Recourse and Residential Mortgage Default: Theory and Evidence from U.S. States[*]

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Abstract

We analyze the impact of lender recourse on mortgage defaults theoretically and empirically across U.S. states. We study the effect of state laws regarding deficiency judgments in a model where lenders can use the threat of a deficiency judgment to deter default or to shorten the default process. Empirically, we find that recourse decreases the probability of default when there is a substantial likelihood that a borrower has negative home equity. We also find that, in states that allow deficiency judgments, defaults are more likely to occur through a lender-friendly procedure, such as a deed in lieu of foreclosure. (JEL: E44, G21, G28, K11, R20.)

Key Words: Deficiency Judgment. Foreclosure. Negative Equity. Residential Mortgage Default. Recourse.

I. Introduction

The recent surge in defaults on residential mortgages has renewed interest in understanding borrowers' decisions of whether to default and what factors influence that decision. One factor of interest is the recourse permitted to lenders. In some U.S. states, recourse in residential mortgages is limited to the value of the collateral securing the loan. In other U.S. states, the lender may be able to collect on debt not covered by the proceedings from a foreclosure sale by obtaining a deficiency judgment. Large increases in defaults in states that severely restrict lender recourse, such as California and Arizona, raise the question of whether allowing lenders more recourse substantially deters default.[1]

Existing literature usually models the default decision as a borrower exercising a default option when it is "in the money", i.e., when the borrower is in a negative equity situation.[2] Thus, if the lender has no recourse, even borrowers who do not experience a change in their income or mortgage payments, but who find themselves having substantial negative equity in their homes, will default on their mortgages. However, allowing the lender recourse to assets other than the mortgaged property lowers the value of the default option and thus reduces the borrower's incentive to default.

In this paper we explore the differences in recourse law across states to study the effect of recourse on residential mortgage default. We examine both how much recourse deters default and to what extent it changes how borrowers default. The effect of recourse on default is not clear a priori. Deficiency judgments may be rare in practice. This may be because it is often costly and time-consuming for a lender to pursue and collect on a deficiency judgment. Alternatively, the mere threat of a deficiency judgment may deter default implying few deficiency judgments in practice. Therefore, the number of deficiency judgments observed may not be a good indicator of their influence on borrowers' behavior.

We present a model in which lenders can use the threat of a deficiency judgment to get the borrower to agree to expedite the default process or to deter default altogether. The borrower first decides how to default and then, based on the expected payoff from default,

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[1] As Martin Feldstein (2008) writes, "[t]he no-recourse mortgage is virtually unique to the United States. That's why falling house prices in Europe do not trigger defaults. The creditors' ability to go beyond the house to other assets or even future salary is a deterrent."

[2] See, for example, Kau, Keenan, Muller, and Epperson (1992) and Deng, Quigley, and Van Order (2000).

decides whether to default. In the subgame perfect equilibrium of the model, lenders rarely pursue deficiency judgments. However, allowing lenders recourse deters default in many situations. Further, recourse has an impact on how default happens: when the lender has recourse, defaults that do occur are likely to lead to smaller losses to lenders.

Following the solution of the theoretical model, we postulate empirical hypotheses and test them using a large sample of residential mortgages from the Lender Processing Services Inc. (LPS) Applied Analytics database. Our empirical findings are as follows:

1. Recourse has a negative effect on the probability of default when there is a substantial likelihood that a borrower has negative home equity (at high values of the default option). At the mean value of the default option at the time of default, the probability of default is 20% higher in states with no recourse as compared to states that allow recourse.

2. The magnitude of the deterrent effect of recourse on default depends on the borrower's wealth. The effect is significant only when the borrower is likely to have significant assets or income which we proxy for with the appraised value of the mortgaged property at origination. For borrowers with properties appraised at less than $200,000, there is no difference in the probability of default across recourse and non-recourse states. At the mean value of the default option at the time of default and for homes appraised at $300,000 to $500,000, borrowers in non-recourse states are 59% more likely to default than borrowers in recourse states. For homes appraised at $500,000 to $750,000, borrowers in non-recourse states are almost twice as likely to default as borrowers in recourse states while for homes appraised at $750,000 to $1 million, borrowers in non-recourse states are 66% more likely to default as borrowers in recourse states.

3. Recourse deters default on loans held privately. We cannot reject the hypothesis that recourse does not have an effect on loans held by government sponsored enterprises (GSEs).

4. Allowing the lender recourse increases the likelihood that default occurs by a more lender-friendly method, such as a deed in lieu, rather than foreclosure.

Our finding that recourse deters some borrowers from defaulting indicates that a non-negligible portion of U.S. mortgage default is in fact strategic rather than borrowers having no choice but to default because of liquidity constraints. This finding contrasts with the view that mortgage defaults are primarily driven by shocks to the borrower's ability to pay (see, for

example, Foote, Gerardi, and Willen [2008]). Based on their analysis of Massachusetts data, Foote, Gerardi, and Willen (2008) conclude that negative equity is not a sufficient condition for default. However, Massachusetts is a recourse state and analyzing data only from recourse states gives an incomplete picture of the role of negative equity in the borrower's default decision. As our findings show, the borrower's decision to default in recourse states is substantially less sensitive to negative equity than in non-recourse states.

To our knowledge, ours is the first study looking at differences in how borrowers default. Earlier work by Clauretie (1987), Jones (1993), and Ambrose, Capone, and Deng (2001) has also looked empirically at differences in defaults across states.[3] Clauretie (1987) estimates a linear regression model of aggregate state default rates and finds that whether or not a state permits a deficiency judgment does not significantly affect the state's default rate. Jones (1993) looks at evidence from Alberta, which does not permit deficiency judgments, and British Columbia, which permits deficiency judgments, and finds that defaults in Alberta are more likely to be due to deliberate defaults, rather than trigger events in the borrower's life. Ambrose, Capone, and Deng (2001) include a dummy variable for whether a state allows a deficiency judgment in their study of the determinants of mortgage default in a sample of Federal Housing Administration (FHA) loans originated in 1989. Because the principal of FHA loans is guaranteed by the FHA, FHA lenders cannot seek a deficiency judgment such that FHA loans may be particularly poorly suited to studying the effect of recourse on default behavior.

Ambrose, Buttimer, and Capone (1997) study theoretically the effect of deficiency judgments on default and find that the probability of default is a decreasing function of the probability of obtaining a deficiency judgment. Our theoretical model builds on Ambrose, Buttimer, and Capone (1997) by exploring the interaction of recourse laws and the lengthiness of the foreclosure process but incorporates more fully the lender and borrower's incentives and the negotiation that goes on between them which determines how the borrower terminates the mortgage.

The remainder of the paper proceeds as follows: The next section describes how lender

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[3]Pence (2006) does not directly study how recourse affects default rate; however, she looks at differences in average loan size in census tracts that span two states and finds that the average loan size is smaller in states with more defaulter-friendly foreclosure laws.

recourse varies across the US states. Section 3 presents a model of the negotiation between borrowers and lenders as a function of lender recourse, default costs, and homeowner equity. In section 4 we describe our data and variables. We present our empirical results in section 5. Section 6 concludes.

II.   Foreclosure Law and Default

A.   Foreclosure Law Across the U.S. States

States vary in the statutes governing how much recourse the lender has in the event the lender forecloses on the property and the proceeds from the foreclosure sale are not sufficient to cover the borrower's debt. States also differ markedly in how long it takes the lender to foreclose.

In most states, the lender may obtain a deficiency judgment to cover the difference between the balance owed and the value of the home in the event the lender must foreclose in a negative equity situation. However, in states that permit deficiency judgments, various restrictions often apply. Usually the lender must credit the borrower's account for fair market value of the property rather than the foreclosure sale price. The fair market value restriction is likely present because the lender is often the only bidder at the foreclosure sale (see, for example, Brueggeman and Fisher [2008]). In the absence of such a restriction, the lender could doubly profit from a foreclosure by bidding an artificially low price. In addition to lowering the likely recovery from a deficiency judgment, such restrictions sometimes imply that the lender must incur substantially higher legal costs and more time in pursuing a deficiency. The increase in costs and time depends on state statutes governing the determination of fair market value. In some states, a single appraiser determines fair market value. In other states, such as Minnesota, fair market value must be determined by a jury. Finally, states differ in how easy it is for the borrower to contest the fair market value of the property.

Lenders have less recourse in practice in states that require lenders to go through a lengthy judicial foreclosure process, rather than a quicker non-judicial foreclosure process, to obtain a deficiency judgment. In other states, such as Idaho and Nebraska, there is a relatively short time frame in which the lender can file. In practice, this can be onerous in

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states that also have a fair market value restriction since the lender does not immediately know the fair market value of the property and thus cannot determine whether there even is a deficiency to be sought. In some states, substantial personal property or wages are exempt from collection on the deficiency. For instance, Florida and Texas have nearly unlimited homestead exemptions such that the lender is very unlikely to collect on a deficiency judgment on an investment property or secondary residence since the borrower can easily shield his or her assets. Finally, in Ohio and Iowa, the lender has a relatively short period in which to collect on the deficiency after the foreclosure sale.

In states that allow deficiency judgments, a borrower retains the option to declare bankruptcy and have some portion or all of the deficiency judgment discharged. As White (1998) reports, prior to the 2005 bankruptcy reform, most unsecured debts were discharged in bankruptcy regardless of whether the borrower filed under chapter 7 or under chapter 13. Furthermore, filing for bankruptcy had a low pecuniary cost before the 2005 act such that the major cost to filing for bankruptcy was reduced availability of credit. In chapter 7 filings, it continues to be the case that deficiency judgments are completely discharged and, if the chapter 7 filing is concurrent with a foreclosure, the lender loses the right to a deficiency judgment. In chapter 13 filings, the lender may pursue a deficiency judgment. Following the 2005 bankruptcy reform, however, borrowers with incomes above the state median income must file under chapter 13, rather than chapter 7, which might make it more difficult to discharge a deficiency judgment for high income borrowers.

A few states explicitly forbid deficiency judgments on most homes (Arizona and Oregon) or on purchase mortgages. In other states, the restrictions on deficiency judgments are so onerous that it is highly impractical for the lender to pursue a judgment in the vast majority of cases which makes the state effectively non-recourse. Table 1 summarizes the extent of recourse the lender has in each state and the time it takes the lender to complete the foreclosure process if the borrower does not contest the foreclosure. We classify Alaska, Arizona, California, Iowa, Minnesota, Montana, North Carolina (purchase mortgages), North Dakota, Oregon, Washington, and Wisconsin as non-recourse states.[4]

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[4] An appendix available from the authors describes the foreclosure and deficiency judgment procedures in the US states. Our time lines come from The National Mortgage Servicer's Reference Directory (2004) published by the USFN (America's Mortgage Banking Attorneys).

Our classification of states is similar to that of the USFN (2004): The states we classify as non-recourse are the same as those for which the USFN (2004, pp. 5-5 - 5-7) states that a deficiency judgment is either not available or for which getting one is impractical. However, we classify purchase mortgages in North Carolina as non-recourse since state law prohibits deficiency judgments on purchase mortgages and we treat South Dakota as a recourse state. We usually were able to speak with at least one foreclosure attorney in each state where the amount of recourse in practice was unclear or the statutes were difficult to understand.

B.   Types of Default

In practice, lenders usually view litigiously foreclosing as a last resort in the event the borrower defaults and will usually try to recover a portion of principal through other means before resorting to foreclosure.[5] Furthermore, lenders have a strong interest in foreclosing quickly on the property even when the lender does choose to exercise the option to foreclose.[6]

Lenders prefer to avoid foreclosures, and, especially, contested foreclosures, for several reasons. First, properties depreciate substantially when the borrower is in default. Second, the property usually sells at a distressed value in a foreclosure sale. Third, lenders incur negative publicity and reputation costs among other prospective borrowers from forcibly removing a borrower from his or her home. For instance, Campbell, Giglio, and Pathak (2009) find that a foreclosure reduces the value of the home by approximately 28%. The depreciation rate is faster when a property is in default because the borrower has no incentive to adequately maintain the property and thus may deliberately accelerate the property's depreciation.

There are at least three ways by which a borrower can default: a short sale, a voluntary conveyance, or simply agreeing not to contest the foreclosure. In a short sale, the borrower finds a buyer for the property who pays a purchase price that is less than the full balance of the debt owed. Usually in a short sale the lender agrees to waive his right for a deficiency in exchange for the borrower selling the property and remitting the proceeds to the lender. Occasionally, the lender may only agree to waive his right to a deficiency if the borrower also

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[5]See, for example, Larsen, Carey, and Carey (2007), Brueggeman and Fisher (2008), and Ling and Archer (2008).

[6]This view was also prevalent among the foreclosure attorneys to whom we spoke.

agrees to give the lender a lump sum payment in addition to the sale proceeds.

In a voluntary conveyance, the borrower hands over the deed to the property to the lender. In the most common voluntary conveyance, a deed in lieu, the lender forgives the debt owed in exchange for the deed. In addition to eliminating the risk of the lender pursuing a deficiency judgment, a deed-in-lieu affects a borrower's future access to credit less severely than if the lender must forcibly evict the borrower (Larsen, Carey, and Carey [2007]). The benefit to the lender is that, in addition to getting the property back more quickly, the lender's legal costs are lower and the deed in lieu of foreclosure "can be beneficial to the lender's public image and to the public perception of the property" (Ling and Archer [2008]).

However, a voluntary conveyance carries some risks to the lender. First, if the borrower declares bankruptcy within one year of a deed-in-lieu, the court may declare the conveyance improper. In such a case the lender's claim becomes an unsecured claim on the borrower's assets and, in the case of the borrower filing under chapter 13, future income which will generally give the lender a worse payoff. Second, a voluntary conveyance does not cut off any subordinate liens on the property the way a proper foreclosure does.

Finally, a borrower may simply agree to what is known as a "friendly foreclosure", i.e., to not contest the foreclosure and submit to the jurisdiction of the court regarding leaving the property and cooperating with the lender. The main benefit of this option is that the lender gets the property back more quickly relative to a contested foreclosure. This takes more time than a voluntary conveyance but is less time-consuming than a regular foreclosure (Brueggeman and Fisher [2008]). A friendly foreclosure may be preferable to the lender as it cuts off any subordinate interests that may exist in the property and protects the lender if the borrower subsequently declares bankruptcy (Ling and Archer [2008]). The benefits to the borrower from a friendly foreclosure relative to a more standard foreclosure are similar to those from a short sale and a deed in lieu: the lender may agree to waive his or her right to a deficiency judgment and the borrower's future credit availability suffers less.

Subsequent to a voluntary conveyance, the property becomes real estate owned (REO), i.e., the lender owns the property. A property can also become REO subsequent to a foreclosure sale if the lender acquires the property by virtue of being the only bidder.

III. A Model of the Default and Default Type Decisions

In this section, we present a static model to study the effect of recourse on default. The model predicts that allowing lenders recourse changes both default rates and the method of default even though lenders seldom actually pursue deficiency judgments in equilibrium. Finally, the model enables us to explore the interaction between recourse and laws that govern the rapidity of the foreclosure process.

