixed Effects	Yes	Yes			

Table 4: Estimate of the Fannie Servicer's Decision with Local Loan Concentrations

*The estimates below are based on the estimation of a multinomial logit and the marginal effect (at means) using a sample of mortgages that are 90+ days delinquent (359,388 loans and 5,613,437 monthly observations) on an individual loan. The dependent variable is defined by the Fannie Mae servicer's decision to modify, foreclose, or take no action (the base category). Estimates followed by * and ** are statistically different from zero with 0.01 and 0.05 significance levels, respectively. The t-values are reported in parentheses below the estimates and are based on robust (clustered) standard errors.*

	Multinomial Logit		**Marginal Effect (at means)**		
Variable	**Modify**	**Foreclose**	**No Action**	**Modify**	**Foreclose**
All Loans in MSA *m* ($, trillions)	-0.38700 (1.01)	-4.50100* (4.49)	0.08620* (4.18)	-0.00554 (0.80)	-0.08070* (4.48)
FNMA Loans in MSA *m* ($, trillions)	-2.68800* (9.15)	-15.75000* (8.73)	0.32600* (10.23)	-0.04380* (9.22)	-0.28200* (9.24)
All Loans across 20 MSAs ($, trillions)	0.46900* (12.12)	0.69700* (10.49)	-0.02070* (12.73)	0.00833* (11.58)	0.01240* (10.72)
FNMA Loans nationally ($, trillions)	3.10800* (9.85)	0.53700 (1.22)	-0.06520* (11.30)	0.05660* (8.77)	0.00858 (1.08)
FNMA Loans foreclosed in MSA *m* serviced by *non-s* servicers (#, thousands)	X	X	X	X	X
Other Loans foreclosed in MSA *m* (#, thousands)	X	X	X	X	X
Loan Age at Delinquency *(in months)*	-0.00492* (5.11)	0.00293 (1.78)	0.00004 (0.94)	-0.00009* (5.06)	0.00005 (1.83)
Current Loan-to-Value (CLTV)	-0.40000* (9.30)	0.86800* (6.59)	-0.00810** (2.93)	-0.00762* (10.04)	0.01570* (6.70)
Change in treasury rate over last 6 mos. ($y_t - y_{t-6}$)	-0.13900* (16.09)	-0.05180** (2.54)	0.00341* (11.19)	-0.00253* (14.45)	-0.00088** (2.41)
Change in treasury rate from Origination ($y_t - y_0$)	0.08580* (6.96)	0.02650 (1.68)	-0.00200* (4.96)	0.00156* (6.88)	0.00045 (1.58)
Months Since Delinquency	-0.02520* (10.81)	0.00610* (4.38)	0.00034* (9.17)	-0.00046* (12.39)	0.00012* (4.91)
Mortgage Insurance Percentage	0.00249* (3.84)	0.00069 (0.56)	-0.00006 (1.92)	0.00005* (3.45)	0.00001 (0.53)
Intercept	-8.61700* (18.24)	-5.79300* (6.01)			
MSA Fixed Effects	Yes	Yes			
Property Type Fixed Effects	Yes	Yes			
Loan Type Fixed Effects	Yes	Yes			
Origination Year Fixed Effects	Yes	Yes			
Delinquency Year Fixed Effects	Yes	Yes			
Servicer Fixed Effects	Yes	Yes			

Table 5: Estimate of the Fannie Servicer's Decision with Local Loan Concentration

*The estimates below are based on the estimation of a multinomial logit and the marginal effect (at means) using a sample of mortgages that are 90+ days delinquent (359,388 loans and 5,613,437 monthly observations).The dependent variable is defined by the Fannie Mae servicer's decision to modify, foreclose, or take no action (the base category) on an individual loan. Estimates followed by * and ** are statistically different from zero with 0.01 and 0.05 significance levels, respectively. The t-values are reported in parentheses below the estimates and are based on robust (clustered) standard errors.*