A. The Economic Environment

The borrower makes two decisions regarding default: whether to terminate the mortgage and how to default if he defaults. The borrower's decision of whether to terminate the mortgage depends on transaction and search costs. Once the borrower decides to default, the borrower and lender must agree to a short sale, a friendly foreclosure / deed in lieu, or a contested foreclosure. We combine the friendly foreclosure and deed in lieu outcomes into one event in the model as we view the lender and borrower as having similar incentives in both situations and the outcomes are relatively similar. Herein, we refer to that outcome as a deed in lieu.

We first consider how default happens once the borrower has decided to default. We then use this analysis to explore the borrower's decision of whether to default conditional upon a given loan-value ratio in both recourse and non-recourse states. We further assume that 1) the borrower can contest foreclosure and, thus, slow down the foreclosure process; 2) the borrower receives free rent during the default period; 3) the borrower incurs search costs of finding a new home and moving costs once he agrees to a short sale, hands over the deed in lieu to the lender, or gets foreclosed upon; 4) the lender agrees to waive a deficiency judgment if the borrower agrees to a short sale or a deed in lieu; 5) at the foreclosure or REO sale, the lender recovers less than the fair market value of the property; 6) the lender recovers a greater fraction of the fair market value in an REO sale subsequent to a deed in lieu than at a foreclosure sale; 7) if the lender sues for a deficiency, the borrower receives credit for the fair market value of the home; and 8), the borrower incurs lower credit costs if he agrees to a short sale or a deed in lieu than if he is foreclosed upon.

Assumption (2) follows Ambrose, Buttimer, and Capone (1997). Assumption (5) is based on widespread evidence that properties depreciate substantially more rapidly during foreclosure and the lender is often the only bidder at a foreclosure sale (see, for example, Campbell, Giglio, and Pathak [2009]). Thus, the lender cannot recover the fair market value of the property in foreclosure. Assumption (7) is consistent with most states foreclosure laws requiring the borrower to receive credit for the fair market value of the home in any deficiency judgment. Assumption (8) is justified by the widespread observation that, in addition to a large drop in the FICO score in the event of foreclosure, the foreclosure itself goes on the borrower's credit record. In general, lenders are more willing to lend again to a borrower that has defaulted through a short sale or a deed in lieu than one that forced the lender to foreclose even if the FICO score drops by the same amount in a foreclosure as in a short sale.

We assume the lender will not agree to a loan modification. This assumption stems from empirical observation that significant principal write downs are rare prior to the end of our sample (December 2008). While loan modifications involving extending the amortization period, a temporary stay in payments, or a reduction in the interest rate, are somewhat more common, they will not alter the default decision of financially unconstrained borrowers.

Lenders may be unwilling to write down principal due to either unclear contractual obligations on securitized loans or borrower heterogeneity in the costs of defaulting that the lender cannot observe. While it is ex-post optimal in many circumstances for a lender to agree to a loan modification rather than have the borrower default, introducing the possibility of principal write-downs may ex-ante cause more borrowers to seek loan modifications than would in the absence of this policy. Because the lender cannot observe the cost of defaulting without the borrower actually defaulting, he would have to allow a loan modification on all loans with a given loan-to-value ratio that would reduce the value of his mortgage pool. See also Foote, Gerardi, Goette, and Willen (2009) for a model of why loan modifications are rare in practice.

B. The Model

We first consider the decision of how default happens in recourse and non-recourse states once the borrower has decided to default.

Recourse States.—Suppose that at time t the borrower decides to terminate his mortgage. The mortgage can be terminated in one of three ways: 1) the borrower and lender agree to a short sale (SHORT), 2) the borrower and lender agree to a deed in lieu or a friendly foreclosure without a deficiency judgment (DIL), or 3) the lender forecloses with a deficiency judgment (F). If the lender pursues a deficiency judgment, he cannot recover his collateral for $\tau + m$ periods. If the lender pursues foreclosure without a deficiency judgment, he cannot recover his collateral for τ periods. τ and m are exogenous to the model and determined by states' foreclosure laws. If default occurs, the house depreciates by a fraction δ^F each period between default and the foreclosure sale.

The lender's payoffs in these three scenarios are

1) $\mu^S H_t$ if short sale;

2) $\left(\frac{1}{1+r}\right)^\tau \left(1 - \delta^F\right)^\tau \mu^{DIL} H_t$ if deed in lieu; or

3) $\left(\frac{1}{1+r}\right)^{\tau+m} \left(\left(1 - \delta^F\right)^{\tau+m} \mu^F H_t + \phi \left[M_{t+\tau+m} - (1 - \delta)^{\tau+m} H_t\right]\right)$ if foreclosure with deficiency judgment,

where ϕ is the expected present value the lender collects on the deficiency net of legal costs, H_t is the price of the house at the time the borrower announces he will default, $\mu^S H_t$, is the recovery amount in the event of a short sale, $\mu^{DIL} H_t$ is the discounted present value of the property to the lender at the time of a deed in lieu, $\mu^F H_t$ is the discounted present value of the property to the lender at the time of foreclosure, where $\mu^F < \mu^{DIL} < \mu^S < 1$, $M_{t+\tau+m}$ is the unpaid mortgage balance at time $t + \tau + m$, δ^F is the fraction by which the house depreciates each period while the borrower is in default, and r is the discount rate.

The borrower receives free rent h in any period in which he is in default but has not been foreclosed upon or agreed to a short sale. Once the borrower either agrees to a short sale or gets foreclosed upon, he must pay the search and moving costs, s, of relocating. If the borrower defaults through a short sale or a deed in lieu, he incurs a cost c_0 that represents the cost of decreased availability of credit. If the borrower defaults by allowing himself to be foreclosed upon, he incurs a credit cost c_1. The borrower's payoffs from the three scenarios are thus

1) $-s - c_0$ if short sale;

2) $\sum_{k=0}^{\tau} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^\tau (c_0 + s)$ if deed in lieu; or

3) $\sum_{k=0}^{\tau+m} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^{\tau+m} \left\{ \phi \left[M_{t+\tau_1} - \left(1 - \delta^F\right)^{\tau+m} H_t \right] + c_1 + s \right\}$ if foreclosure with deficiency judgment.

Non-Recourse States.—Since, conditional on opting for foreclosure, the borrower always prefers a lengthier foreclosure process, the lender's payoff in states without recourse are

1) $\mu^S H_t$ if short sale;

2) $\left(\frac{1}{1+r}\right)^\tau \left(1 - \delta^F\right)^\tau \mu^{DIL} H_t$ if deed in lieu;

3) $\left(\frac{1}{1+r}\right)^{\tau+m} \left(1 - \delta^F\right)^{\tau+m} \mu^F H_t$ if foreclosure.

Similarly, the borrower's payoffs become

1) $-s - c_0$ if short sale;

2) $\sum_{k=0}^{\tau} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^\tau (c_0 + s)$ if deed in lieu;

3) $\sum_{k=0}^{\tau+m} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^{\tau+m} (c_1 + s)$ if foreclosure with deficiency judgment.

The first conclusion is that, other things equal, borrowers should be more willing to agree to a deed in lieu or a short sale in states that allow deficiency judgments. To see this, note the following:

$$\sum_{k=0}^{\tau+m} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^{\tau+m} \left\{ \phi \left[M_{t+\tau_1} - \left(1 - \delta^F\right)^{\tau+m} H_t \right] + c_1 + s \right\}$$
$$< \sum_{k=0}^{\tau+m} \left(\frac{1}{1+r}\right)^k h \left(1 - \delta^F\right)^k H_t - \left(\frac{1}{1+r}\right)^{\tau+m} (c_1 + s).$$

Then if the borrower's payoff from the short sale or deed in lieu exceeds the payoff from foreclosure in a non-recourse state, it will also exceed the payoff from the foreclosure in a recourse state.

The second conclusion is that lenders will be less willing to agree to a short sale or a deed in lieu in states that allow deficiency judgments. Clearly, the lender always prefers a short sale or deed in lieu to foreclosure in non-recourse states. In recourse states, there may be cases in which it is beneficial for the lender to pursue foreclosure if the deficiency is sufficiently large.

However, the threat of a deficiency judgment will often induce the borrower to agree to a

short sale or a deed in lieu and the lender will often agree to this rather than actually pursue the deficiency judgment. The reason is that, when $\phi < 1$ or the borrower receives credit for the fair market value of the property, rather than the foreclosure sale price, the amount the lender can recover through a foreclosure sale may be smaller than what the lender can recover from foreclosing with a deficiency judgment.

The optimal default type is the equilibrium outcome of bargaining between lenders and borrowers. Lenders pursue the course of action that gives them the highest payoff conditional on what the borrower will agree to. The borrower and lender know each other's expected payoffs such that a threat to pursue a deficiency judgment in situations in which the payoff to the lender is higher without a deficiency judgment is not credible. Thus, the borrower knows before he decides whether to agree to a short sale whether the lender will be willing to agree to a deed in lieu such that, if the lender's payoff is higher with a deed in lieu than a contested foreclosure, the borrower can guarantee that his payoff will be that of the deed in lieu.

Conditional on the payoff from defaulting, the borrower decides whether to default conditional on the current loan-value ratio. Consider a borrower that currently owes M_t dollars on his mortgage used to finance a house that is now worth H_t, $M_t > H_t$. There are two possible outcomes:

1. Stay in the house and receive the payoff $H_t - M_t$.

2. Default and receive the payoff determined by the negotiation outlined above.

C. Model Solution

We solve a special parameterized case of the model to further explore its implications.

Optimal Type of Default.—Table 2 explores how recourse affects how the borrower chooses to terminate his mortgage as a function of how much the lender can recover and the home owner's LTV for a particular calibration. We normalize H to 1 and assume $\delta^F = 0.005$ per month, $m = 6$ months, $r = 0.05/12$, $s = 0.1$, $H = 0.1$, $h = 0.05/12$, $\mu^S = 0.9$, $\mu^{DIL} = 0.8$, and $\mu^F = 0.75$. We assume $\mu^S = 0.9$ because the borrower must find a buyer for the home quickly under distressed conditions such that the home sells for slightly less

than its fair market value. Our choice for the rent-price ratio is equal to the U.S. average rent-price ratio from $1960Q1 - 2008Q4$ based on the calculations of Davis, Lehnert, and Martin (2008). We assume $c_0 = 0.08$ and $c_1 = 0.1$. The top panel, our benchmark case, assumes that it takes 6 months to complete an uncontested foreclosure. Finally, we assume the mortgage is a fully amortizing, 30 year constant-payment, 6% mortgage to get $M_{t+\tau+m}$.

The first column of table 2 illustrates the default method in non-recourse states for our benchmark case. In non-recourse states borrowers always do better by contesting the foreclosure process since they get an additional several months of rent and delay search and credit costs which, for our calibration, outweighs the lower credit costs they would incur by agreeing to a short sale or a deed in lieu.

In recourse states, for very low recovery rates ($\phi = 0.05$ or 0.1), the home owner never agrees to a short sale since the amount the lender can recover through a deficiency judgment is much lower than the present value of free rents the home owner receives during the foreclosure process. However, both the borrower and the lender do better with a deed in lieu in the case of low recovery rates. The lender has a higher payoff because the discount at which he sells the home is lower and it depreciates less. The homeowner has a higher payoff from deed in lieu because the amount he has to repay in the event of a deficiency judgment is sufficient to exceed the benefits of an additional six months of the free rent. The exception is when the initial LTV is 100% and the uncontested foreclosure time is 3 or 6 months. In this case there is only a slight deficiency – the amount of negative amortization that has accumulated since default. Then the borrower has such a small deficiency that the extra six months of free rent outweighs what he will eventually have to pay out on a deficiency judgment.

As the recovery rate and loan-to-value increase, short sales occur increasingly frequently and deeds in lieu become increasingly rare. The reason is that the lenders threat to pursue a deficiency judgment becomes credible as the lender receives a higher payoff from foreclosing with a deficiency judgment than agreeing to the deed in lieu. This ensures the borrower that he will receive the foreclosure payoff if he does not agree to a short sale and the borrower gets a higher payoff with a short sale than a foreclosure with a deficiency judgment.

We do not see lenders preferring foreclosing with a deficiency judgment rather than doing a short sale until ϕ rises to 35%. Starting at $\phi = 35\%$, if the initial LTV is sufficiently

high, the lender can recover enough from a deficiency judgment such that he will always seek one and the borrower is guaranteed to have to pay back a portion of the deficit if he defaults.

Comparing across the panels in table 2 illustrates the effect of the length of the foreclosure process on the optimal default decision. The panels show the optimal default decision when the uncontested foreclosure time frame is 3, 6, and 12 months. Changing the foreclosure time frame does not usually result in a different foreclosure type. For very low LTVs and recovery rates, a faster foreclosure process benefits the borrower because the amount of amortization on the mortgage is smaller than the present value of the free rent he gets. Thus, for very low LTVs, we see a few more defaults completed by foreclosure in states with more rapid foreclosure processes. However, when the LTV and recovery rate are high, a faster foreclosure process works to the lenders advantage since the amount the lender can recover from a deficiency judgment is higher as the property has less time in which to depreciate. Thus, for high LTVs, we also expect to see more defaults completed by foreclosure in states with more rapid foreclosure processes.

Optimal Decision to Default.—Table 3 illustrates the effect of recourse on whether default occurs as a function of the recovery rate and home owner equity. When expected recovery is low, there is little difference in when the borrower defaults between recourse and non-recourse states. Overall, changing the time of default from 6 to 12 months or from 6 to 3 months changes the decision of whether to default in only a few cases and so we do not expect the length of the foreclosure process to substantially affect default rates.

It is only when the expected recovery is above 35% that recourse has a strong deterrent effect. This deterrent effect is stronger the lengthier is the foreclosure process. In some situations, the structure of the lender's and borrower's incentives imply that the borrowers know that the lender would prefer a short sale or a deed in lieu and the borrower's payoff from defaulting is thus that from a short sale such that allowing the lender recourse does not deter the borrower from defaulting.

Combining the information in the top panels of table 2 and table 3, we see that there are only a few combinations of recourse and the LTV ratio in which the outcome is actually that of the lender pursuing a deficiency judgment. When recourse is moderate, 35% − 40% and the LTV ratio is high, is it both worthwhile for the lender to pursue a deficiency judgment

and the borrower to incur the fixed costs of defaulting. The lender wants to pursue a deficiency judgment because the payoff from a short sale or a deed in lieu is low relative to the balance owing but does not recover enough to deter default. Once the recovery rate becomes sufficiently high, the lender both pursues a deficiency judgment and the recovery rate is sufficiently large to deter default. In other circumstances in which default would have occurred through foreclosure with a deficiency judgment, the borrower earns a higher payoff by not defaulting because the balance owed is not high enough for it to be worthwhile for him to incur the credit and search costs of defaulting.

D.   Discussion

To summarize, our model explains why lenders rarely pursue deficiency judgments. Furthermore, the model suggests that the presence of recourse will deter relatively well-off borrowers (i.e., those where the lender faces a high ϕ) from defaulting. It also suggests that borrowers will default differently, in ways that lead to lower losses for lenders, in states that allow lenders recourse. This is consistent with the results of Clauretie and Herzog (1990) and Crawford and Rosenblatt (1995) who find that, conditional upon foreclosure occurring, losses on foreclosures are lower in states that permit deficiency judgments. Our model suggests a reason why, even if lenders rarely actually pursue deficiency judgments, losses are lower in states that permit lenders recourse.

It is worth noting that recourse laws will affect the choice of how the borrower chooses to default both in the case of strategic defaulters (borrowers who can continue to make payments on their mortgage if they choose to) and non-strategic defaulters (borrowers who are insolvent and unable to make payments). In our model, any borrower that is insolvent defaults. In the case of non-strategic defaulters, lenders still can recover some portion of any deficiency in most states since the lender typically has 10 years to collect on a deficiency and can file for a 10 year extension on that recovery, ample time to see an improvement in a borrower's financial circumstances.

The results in tables 2 and 3 are stylized and assume that all borrowers face the same fixed default costs. In practice, these costs vary greatly across borrowers and so the type of default borrowers and lenders agree to is relevant. If the fixed default costs are lower for

some borrowers, we should expect to see deficiency judgments primarily in the low-recovery regions.[7] When the recovery rate is higher, usually either the borrower is deterred from defaulting altogether by the threat of a deficiency or the lender and borrower agree to a short sale.

Which cases in tables 2 and 3 are most common, and thus how big a deterrent recourse is to default in practice, is an empirical question. In the next two sections, we empirically examine how big an effect recourse has on default rates. We then test whether defaults occur more frequently via deeds in lieu or short sales in states that permit lenders recourse.

IV. Data

The data used in the study is loan-level data from LPS Applied Analytics, Inc. The data contain information about loans on a monthly basis.[8]

A. Variable Definitions

Definition of Default.—We consider the loan as defaulted if the loan is terminated in one of the following ways: by REO sale, by short sale, by pay off out of foreclosure, by pay off out of bankruptcy and serious delinquency, or by liquidation to termination. In the analysis of the probability of default, the dependent variable takes a value of 1 in the month the loan defaults. We drop all observations on defaulted loans subsequent to the default month. Consequently, the dependent variable takes a value of 0 in months that we observe the defaulted loans prior to the default month and observations on loans that do not default, whether terminated or current.

Default Type.—In our analysis of whether recourse changes how default happens, we consider loans terminated by default. We divide defaults into defaults by foreclosure and other types of default such as short sales, deeds in lieu, and friendly foreclosures. We identify non-foreclosure defaults as loans which directly become REO loans or short sales. We also define any default where the lender received a payoff out of bankruptcy or serious delinquency

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[7]This is consistent with foreclosure practice: Our conversations with foreclosure professionals indicated that deficiencies judgments typically sell for $5 - 10$ cents on the dollar.

[8]An appendix available from the authors provides details about the variables by LPS codes.

as a foreclosure since these are loans in which the borrower likely declared bankruptcy to halt foreclosure proceedings. Such a default is akin to a contested foreclosure process. Thus, default type takes on a value of 1 if the loan defaulted via a foreclosure and 0 otherwise.

Default Option Variables.—We define the value of the default option as the probability the borrower has negative equity in the house as in Deng, Quigley, and Van Order (2000) and Ambrose, Capone, and Deng (2001). Since we know the balance owed on the loan, we need only infer the distribution of individual house prices. The value of equity to market value k_i months after loan origination is

$$E_{i,t,k_i} = \frac{M_{i,t,k_i} - L_{i,t,k_i}}{M_{i,t,k_i}},$$

where M_{i,t,k_i} is a market value of the property purchased at time $t - k_i$, and L_{i,t,k_i} is a present value of the remaining loan balance. The market value of the property is

$$M_{i,t,k_i} = C_i \frac{HPI_{i,t}}{HPI_{i,t-k_i}},$$

where $C_{i,t-k_i}$ is a cost of a property at the time of a purchase, $HPI_{i,t}$ is house price index in the state where property i is located, and $\frac{HPI_{i,t}}{HPI_{i,t-k_i}}$ follows a lognormal distribution (see Case and Shiller [1987] and Deng, Quigley, and Van Order [2000] for details). The mean and variance of $\frac{HPI_{i,t}}{HPI_{i,t-k_i}}$ is obtained using the data available from the Office of Federal Housing Enterprise Oversight (OFHEO).[9]

The value of the default option for mortgage i k_i months after origination is the probability that equity is negative:

$$DEFAULT\_OPTION_{i,k_i} = \Pr(E_{i,t,k_i} < 0) = \Phi\left(\frac{\ln L_{i,k_i} - \ln M_{i,k_i}}{\sqrt{\sigma^2_{HPI_{i,k_i}}}}\right),$$

where $\Phi(\cdot)$ is the cumulative standard normal distribution and $\sigma^2_{HPI_{i,k_i}}$ is the variance of

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[9]To calculate the standard deviation of $\frac{HPI_{i,t}}{HPI_{i,t-k_i}}$, $\sigma_{HPI_{i,k_i}}$, we use the volatility parameters A and B provided by OFHEO as follows:

$$\sigma_{HPI_{i,k_i}} = \sqrt{Ak_i + Bk_i{}^2}.$$

See Calhoun (1996) for the technical description of OFHEO index.

individual house prices in state i around the mean in state i.

We also include the default option squared as in Deng, Quigley, and Van Order (2000).[10]

Prepay Option Variables.—As a proxy for prepayment option, we use a spread between current market mortgage rate, r_t, and the mortgage rate on the contract, r_0. We use indicator variables, rather than a continuous variable, based on the results of Kau, Keenan, and Kim (1994) that the spread affects default rates in a nonlinear fashion. Following Ambrose, Capone, and Deng (2001), we define the following dummy variables: Rate1 $= 1$ if $r_0 + 2\% \leq r_t$, and 0 otherwise; Rate2 $= 1$ if $r_0 + 1\% \leq r_t < r_0 + 2\%$, and 0 otherwise; Rate3 $= 1$ if $r_0 - 1\% \leq r_t < r_0 + 1\%$, and 0 otherwise; Rate4 $= 1$ if $r_0 - 2\% \leq r_t < r_0 - 1\%$, and 0 otherwise; and Rate5 $= 1$ if $r_t < r_0 - 2\%$, and 0 otherwise, where r_t and r_0 are in percentages.

Foreclosure Timing and Recourse Variables.—We include the time it takes for uncontested foreclosure in the state in which the property is located since our model predicts that a lengthier foreclosure process will increase defaults. Table 1 contains the recourse classification of states and the foreclosure timelines. In one specification, we also include foreclosure timing as a dummy variable that takes on a value of 1 if the uncontested foreclosure time is less than 185 days, and zero otherwise.

Trigger Events.—We control for trigger events, as Capozza, Kazarian, and Thomson (1997) emphasize, by including the contemporaneous state divorce rate and the state unemployment rate. We use lagged monthly seasonally unadjusted unemployment rates from the BLS.[11]

Loan Level Variables and Borrower Characteristics.—We also use several loan level characteristics that other studies have found to be important in explaining defaults, such as the age of the loan (in months) and the LTV at origination, an indicator variable that takes a value of 1 if the loan is interest only at origination, an indicator variable that takes a value of 1 if the loan is an ARM, an indicator variable that takes a value of 1 if the loan is a jumbo, an indicator variable that takes a value of 1 if the loan is a first mortgage,

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[10]As a robustness exercise, we verified that the coefficient on recourse is negative and significant (at slightly higher than the 5% level) on the linear term when we do not include the quadratic term.

[11]We do not use seasonally adjusted unemployment rates as there may be a seasonal pattern to defaults due to seasonal economic conditions.

an indicator variable that takes a value of 1 if the loan is not a purchase mortgage, and the borrower's FICO score at origination. We convert nominal appraisal amounts at origination into real 2005 dollars by deflating using the CPI excluding shelter.

B. Sample Description

We use information on loans originated between August 1997 and December 2008. August 1997 is the first month that the FICO score variable is available in the data. We drop all FHA and VA loans because deficiency judgments are prohibited on FHA loans and strongly discouraged on VA loans (Larsen, Carey, and Carey [2007]). We drop all loans with private mortgage insurance. We restrict our analysis to mortgages with constant principal and interest, ARMs, or Graduated Payment Mortgages (GPMs). We also drop mortgages for home improvement, debt consolidation, education, or medical expenses. We limit our analysis to first or second mortgages. Finally, we drop observations for loans on properties with more than one unit.

We then draw a 10% random sample from the LPS database. Our restrictions imply that we have 82,828,381 loan-month observations. 67% of our observations come from recourse states and on average there is a 1% probability that a home owner in our sample has negative equity. 7% of our observations are interest only at origination and 97% of our observations are on first mortgages. 20% of our observations are adjustable rate mortgages. In total, our sample includes $2,924,160$ loans and $38,440$ defaults. An appendix available from the authors lists the default rates in each state over the full sample, over the 1997-2004 period, and over the 2005-2008 period as well as summary statistics for the variables.

V. Empirical Results

We structure our empirical analysis in two parts: first, we examine the effect of recourse on the probability of default; second, we examine the effect of recourse on the way borrowers default.

A.   The Impact of Recourse on Default

We assume that the borrower defaults if an unobserved variable $x = X\beta + \varepsilon$, falls below 0 where $\varepsilon \tilde{} N(0,1)$ and X is a vector of variables that controls for the borrower's prepay and default options, other loan-level characteristics, and trigger event variables.

As the theoretical model in section 3 shows, recourse affects the borrower's payoff from defaulting. Different payoffs from the default decision in recourse and non-recourse states may lead to different threshold values of the default option at which the borrower defaults in recourse and non-recourse states. Thus, to estimate the impact of the recourse on the probability of default, we model recourse in our empirical specification as an interaction term between the value of the default option and the recourse dummy variable. The recourse dummy variable takes a value of 1 if the mortgaged property is located in a state with a provision for recourse and 0 otherwise.

The first column of table 4 contains the results without recourse variables. The results in the column illustrate the effect of the prepay and default options, trigger events, and loan-level characteristics on default when we do not control for recourse. All of the coefficients have the expected sign. Having an interest-only loan, an ARM, or a second mortgage raises the probability of default. Borrowers with higher FICO scores at origination are less likely to default while loans with a high LTV at origination are more likely to default. Finally, younger loans are much more likely to default than older loans. The divorce rate has the expected sign but is significant only at the 10% level when we cluster the standard errors, likely because there is relatively little variation across time in the divorce rate within a state. The unemployment rate has the expected sign but becomes insignificant when the standard errors are clustered.

Following the theoretical model, we specify the hypotheses for our empirical analysis and test them against the alternatives that follow from the solution of the model.

Hypothesis 1.—*Hypothesis 1.0*: Recourse does not have an impact on the effect of the default option on the probability of default.

Hypothesis 1.1: Recourse decreases the probability of default for a given value of the default option.

Hypothesis 1.1 follows from the results in table 3 which depicts the decision of whether to default for a borrower who has negative home equity. There are many situations in table 3 in which recourse deters default for a borrower who has negative home equity. In particular, in all three panels default occurs at slightly higher values of the default option. At high values of the default option and when the recovery rate on the deficiency is high, recourse deters default altogether. The empirical analysis allows us to examine whether this effect is present and quantitatively important in the data. To test the effect of the recourse on the impact of negative equity on the probability of default, we include the interaction terms of the default option value and default option value squared with the recourse variable.

Column 2 of table 4 contains the results of our benchmark specification. The coefficient on the interaction term between recourse and negative equity is negative and statistically significant. The coefficient on the interaction between recourse and squared term of the probability of negative equity is positive and statistically significant. The negative coefficient on the linear term of default option value indicates that recourse decreases the impact of the negative equity on the probability of default. The positive coefficient on the square term indicates that the effect decreases as the default option value increases. Because of this nonlinear effect of default option value on the probability of default, the effect of recourse depends on a particular value of the default option.

To gauge the magnitude of the deterrent effect of recourse, we evaluate the probability of default in recourse and non-recourse states at different values of the default option. Table 5 contains the estimates of the probabilities. Column 1 shows the probabilities at the means of the continuous variables and the modes of the dummy variables at the time of default. At the mean of the default option at the time of default, borrowers in non-recourse states are 21% more likely to default than borrowers in recourse states.

In columns $2 - 4$ of table 5, we estimate default probabilities at the means of the continuous variables and the modes of the dummy variables for all observations at different values of the default option. At the mean of the default option, the probability of default is 6% higher in non-recourse states than in recourse states. At the 90th percentile of the value of the default option, 0.3%, the probability of default in non-recourse states is 2% higher. This difference increases to 13% at the 95th percentile, when the default option is

2.12%. The results in columns $2 - 4$ indicate that recourse has a deterrent effect on default at high values of the distribution of the default option value, which are precisely the values associated with default. Thus, the data reject Hypothesis 1.0 in favor of Hypothesis 1.1.

In columns 3 and 4 of table 4, we present the results for two of the specifications in which we verified the robustness of our result regarding recourse. In column 3, we include the difference between the contract rate and current mortgage rates in interactions with the probability of negative equity as in Ambrose, Capone, and Deng (2001). The results are quite similar to our benchmark specification although the log-likelihood is somewhat higher when rates are included in interactions suggesting that including rates in levels fits the data better.

In column 4, we explore whether our results regarding recourse are due to state-specific factors by including state dummy variables. We drop the divorce rate in this specification as our divorce rate data is only available at the annual frequency. Also, for some states we only have a few divorce rate observations over the entire sample, thus there is little variation remaining in the divorce rate after we control for state specific effects. When we control for the state specific fixed effects, the results on the effect of recourse carries through: the coefficient on the interaction between recourse and the default option value is statistically significant and are numerically similar to that in the benchmark specification. Thus, our results regarding the deterrent effect of recourse are not driven by unobserved differences between recourse and non-recourse states.[12]

Hypothesis 2.—*Hypothesis 2.0*: The probability of default is not affected by state foreclosure timelines.

Hypothesis 2.1: The probability of default is higher in states with longer foreclosure timelines.

In column 5 of table 4, we show the effect of the lengthiness of the uncontested foreclosure process, as stated in USFN (2004), on the probability of default. We model the lengthiness of the foreclosure process in two ways. In column 5 we include the length of the uncontested

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[12]We also consider a specification in which we include year of origination dummies. The coefficient on the interaction between the default option value and recourse is very similar to that of our benchmark specification in column 2 and the results are in an appendix available from the authors. With 2003 as the omitted category, the coefficients on origination years prior to 2003 are negative.

foreclosure process in months for the state in which the property is located. When we do not cluster the standard errors, states with lengthier foreclosure processes appear to experience more defaults. However, the effect becomes insignificant when we cluster the standard errors. We also did not find that the lengthiness of the foreclosure process significantly affects default in other specifications in which we interacted the foreclosure time frame with recourse variables. While our model predicts that a lengthier foreclosure process will increase the default rate in a few cases, the empirical evidence in columns 5 suggests those cases are infrequent in practice. We also tried a specification in which we included foreclosure timing by using a dummy variable that takes on a value of 1 if the state's uncontested foreclosure process takes more than 6 months and 0 otherwise and obtained similar results. Thus we cannot reject Hypothesis 2.0 that the lengthiness of the foreclosure process has no effect on the probability of default.

Hypothesis 3.—The model in section 3 predicts that the deterrent effect of default on the probability of default depends on the amount of the deficiency judgment that a lender can actually recover. In particular, as the right hand side columns in table 3 show, the recourse has a substantial deterrent effect if the recovery rate is high. This leads to the following null hypothesis tested against the alternative that the model predicts:

Hypothesis 3.0: The effect of recourse on the probability of default does not depend on the lender's recovery rate.