	Multinomial Logit		**Marginal Effect (at means)**		
Variable	**Modify**	**Foreclose**	**No Action**	**Modify**	**Foreclose**
All Loans in MSA *m*	-0.51300	-3.80300*	0.07530*	-0.00810	-0.06720*
($, trillions)	(1.42)	(6.59)	(6.11)	(1.23)	(6.35)
FNMA Loans in MSA *m*	-1.67000*	-11.23000*	0.22500*	-0.02680*	-0.19800*
($, trillions)	(4.28)	(3.96)	(4.13)	(4.21)	(4.03)
All Loans - across 20 MSAs	0.43300*	0.53700*	-0.01710*	0.00774*	0.00937*
($, trillions)	(11.76)	(8.94)	(10.87)	(11.05)	(8.79)
FNMA Loans - Nationally	3.02800*	0.16100	-0.05710*	0.05530*	0.00184
($, trillions)	(9.44)	(0.36)	(9.61)	(8.36)	(0.23)
FNMA Loans foreclosed in MSA *m*	0.62600*	2.12000*	-0.04810*	0.01070*	0.03740*
serviced by *non-s* servicers	(4.52)	(4.87)	(5.37)	(4.45)	(4.93)
(#, thousands)					
Other Loans foreclosed in MSA *m*	-0.00226*	-0.00871*	0.00019*	-0.00004*	-0.00015*
(#, thousands)	(4.826)	(5.94)	(7.19)	(4.45)	(5.87)
Loan Age at Delinquency *(in months)*	-0.00470*	0.00350*	0.00002	-0.00009*	0.00006**
	(4.86)	(2.27)	(0.64)	(4.79)	(2.34)
Current Loan-to-Value (CLTV)	-0.40900*	0.79100*	-0.00643*	-0.00774*	0.01420*
	(9.08)	(7.39)	(3.00)	(9.36)	(7.85)
Change in treasury rate over last 6	-0.13500*	-0.05600*	0.00340*	-0.00245*	-0.00095*
mos. ($y_t - y_{t-6}$)	(13.45)	(3.65)	(13.38)	(12.22)	(3.47)
Change in treasury rate from	0.08320*	0.01470	-0.00175*	0.00152*	0.00023
Origination ($y_t - y_0$)	(7.01)	(1.34)	(6.08)	(6.84)	(1.19)
Months Since Delinquency	-0.02520*	0.00605*	0.00035*	-0.00046*	0.00012*
	(10.92)	(4.43)	(9.31)	(12.79)	(4.80)
Mortgage Insurance Percentage	0.00260*	0.00140	-0.00007*	0.00005*	0.00002
	(3.79)	(1.32)	(2.78)	(3.75)	(1.28)
Intercept	-8.29200*	-4.87400*			
	(17.90)	(6.10)			
MSA Fixed Effects	Yes	Yes			
Property Type Fixed Effects	Yes	Yes			
Loan Type Fixed Effects	Yes	Yes			
Origination Year Fixed Effects	Yes	Yes			
Delinquency Year Fixed Effects	Yes	Yes			
Servicer Fixed Effects	Yes	Yes			

Table 6: Estimate of the Fannie Servicer's Decision with Local Loan Concentrations utilizing a Control Function (2SRI)

*The first stage is a regression where the dollar amount of Fannie Mae serviced loans are regressed on the term an area representative has served on the house appropriations committee, as well as the remaining variable from the base model. The second estimates are based on the estimation of a multinomial logit and the marginal effect (at means) using a sample of mortgages that are 90+ days delinquent (359,388 loans and 5,613,437 monthly observations).The second stage dependent variable is defined by the Fannie Mae servicer's decision to modify, foreclose, or take no action (the base category) on an individual loan. Estimates followed by * and ** are statistically different from zero with 0.01 and 0.05 significance levels, respectively. The t-values are reported in parentheses below the estimates and are based on robust (clustered) standard errors. The standard errors for the multinomial logit in Stage II are clustered and bootstrapped.*