Hypothesis 3.1: The effect of recourse on the probability of default is stronger when the lender's recovery rate is high.

In the empirical analysis we proxy for the lender's recovery rate with the appraised value of the mortgaged property. A higher appraisal amount likely indicates that the borrower has more assets that can be used by the lender to recover on the deficiency judgment. Additionally, a higher appraisal amount is more likely to be associated with higher income since the ratio of debt to income is a key ratio in the underwriting process. Higher income borrowers who declare bankruptcy also may have less chance to have their debt discharged during a bankruptcy proceeding. This is particularly true for borrowers considering default after the 2005 bankruptcy reform, which requires borrowers above the state median income to file under chapter 13 rather than under chapter 7. This implies that, unlike with poor

borrowers, lenders have better recovery rates with richer borrowers.

Table 6 contains the results on estimating our benchmark specification separately for different values of the appraisal value of the mortgaged property. As the results in table 6 show, recourse does not deter default for all households in the same way. Recourse is a deterrent for default when the appraisal amount exceeds $200,000: the coefficient on the recourse interaction with the default option value and its square are statistically insignificant when the appraisal amount is $200,000 or less. The coefficient on the interaction of the recourse with a linear default option term is particularly large in the samples with appraisal amounts from $300,000 to $500,000, from $500,000 to $750,000, and from $750,000 to $1,000,000. The deterrent effect of recourse increases as the appraisal amount increases up until we reach property values that exceed $1,000,000. For the sample with appraisal amounts of $1,000,000 or higher, the coefficient has the expected sign and is similar in magnitude to our benchmark specification but loses its statistical significance.

The results of the estimation of the probability of default in the samples by appraisal amount indicate that the effect of recourse on the probability of default is mainly driven by the borrowers with mortgages on the properties appraised $200,000 and higher. Thus we reject Hypothesis 3.0 in favor of the alternative that recourse has a substantial deterrent effect on default in case of high recovery rates on the deficiency judgment and does not have a statistically significant effect when the recovery on deficiency judgment is likely to be low.

To gauge the magnitude of the deterrent effect of recourse on the default probabilities, in table 5 we present estimates of the probabilities of default in recourse and non-recourse states. At the mean value of the default option at the time of default and for homes appraised at $300,000 to $500,000, borrowers in non-recourse states are 60% more likely to default than borrowers in recourse states. For homes appraised at $500,000 to $750,000, borrowers in non-recourse states are almost twice as likely to default as borrowers in recourse states. For homes appraised at $750,000 to $1 million, borrowers in non-recourse states are 66% more likely to default than borrowers in recourse states.

Hypothesis 4.—Some lenders may have a reputation for being more likely to pursue deficiency judgments. In this case, the borrower's decision to default has a lower expected payoff. This translates into a lower payoff from defaulting for a borrower with negative home

equity in recourse states when the lender has a reputation of pursuing deficiency judgments relative to when the lender does not have a reputation of pursuing deficiency judgments. We postulate the following hypothesis against the alternative:

Hypothesis 4.0: The effect of recourse on the probability of default does not depend on the type of a lender.

Hypothesis 4.1: The effect of recourse on the probability of default depends on the type of a lender.

Under Hypothesis 4.1 we expect a stronger negative effect of the recourse interaction terms on the probability of default for some types of lenders. Table 7 presents the results from the probit regression estimated separately for loans held by Ginnie Mae (GNMA), loans held by Fannie Mae (FNMA), loans held by Freddie Mac (FHMLC), loans that are privately held and securitized, and loans held in a bank's portfolio.

As can be seen in table 7, the coefficient on the interaction of the recourse dummy with the default option value is negative, sizeable, and statistically significant for privately securitized and private portfolio loans. Table 5 presents estimates of the probabilities for recourse and non-recourse states. At the mean value of the default option at the time of default and for securitized privately held loans, borrowers in non-recourse states are 24% more likely to default than borrowers in recourse states while, for privately held portfolio loans, borrowers in non-recourse states are 31% more likely to default.

The estimation results in table 7 indicate that recourse does not have a significant deterrent effect on default for loans held by GNMA, FNMA or FHMLC. In particular, the coefficient on the interaction between the default option value and the recourse for the GNMA sample is negative but insignificant. The coefficients on the interaction between the default option value and recourse for the FNMA and FHMLC samples are two orders of magnitude smaller than the ones for privately securitized loans and statistically insignificant. This is true even when we consider only FNMA and FHMLC loans on properties appraised at \$200,000 or more, the threshold above which we found recourse matters. We conclude that recourse has a statistically significant deterrent effect on default only for privately held loans.

Discussion.—Our empirical findings shed light on the ongoing discussions on whether

there is strategic default (see, for example, Foote, Gerardi, and Willen [2008]) and whether the default decision depends on the borrower's income. The result that recourse deters default indicates that at least some of the defaults in the data are strategic rather than the borrower having no choice but to default because of liquidity constraints. Our results indicate that at least some borrowers choose not to default when the lender has recourse indicating that they are capable of continuing to make payments on their mortgage.

Additionally, our results on the differential effect of recourse by the appraisal amount of the mortgaged property indicate that at least some defaults on high and moderately priced homes are strategic. We cannot eliminate the possibility that some of the defaults on low priced homes are strategic as the appraisal amount proxies for both the amount of recourse the lender has and the borrower's financial means in general. Thus, recourse may not significantly affect default on low priced homes for one of two reasons. The first possibility is that most households with low priced homes are liquidity constrained, and thus default non-strategically. Alternatively, for households that buy low priced homes, the lender's recovery on a deficiency judgment may be low in practice such that the borrower's payoffs in recourse and non-recourse states are similar.

The finding that recourse has a differential effect on the probability of default depending on the appraisal amount of the mortgaged property also suggests that the default decision depends on the borrower's income in recourse states. This effect works via the expected deficiency judgment that allows the lender to claim a part of the borrower's assets. The fact that the default decision depends on income is relevant for policy discussions of the impact of default on welfare (see Hatchondo, Martinez, and Sanchez [2009]).

B.   The Impact of Recourse on the Way a Borrower Defaults

We next turn to the question of how lender recourse affects the way in which the borrower defaults. We estimate a probit to determine which factors influence whether borrowers are more likely to default by foreclosure. The sample is restricted to the observations for which the default variable takes a value of 1. The dependent variable takes a value of 1 if the default is by a foreclosure and 0 otherwise.

Hypothesis 5.—From table 2, our model suggests that borrowers are less likely to

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default by litigious foreclosure in states with recourse. We are unable to empirically distinguish between friendly foreclosures and contested foreclosures although our model also predicts that we should see more defaults by friendly foreclosure than by contested foreclosure in recourse states. The model also predicts that the effect recourse has on the way a borrower defaults is influenced by how much recourse the lender has as well as the LTV at the time of default. In situations towards the upper right of table 2, the deterrent effect of a deficiency judgment is strong enough to deter default altogether (see table 3) so we expect foreclosures to be strictly decreasing in the amount of negative equity the borrower has in recourse states. To test the model's predictions we test the following hypothesis against the alternative predicted by the model:

Hypothesis 5.0. Recourse does not have an impact on the way the borrower defaults.

Hypothesis 5.1. Recourse reduces the probability of default by foreclosure. Recourse has a stronger negative effect on the probability of default by foreclosure at lower values of the default option.

To test the hypothesis, we first include only a recourse variable dummy as explanatory variable for the probability of default by foreclosure. Column 1 of table 8 contains the results of the estimation. As the results indicate, recourse lowers the probability of default by foreclosure. The estimated coefficient is negative and statistically significant. In particular, the probability of default by foreclosure in recourse states is 9% lower than the probability in non-recourse states.[13] The result carries through if we include additional explanatory variables. In particular, we include the borrower's FICO score at origination and the LTV at origination to control for any unobserved heterogeneity in the borrower's costs of decreased access to credit or search costs in columns $2 - 4$; for the specification in column 4, the probability of default by foreclosure is 11% lower in recourse states than in non-recourse states.

To test whether recourse has a stronger effect for higher values of the default option value, we add the default option value and default option value interacted with recourse dummy in addition to the recourse variable as the explanatory variables for the probability of default by foreclosure. If recourse has a stronger negative effect at higher values of the

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[13]We calculate the partial effects at the mean of continuous variables and at the modes of dummy variables.

default option, we expect a negative coefficient on the interaction term between recourse and the default option value. As can be seen from the results in table 8, the negative effect of recourse on the probability to default by foreclosure is stronger for higher values of the default option.

Our model suggests the time it takes to foreclose on a home has an ambiguous effect on the share of short sales in defaults. On the one hand, a longer foreclosure process makes it more likely the lender will prefer a short sale to a foreclosure and is more likely to forgo a deficiency judgment in favor of a deed in lieu or a short sale. However, the borrower prefers foreclosure when he can delay the search and credit costs and receive a longer period of free rent as a result of a lengthier foreclosure process. A priori, it is unclear what effect foreclosure timing will have on the process. To examine the effect empirically, we include a dummy variable that takes a value of 1 if the uncontested foreclosure time is less than six months, and zero otherwise. As the results in columns 5 and 6 indicate, the foreclosure timing does not have a significant effect on the probability of default by the litigious foreclosure: the partial effect evaluated at the means implies an increase in probability of 1% and is far from statistically significant. The results were very similar when we included foreclosure timing as a continuous variable rather than as a dummy variable.

Default Types for Different Lenders and Appraisal Amounts.—Finally, we examine whether a lender's type and the appraisal amount affects the probability to default by litigious foreclosure. To examine the effect of a lender's type, we include a dummy variable that takes value 1 if a lender type is a GSE and 0 otherwise, i.e., when the investor type is "Private securitized" or "Private portfolio". As can be seen from the results in columns 7 and 8, mortgages held by a GSE are more likely to default by foreclosure than mortgages held by private lenders. This is consistent with our earlier findings that recourse does not have a significant impact on the probability of default for mortgages held by a GSE. In particular, for the specification in column 7 the probability of default by foreclosure increases by 7% for mortgages held by a GSE as compared to the mortgages held by private lenders. However, the effect decreases to 3% when we control for other variables.

To examine the effect of the appraisal amount of the property on the probability of default by foreclosure, we include the appraisal amount and the appraisal amount interacted

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with the recourse dummy as explanatory variables. We present the estimation results in columns 9 and 10 of table 8. The coefficient on the appraisal amount is positive and statistically significant. The effect on the interaction term is negative but statistically insignificant.

VI. Conclusions

Our model predicts that we do not need to actually observe lenders frequently pursuing deficiency judgments to conclude that recourse alters borrowers' behavior. The threat of a deficiency judgment deters would-be strategic defaulters under many combinations of negative equity and the degree of lender's recourse. In other situations, if the borrower does default, allowing lenders to pursue a deficiency judgment changes how borrowers default. In particular, in states that allow lenders recourse, default occurs more frequently by deeds in lieu and short sales as recourse gives lenders a better negotiating position.

Empirically, we find that, at the mean value of the default option at the time of default, the probability of default is 20% higher in non-recourse states than in recourse states. The deterrent effect on default is significant only for borrowers with appraised property values of $200,000 or more. At the mean value of the default option at the time of default and for homes appraised at $300,000 to $500,000, borrowers in non-recourse states are 59% more likely to default than borrowers in recourse states. For homes appraised at $500,000 to $750,000, borrowers in non-recourse states are almost twice as likely to default as borrowers in recourse states while for homes appraised at $750,000 to $1 million, borrowers in non-recourse states are 66% more likely to default. We also find that recourse deters default on loans held privately; we cannot reject the hypothesis that recourse does not have an effect on loans held by the Government Sponsored Enterprises. Finally, we find that allowing lenders recourse increases the likelihood that default occurs by a more lender-friendly method, such as a deed in lieu of foreclosure.

REFERENCES

Ambrose, Brent W., Richard J. Buttimer Jr., and Charles A. Capone. 1997. "Pricing Mortgage Default and Foreclosure Delay." *Journal of Money, Credit, and Banking*, 29(3): 314-25.

Ambrose, Brent W., Charles A. Capone, and Yongheng Deng. 2001. "Optimal Put Exercise: An Empirical Examination of Conditions for Mortgage Foreclosure." *Journal of Real Estate Finance and Economics*, 23(2): 213-34.

Brueggeman, William B. and Jeffrey D. Fisher. 2008. *Real Estate Finance and Investments.* 13th Ed. New York: McGraw-Hill Irwin.

Calhoun, Charles A. 1996. "OFHEO House Price Indexes: HPI Technical Description." Manuscript, OFHEO.

Campbell, John Y., Stefano Giglio, and Parag Pathak. 2009. "Forced Sales and House Prices." NBER Working Paper 14866.

Capozza, Dennis R., Dick Kazarian, and Thomas A. Thomson. 1997. "Mortgage Default in Local Markets." *Real Estate Economics*, 25(4): 631-55.

Case, Karl E. and Robert J. Shiller. 1987. "Prices of Single-Family Homes since 1970: New Indexes for Four Cities." *New England Economic Review*, Sept./Oct.: 45-56.

Clauretie, Terrence M. 1987. "The Impact of Interstate Foreclosure Cost Differences and the Value of Mortgages on Default Rates." *American Real Estate and Urban Economics Association Journal*, 15(3): 152-67.

Clauretie, Terrence M. and Thomas Herzog. 1990. "The Effect of State Foreclosure Laws on Loan Losses: Evidence from the Mortgage Industry." *Journal of Money, Credit, and Banking*, 22(2): 221-33.

Crawford, Gordon W. and Eric Rosenblatt. 1995. "Efficient Mortgage Default Option Exercise: Evidence from Loss Severity." *Journal of Real Estate Research,* 10(5): 543-55.

Davis, Morris A., Andreas Lehnert, and Robert F. Martin. 2008. "The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing." *Review of Income and Wealth*, 54(2): 279-84.

Deng, Yongheng, John M. Quigley, and Robert Van Order. 2000. "Mortgage Terminations, Heterogeneity, and the Exercise of Mortgage Options." *Econometrica*, 68(2): 275-307.

Feldstein, Martin. 2008. "How to Help People Whose Home Values Are Underwater." *Wall Street Journal*, November 18th, A21.

Foote, Christopher L., Kristopher S. Gerardi, Paul S. Willen. 2008. "Negative Equity and Foreclosure: Theory and Evidence." *Journal of Urban Economics*, 64(2): 234-45.

Foote, Christopher L., Kristopher S. Gerardi, Lorenz Goette, and Paul S. Willen. 2009. "Reducing Foreclosures." Working Paper No. 09-2, Federal Reserve Bank of Boston.

Hatchondo, Juan C., Leonardo Martinez, and Juan M. Sanchez. 2009. "Mortgage Defaults and Welfare." Manuscript, Federal Reserve Bank of Richmond.

Jones, Lawrence D. 1993. "Deficiency Judgments and the Exercise of the Default Option in Home Mortgage Loans." *Journal of Law and Economics*, 36(1): 115-38.

Kau, James B., Donald C. Keenan, and Taewon Kim. 1994. "Default Probabilities for Mortgages." *Journal of Urban Economics*, 35(3): 278-296.

Kau, James B., Donald C. Keenan, Walter J. Muller, and James F. Epperson. 1992. "A Generalized Valuation Model for Fixed-Rate Residential Mortgages." *Journal of Money, Credit, and Banking*, 24(3): 279-99.

Larsen, James E. with Bill Carey and Chantal Howell Carey. 2007. *Real Estate*. Hoboken: Wiley.

Ling, David C. and Wayne R. Archer. 2008. *Real Estate Principles: A Value Approach*. 2nd Ed. New York: McGraw-Hill Irwin.

Pence, Karen M. 2006. "Foreclosing on Opportunity: State Laws and Mortgage Credit." *Review of Economics and Statistics*, 88(1): 177-82.

USFN. 2004. *The National Mortgage Servicer's Reference Directory*. USFN: Tustin, CA.

White, Michelle J. 1998. "Why it Pays to File for Bankruptcy: A Critical Look at the Incentives Under US Personal Bankruptcy Law and a Proposal for Change." *The University of Chicago Law Review*, 65(3): 685-732.

Table 1: State Foreclosure Laws

State	Judicial or Non-Judicial Foreclosure	Optimum Timeline*	Recourse Classification	State	Judicial or Non-Judicial Foreclosure	Optimum Timeline*	Recourse Classification
Alabama	NJ	49-74	Recourse	Nebraska	NJ	121	Recourse
Alaska	NJ	108-111	Non-Recourse	Nebraska	J	176	
Arizona	NJ	115	Non-Recourse	Nevada	Nj	116	Recourse
Arkansas	NJ	90	Recourse	New Hampshire	NJ	75	Recourse
California	NJ	120	Non-Recourse	New Jersey	J	295	Recourse
Colorado	NJ	173	Recourse	New Mexico	J	225	Recourse
Connecticut	J, strict	160	Recourse	New York (NYC)	J	445	Recourse
Connecticut	J, by decree of sale	235		New York (Outside NYC)	J	299	
DC	NJ	48	Recourse	New York (Outside NYC)	NJ	355	
Delaware	J	200-300	Recourse	North Carolina Purchase Mortgages	NJ	120	Non-Recourse
Florida	J	150	Recourse	North Carolina Other Mortgages	NJ	120	Recourse
Georgia	NJ	48	Recourse	North Dakota	J	150	Non-Recourse
Hawaii	NJ	195	Recourse	Ohio	J	217	Recourse
Hawaii	J	320		Oklahoma	NJ	201	Recourse
Idaho	NJ	150	Recourse	Oregon	NJ	160	Non-Recourse
Illinois	J	345	Recourse	Pennsylvania	J	300	Recourse
Indiana	J	266	Recourse	Rhode Island	NJ	74	Recourse
Iowa	J	180	Non-Recourse	South Carolina	J	180	Recourse
Kansas	J	230	Recourse	South Dakota	J	340	Recourse
Kentucky	J	198	Recourse	Tennessee	NJ	50-55	Recourse
Louisiana	J, executory process	209	Recourse	Texas	NJ	35-60	Recourse
Louisiana	J, non-executory	269		Texas	J	80-180	
Maine	J	270	Recourse	Utah	NJ	139	Recourse
Maryland	J	46	Recourse	Vermont	J	275	Recourse
Massachusetts	J	75	Recourse	Virginia	NJ	60	Recourse
Michigan	NJ	360**	Recourse	Washington	NJ	140-150	Non-Recourse
Minnesota	NJ	270-280***	Non-Recourse	West Virginia	NJ	120	Recourse
Missouri	NJ	61-65	Recourse	Wisconsin	J	315	Non-Recourse
Montana	NJ	163	Non-Recourse	Wyoming	NJ	180	Recourse
Mississippi	NJ	90	Recourse				

Notes: * These are optimum timelines from The National Mortgage Servicer's Reference Directory, 21st edition (2004). The optimum timelines assume no delays and are based on uncontested foreclosure actions. ** The non-judicial foreclosure optimally takes 60 days; however, after that the redemption period begins to run, typically for 6 months. Estimated time for completion for uncontested foreclosure without eviction action is 12 months. ***The sale in non-judicial foreclosure can generally be held within 90 days; however, there are substantial redemption rights in Minnesota. Thus, including the redemption period the optimum timeframe for non-judicial foreclosure is 270-280 days.

Table 2: Recourse and the Default Method

Initial LTV	Non-recourse	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%
							Recovery Percent								
			Uncontested Default Time = 6 months (Benchmark)												
150%	F	DIL	DIL	SH	SH	SH	SH	F	F	F	F	F	F	F	F
145%	F	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F	F
140%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F
135%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F
130%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	F	F	F	F
125%	F	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	F	F	F
120%	F	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH	SH	F
115%	F	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH	SH
110%	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH
105%	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH
100%	F	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH
			Uncontested Default Time = 3 months												
150%	F	DIL	DIL	SH	SH	SH	SH	F	F	F	F	F	F	F	F
145%	F	DIL	DIL	DIL	SH	SH	SH	F	F	F	F	F	F	F	F
140%	F	DIL	DIL	DIL	SH	SH	SH	SH	F	F	F	F	F	F	F
135%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F
130%	F	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F
125%	F	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	F	F	F	F
120%	F	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	F
115%	F	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH
110%	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH
105%	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH
100%	F	F	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH
			Uncontested Default Time = 12 months												
150%	F	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F	F
145%	F	DIL	DIL	SH	SH	SH	SH	SH	F	F	F	F	F	F	F
140%	F	DIL	DIL	SH	SH	SH	SH	SH	SH	F	F	F	F	F	F
135%	F	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	F	F	F	F	F
130%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	F	F	F	F
125%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH	F	F	F
120%	F	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH	SH	F	F
115%	F	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH	SH
110%	F	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH
105%	F	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH	SH	SH
100%	F	DIL	DIL	DIL	DIL	DIL	DIL	DIL	DIL	SH	SH	SH	SH	SH	SH

Notes: F = contested foreclosure with a deficiency judgment, DIL = deed in lieu or friendly foreclosure without a deficiency judgment, SH = short sale. Initial LTV refers to the LTV at the time of default.

Table 3: Recourse and the Decision to Default

Initial LTV	Recovery Percent														
	Non-recourse	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%
Uncontested Default Time = 6 months (Benchmark)															
150%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
145%	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND
140%	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND	ND
135%	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND	ND	ND
130%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
125%	D	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND
120%	D	D	D	D	D	D	D	D	D	D	D	D	D	D	ND
115%	D	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
110%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
105%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
100%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Uncontested Default Time = 3 months															
150%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
145%	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND
140%	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND	ND
135%	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND	ND	ND
130%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
125%	D	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND
120%	D	D	D	D	D	D	D	D	D	D	D	D	D	D	ND
115%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
110%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
105%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
100%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Uncontested Default Time = 12 months															
150%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
145%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
140%	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND
135%	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND	ND
130%	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND	ND
125%	D	D	D	D	D	D	D	D	D	D	D	D	D	ND	ND
120%	D	D	D	D	D	D	D	D	D	D	D	D	D	D	ND
115%	D	D	D	D	D	D	ND	ND	ND	ND	ND	ND	ND	ND	ND
110%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
105%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
100%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: D = default, ND = no default. Initial LTV refers to the LTV at the time of default.

Table 4: Recourse and the Probability of Default

	(1) No Recourse Dummies	(2) Benchmark	(3) Rates in Interactions	(4) State Dummies	(5) Foreclosure Timing
Default Option	0.61	1.44	1.59	1.43	1.46
	(0.26)	(0.22)	(0.24)	(0.22)	(0.20)
Default Option Squared	-1.22	-2.27	-3.08	-2.15	-2.29
	(0.33)	(0.33)	(0.43)	(0.34)	(0.33)
Default Option * Recourse	-	-1.46	-1.44	-1.62	-1.50
		(0.49)	(0.49)	(0.40)	(0.45)
Default Option Sq. * Recourse	-	1.74	1.41	2.03	1.78
		(0.64)	(0.63)	(0.58)	(0.62)
Rate 1	-0.326	-0.318	-	-0.327	-0.318
	(0.0288)	(0.027)		(0.025)	(0.026)
Rate 2	-0.295	-0.290	-	-0.304	-0.291
	(0.040)	(0.038)		(0.036)	(0.037)
Rate 4	0.302	0.302	-	0.314	0.302
	(0.011)	(0.011)		(0.0089)	(0.011)
Rate 5	0.436	0.440	-	0.456	0.441
	(0.015)	(0.0157)		(0.014)	(0.015)
Default Option * Rate 1	-	-	-3.43	-	-
			(1.14)		
Default Option * Rate 2	-	-	-2.81	-	-
			(0.65)		
Default Option * Rate 4	-	-	0.76	-	-
			(0.06)		
Default Option * Rate 5	-	-	0.92	-	-
			(0.12)		
Divorce Rate	0.026	0.025	0.027	-	0.029
	(0.015)	(0.015)	(0.014)		(0.014)
Lagged Unemp Rate	0.013	0.012	0.020	-0.057	0.010
	(0.018)	(0.020)	(0.019)	(0.013)	(0.016)
Fico Score at Origination	-0.274	-0.275	-0.352	-0.274	-0.275
	(0.015)	(0.016)	(0.022)	(0.016)	(0.016)
Interest Only Dummy	0.214	0.206	0.125	0.206	0.207
	(0.039)	(0.037)	(0.039)	(0.035)	(0.036)
Jumbo Dummy	0.0513	0.0367	-0.0197	0.0237	0.0379
	(0.0297)	(0.0253)	(0.0292)	(0.0116)	(0.0254)
Mortgage Type Dummy	-0.757	-0.781	-1.179	-0.765	-0.782
	(0.071)	(0.084)	(0.086)	(0.085)	(0.084)
ARM Dummy	0.274	0.271	0.339	0.247	0.271
	(0.010)	(0.010)	(0.011)	(0.008)	(0.009)
LTV Ratio at Origination	0.0104	0.0110	0.0130	0.0110	0.0110
	(0.0008)	(0.0012)	(0.0011)	(0.0012)	(0.0011)
Ln Loan Age	0.0847	0.0836	0.0710	0.0950	0.0837
	(0.0053)	(0.0049)	(0.0051)	(0.0072)	(0.0048)
Purpose Type Dummy	-0.0967	-0.0983	-0.1056	-0.1113	-0.0994
	(0.0199)	(0.0207)	(0.0207)	(0.0199)	(0.0204)

Table 4 (Continued) : Recourse and the Probability of Default

	(1) No Recourse Dummies	(2) Benchmark	(3) Rates in Interactions	(4) State Dummies	(5) Foreclosure Timing
Foreclosure Timing	-	-	-	-	0.00378 (0.00758)
Constant	**-2.06** (0.14)	**-2.05** (0.15)	**-1.20** (0.18)	**-1.53** (0.14)	**-2.08** (0.17)
% Defaults	0.0464%	0.0464%	0.0464%	0.0464%	0.0464%
Log ps. likelihood	-283,742	-283,476	-289,682	-280,881	-283,450
Pseudo R-squared	14.9%	15.0%	13.1%	15.8%	15.0%
Number of obs.	82,828,381	82,828,381	82,828,381	82,828,381	82,828,381

Notes: The dependent variable in the probit is a binary variable that takes a value of 1 if the loan defaults in that month, 0 otherwise. Default Option is the probability that the borrower has negative home equity. Recourse is a dummy variable that takes a value of 1 if the property is in a recourse state, 0 otherwise; for North Carolina, recourse takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. The rate variables control for the difference between the current mortgage rate and the contract rate. Mortgage Type Dummy takes a value of 1 if the mortgage is a first mortgage, 0 otherwise. Purpose Type Dummy takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. Standard errors are in parentheses. The coefficients and standard errors for Fico Score at Origination show the effect of a 100 point increase in the FICO score. Standard errors are clustered by state. Coefficients in bold font are significant at the 5% level. % Defaults is the percentage of observations that are defaults. The standard error on Foreclosure Timing when the standard errors are not clustered is 0.00053.

Table 5: Estimated Default Probabilities in Recourse and Non-Recourse States

	At Time of Default	All Loans Value of Default Option		
	At Mean of Default Option	At Mean	At 90th percentile	At 95th percentile
	(1)	(2)	(3)	(4)
	Benchmark Specification			
Default option value	4.02%	1.02%	0.30%	2.12%
Non-Recourse Def. Prob.	0.1191%	0.0083%	0.0079%	0.0088%
Recourse Def. Prob.	0.0988%	0.0078%	0.0078%	0.0078%
Ratio NR/R	121%	106%	102%	113%
	By Appraisal Amount $200,000 to $300,000			
Default option value	3.90%	0.89%	0.23%	1.41%
Non-Recourse Def. Prob.	0.1028%	0.0058%	0.0056%	0.0059%
Recourse Def. Prob.	0.0823%	0.0054%	0.0055%	0.0054%
Ratio NR/R	125%	106%	102%	110%
	$300,000 to $500,000			
Default option value	5.57%	1.26%	0.26%	2.40%
Non-Recourse Def. Prob.	0.1136%	0.0042%	0.0040%	0.0045%
Recourse Def. Prob.	0.0713%	0.0037%	0.0039%	0.0035%
Ratio NR/R	159%	115%	103%	131%
	$500,000 to $750,000			
Default option value	6.20%	1.62%	0.34%	4.25%
Non-Recourse Def. Prob.	0.0887%	0.0036%	0.0034%	0.0042%
Recourse Def. Prob.	0.0461%	0.0029%	0.0032%	0.0024%
Ratio NR/R	192%	125%	105%	175%
	$750,000 to $1,000,000			
Default option value	3.70%	1.21%	0.12%	2.05%
Non-Recourse Def. Prob.	0.0373%	0.0034%	0.0032%	0.0035%
Recourse Def. Prob.	0.0225%	0.0028%	0.0032%	0.0025%
Ratio NR/R	166%	122%	102%	139%
	$1,000,000 <			
Default option value	3.06%	0.93%	0.04%	0.99%
Non-Recourse Def. Prob.	0.0205%	0.0051%	0.0050%	0.0052%
Recourse Def. Prob.	0.0200%	0.0051%	0.0050%	0.0051%
Ratio NR/R	103%	101%	100%	101%
	By Investor Type Private Securitized			
Default option value	3.98%	2.21%	2.40%	11.32%
Non-Recourse Def. Prob.	0.5539%	0.0214%	0.0216%	0.0295%
Recourse Def. Prob.	0.4463%	0.0182%	0.0181%	0.0143%
Ratio NR/R	124%	118%	119%	206%
	Private Portfolio			
Default option value	6.95%	2.24%	1.49%	12.17%
Non-Recourse Def. Prob.	0.0537%	0.0068%	0.0065%	0.0118%
Recourse Def. Prob.	0.0405%	0.0061%	0.0060%	0.0070%
Ratio NR/R	133%	112%	108%	168%

Note: The benchmark specification is specification (2) from table 5. The probabilities are estimated at the modes for dummy variables and means for the variables other than the default option value and default option value squared. In column 1, we estimate the probabilities at the modes of dummy variables and the means of all variables at the time of default for defaulted loans. Ratio is the ratio of the probabilities in non-recourse and recourse states.