	Stage I	**Stage II**		**Marginal Effect (at means)**		
Variable	**Estimate**	**Modification Estimate**	**Foreclosure Estimate**	**No Action**	**Modify**	**Foreclose**
FNMA Loans in MSA *m* ($, trillions)	X	-4.69400* (2.77)	-7.35400* (4.47)	0.21200 (0.67)	-0.08330 (0.79)	-0.12900 (0.45)
Term of House Representative on Appropriations Committee	0.38392** (2.39)	X	X	X	X	X
All Loans in MSA *m* ($, trillions)	0.07430 (1.11)	-0.29000** (1.98)	-4.08900* (22.18)	0.07630** (2.98)	-0.00392 (0.41)	-0.07240* (2.87)
All Loans across 20 MSAs ($, trillions)	-0.00329 (0.81)	0.42300* (17.10)	0.55000* (24.46)	-0.01710* (10.57)	0.00755* (11.00)	0.00960* (7.66)
FNMA Loans Nationally ($, trillions)	0.02760* (2.72)	3.11500* (19.32)	0.04810 (0.33)	-0.05670* (4.97)	0.05690* (8.09)	-0.00020 (0.02)
FNMA Loans foreclosed in MSA *m* serviced by *non-s* servicers (#, thousands)	-0.01710 (1.10)	0.57300* (11.63)	2.18500* (49.84)	-0.04830* (4.81)	0.00975* (4.54)	0.03850* (4.64)
Other Loans foreclosed in MSA *m* (#, thousands)	0.00017* (2.70)	-0.00179* (5.71)	-0.00924* (30.63)	0.00019* (3.62)	-0.00003 (1.37)	-0.00016* (3.75)
Residual from Stage I	X	3.07500 (1.79)	-4.0230** (2.41)	X	X	X
Loan Age at Delinquency (in months)	-0.003e-3 (0.21)	-0.00471* (6.31)	0.00353* (5.90)	0.00002 (0.63)	-0.00009* (4.82)	0.00006** (2.41)
Current Loan-to-Value (CLTV)	-0.00096 (0.78)	-0.41100* (23.08)	0.79500* (45.28)	-0.00644* (3.04)	-0.00779* (9.20)	0.01420* (8.28)
Change in treasury rate over last 6 mos. ($y_t - y_{t-6}$)	-0.00029 (1.46)	-0.13600* (17.23)	-0.05480* (8.24)	0.00340* (12.33)	-0.00247* (12.30)	-0.00093* (3.19)
Change in treasury rate from Origination ($y_t - y_0$)	0.00011 (1.13)	0.08350* (8.48)	0.01420 (1.94)	-0.00175* (5.97)	0.00152* (6.74)	0.00022 (1.13)
Months Since Delinquency	-0.00002 (0.62)	-0.02530* (103.67)	0.00611* (29.46)	0.00035* (9.15)	-0.00046* (12.83)	0.00012* (4.46)
Mortgage Insurance Percentage	0.00001 (1.52)	0.00265* (8.14)	0.00134* (4.20)	-0.00007* (2.70)	0.00005* (3.95)	0.00002 (1.18)
MSA Fixed Effects	Yes	Yes	Yes			
Property Type Fixed Effects	Yes	Yes	Yes			
Loan Type Fixed Effects	Yes	Yes	Yes			
Origination Year Fixed Effects	Yes	Yes	Yes			
Delinquency Year Fixed Effects	Yes	Yes	Yes			
Seller Fixed Effects	Yes	No	No			
Servicer Fixed Effects	Yes	Yes	Yes			

Table 7: Estimate of the Servicer's Decision with Local Loan Concentrations utilizing a Control Function (2SRI)