Table 6: Recourse and the Probability of Default by Appraisal Amount

	All	< $100,000	$100,000 to $200,000	$200,000 to $300,000	$300,000 to $500,000	$500,000 to $750,000	$750,000 to $1,000,000	> $1,000,000
Default Option	1.44	0.65	0.32	1.41	1.50	1.42	1.19	1.01
	(0.22)	(0.39)	(0.26)	(0.20)	(0.25)	(0.23)	(0.23)	(0.27)
Default Option Squared	-2.27	-1.46	-0.49	-2.14	-2.46	-2.55	-2.11	-1.61
	(0.33)	(0.62)	(0.38)	(0.34)	(0.25)	(0.28)	(0.22)	(0.28)
Default Option * Recourse	-1.46	0.24	-0.01	-1.75	-2.75	-3.30	-3.88	-0.16
	(0.49)	(0.39)	(0.33)	(0.44)	(0.46)	(0.69)	(1.24)	(1.23)
Default Option Sq. * Recourse	1.74	-0.22	-0.45	1.92	3.37	4.52	5.02	-1.98
	(0.64)	(0.69)	(0.39)	(0.57)	(0.57)	(0.88)	(1.39)	(2.68)
Rate 1	-0.318	-0.125	-0.268	-0.279	-0.368	-0.449	-0.250	-0.089
	(0.027)	(0.096)	(0.046)	(0.033)	(0.048)	(0.055)	(0.090)	(0.073)
Rate 2	-0.290	-0.147	-0.232	-0.300	-0.327	-0.463	-0.337	-0.279
	(0.038)	(0.028)	(0.028)	(0.031)	(0.066)	(0.046)	(0.124)	(0.069)
Rate 4	0.302	0.229	0.237	0.298	0.379	0.381	0.525	0.440
	(0.011)	(0.016)	(0.013)	(0.019)	(0.024)	(0.017)	(0.052)	(0.053)
Rate 5	0.440	0.356	0.364	0.455	0.556	0.594	0.713	0.719
	(0.016)	(0.025)	(0.020)	(0.021)	(0.028)	(0.033)	(0.069)	(0.072)
Divorce Rate	0.025	0.018	-0.009	0.031	0.069	0.109	0.065	0.012
	(0.015)	(0.022)	(0.019)	(0.016)	(0.024)	(0.029)	(0.030)	(0.026)
Lagged Unemp Rate	0.012	0.043	0.015	-0.005	-0.014	-0.015	-0.048	-0.029
	(0.020)	(0.021)	(0.022)	(0.015)	(0.013)	(0.022)	(0.030)	(0.027)
Fico Score at Origination	-0.275	-0.218	-0.296	-0.309	-0.295	-0.300	-0.285	-0.296
	(0.016)	(0.020)	(0.015)	(0.012)	(0.015)	(0.025)	(0.020)	(0.029)
Interest Only Dummy	0.206	-0.025	0.160	0.231	0.247	0.246	0.244	0.183
	(0.037)	(0.029)	(0.026)	(0.030)	(0.023)	(0.025)	(0.025)	(0.071)
Mortgage Type Dummy	-0.781	-0.484	-0.746	-0.851	-0.999	-1.080	-0.767	-0.552
	(0.085)	(0.059)	(0.056)	(0.075)	(0.135)	(0.203)	(0.189)	(0.084)
ARM Dummy	0.271	0.266	0.294	0.306	0.272	0.138	0.083	0.021
	(0.010)	(0.014)	(0.017)	(0.020)	(0.013)	(0.020)	(0.032)	(0.062)
LTV Ratio at Origination	0.0110	0.0064	0.0096	0.0117	0.0158	0.0198	0.0156	0.0114
	(0.0012)	(0.0007)	(0.0006)	(0.0009)	(0.0021)	(0.0037)	(0.0031)	(0.0012)
Ln Loan Age	0.0836	0.0339	0.0868	0.1120	0.1278	0.1097	0.0870	0.1073
	(0.0049)	(0.0061)	(0.0062)	(0.0086)	(0.0142)	(0.0226)	(0.0142)	(0.0236)
Purpose Type Dummy	-0.0983	-0.0523	-0.0833	-0.1102	-0.1536	-0.1504	-0.0920	-0.0956
	(0.0207)	(0.0155)	(0.0171)	(0.0201)	(0.0296)	(0.0157)	(0.0385)	(0.0245)
Constant	-2.05	-2.25	-1.75	-1.87	-2.20	-2.37	-2.15	-1.86
	(0.15)	(0.16)	(0.18)	(0.14)	(0.12)	(0.17)	(0.28)	(0.22)
% Defaults	0.046%	0.102%	0.044%	0.035%	0.042%	0.043%	0.027%	0.021%
Log ps. likelihood	-283,476	-58,922.51	-91,326.18	-50,894.29	-53,570.32	-20,252.92	-3,938.02	-2,778.57
Pseudo R-squared	15.0%	11%	14%	16%	18%	18%	16%	13%
Number of obs.	82,828,381	8,231,808	27,580,379	19,146,465	17,840,518	6,567,914	1,858,369	1,602,928

Notes: The dependent variable in the probit is a binary variable that takes a value of 1 if the loan defaults in that month, 0 otherwise. Default Option is the probability that the borrower has negative home equity. Recourse is a dummy variable that takes a value of 1 if the property is in a recourse state, 0 otherwise; for North Carolina, recourse takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. The benchmark specification is specification (2) from table 5. The coefficients and standard errors for Fico Score at Origination show the effect of a 100 point increase in the FICO score. The rate variables control for the difference between the current mortgage rate and the contract rate. Mortgage Type Dummy takes a value of 1 if the mortgage is a first mortgage, 0 otherwise. Purpose Type Dummy takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. % Defaults is the percentage of observations that are defaults. Standard errors are in parentheses. Standard errors are clustered by state. Coefficients in bold font are significant at the 5% level. Appraisal amounts are in 2005 dollars.

Table 7: Recourse and the Probability of Default by Investor Type

	All	GNMA	Fannie Mae (FNMA)		Freddie Mac (FHMLC)		Private Securitized	Private Portfolio
			All	Appraisal >$200,000	All	Appraisal >$200,000		
Default Option	1.44	4.32	1.41	1.97	1.54	1.94	1.27	1.69
	(0.22)	(2.39)	(0.33)	(0.28)	(0.39)	(0.27)	(0.22)	(0.18)
Default Option Squared	-2.27	-13.18	-1.56	-2.39	-2.27	-2.75	-2.34	-2.09
	(0.33)	(9.33)	(0.47)	(0.34)	(0.62)	(0.30)	(0.32)	(0.21)
Default Option * Recourse	-1.46	-1.07	0.07	-0.69	0.11	0.51	-1.98	-1.23
	(0.49)	(2.41)	(0.32)	(0.57)	(0.52)	(0.71)	(0.61)	(0.41)
Default Option Sq. * Recourse	1.74	5.78	-0.69	-0.02	-0.60	-2.19	2.53	1.29
	(0.64)	(9.61)	(0.62)	(0.69)	(0.70)	(1.76)	(0.79)	(0.50)
Rate 1	-0.318	-	-0.128	-0.138	-0.143	-0.211	-0.416	-0.256
	(0.027)		(0.039)	(0.067)	(0.066)	(0.144)	(0.028)	(0.059)
Rate 2	-0.290	-0.206	-0.163	-0.159	-0.142	-0.133	-0.393	-0.298
	(0.038)	(0.063)	(0.020)	(0.021)	(0.027)	(0.038)	(0.039)	(0.053)
Rate 4	0.302	0.073	0.266	0.317	0.275	0.343	0.249	0.348
	(0.011)	(0.090)	(0.019)	(0.020)	(0.0185)	(0.043)	(0.013)	(0.019)
Rate 5	0.440	0.223	0.444	0.501	0.526	0.608	0.326	0.566
	(0.016)	(0.132)	(0.024)	(0.058)	(0.032)	(0.068)	(0.012)	(0.028)
Divorce Rate	0.025	0.064	0.005	0.002	0.012	0.017	0.029	0.044
	(0.015)	(0.032)	(0.023)	(0.016)	(0.020)	(0.017)	(0.017)	(0.019)
Lagged Unemp Rate	0.012	-0.080	0.021	-0.002	0.011	-0.016	0.017	0.011
	(0.020)	(0.029)	(0.026)	(0.025)	(0.022)	(0.024)	(0.018)	(0.022)
Fico Score at Origination	-0.275	-0.138	-0.302	-0.324	-0.270	-0.284	-0.259	-0.179
	(0.016)	(0.038)	(0.014)	(0.011)	(0.017)	(0.018)	(0.010)	(0.028)
Interest Only Dummy	0.206	-	0.195	0.279	0.291	0.363	0.150	0.240
	(0.037)		(0.0645)	(0.067)	(0.076)	(0.085)	(0.037)	(0.042)
Mortgage Type Dummy	-0.781	-	-	-	-	-	-0.850	-0.249
	(0.085)						(0.097)	(0.101)
ARM Dummy	0.271	0.134	0.149	0.173	0.044	0.041	0.240	0.200
	(0.010)	(0.324)	(0.017)	(0.027)	(0.034)	(0.052)	(0.012)	(0.018)
LTV Ratio at Origination	0.0110	0.0026	0.0123	0.0128	0.0103	0.0102	0.0115	0.0086
	(0.0012)	(0.0023)	(0.0009)	(0.0011)	(0.0009)	(0.0011)	(0.0016)	(0.0014)
Ln Loan Age	0.0836	0.1881	0.0827	0.1067	0.1152	0.1198	0.0846	0.1238
	(0.0049)	(0.0385)	(0.0068)	(0.0106)	(0.0076)	(0.0103)	(0.0079)	(0.0078)
Purpose Type Dummy	-0.0983	-0.4019	0.0282	0.0109	0.0751	0.0600	-0.1439	-0.0873
	(0.0207)	(0.211)	(0.0152)	(0.0266)	(0.0244)	(0.0418)	(0.0172)	(0.0158)
% Defaults	0.046%	0.1167%	0.0179%	0.010%	0.0119%	0.0072%	0.1472%	0.0478%
Log ps. likelihood	-283,476	-985	-54,559	-16,861	-23,555	-7,772	-172,033	-28,420
Pseudo R-squared	15.0%	5.1%	10.0%	10.1%	7.9%	8.3%	10.9%	11.4%
Number of obs.	82,828,381	114,351	35,258,604	18,385,916	21,389,732	11,226,747	17,465,885	7,755,789

Notes: The dependent variable in the probit is a binary variable that takes a value of 1 if the loan defaults in that month, 0 otherwise. Default Option is the probability that the borrower has negative home equity. Recourse is a dummy variable that takes a value of 1 if the property is in a recourse state, 0 otherwise; for North Carolina, recourse takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. The benchmark specification is specification (2) from table 5. The coefficients and standard errors for Fico Score at Origination show the effect of a 100 point increase in the FICO score. The rate variables control for the difference between the current mortgage rate and the contract rate. Mortgage Type Dummy takes a value of 1 if the mortgage is a first mortgage, 0 otherwise. Purpose Type Dummy takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. % Defaults is the percentage of observations that are defaults. Standard errors are in parentheses. Standard errors are clustered by state. Coefficients in bold font are significant at the 5% level. All regressions include a constant.

Table 8: Recourse and the Type of Default

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Recourse	-0.347	-0.460	-0.313	-0.449	-0.333	-0.436	-0.383	-0.450	-0.266	-0.371
	(0.119)	(0.142)	(0.105)	(0.133)	(0.090)	(0.118)	(0.116)	(0.121)	(0.136)	(0.125)
Default Option	-	-	0.365	-0.942	-	-0.950	-	-0.899	-	-1.001
			(0.188)	(0.214)		(0.213)		(0.229)		(0.190)
Default Option * Recourse	-	-	-0.80	-1.70	-	-1.68	-	-1.68	-	-1.63
			(0.56)	(0.47)		(0.42)		(0.41)		(0.41)
Fico Score at Origination	-	0.00937	-	0.01596	-	0.014890	-	-0.001760	-	0.001060
		(0.02750)		(0.03280)		(0.035000)		(0.04040)		(0.03230)
LTV Ratio at Origination	-	0.0255	-	0.0285	-	0.0285	-	0.0283	-	0.0287
		(0.0026)		(0.0023)		(0.0024)		(0.0024)		(0.0023)
Foreclosure Timing Dummy	-	-	-	-	0.0469	0.0450	-	0.0674	-	0.0297
					(0.2226)	(0.2555)		(0.2534)		(0.2547)
Investor Type 1	-	-	-	-	-	-	0.263	0.131	-	-
							(0.076)	(0.050)		
Appraisal Amount	-	-	-	-	-	-	-	-	0.0217	0.0341
									(0.0048)	(0.0075)
Appraisal Amount * Recourse	-	-	-	-	-	-	-	-	-0.0241	-0.0107
									(0.0150)	(0.0225)
Constant	1.05	-0.74	1.03	-0.93	1.01	-0.96	1.03	-0.87	0.98	-0.99
	(0.01)	(0.32)	(0.02)	(0.31)	(0.20)	(0.33)	(0.03)	(0.37)	(0.03)	(0.31)
% Foreclosures	79.2%	79.2%	79.2%	79.2%	79.2%	79.2%	79.3%	79.3%	79.2%	79.2%
Log ps. likelihood	-19,437.70	-16,619	-19,420	-16,254	-19,433	-16,251	-19,245	-16,136	-19,431	-16,222
Pseudo R-squared	1.2%	15.5%	1.3%	17.4%	1.2%	17.4%	1.8%	17.7%	1.3%	17.6%
Number of obs.	38,444	38,444	38,444	38,444	38,444	38,444	38,390	38,390	38,444	38,444

Notes: The dependent variable in the probit is a binary variable that takes a value of 1 if default is by foreclosure, 0 otherwise. Default Option is the probability that the borrower has negative home equity. Recourse is a dummy variable that takes a value of 1 if the property is in a recourse state, 0 otherwise. The coefficients and standard errors for Fico Score at Origination show the effect of a 100 point increase in the FICO score. Foreclosure timing dummy is a dummy variable that takes a value of 1 if the uncontested foreclosure time is less than six months, and zero otherwise. Investor type 1 is a dummy variable that takes a value of 1 if the lender type is not "Private Portfolio" or "Private Securitized", 0 otherwise. Appraisal amount is the appraisal amount of the property at origination; coefficients and standard errors shown are for the effect of a $100,000 increase in the appraisal amount. The number of observations in columns 7 and 8 differs from the number of observations in other columns because we exclude observations with investor type "Unknown" for these specifications. In all specifications standard errors are clustered by state the property is located in. Coefficients in bold font are significant at the 5% level. Appraisal amounts are in 2005 dollars.

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A   Foreclosure Laws State by State

Alabama: Lenders may foreclose through either a judicial or a non-judicial procedure. State law permits deficiency judgments without significant restrictions. We classify Alabama as a RECOURSE state. The borrower retains a right of redemption for one year after foreclosure. The relevant statutes are in section 35-10 of the Alabama Code.