*The first stage is a regression where the dollar amount of Fannie Mae serviced loans are regressed on the term an area representative has served on the house appropriations committee, as well as the remaining variable from the base model. The second estimates are based on the estimation of a multinomial logit and the marginal effect (at means) using a sample of mortgages that are 90+ days delinquent (359,388 loans and 5,613,437 monthly observations).The second stage dependent variable is defined by the Fannie Mae servicer's decision to modify, foreclose, or take no action (the base category) on an individual loan. Estimates followed by * and ** are statistically different from zero with 0.01 and 0.05 significance levels, respectively. The t-values are reported in parentheses below the estimates and are based on robust (clustered) standard errors. The standard errors for the multinomial logit in Stage II are clustered and bootstrapped.*

	Stage II		**Marginal Effect (at means)**		
Variable	**Modification Estimate**	**Foreclosure Estimate**	**No Action**	**Modify**	**Foreclose**
FNMA Loans in MSA *m* serviced by servicer *s* ($, trillions)	-0.609 (0.32)	-5.754 (3.11)	0.11100 (0.32)	-0.00918 (0.09)	-0.10200 (0.33)
FNMA Loans in MSA *m* serviced by *non-s* ($, trillions)	-4.905* (2.80)	-12.02* (8.95)	0.29700 (1.00)	-0.08540 (0.85)	-0.21200 (0.88)
Other Loans in MSA *m* ($, trillions)	-0.366** (2.80)	-4.130* (20.18)	0.07840* (2.99)	-0.00528 (0.53)	-0.07310* (2.88)
FNMA Loans nationally serviced by servicer *s* ($, trillions)	1.092* (6.21)	0.107 (0.69)	-0.02140 (1.51)	0.01990* (2.93)	0.00152 (0.12)
FNMA Loans nationally serviced by *non-s* servicers ($, trillions)	3.928* (24.47)	0.673* (4.75)	-0.08200* (7.65)	0.07140* (9.20)	0.01060 (1.00)
Other loans across 20 MSAs ($,trillions)	0.431* (16.75)	0.552* (24.77)	-0.01730* (10.35)	0.00767* (10.78)	0.00964* (7.63)
FNMA loans foreclosed in MSA *m* serviced by servicer *s* (#, thousands)	0.552* (9.38)	2.186* (52.03)	-0.04790* (4.68)	0.00934* (4.07)	0.03860* (4.63)
Other loans foreclosed in MSA *m* (#, thousands)	-0.002* (6.01)	-0.009* (29.42)	0.00020* (3.65)	-0.00003 (1.55)	-0.00016* (3.74)
Residual from Stage I	2.333 (1.22)	-4.109 (2.75)	X	X	X
Loan Age at Delinquency (in months)	-0.006* (10.29)	0.003* (4.81)	0.00004 (1.17)	-0.00011* (5.79)	0.00006* (2.25)
Current Loan-to-Value (CLTV)	-0.400* (22.45)	0.799* (8.72)	-0.00675* (3.26)	-0.00755* (9.12)	0.01430* (8.37)
Change in treasury rate over last 6 mos. ($y_t - y_{t-6}$)	-0.135* (16.53)	-0.055* (7.77)	0.00337* (12.02)	-0.00244* (12.15)	-0.00093* (3.17)
Change in treasury rate from Origination ($y_t - y_0$)	0.087* (10.14)	0.015 (1.85)	-0.00181* (6.14)	0.00157* (6.81)	0.00024 (1.19)
Months Since Delinquency	-0.025* (109.25)	0.006* (33.54)	0.00035* (9.53)	-0.00047* (13.18)	0.00012* (4.48)
Mortgage Insurance Percentage	0.003* (8.35)	0.001 (4.94)	-0.00007* (2.62)	0.00005* (3.75)	0.00002 (1.15)
MSA Fixed Effects	Yes	Yes			
Property Type Fixed Effects	Yes	Yes			
Loan Type Fixed Effects	Yes	Yes			
Origination Year Fixed Effects	Yes	Yes			
Delinquency Year Fixed Effects	Yes	Yes			
Seller Fixed Effects	No	No			
Servicer Fixed Effects	Yes	Yes			