Alaska: Lenders may foreclose through either a judicial or a non-judicial procedure. The usual financing instrument is a deed of trust and non-judicial foreclosure is the usual foreclosure process. State law permits deficiency judgments only if the lender pursues judicial foreclosure under the promissory note, no separate "deficiency judgment" is entered. The property sold at a judicial sale is subject to a right of redemption, and the redemption period is 12 months. As judicial foreclosure is substantially more time consuming and cumbersome, we classify Alaska as a NON-RECOURSE state. The relevant statutes are in Title 34, Ch. 20, Section 100 of the Alaska Statutes.

Arizona: Lenders may foreclose through either a judicial or a non-judicial procedure. The usual financing instrument is a deed of trust and non-judicial foreclosure is the usual foreclosure process. Deficiency judgments are not permitted if the property is residential and on 2.5 acres or less and its intended use was for a one-family dwelling or two-family dwelling. We classify Arizona as a NON-RECOURSE state. The relevant statute is Article 33 of the Arizona State Code.

Arkansas: Lenders may foreclose through either a judicial or a non-judicial procedure. Lenders usually foreclose on a deed of trust through a non-judicial procedure. State law permits deficiency judgments with the restriction that borrowers must receive credit for the greater of the foreclosure sales price or the fair market value of the property. We classify Arkansas as a RECOURSE state. The relevant statutes are in sections 18-50-212 and 18-50-216 of the Arkansas Code.

California: Lenders may foreclose through either a judicial or a non-judicial procedure. Non-judicial foreclosure is the usual foreclosure process. The borrower has five days to reinstate in a non-judicial foreclosure process. State law prohibits deficiency judgments on

purchase mortgages. On other residential mortgages, state law permits deficiency judgments only if the lender pursues the more expensive and time-consuming judicial foreclosure process rather than the non-judicial foreclosure process. The lender may only file for a payment of the difference between the debt owed and the fair market value of the property. A deficiency suit also gives the borrower a right to redemption. We classify California as a NON-RECOURSE state. The relevant statutes are in sections 2920-2944.5 of the California Code.

Colorado: Lenders may foreclose through either a judicial or a non-judicial procedure. Non-judicial foreclosure is the norm. State law permits deficiency judgments. However, judges require lenders to bid fair market value on the property in the event that total debt owed exceeds the property value less reasonable expenses; if the borrower can show that lenders bid less than fair market value, the borrower can avoid a deficiency judgment. After the sale there is a redemption period of 75 days. There are no unreasonably burdensome statutory limitations on either filing or collecting on a deficiency or collection. We classify Colorado as a RECOURSE state. The relevant statutes are Title 38, Articles 37-39 of the Colorado Revised Statutes.

Connecticut: Lenders may foreclose only through one of two judicial procedures. The two procedures are a strict foreclosure and a decree of sale foreclosure. State law permits deficiency judgments under both procedures; however, if the lender pursues decree of sale foreclosure the lender must first credit the borrower with one-half the difference between the debt and the appraised value if the property is sold pursuant to a court-order and the property sells for less than the appraised value. In strict foreclosure, the judge determines the fair market value of the property for which the borrower receives credit; a motion for deficiency judgment must be filed within 29 days of title vesting. There is no statutory deadline to file the motion for deficiency judgment after foreclosure-by-sale. We classify Connecticut as a RECOURSE state. The relevant statutes are sections 49-14 and 49-28 of the General Statutes of Connecticut.

Delaware: Lenders may foreclose only through a judicial procedure. State law permits deficiency judgments without significant restrictions. We classify Delaware as a RECOURSE state. The relevant statute is Title 10, Ch. 49:XI of the Delaware Code.

District of Columbia: Lenders may only foreclose through a non-judicial procedure. At any time within thirty days after the time limit for redemption has expired, any party to a mortgage foreclosure may file a motion seeking a deficiency judgment. We classify the District of Columbia as a RECOURSE district. The relevant statute is Title 42, Ch. 8 of the District of Columbia Code.

Florida: Lenders may foreclose only through judicial foreclosure. State law permits deficiency judgments subject to the borrower receiving credit for the greater of fair market value of the property or the foreclosure sale price. A deficiency judgment can be pursued against the original makers of a note even if they were not a party to the foreclosure action. However, Florida has an extremely generous homestead exemption such that if the property is an investment property, rather than a primary residence, the borrower can partially shield his or her assets from collection on the deficiency. We classify Florida as a RECOURSE state. The relevant statutes are Title 40, Ch. 702 of the Florida Statutes.

Georgia: Lenders may foreclose through either a judicial or a non-judicial procedure. Non-judicial foreclosure is the usual process. A prerequisite to a deficiency judgment is that the court has confirmed and approved the sale which in turn requires that the sale price was equal to at least the fair market value of the property. The lender must receive such confirmation and approval within 30 days of the foreclosure sale. There is no right of redemption. We classify Georgia as a RECOURSE state. The relevant statutes are in Title 44, Ch. 14 of the Official Code of Georgia.

Hawaii: Lenders may foreclose through either a judicial or a non-judicial procedure. A judicial foreclosure takes 320 days; non-judicial takes 195 days if uncontested. State law permits deficiency judgments if the lender pursues judicial foreclosure. The deficiency judgment process, if not contested, is fairly inexpensive. We classify Hawaii as a RECOURSE state. The relevant statutes are Ch. 667-5 and Ch. 667-38 of the Hawaii Revised Statutes.

Idaho: Lenders may foreclose through either a judicial or a non-judicial procedure although judicial foreclosure is exceptionally rare. State law permits a deficiency judgment provided one is filed within 90 days of the foreclosure sale. The deficiency is limited to the

difference between the balance owed and the fair market value of the property. The deficiency judgment process is onerous in practice since the lender must prove fair market value and the borrower can contest the fair market value of the property. We classify Idaho as a RECOURSE state. The relevant statutes are in Idaho Statutes, Title 45, Ch. 15, section 45.12.

Illinois: Lenders may foreclose only through judicial foreclosure. State law permits deficiency judgments provided the borrower is personally served with the deficiency suit. Furthermore, a judge must confirm the sale and, according to chapter 735, article XV, section 15-1508, the judge may opt to not confirm the sale on the grounds that "justice was not otherwise done". In practice, this means that is at the discretion of the judge whether to grant a deficiency judgment and judges rarely grant deficiency judgments on residential property. We decided to classify Illinois as a RECOURSE state as the possibility of personal recourse may be sufficient to deter some strategic defaulters even if deficiency judgments are rarely granted. The relevant statutes are in chapter 735, article XV of the Illinois Compiled Statutes.

Indiana: Lenders may foreclose only through judicial foreclosure which optimally takes 266 days if uncontested. State law permits deficiency judgments on residential properties without significant restrictions. The borrower must be served in person which is not a significant restriction in practice. We classify Indiana as a RECOURSE state. The relevant statutes are in Article 29, chapter 7 of the Indiana State code.

Iowa: Lenders may foreclose only through judicial foreclosure. State law permits deficiency judgments on non-agricultural residential properties. However, seeking a deficiency judgment significantly delays the foreclosure process. Furthermore, there is a two year statute of limitations on collecting on the deficiency judgment and generous limits on garnishment of wages. The law makes it much faster to foreclosure on property if the lender waives the right to a deficiency judgment. Because deficiencies are hard to collect in Iowa, lenders may even compensate the borrower who agrees to vacate the property fast by paying the first month of rent on new housing. We classify Iowa as a NON-RECOURSE state. The relevant statute

is Ch. 654.6 of the Iowa code. There was a bill pending that may change the foreclosure laws significantly as of March 2009.

Kansas: Lenders may foreclose only through judicial foreclosure. Following a foreclosure sale, a deficiency judgment is automatically entered if the sale proceeds less expenses are not sufficient to cover the debt owed. The borrower may contest the deficiency if the foreclosure sales price was less than the fair market value of the property. Kansas is unusual as redemption rights can be sold to third parties such that if the lender bids substantially less for the property than its fair market value, the holder of the redemption rights may obtain the property at significantly below market value. Further, second lien holders lose the right to a deficiency if they do not ask for a foreclosure themselves. We classify Kansas as a RECOURSE state. The relevant statute is Ch. 60, 2417 of the Kansas Statutes.

Kentucky: Lenders may foreclose only through judicial foreclosure. Following a foreclosure sale, a deficiency judgment is automatically entered if the sale proceeds less expenses are not sufficient to cover the debt owed. There are no significant restrictions. We classify Kentucky as a RECOURSE state. The relevant statutes are in Ch. 426 of the Kentucky Revised Statutes.

Louisiana: Lenders may foreclose only through judicial foreclosure. State law permits deficiency judgments on residential properties without significant restrictions. We classify Louisiana as a RECOURSE state. The relevant statutes are in Title 10:9-629 of the Louisiana Code.

Maine: Lenders may foreclose only through judicial foreclosure. State law permits deficiency judgments on residential properties provided the lender credits the borrower's account for fair market value of the property. We classify Maine as a RECOURSE state. The relevant statutes are in Title 14, part 4, Ch. 403 of the Revised Maine Statutes.

Maryland: Lenders may foreclose through either a judicial or a non-judicial procedure. State law permits deficiency judgments on residential properties without significant restrictions. We classify Maryland as a RECOURSE state. The relevant statutes are in the Maryland Rules, Title 14, Ch. 200.

Massachusetts: Lenders may foreclose through either a judicial or a non-judicial procedure. State law permits a deficiency judgment provided that the lender gives the borrower notice in writing prior to the foreclosure sale that he or she intends to pursue a deficiency. We classify Massachusetts as a RECOURSE state. The relevant statutes are in Ch. 244 of the General Laws of Massachusetts.

Michigan: Lenders may foreclose through either a judicial or a non-judicial procedure. There is typically a six month redemption period after the completion of a non-judicial foreclosure. State law permits a deficiency judgment without significant restrictions in the case of judicial foreclosure; in the case of non-judicial foreclosure, the borrower can contest the deficiency if the property sold for substantially less than the fair market value of the property. We classify Michigan as a RECOURSE state. Michigan Compiled Laws, Ch. 451; EPIC Act 236, Sections 600 and 700.

Minnesota: Lenders may foreclose through either a judicial or a non-judicial procedure although in the vast majority of cases lenders foreclose through a non-judicial process. There are substantial redemption rights in Minnesota. In particular, the mortgagor is entitled to a six- or twelve-month period after the foreclosure sale. The mortgagor is entitled to possession of the property and the lender has limited right to enter the property. The redemption period can be shortened to 6 months if certain conditions are met. A separate court procedure is required to shorten the redemption period to 5 weeks if the residential property is deemed "abandoned" and of less than 5 units and is on less than 10 acres. Thus, including the redemption period the optimum time-frame for non-judicial foreclosure is 270-280 days. In the event the lender forecloses by advertisement, state law prohibits deficiency judgments. In judicial foreclosure, the lender may obtain a deficiency judgment subject to the borrower receiving credit for the fair market value of the property. The fair market value of the property is determined by a jury. Because judicial foreclosure is substantially more onerous than the non-judicial procedure, lenders pursue non-judicial foreclosure in the vast majority of cases. We classify Minnesota as a NON-RECOURSE state. The relevant statutes are in 580 and 582 of the 2008 Minnesota Statutes and, particularly, 582.2, subdivision 2.

Mississippi: Lenders may foreclose on deeds of trusts or mortgages in default using ei-

ther a judicial or non-judicial foreclosure process. State law permits a deficiency judgment provided the lender files for one within one year of the foreclosure sale date. If a mortgagee participates in foreclosure sale auction, his bid must pass a judicial standard of reasonableness. We classify Mississippi as a RECOURSE state. The relevant statutes are in section 89-1-305 of the Mississippi State Code.

Missouri: Lenders may foreclose through either a judicial or a non-judicial procedure. The state has a statutory right of redemption, but a burden on the borrower is prohibitively heavy and this right can be rarely exercised. In the case of non-judicial foreclosure sale a separate court action must be filed to obtain a deficiency judgment but there are no other significant restrictions on obtaining a deficiency judgment. We classify Missouri as a RECOURSE state. The relevant statutes are in the Missouri Revised Statutes, Chapter 141 sections 400-590.

Montana: Lenders may foreclose through either a judicial or a non-judicial procedure. Deficiency judgments are prohibited on purchase mortgages by title 71, chapter 1-232 of the Montana Code Annotated. Deficiency judgments are permitted on other types of residential mortgages only if the lender pursues judicial foreclosure; however, judicial foreclosure is often impractical because the grantor is entitled to a one year right of redemption. The non-judicial foreclosure process is also substantially less complicated and costly. We classify Montana as a NON-RECOURSE state. The relevant statutes are in title 71, chapter 1 of the Montana Code Annotated.

Nebraska: Lenders may foreclose through either a judicial or a non-judicial procedure. Lenders may obtain a deficiency judgment; however, the borrower must receive credit for the fair market value of the property and the deficiency must be filed for within 90 days of the foreclosure sale by non-judicial foreclosure and within 5 years in case of judicial foreclosure. We classify Nebraska as a RECOURSE state. The relevant statutes are in the Nebraska Revised Statutes Chapter 76-1013.

Nevada: Lenders may foreclose through either a judicial or a non-judicial procedure. Usually properties are foreclosed through a non-judicial procedure. A deficiency judgment

can be obtained; however, the borrower must receive credit for the greater of the fair market value of the property, as determined through a hearing, or the foreclosure sale price. The lender must file for a deficiency judgment with 90 days of the foreclosure sale. We classify Nevada as a RECOURSE state. The relevant statutes are in the Nevada Revised Statutes, chapters 40, 106, and 107.

New Hampshire: Lenders may foreclose through either a judicial or a non-judicial procedure. Almost all properties are foreclosed non-judicially. There are no significant restrictions on deficiency judgments. We classify New Hampshire as a RECOURSE state. The relevant statutes are in Title 38, chapter 479 of the New Hampshire Revised Statutes.

New Jersey: Lenders foreclose through a judicial process. State law permits deficiency judgments but the borrower must be given credit for the fair market value of the property and must be brought within three months of the foreclosure sale. The pursuit of a deficiency judgment extends the redemption period from 10 days to 6 months. We classify New Jersey as a RECOURSE state. The relevant statutes are in the New Jersey Permanent Statutes Title 2A, section 50.

New Mexico: Lenders foreclose on residential properties through a judicial process. Deficiency judgments on mortgages and deeds of trust other than those used to finance low-income housing can be obtained and there are no significant restrictions. We classify New Mexico as a RECOURSE state. The relevant statutes are in Ch. 48, Articles 48-7-1 to 48-7-24 and Articles 48-10-1 to 48-10-21 of the New Mexico Statutes Annotated.

New York: Lenders may foreclose through either a judicial or a non-judicial procedure, although non-judicial foreclosure is exceptionally rare. State law permits a deficiency judgment provided that the lender submits a request for a deficiency judgment within 90 days of filing the foreclosure suit. However, the borrower receives credit for the greater of the foreclosure sale price or the fair market value of the property. The judge usually sides with the borrower regarding the fair market value of the property. A typical deficiency judgment is relatively expensive. We classify New York as a RECOURSE state. The relevant statutes are in Article 13 of the New York State Consolidated Laws.

North Carolina: Lenders may foreclose through either a judicial or a non-judicial process. Ch. 45, Article 2B, section 21.38 of the North Carolina General Statutes prohibits deficiency judgments on purchase mortgages. We classify purchase mortgages in North Carolina as NON-RECOURSE. Deficiency judgments are permitted on other types of residential mortgages but the borrower has the right to contest the deficiency judgment such that he or she receives credit for the fair market value of the property. The deficiency judgment must be filed within 1 year. North Carolina law does not permit garnishment of wages to collect debt. We classify non-purchase mortgages in North Carolina as RECOURSE. The relevant statutes are sections 21.36 and 21.38 of Article 2B in Ch. 45 of the North Carolina General Statutes.

North Dakota: Lenders foreclose through a judicial process. Chapter 32-19-01 of the North Dakota Century Code prohibits deficiency judgments on residential properties. There is a provision for so called deficiency mortgages but the value must be determined by a juror trial and is not pursued in practice. We classify North Dakota as a NON-RECOURSE state.

Ohio: Lenders may foreclose only through judicial foreclosure. If the debt is greater than the foreclosure sales price plus reasonable expenses, a deficiency judgment is automatic. However, lenders have only two years to collect on the deficiency. We classify Ohio as a RECOURSE state. The relevant statutes are in the Ohio Revised Code, section 2329.08.

Oklahoma: Lenders may foreclose through either judicial or non-judicial foreclosure. The optimum time-frame for non-judicial foreclosure is 201 days. Lenders may only receive a deficiency judgment if they pursue non-judicial foreclosure and the borrower must receive credit for the greater of the fair market value or the foreclosure sale price. The lender must file for a deficiency judgment within 90 days of the foreclosure sale. We classify Oklahoma as a RECOURSE state. The relevant statute is Title 12, Chapter 12, section 686 of the Oklahoma Statutes Citationized.

Oregon: Lenders may foreclose through either a judicial or a non-judicial procedure. Lenders can generally not obtain a deficiency judgment on a residential property. We classify Oregon as a NON-RECOURSE state.

Pennsylvania: Lenders foreclose through a judicial procedure. Pennsylvania Law permits the lender to file for a deficiency judgment through a separate suit from the foreclosure but the borrower must receive credit for the fair market value of the property. The deficiency suit must be brought within six months of the foreclosure sale. We classify Pennsylvania as a RECOURSE state. The relevant statute is the Pennsylvania Deficiency Judgment Act, Chapter 81 Section 8103 of the Pennsylvania Consolidated Statutes.

Rhode Island: Lenders may foreclose through either a judicial or a non-judicial procedure. Deficiency judgments can be obtained and there are no significant restrictions. We classify Rhode Island as a RECOURSE state. The relevant statutes are in Ch. 34-27 of the Rhode Island General Laws.

South Carolina: Lenders foreclose through a judicial procedure. State law permits deficiency judgments subject to the restriction that the borrower receive may present a motion to receive credit for the fair market value of the property. In such a circumstance, the borrower, judge, and lender all hire appraisers to determine the fair market value of the property. We classify South Carolina as a RECOURSE state. The relevant statutes are in Title 29, Ch. 3, Article 7 of the South Carolina Code of Laws.

South Dakota: Lenders may foreclose through either a judicial or a non-judicial procedure. State law permits deficiency judgments provided the borrower is credited for the fair market value of the property. We classify South Dakota as a RECOURSE state. The relevant statutes are in ch. 21-47 of the South Dakota Codified Laws.

Tennessee: Lenders may foreclose through either a judicial or a non-judicial procedure although lenders seldom use the judicial foreclosure process. State law permits deficiency judgments without significant restrictions. We classify Tennessee as a RECOURSE state. The relevant statutes for non-judicial foreclosure are Title 21, Ch. 1, Section 803 of the Tennessee Code.

Texas: Lenders may foreclose through either a judicial or a non-judicial procedure. The lender must foreclose on a home equity loan through a judicial foreclosure process, however. State law permits deficiency judgments subject to the borrower receiving credit for the fair

market value of the property. However, Texas has a nearly unlimited homestead exemption such that lenders have less recourse on mortgages backed by investment properties if the borrower's primary residence is also in Texas. We classify Texas as a RECOURSE state. The relevant statutes are in Title 5, Section 51 of Texas Statutes.

Utah: Lenders may foreclose through either a judicial or a non-judicial procedure. State law permits deficiency judgments without significant restrictions. We classify Utah as a RECOURSE state. The relevant statutes are in Title 38, Ch.1-16 and Title 57, Ch. 1 of the Utah Code.

Vermont: Lenders may foreclose through either a judicial or, if the mortgage contains a power of sale clause, a non-judicial procedure. The norm, however, is judicial foreclosure. State law permits deficiency judgments with no significant restrictions. We classify Vermont as a RECOURSE state. The relevant Vermont Statutes are in Title 12, Chapter 163.

Virginia: Lenders may foreclose through either a judicial or non-judicial process. State law permits deficiency judgments with no significant restrictions. We classify Virginia as a RECOURSE state. The relevant statutes are in Title 8.9A Part 6 and Title 55, Ch. 4 of the Code of Virginia.

Washington: Lenders may foreclose through either a judicial or non-judicial process. If the lender wishes to pursue a deficiency judgment, however, it must pursue judicial foreclosure and pursuit of a deficiency judgment triggers a 12 month right of redemption. Furthermore, the judicial foreclosure process is substantially more time-consuming than the non-judicial process. Deficiency judgments can also not be obtained if the property has been abandoned for six months or more which we view as one way a strategic defaulter could evade a deficiency judgment relatively easily. We classify Washington as a NON-RECOURSE state. The relevant statutes are in Title 61, Ch. 61-12 of the Revised Code of Washington.

West Virginia: Lenders may foreclose through either a judicial or non-judicial process. West Virginia permits deficiency judgments without significant restrictions. We classify West Virginia as a RECOURSE state. The relevant statutes are in Articles 1 and 16 of Ch. 38 of the West Virginia Code.

Wisconsin: Lenders foreclose through a non-judicial process. A deficiency judgment must be filed at the time the foreclosure action starts. A waiver of a deficiency judgment may reduce a redemption period of 12 months to 6 months, and a redemption period of 6 months to 3 months. The redemption period depends on a number of characteristics including parcel size. We classify Wisconsin as a NON-RECOURSE state. The relevant statutes can be found in Wisconsin Statutes and Annotations, Ch. 846.

Wyoming: Lenders may foreclose through either a judicial or non-judicial process. The lender generally bids the lesser of the debt owed or the fair market value for the property at a foreclosure sale. State law permits deficiency judgments without significant restrictions. We classify Wyoming as a RECOURSE state. The relevant statutes are in Title 34, Ch. 4 of the Wyoming Statutes.

B   Data Description

A.   Sample Restrictions

We restrict our analysis to mortgages with constant principal and interest, ARMs, or Graduated Payment Mortgages (GPM) (variable INT_TYPE takes values 1, 2, 5, respectively). Also, we restrict the analysis to mortgages taken for purchase or refinance (PURPOSE_TYPE_MCDASH variable takes values 1 = Purchase, 2 = Refinance (Cash out), 3 = Refinance (No cash out), 5 = Refinance (unknown cash). Mortgages for home improvement, debt consolidation, education, medical, or other were dropped. The analysis is limited to first or second mortgages (Variable MORT_TYPE takes values 1 = First mortgage, 2 = Second mortgage, 4 = First mortgage, grade "B" or "C", 5 = Second Mortgage (Home Equity), Grade "B" or "C"). We also drop all observations for loans on properties with more than one unit (Variable is UNITS_NO).

B.   Variable Definitions

Definition of Default.—We consider the loan as defaulted if the loan is terminated in one of the following ways: by REO sale, by short sale, by pay off out of foreclosure, pay off out of bankruptcy and serious delinquency or by liquidation to termination. We do not count

terminations by voluntary pay off, by a loan transfer from a servicer, or by a third party sale as defaults. The default month is determined as the first month the loan that defaulted was reported as being in foreclosure, in REO proceedings or under liquidation, whichever comes first (MBA_STAT variables takes values F, R, L, respectively). In addition, if the loan is terminated by default without loan status reported as any of the three mentioned above, the default month is the month when the loan is reported as paid off. Finally, if TERMI-NATION_TYPE=8, we count the loan as defaulted since the FORECLOSURE_TYPE for these variables is non-zero, indicating that there was a foreclosure although less than 0.1% of loans are terminated in this fashion.

In the analysis of the probability of default the dependent variable takes value 1 if it corresponds to the default month of the loan that defaulted. Thus, all subsequent to default month observations on the defaulted loans are dropped. Consequently, the dependent variable takes value 0 for all months that we observe the defaulted loans prior to the default month and all observations on loans that did not default, whether terminated or current. Observations on current mortgages or mortgages terminated not be default for which the value of the principal balance amount is 0, i.e. the balance is paid off, are dropped.

Default Type.—If a loan goes from being in foreclosure to being an REO loan, we treat that as a foreclosure. That is, we define a foreclosure as any loan for which MBA_STAT=F prior to it being any other MBA_STAT.

Default Option.—For the current principal balance amount we use variable PRIN_BAL_AMT (the balance the borrower owns on the loan); for the cost of a purchase we use variable ORIG_AMT (original loan amount). Loans for which the principal balance amount at the time of default (which is described bellow) is 0 or missing and cannot be imputed from up to two previous months are dropped from the analysis. To calculate k_i we use the loan closing date (CLOSE_DT; as is used by McDash).

The OFHEO provides a quarterly (not seasonally adjusted) measure of the House Price Index by state (http://www.ofheo.gov/hpi_download.aspx). The OFHEO provides A and B in quarters and so we convert months since origination into quarters since origination. We also construct monthly values of $HPI_{i,t}$ by linearly interpolating from the quarterly values attributing the quarterly value to the second month of the quarter.

Prepay Option Variables.— The ongoing contract rate on the mortgage is contained in variable CUR_INIT_RATE. (Variable ARM_INT_RATE contains initial interest rate on the loan; however, it is sparsely populated). The market mortgage rate is a contract rate on the composite of all conventional mortgage loans (fixed- and adjustable-rate) from the Finance Board's Monthly Survey of Rates and Terms on Conventional Single-Family Non-farm Mortgage Loans. The survey collects information on fully amortized conventional mortgage loans used to purchase single-family non-farm homes; mortgage loans insured by the Federal Housing Administration or guaranteed by the Veterans Administration are excluded. Also loans used to refinance houses and non-amortized and balloon loans are excluded. The data are available in Table 17, (see [MIRS page on FHFA site](#) *updated link to revised FHFA site).

Trigger Events.—State divorce rates are available on an annual basis for most years in our sample from the Division of Vital Statistics, National Center for Health Statistics, CDC. The data are available at http://www.cdc.gov/nchs/data/nvss/Divorce%20Rates%2090%2095%20and%2099-07.pdf. We interpolate the values for 1997 and 1998 from the 1995 and 1999 and use the 2007 value for 2008.

Loan Level Characteristics.—

- ln loan age in months from the closing date to the contemporaneous month,

- LTV (LTV_RATIO),

- an indicator variable if the loan was interest only at origination (IO_FLAG),

- an indicator variable if the loan was an option ARM (INT_TYPE),

- an indicator variable if the loan is a jumbo (JUMBO_FLG),

- an indicator variable if the loan is a first mortgage (MORT_TYPE),

- the borrower's FICO score at origination (FICO_ORIG - original FICO score, available from 8/1997).

Table A1: Default Rates by State

State	1997-2008	1997-2004	2005-2008	State	1997-2008	1997-2004	2005-2008
AK	0.78%	0.19%	0.83%	MT	0.72%	0.52%	0.62%
AL	1.68%	0.82%	1.66%	NC	1.18%	0.47%	1.21%
AR	1.19%	0.30%	1.34%	ND	0.33%	0.14%	0.34%
AZ	1.40%	0.27%	1.59%	NE	1.48%	0.54%	1.64%
CA	1.51%	0.07%	1.78%	NH	0.83%	0.16%	0.95%
CO	1.79%	0.39%	2.13%	NJ	0.52%	0.19%	0.53%
CT	0.65%	0.15%	0.73%	NM	0.80%	0.39%	0.79%
DC	0.44%	0.18%	0.44%	NV	2.13%	0.26%	2.42%
DE	0.55%	0.18%	0.57%	NY	0.59%	0.19%	0.60%
FL	1.17%	0.21%	1.28%	OH	2.34%	0.77%	2.48%
GA	2.13%	0.41%	2.43%	OK	1.99%	0.74%	2.02%
HI	0.34%	0.06%	0.35%	OR	0.72%	0.49%	0.63%
IA	1.09%	0.36%	1.21%	PA	0.80%	0.39%	0.77%
ID	0.80%	0.44%	0.77%	RI	1.08%	0.12%	1.30%
IL	1.03%	0.28%	1.12%	SC	1.42%	0.74%	1.35%
IN	2.62%	1.03%	2.68%	SD	0.65%	0.42%	0.60%
KS	1.30%	0.41%	1.39%	TN	2.14%	0.50%	2.40%
KY	1.60%	0.44%	1.74%	TX	1.56%	0.43%	1.65%
LA	1.11%	0.54%	1.09%	UT	1.02%	0.60%	0.97%
MA	0.81%	0.09%	0.98%	VA	0.94%	0.09%	1.10%
MD	0.57%	0.18%	0.60%	VT	0.21%	0.05%	0.22%
ME	0.68%	0.20%	0.74%	WA	0.70%	0.31%	0.68%
MI	3.23%	0.52%	3.67%	WI	0.93%	0.31%	1.11%
MN	1.22%	0.29%	1.52%	WV	1.43%	0.63%	1.41%
MO	1.88%	0.43%	2.11%	WY	0.67%	0.38%	0.65%
MS	2.13%	0.60%	2.31%				

Table A2: Summary Statistics

	Mean	Std. Dev.	5th Percentile	95th Percentile
Recourse	0.67	0.47	0	1
Default Option (Probability of Negative Equity)	0.010	0.063	0	0.0212
Rate 1	0.014	0.118	0	1
Rate 2	0.14	0.35	0	1
Rate 4	0.087	0.281	0	1
Rate 5	0.051	0.221	0	1
Divorce Rate	3.80	0.88	2.6	5.1
Lagged Unemployment Rate	5.1	1.1	3.3	7.1
Fico Score at Origination	721	61	609	798
Interest Only (at Origination) Dummy	0.068	0.253	0	1
Jumbo Dummy	0.090	0.286	0	1
Mortgage Type Dummy	0.97	0.17	1	1
ARM Dummy	0.20	0.40	0	1
LTV Ratio at Origination	65	18	26.4	80
Natural Log of Loan Age	3.06	0.88	1.39	4.20
Purpose Type Dummy	0.63	0.48	0	1
Foreclosure Timing (in months)	6.37	3.28	2	12
Appraisal Amount (at Origination)	309,667	350,761	83,000	750,000
Number of Loans	2,924,160			
Number of Defaults	38,440			

Notes: Recourse is a dummy variable that takes a value of 1 if the property is in a recourse state, 0 otherwise; for North Carolina, recourse takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. The rate variables control for the difference between the current mortgage rate and the contract rate. Mortgage Type Dummy takes a value of 1 if the mortgage is a first mortgage, 0 otherwise. Purpose Type Dummy takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise.