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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.

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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.

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.[1] 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 lack 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, decides whether to default. In the subgame perfect equilibrium of the model, lenders rarely

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

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.

We investigate the effect of recourse on default empirically using a large sample of residential mortgages from the Lender Processing Services Inc. (LPS) Applied Analytics database. Our empirical findings are as follows. First, 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). Second, the magnitude of the deterrent effect of recourse on default varies with the appraised value of the mortgaged property at origination. The effect is significant only for higher-appraised properties. In particular, we find that, for properties appraised at less than $200,000 (at origination, in real 2005 terms), 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 $500,000 to $750,000, borrowers in non-recourse states are more than twice as likely to default as borrowers in recourse states. 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 government sponsored enterprises (GSEs). Third, 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 involuntary, whereby borrowers have 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 a rich dataset from Massachusetts, 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. Guiso, Sapienza, and Zingales (2009) and Bhutta, Dokko, and

Shan (2010) also find that at least some portion of default is not due to liquidity constraints.

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.[2] 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 due to 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 recourse varies across the U.S. 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.

[2]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.

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 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. In states that permit deficiency judgments, various restrictions often apply. Usually, the lender must credit the borrower's account for the 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 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 period in which the lender can file. In some states, substantial personal property or wages are exempt from collection on the deficiency. 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 of 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 usually 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.[3]

Our classification of states is similar to that of the USFN (America's Mortgage Banking Attorneys). The states we classify as non-recourse are the same as those for which the USFN (2004, pp. 5-5 - 5-7) indicates 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.

[3] Appendix A describes the foreclosure and deficiency judgment procedures in the U.S. states. We use the foreclosure timelines from the National Mortgage Servicer's Reference Directory (2004) published by the USFN (America's Mortgage Banking Attorneys).

B. Types of Default

In this paper, we use the term default to refer to a default that ends with the borrower vacating the home. In practice, lenders usually view litigiously foreclosing as a last resort in the event the borrower defaults and will often try to recover a portion of principal through other means before resorting to foreclosure.[4] Furthermore, lenders have a strong interest in foreclosing quickly on the property even when the lender does choose to exercise the option to foreclose.[5]

Lenders prefer to avoid foreclosures, 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 may 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 lender-friendly 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 to 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 agrees to give the lender a lump sum payment in addition to the sale proceedings.

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 may affect a borrower's future access to credit less severely

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

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

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, on the borrower's 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 foreclosure does.

Finally, a borrower may simply agree to what is known as a "friendly foreclosure". In a friendly foreclosure, the borrower agrees to not contest the foreclosure and to 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 standard foreclosure (Brueggeman and Fisher [2008]). A friendly foreclosure may be preferable to the lender as it cuts off any subordinate interests that may exist on 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 usually agrees to waive his or her right to a deficiency judgment.

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 Decisions

In this section, we present a static model to study the effect of recourse on default. In the model, default refers to a situation that ends in the borrower vacating the home. The model predicts that allowing lenders recourse changes both default rates and the method of default even if lenders seldom actually pursue deficiency judgments in equilibrium.

A. The Economic Environment

The borrower makes two decisions regarding default: whether to default on the mortgage and how to default if she defaults. The borrower's decision of whether to default on the mortgage depends on the costs of default which, in turn, depend on whether the lender will pursue a deficiency. Default can happen through a litigious foreclosure or a lender-friendly default. A lender-friendly default is a termination method that results in the lender getting the property back more quickly and in better condition, which we view as being akin to a friendly foreclosure, a deed in lieu of foreclosure, or a short sale. We combine lender-friendly default outcomes into one event in the model for simplicity and because the lender and borrower have similar incentives in both situations. The central issue is whether the borrower cooperates with the lender or contests the foreclosure, not the precise method of mortgage termination. Herein, we refer to that outcome as a lender-friendly default. In the event of a foreclosure, the lender has the opportunity to seek a deficiency judgment.

We assume that 1) the lender can get the property back more quickly if the borrower agrees to default through a lender-friendly method; 2) the borrower receives free rent during the default period; 3) the lender agrees to waive a deficiency judgment if the borrower defaults through a lender-friendly method; 4) at the foreclosure sale, the lender recovers less than the fair market value of the property; 5) the lender recovers a greater fraction of the fair market value if the default is lender-friendly; 6) if the lender sues for a deficiency, the borrower receives credit for the fair market value of the home; 7) the lender must pay a fixed cost to pursue a deficiency judgment; and 8) the borrower must pay a fixed cost to default.

Assumption (2) follows Ambrose, Buttimer, and Capone (1997). Assumption (4) 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 (6) 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. The fixed cost in assumption (8) refers to the search costs, transactions costs, and the cost of being excluded from credit markets that the borrower must face if she

defaults.

In the model, we assume the lender will not agree to a loan modification. This assumption stems from empirical evidence that loan modifications are rare prior to the end of our sample (December 2008). For example, Adelino, Gerardi, and Willen (2009) find that only 3% of seriously delinquent loans receive payment-reducing modifications; see also White (2009) for evidence on the infrequency of modifications. See Adelino, Gerardi, and Willen (2009) and Piskorski, Seru, and Vig (2009) for discussions of why residential mortgage modifications are rare during our sample period.

B. The Model

Consider a borrower with a home worth H and a balance owed on her mortgage of M, $H < M$, i.e., the borrower has negative equity. The borrower decides whether to terminate her mortgage or whether to continue making payments. The mortgage can be terminated in one of three ways: 1) the borrower and lender agree to a lender-friendly default (LFD), 2) the borrower and lender agree to a foreclosure and the lender does not seek a deficiency judgment (F), or 3) the lender forecloses with a deficiency judgment (FDJ). If the lender pursues a deficiency judgment, he cannot recover his collateral for τ periods. τ is exogenous to the model and determined by states' foreclosure laws.

The lender's payoffs from each of these possibilities are as follows. The payoff from no default, X_{ND}, is

$$X_{ND} = M,$$

where M is the unpaid mortgage balance. The lender's payoff from a lender-friendly default, X_{LFD}, is

$$X_{LFD} = \mu^{LFD} H,$$

where H is the value of the home at the time the borrower announces he will default and μ^{LFD} is the recovery rate in the event of a lender-friendly default, $0 < \mu^{LFD} < 1$.

The lender's payoff from a foreclosure with no deficiency judgement, X_F, is

$$X_F = \left(\frac{1}{1+r}\right)^{\tau} \mu^F H,$$

where μ^F is the lender's recovery rate in the event of a foreclosure, $0 < \mu^F < \mu^{LFD} < 1$, and r is the discount rate. The lender's payoff from a foreclosure with a deficiency judgement, X_{FDJ}:

$$X_{FDJ} = \left(\frac{1}{1+r}\right)^{\tau} \left(\mu^F H + \phi\left[M - H + c_{DJ}\right] - c_{DJ}\right),$$

where ϕ is the recovery rate, i.e., the fraction of the expected present value the lender collects on the deficiency, and c_{DJ} is a fixed cost the lender must pay to pursue a deficiency judgment. The lender can recover a portion ϕ of c_{DJ} from the borrower.

The borrower receives free rent h (a fraction of the home value akin to the rent-price ratio) in any period in which she is in default but has not been foreclosed upon. Once the borrower either agrees to a lender-friendly default or gets foreclosed upon, she must pay the default cost. If the borrower defaults, she incurs a fixed cost c_D.

The borrower's payoffs are thus as follows. The payoff in case of no default, Y_{ND}, is

$$Y_{ND} = H - M.$$

The borrower's payoff from a lender-friendly default, Y_{LFD}, is

$$Y_{LFD} = -c_D.$$

The borrower's payoff from a foreclosure with no deficiency judgement, Y_F, is

$$Y_F = \sum_{k=0}^{\tau} \left(\frac{1}{1+r}\right)^{k} hH - \left(\frac{1}{1+r}\right)^{\tau} c_D.$$

and the borrower's payoff from a foreclosure with deficiency judgement, Y_{FDJ}, is

$$Y_{FDJ} = \sum_{k=0}^{\tau} \left(\frac{1}{1+r}\right)^{k} hH - \left(\frac{1}{1+r}\right)^{\tau} \left[\phi\left(M - H + c_{DJ}\right) + c_D\right].$$

C. Model Solution

Figure 1 illustrates the sequential problem the lender and the borrower solve. The borrower and the lender choose the strategy that delivers the highest payoff. The game has

a unique pure strategy equilibrium; we do not consider mixed strategy equilibria.

The model can be solved recursively. The borrower solves the lender's problem and ascertains, conditional on default, whether the lender will pursue a deficiency judgment and whether the lender will accept a lender-friendly default. After comparing the payoffs, the borrower makes her decisions regarding how to default and whether to default.

In a non-recourse situation, the option of default through a foreclosure with deficiency judgement is eliminated from both the lender's and the borrower's payoff set. In this situation, the solution to the game is simple: the borrower always defaults through a foreclosure. The reason is that the borrower gets a higher payoff from being foreclosed upon since she enjoys free rent during the foreclosure period.[6]

If the lender has the legal right to pursue recourse, and then either the borrower or the lender opts for foreclosure, the lender decides whether to pursue a deficiency judgment. Conditional on foreclosing, the lender will pursue a deficiency judgement if $X_{FDJ} > X_F$, i.e., if

$$\frac{\phi}{1-\phi}\left(\frac{M}{H}-1\right)-\frac{c_{DJ}}{H}>0. \tag{1}$$

That is, the lender will foreclose with a deficiency judgment if the value of the deficiency exceeds the recoverable portion of the fixed costs of pursuing the judgment. In the extreme cases where there is full recovery or the cost of pursuing a deficiency is zero, the lender always pursues a deficiency judgment if the lender forecloses. At the other extreme, the lender never pursues a deficiency judgment if $\phi = 0$. In general, the lender is more likely to pursue a deficiency judgment when the expected recovery is high, when the current loan to value is much greater than 1, and when the cost of pursuing a deficiency judgment is small relative to the value of the home.

If (1) does not hold, introducing recourse does not change the equilibrium outcome. In this case, any threat on the part of the lender to pursue a deficiency is not credible. The solution is the same as in a non-recourse situation, i.e. the borrower defaults via foreclosure. Thus, recourse will not change the equilibrium outcome when either the recovery rate is very

[6]The borrower will, in fact, enjoy free rent during any period between default and an LFD as well. The difference the model captures is thus the difference in the length of the period of free rent.

low or the cost of pursuing a deficiency is high relative to the value of the property.

If (1) holds, the lender agrees to a lender-friendly default only if $X_{LFD} > X_{FDJ}$, i.e., if

$$\frac{\mu^{LFD} - (1+r)^{-\tau}\mu^{F}}{1-\phi} > \left(\frac{1}{1+r}\right)^{\tau}\left\{\frac{\phi}{1-\phi}\left(\frac{M}{H}-1\right) - \frac{c_{DJ}}{H}\right\}. \tag{2}$$

That is, the lender agrees to a lender-friendly foreclosure if the discount on the home from foreclosure relative to that from a lender-friendly method is larger than the present value of the deficiency recovered less the costs of pursuing the deficiency relative to the home value that cannot be recovered. Clearly, the lender will always agree to a lender-friendly default if the lender would not pursue a deficiency on a foreclosure.

Thus, there are three possible ways that introducing recourse can change the equilibrium from the non-recourse equilibrium: 1) recourse deters default; 2) recourse results in a deficiency judgment; 3) recourse induces a lender-friendly foreclosure. Recourse deters default when the following two conditions are met: 1) the lender will not agree to a lender-friendly default, i.e., if condition (2) does not hold, and 2) the borrower's payoff from not defaulting exceeds the payoff from a foreclosure with deficiency judgement, i.e.,

$$1 - \frac{M}{H} > \sum_{k=0}^{\tau}\left(\frac{1}{1+r}\right)^{k} h + \left(\frac{1}{1+r}\right)^{\tau}\left[\phi\left(1 - \frac{M}{H} - \frac{c_{DJ}}{H}\right) - \frac{c_D}{H}\right]. \tag{3}$$

For the lender to pursue a deficiency judgment, the present value of what the lender will recover from pursuing a deficiency net of costs must exceed the higher value of the collateral the lender recovers by agreeing to a lender-friendly default. If this is the case, the borrower will only default if she does not have so much negative equity that the value of not defaulting is higher than the free rents she receives less what she will have to pay back the lender from the deficiency judgment.

Examining conditions (2) and (3) also shows when the deficiency judgments are actually observed in equilibrium. If the loan-to-value is very high and ϕ is moderate, the borrower still benefits more from paying some of the deficiency back than from not defaulting, particularly since she also receives free rent during the foreclosure period.

The conditions under which recourse deters default also depend on how much delay

pursuing a deficiency introduces into the foreclosure process. From examining (2), it is clear that the lender is more likely to agree to a lender-friendly default when pursuing a deficiency would substantially delay the default process. Similarly, the deterrent effect of recourse decreases with the length of time it takes to foreclose because 1) the period of free of rent increases, and 2) the deficiency and fixed cost of default the borrower eventually has to pay are discounted more heavily.

The second way that recourse changes the equilibrium outcome occurs when the recovery on the deficiency is sufficiently high that (1) holds, but is sufficiently low that (2) also holds. In this situation, the lender pursues a deficiency in the event of a foreclosure. For the borrower to still default in this situation, it must also be the case that

$$-\frac{c_D}{H} > 1 - \frac{M}{H}$$

and

$$\frac{-c_D}{H} > \sum_{k=0}^{\tau} \left(\frac{1}{1+r}\right)^k h + \left(\frac{1}{1+r}\right)^{\tau} \left[\phi\left(1 - \frac{M}{H} - \frac{c_{DJ}}{H}\right) - \frac{c_D}{H}\right].$$

The first condition states that the fixed cost of default must be sufficiently low relative to the amount of negative equity. The second condition states that the present value of the deficiency that the borrower must repay the lender must be larger than the value to the borrower of the period of free rent and of delaying the payment of the fixed cost of default. Thus, for even moderate values of ϕ, introducing recourse is likely to lead to a more lender-friendly method of default.

D. Discussion

To summarize, our model suggests that the presence of recourse will often change the equilibrium outcome even if it does not often result in deficiency judgments. The model predicts that recourse will likely deter default when the expected recovery rate is high or when the cost of pursuing a deficiency is small relative to the value of the home. The model also implies that, even for moderate recovery rates, borrowers will default differently, in ways that lead to lower losses for lenders, in states that allow lenders recourse. This prediction of the model 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 how the borrower chooses to default both in the case of voluntary defaulters (borrowers who can continue to make payments on their mortgage if they choose to) and involuntary defaulters (borrowers who are insolvent and unable to make payments). In our model, any borrower who is insolvent defaults such that recourse does not deter involuntary default. In the case of involuntary defaulters, lenders still can recover some portion of any deficiency in most states since the lender typically has ten years to collect on a deficiency and can file for a ten-year extension on that recovery, ample time to see an improvement in a borrower's financial circumstances.

Our model is static in the sense that we examine the equilibrium default decisions conditional upon a borrower already being in a situation where she has negative equity. We also do not consider how future house price expectations might affect equilibrium outcomes. Studying a static problem enables us to model the borrower's and lender's incentives in more detail as well as to study how default occurs. The results in Corbae and Quintin (2010) suggest that the deterrent effect of recourse on default continues to hold in a dynamic setting. Corbae and Quintin present a dynamic general equilibrium life cycle model in which they find that recourse substantially reduces the foreclosure rate. Corbae and Quintin also find that introducing recourse changes the home ownership rate and the cost of mortgage credit.

In the remainder of the paper, we empirically examine how large a deterrent recourse is to default in practice and whether defaults occur more frequently via lender-friendly methods when state laws 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. The data contain information on prime and non-prime private securitized loans, portfolio loans, and GSE loans. Appendix B

provides details about the variables by LPS codes.

A. Variable Definitions

Definition of Default.—We consider the loan as defaulted if it is terminated in one of the following ways: by REO sale, by short sale, by payoff out of foreclosure, by payoff 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 for observations in months prior to default for defaulted loans and for all observations on loans that do not default.

Default Type.—In the analysis of whether recourse changes how default happens, we consider only defaulted loans. We divide defaults into default by foreclosure and by a lender-friendly method, i.e., a short sale or a deed in lieu. We define a default as lender-friendly if the loan passes directly to an REO loan or a short sale. We define a default as a foreclosure if the lender received a payoff out of bankruptcy or serious delinquency. Such a default is akin to a contested foreclosure process since the borrower likely declared bankruptcy to halt foreclosure proceedings. The default type variable takes 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 that 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 i's 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 the market value of the property purchased at time $t - k_i$, and L_{i,t,k_i} is the 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 the cost of the property at the time of a purchase, $HPI_{i,t}$ is house price index in the state where the property associated with mortgage 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).[7]

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 individual house prices in the state in which the property associated with mortgage i is located.

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

Prepay Option Variables.—As a proxy for the 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 to complete an 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 our

[7]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:

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

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

benchmark recourse classification of states and the foreclosure timelines. We classify North Carolina purchase mortgages as non-recourse and other mortgages on property located in North Carolina as recourse.

Trigger Events.—We control for trigger events by including the contemporaneous state divorce rate and the state unemployment rate. We use lagged monthly seasonally unadjusted unemployment rates from the BLS.[8]

Loan Level Variables and Borrower Characteristics.—Additional variables that we use in the empirical analysis are the age of the loan (in months), 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 adjustable rate mortgage (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 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.

Since a mortgage with an 80% LTV at origination may indicate a higher likelihood of a second mortgage being present, we include a dummy variable that takes on a value of 1 if the LTV is exactly equal to 80%. We also include interactions of this variable with the default option value and its square since, if an LTV of 80% makes it more likely the property has a second mortgage, the default option value is in fact higher for these mortgages such that it may have a stronger effect on the probability of default. See Foote, Gerardi, Goette, and Willen (2009) for empirical evidence that an LTV of exactly 80% increases the risk of default.

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 restrict our analysis to first mortgages with constant principal and interest, ARMs, or Graduated Payment Mortgages (GPMs) on single-family residences, townhouses, or condos. We drop all

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

FHA and VA loans because deficiency judgments are prohibited on FHA loans and strongly discouraged on VA loans (Larsen, Carey, and Carey [2007]). We also drop loans with private mortgage insurance.

We then draw a 10% random sample from the LPS database. Our restrictions imply that we have 85,888,286 loan-month observations. Table 2 provides a summary of the sample: 67% of our observations are on recourse mortgages 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 20% of our observations are adjustable rate mortgages. In total, our sample includes $2,922,196$ loans and $43,353$ defaults.

V. The Impact of Recourse on Default

We use a probit as our benchmark model to study the effect of recourse on whether a borrower defaults. We assume that the borrower defaults if an unobserved variable x, $x = X\beta + \varepsilon$, falls below 0 where $\varepsilon \sim N(0,1)$. 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 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 indicator 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 3 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 purchase 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.

Column 2 of table 3 contains the main result of the paper. The coefficient on the interaction term between recourse and negative equity is negative and statistically significant. The coefficient on the interaction between recourse and the square of the probability of negative equity is positive and statistically significant. The negative coefficient on the default option value indicates that recourse decreases the impact of the negative equity on the probability of default. The positive coefficient on the squared 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.

The coefficient on the interaction between the default option value and the dummy for an LTV of exactly 80% is significant and positive, suggesting that properties on mortgages with an LTV of exactly 80% are more likely to have second mortgages attached to them and that first mortgages are thus more sensitive to negative equity. It is important that we include this term to ensure that our results are not driven by the fact that there may be more second mortgages in non-recourse states than in recourse states.[9]

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 4 contains the estimates of the probabilities. Columns 1 to 4 show the probabilities at the means of the continuous variables and the modes of the dummy variables. At the mean of the default option at the time of default, borrowers in non-recourse states are 32% more likely to default than borrowers in recourse states. At the mean of the default option for all observations, 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 for all observations, the probability of default in non-recourse states is 2% higher. This difference increases to 13%

[9] All our results are similar when we do not include the LTV80 variable and its interactions.

at the 95th percentile. The results in table 4 indicate that recourse has a deterrent effect on default at high values of the default option value, which are precisely the values associated with default. Thus, the data allow us to reject the hypothesis that recourse has no effect on default.

In columns 3 and 4 of table 3, we present the results for two alternative specifications. In column 3, we include the prepay option, 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 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.[10] 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, negative, and slightly larger in magnitude than 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.

A. Default and State Foreclosure Timelines

In column 5 of table 3, we show the effect of the lengthiness of the uncontested foreclosure process, as stated in USFN (2004), on the probability of default. In column 5 we include the length of the uncontested 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 by state. We also do not find that the lengthiness of the foreclosure process significantly affects default in other specifications in which we include the interaction of the foreclosure timeframe with recourse. While our model predicts that a lengthier foreclosure process will increase the default rate in a few cases, the empirical

[10] We drop the divorce rate in this specification as our divorce rate data are only available at the annual frequency. Also, for some states, we only have a few divorce rate observations over the entire sample such that there is little variation remaining in the divorce rate after we control for state-specific effects.

evidence in column 5 suggests those cases are infrequent in practice. We obtain similar results with a specification in which we include 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. Thus, we cannot reject the hypothesis that the lengthiness of the foreclosure process has no effect on the probability of default.

B. A Finer Recourse Classification

In our benchmark specification, we define mortgages as being either recourse or non-recourse. Our benchmark classification (see table 1) defines a mortgage as non-recourse if deficiency judgments are either explicitly prohibited or impractical in the vast majority of cases. We also consider a finer classification of non-recourse. In this specification, we categorize a mortgage as being non-recourse if it is *de jure* non-recourse and a mortgage as being subject to limited recourse if the mortgage is *de facto* non-recourse. We define California and Montana non-purchase mortgages as well as mortgages on property in Alaska, Iowa, Minnesota, Washington state, and Wisconsin as *de facto* non-recourse. We define mortgages on property in Arizona, North Dakota, and Oregon, as well as purchase mortgages in California, Montana, and North Carolina, as *de jure* non-recourse.

In column 6 of table 3, we present the results from the specification in which we use the finer recourse classification: recourse (same mortgages as in the benchmark specification), *de facto* non-recourse, and *de jure* non-recourse. The omitted category is *de jure* non-recourse while limited recourse is a dummy variable that takes a value of 1 if the mortgage is *de facto* non-recourse and 0 otherwise. The coefficient on recourse remains significantly negative and is slightly larger in magnitude than in our benchmark specification. The coefficient on limited recourse is significantly negative but much smaller in magnitude than the coefficient on recourse. Thus, while default is less likely if the mortgage is *de facto* non-recourse than if it is explicitly non-recourse, default is more likely if the mortgage is *de facto* non-recourse than if it is recourse.

C. Robustness

In table 5, we conduct several additional robustness exercises. First, we repeat our analysis using only data on mortgages originated from 2005 onwards. There is some concern that the data is of higher quality from 2005 onwards. Furthermore, a very large servicer enters the database in 2005. Column 1 presents the results from our benchmark specification but using only data on originations from 2005 to the end of our sample. Column 2 presents the results using our specification that includes state fixed effects using only data on originations from 2005 to the end of our sample. The results are consistent with those we found using our benchmark specification.

Columns 3 to 5 of table 5 contain the additional results from the full sample. Column 3 contains the results from a specification in which we include year of origination dummies. The coefficient on the interaction between the default option value and recourse is similar to that of our benchmark specification in column 2 of table 3. With 2003 as the omitted category, the coefficients on origination years from 1998 to 2001 are negative and statistically significant while the coefficients on 2004, 2005, and 2006 are positive and statistically significant. These results provide some evidence that, controlling for a set of variables used in our benchmark specification, the mortgages originated in the later years of the sample, particularly from 2004 to 2006, have a higher probability of default than the mortgages originated earlier.

In columns 4 and 5 of table 5, we present proportional competing hazard models (see, for example, Deng, Quigley, and Van Order, 2000). In our benchmark specification, we use a probit model and control for time-dependence with the time elapsed from loan origination. Thus, our benchmark specification provides an estimate of the probability of the loan defaulting in any particular month. Alternatively, we can estimate the hazard model of the risk of default.

Generally, a mortgage can be terminated by default or prepayment such that a mortgage is subject to two competing hazards. Column 4 contains the results (for default) from fitting models for each termination type separately and treating failures due to a competing type of termination as censored data. The hazard ratio on the interaction between recourse and the default option is below 1 and highly significant, indicating that recourse reduces the

sensitivity of default to negative equity as we found using our benchmark specification.

We also estimate the two hazard functions jointly. In estimating them jointly, we assume that the two competing hazard functions are additive. Consequently, the hazard of failure by any termination type is a sum of the two competing processes. The observed time of failure is the minimum time of failure of the two competing processes. Thus, at the time of failure two survival times are observed: one for a process that corresponds to the failure type and another one, censored, for the competing process.

We use a proportional hazard model with grouped duration data. To estimate the competing hazards of default and prepayment, we duplicate the data using the method in Lunn and McNeal (1995). The duplicated data set contains twice as many observations as the original one with each new observation showing a censored observation for a competing termination type. The censored observations are also duplicated, creating two censored observations – one for each failure type. We then define a variable that identifies two strata – one for prepayment and one for default. The failure indicator then reflects failures from a type of termination corresponding to the respective stratum. We estimate the semi-parametric Cox model including, in addition to our benchmark covariates, a strata indicator as a covariate, as well as interactions of the strata indicator with all covariates. Inclusion of the strata indicator as a covariate assumes proportional baseline hazards for the two competing types of termination while allowing the effect of covariates on the hazard to differ.

Column 5 presents the results for default from the joint estimation of the competing hazards model. The results from estimating competing hazards jointly are similar to those obtained from estimating the hazards separately. The hazard ratio on the interaction between recourse and the default option is below 1 and highly statistically significant.

D. Results by Appraisal Amount

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 our empirical analysis, we proxy for the lender's recovery rate with the appraised value of the mortgaged property. A higher appraised value 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 bankruptcy proceedings. This is particularly true for borrowers considering default after the 2005 bankruptcy reform, which usually 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. In fact, data from the Survey of Consumer Finance indicate that there is a positive relationship between the median value of the primary residence and financial (non-housing) wealth.[11]

Table 6 contains the results on estimating our benchmark specification separately for different values of the appraised value (real 2005 dollars) of the mortgaged property at origination. 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 and from $500,000 to $750,000. For the sample with appraisal amounts of $1,000,000 or higher, the coefficient changes sign and is not statistically significant.

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 borrowers with mortgages on properties appraised at $200,000 and higher. To the extent that the appraisal amount at origination proxies for the recovery rate on a deficiency judgment, these results indicate that recourse has a substantial deterrent effect on default in cases with higher recovery rates**.** Recourse does not have a statistically significant effect when the recovery on a deficiency judgment is likely to be low.

To gauge the magnitude of the deterrent effect of recourse on the default probabilities, we present estimates of the probabilities of default in recourse and non-recourse states in

[11] In 2007, households in the lowest quintile of financial (non-housing) wealth held homes worth $81,946 on average while households in the second, third, fourth, and fifth quintiles of non-housing wealth held homes worth on average $118,367, $154,788, $191,208, and $318,681, respectively (in real 2004 dollars).

table 4. 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 81% more likely to default than borrowers in recourse states. For homes appraised at $500,000 to $750,000, borrowers in non-recourse states are more than 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 60% more likely to default than borrowers in recourse states.

Importantly, the size of the deficiency judgment relative to the lender's fixed cost of filing for a deficiency is likely to be lower for low-value properties than for high-value properties. This lowers the incentive for a lender to file for a deficiency judgment for low-value properties. If the recovery rate is 100%, costs do not matter because they are recoverable. However, if the recovery rate is less than 100%, the effect of allowing the lender recourse depends on the cost of pursuing the deficiency judgment as well as the recovery rate; the effect of costs decreases as the recovery rate increases. As a result, the finding that recourse does not have a deterrent effect on default for low-value properties is consistent with costs being an important determinant of the effect of allowing lenders recourse.

E. Recourse and Lender Types

Table 7 presents the results from the probit regression estimated separately for 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 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 4 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 45% more likely to default than borrowers in recourse states while, for privately held portfolio loans, borrowers in non-recourse states are 44% more likely to default.[12]

[12] We also estimate our benchmark specification on FHA and VA loans. Since these loans are explicitly non-recourse in all states, we should not find a significant negative coefficient on the interaction between recourse and the default option value. We find that the coefficient on the interaction between recourse and the default option value is positive, albeit small, for FHA and VA loans.

The estimation results in table 7 indicate that recourse does not have a significant deterrent effect on default for loans held by FNMA or FHMLC. The coefficients on the interaction between the default option value and recourse for the FNMA and FHMLC samples are much smaller in magnitude than the ones for privately securitized loans and are statistically insignificant. This is true even when we consider only FNMA and FHMLC loans on properties appraised at $200,000 or more (in real 2005 dollars), 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.

F. 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 (i.e., default occurs through a deed in lieu or a short sale).

Our model suggests that borrowers are less likely to 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. To test the hypothesis that recourse influences how the borrower defaults, we include a recourse variable dummy as explanatory variable for the probability of default by foreclosure. As controls, we include the borrower's FICO score at origination and the LTV at origination to control for unobserved heterogeneity in the borrower's costs of decreased access to credit or search costs. 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 10% lower than the probability in non-recourse states.[13]

The model also predicts that the effect recourse has on the way a borrower defaults

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

is influenced by how much recourse the lender has as well as the LTV at the time of default. However, the relationships are nonlinear. For high LTVs and high recovery rates, the deterrent effect of a deficiency judgment is strong enough to deter default altogether. For high LTVs and more moderate recovery rates, it is sometimes worthwhile for the lender to pursue a deficiency judgment and yet for the borrower to default. For moderate LTVs and low-to-moderate recovery rates, recourse changes how the borrower defaults rather than whether the borrower defaults.

To test whether recourse has a stronger effect for higher values of the default option value, we add the default option value and the default option value interacted with the 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 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 column 2 of table 8, the negative effect of recourse on the probability to default by foreclosure is stronger for higher values of the default option. However, the effect is not statistically significant.

Our model suggests that the time it takes to foreclose on a home has an ambiguous effect on the share of lender-friendly defaults. On the one hand, a longer foreclosure process makes it more likely the lender will prefer a lender-friendly default to a foreclosure and will forgo a deficiency judgment in favor of a deed in lieu or a short sale. However, the borrower prefers foreclosure when she 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 column 3 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 2% 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.

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 a value of 1 if the lender is a GSE and 0 otherwise, i.e., when the loan is privately securitized or held in a private lender's portfolio. As can be seen from the results in column 4, mortgages held by a GSE are no more likely to default by foreclosure than mortgages held by private lenders.

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 with the recourse dummy as explanatory variables. We present the estimation results in column 5 of table 8. The coefficient on the appraisal amount is positive and marginally significant. The effect on the interaction term is negative but statistically insignificant.

G. Discussion

Our empirical findings shed light on the ongoing discussions about 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 involuntary, whereby the borrower has 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.

Our results regarding 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 lender's amount of recourse 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 because of their inability to carry payments. Alternatively, for low-value properties, the lender's recovery on a deficiency judgment may be low in practice both because of a low recovery rate and a relatively higher fixed cost.

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]).

VI. Conclusions

Our model predicts that we do not need to 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 recourse. In other situations, if the borrower does default, then allowing the lender to pursue a deficiency judgment changes how the borrower defaults. In particular, in states that allow lenders recourse, default occurs more frequently by deeds in lieu and short sales, as recourse gives lenders better negotiating positions.

Empirically, we find that, in a sample of loans originated between August 1997 and December 2008**,** at the mean value of the default option at the time of default, the probability of default is 32% 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 origination. 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 81% more likely to default than borrowers in recourse states. For homes appraised at $500,000 to $750,000, borrowers in non-recourse states are more than 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 60% 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.

Our findings pose a number of interesting questions. For example, what are the implications of recourse laws for welfare? Furthermore, to what extent do lenders take into account the higher risk of default in non-recourse states at the time of mortgage origination? We

leave these questions for future research.

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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	
Connecticut	J, by decree of sale	235		New York (Outside NYC)	J	299	Recourse
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: 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	0.021
Rate 1	0.015	0.121	0	0
Rate 2	0.153	0.360	0	1
Rate 4	0.080	0.271	0	1
Rate 5	0.033	0.177	0	0
Divorce Rate	3.82	0.87	2.60	5.10
Lagged Unemployment Rate	5.07	1.14	3.30	7.00
Fico Score at Origination	723	61	611	799
Interest Only (at Origination) Dummy	0.067	0.250	0	1
Jumbo Dummy	0.090	0.287	0	1
ARM Dummy	0.196	0.397	0	1
LTV Ratio at Origination	67	16	33	80
Natural Log of Loan Age	3.09	0.87	1.39	4.22
Purpose Type Dummy	0.649	0.477	0	1
Foreclosure Timing (in months)	6.30	3.25	2	12
LTV 80 Dummy	0.14	0.35	0	1
Appraisal Amount (at Origination)	308,043	303,093	82,000	750,000
Number of Loans	2,922,196			
Number of Defaults	43,353			

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. Purpose Type Dummy takes a value of 1 if the loan is not a purchase mortgage, 0 otherwise. LTV80 Dummy takes a value of 1 if the loan-to-value at origination is 80%.

Table 3: Recourse and the Probability of Default

	(1) No Recourse Dummies	(2) Benchmark	(3) Rates in Interactions	(4) State Dummies	(5) Foreclosure Timing	(6) Finer Recourse Classification
Default Option	**1.06** (0.25)	**1.97** (0.19)	**1.97** (0.22)	**1.99** (0.20)	**1.98** (0.17)	**2.32** (0.21)
Default Option Squared	**-1.18** (0.22)	**-2.22** (0.21)	**-2.81** (0.27)	**-2.17** (0.21)	**-2.23** (0.20)	**-2.83** (0.27)
Default Option * Recourse	-	**-1.52** (0.35)	**-1.51** (0.35)	**-1.65** (0.30)	**-1.55** (0.31)	**-1.86** (0.36)
Default Option Sq. * Recourse	-	**1.57** (0.43)	**1.33** (0.47)	**1.82** (0.37)	**1.60** (0.40)	**2.17** (0.46)
Default Opt. * Limited Recourse						**-0.68** (0.20)
Default Opt. Sq. * Limited Recourse						**1.19** (0.24)
LTV80	**0.13** (0.02)	**0.13** (0.02)	**0.12** (0.02)	**0.13** (0.02)	**0.13** (0.02)	**0.13** (0.02)
LTV80 * Default Option	**0.98** (0.30)	**0.57** (0.19)	**0.87** (0.20)	**0.58** (0.14)	**0.57** (0.19)	**0.53** (0.19)
LTV80 * Default Option Sq.	**-1.81** (0.50)	**-1.40** (0.30)	**-1.74** (0.30)	**-1.31** (0.26)	**-1.40** (0.30)	**-1.35** (0.30)
Rate 1	**-0.359** (0.027)	**-0.350** (0.025)	-	**-0.359** (0.024)	**-0.350** (0.025)	**-0.350** (0.025)
Rate 2	**-0.311** (0.035)	**-0.306** (0.033)	-	**-0.317** (0.032)	**-0.306** (0.033)	-0.306 (0.033)
Rate 4	**0.326** (0.011)	**0.327** (0.011)	-	**0.337** (0.008)	**0.328** (0.010)	**0.327** (0.010)
Rate 5	**0.444** (0.014)	**0.451** (0.015)	-	**0.465** (0.013)	**0.451** (0.014)	**0.451** (0.015)
Default Option * Rate 1	-	-	**-2.418** (1.121)	-	-	-
Default Option * Rate 2	-	-	**-2.210** (0.492)	-	-	-
Default Option * Rate 4	-	-	**0.796** (0.053)	-	-	-
Default Option * Rate 5	-	-	**0.906** (0.093)	-	-	-
Divorce Rate	0.023 (0.014)	0.023 (0.014)	0.024 0.013	-	0.025 (0.014)	0.022 (0.015)
Lagged Unemp Rate	0.008 (0.018)	0.007 (0.020)	0.015 (0.019)	**-0.054** (0.015)	0.006 (0.017)	0.007 (0.021)
Fico Score at Origination	**-0.263** (0.014)	**-0.264** (0.015)	**-0.348** (0.021)	**-0.264** (0.015)	**-0.264** (0.015)	**-0.264** (0.015)
Interest Only Dummy	**0.195** (0.023)	**0.187** (0.022)	**0.111** (0.023)	**0.187** (0.021)	**0.188** (0.021)	**0.186** (0.022)
Jumbo Dummy	**0.046** (0.020)	0.027 (0.017)	-0.019 (0.018)	0.021 (0.014)	0.028 (0.017)	0.027 (0.017)
ARM Dummy	**0.313** (0.014)	**0.310** (0.012)	**0.375** (0.008)	**0.289** (0.009)	**0.310** (0.012)	**0.310** (0.012)

Table 3 (Continued) : Recourse and the Probability of Default

	(1) No Recourse Dummies	(2) Benchmark	(3) Rates in Interactions	(4) State Dummies	(5) Foreclosure Timing	(6) Finer Recourse Classification
LTV Ratio at Origination	**0.009** (0.001)	**0.010** (0.001)	**0.013** (0.001)	**0.010** (0.001)	**0.010** (0.001)	**0.010** (0.001)
Ln Loan Age	**0.078** (0.005)	**0.077** (0.005)	**0.065** (0.006)	**0.087** (0.007)	**0.078** (0.005)	**0.077** (0.005)
Purpose Type Dummy	**-0.097** (0.020)	**-0.099** (0.021)	**-0.099** (0.021)	**-0.113** (0.020)	**-0.099** (0.021)	**-0.096** (0.021)
Foreclosure Timing	-	-	-	-	0.003 (0.007)	-
Constant	**-2.75** (0.13)	**-2.78** (0.13)	**-2.35** (0.17)	**-2.28** (0.12)	**-2.80** (0.16)	**-2.78** (0.13)
% Defaults	0.050%	0.050%	0.050%	0.050%	0.050%	0.050%
Log ps. likelihood	-311,161	-310,662	-318,205	-308,237	-310,649	-310,621
Pseudo R-squared	16.46%	16.59%	14.57%	17.24%	16.59%	16.60%
Number of obs.	85,888,286	85,888,286	85,888,286	85,888,286	85,888,286	85,888,286

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. LTV80 takes a value of 1 if the loan has an LTV of exactly 80%, 0 otherwise. The rate variables control for the difference between the current mortgage rate and the contract rate. 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.

Table 4: Estimated Default Probabilities in Recourse and Non-Recourse States

	At Time of Default	**All Loans**		
		Value of Default Option		
	At Mean of Default	At Mean	At 90th percentile	At 95th percentile
	(1)	(2)	(3)	(4)
		Benchmark Specification		
Default option value	6.08%	1.00%	0.29%	2.07%
Non-Recourse Def. Prob.	0.1801%	0.0088%	0.0083%	0.0095%
Recourse Def. Prob.	0.1361%	0.0083%	0.0082%	0.0084%
Ratio NR/R	132%	106%	102%	113%
		By Appraisal Amount (Real, 2005$)		
		$200,000 to $300,000		
Default option value	6.09%	0.84%	0.23%	1.28%
Non-Recourse Def. Prob.	0.1750%	0.0069%	0.0066%	0.0072%
Recourse Def. Prob.	0.1263%	0.0065%	0.0065%	0.0066%
Ratio NR/R	139%	106%	102%	109%
		$300,000 to $500,000		
Default option value	8.84%	1.14%	0.24%	2.01%
Non-Recourse Def. Prob.	0.2141%	0.0048%	0.0045%	0.0052%
Recourse Def. Prob.	0.1185%	0.0044%	0.0044%	0.0044%
Ratio NR/R	181%	111%	102%	120%
		$500,000 to $750,000		
Default option value	10.12%	1.57%	0.32%	4.00%
Non-Recourse Def. Prob.	0.1721%	0.0043%	0.0039%	0.0053%
Recourse Def. Prob.	0.0756%	0.0036%	0.0037%	0.0034%
Ratio NR/R	228%	120%	104%	156%
		$750,000 to $1,000,000		
Default option value	8.54%	1.30%	0.17%	2.55%
Non-Recourse Def. Prob.	0.0818%	0.0039%	0.0035%	0.0043%
Recourse Def. Prob.	0.0512%	0.0036%	0.0035%	0.0037%
Ratio NR/R	160%	109%	101%	119%
		By Investor Type		
		Private Securitized		
Default option value	6.41%	2.21%	2.47%	11.40%
Non-Recourse Def. Prob.	0.3306%	0.0231%	0.0235%	0.0413%
Recourse Def. Prob.	0.2283%	0.0196%	0.0196%	0.0196%
Ratio NR/R	145%	118%	120%	210%
		Private Portfolio		
Default option value	10.16%	2.55%	2.80%	15.37%
Non-Recourse Def. Prob.	0.0807%	0.0211%	0.0215%	0.0448%
Recourse Def. Prob.	0.0558%	0.0189%	0.0191%	0.0257%
Ratio NR/R	144%	111%	113%	174%

Note: The benchmark specification is specification (2) from table 3. 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 5: Robustness

	2005-2008 Sample		Full Sample		
	(1)	(2)	(3)	(4)	(5)
	Coefficients		Coefficients	Hazard Ratios	
	Benchmark	State Dummies	Year of Origination Dummies	Competing Hazards, Separate Est.	Competing Hazards, Joint Est.
Default Option	**1.53**	**1.27**	**1.47**	**1.057**	**1.060**
	(0.20)	(0.10)	(0.19)	(0.002)	(0.003)
Default Option Squared	**-1.84**	**-1.46**	**-1.80**	**0.999**	**0.999**
	(0.18)	(0.12)	(0.18)	(0.000)	(0.000)
Default Option * Recourse	**-1.94**	**-1.53**	**-1.60**	**0.958**	**0.958**
	(0.43)	(0.29)	(0.36)	(0.002)	(0.003)
Default Option Sq. * Recourse	**2.18**	**1.79**	**1.70**	**1.000**	**1.000**
	(0.48)	(0.34)	(0.43)	(0.000)	(0.000)
LTV80	**0.16**	**0.14**	**0.12**	**1.562**	**1.571**
	(0.02)	(0.02)	(0.02)	(0.020)	(0.030)
LTV80 * Default Option	0.12	0.08	0.42	**1.014**	**1.008**
	(0.19)	(0.14)	(0.23)	(0.003)	(0.004)
LTV80 * Default Option Sq.	**-0.75**	-0.47	**-1.11**	**1.000**	**1.000**
	(0.31)	(0.25)	(0.36)	(0.000)	(0.000)
Rate 1	-0.040	-0.016	**-0.285**	**0.279**	**0.274**
	(0.05)	(0.05)	(0.03)	(0.023)	(0.035)
Rate 2	**-0.402**	**-0.426**	**-0.275**	**0.324**	**0.302**
	(0.035)	(0.034)	(0.02)	(0.010)	(0.016)
Rate 4	**0.333**	**0.338**	**0.321**	**2.857**	**2.985**
	(0.012)	(0.011)	(0.01)	(0.040)	(0.066)
Rate 5	**0.430**	**0.460**	**0.425**	**3.877**	**4.103**
	(0.012)	(0.013)	(0.01)	(0.070)	(0.118)
Divorce Rate	**0.060**	-	**0.031**	**1.071**	**1.069**
	(0.022)		(0.015)	(0.006)	(0.010)
Lagged Unemp Rate	-0.005	**-0.115**	0.016	**1.100**	**1.079**
	(0.021)	(0.008)	(0.019)	(0.005)	(0.008)
Fico Score at Origination	**-0.260**	**-0.267**	**-0.274**	**0.992**	**0.993**
	(0.016)	(0.018)	(0.013)	(0.000)	(0.000)
Interest Only Dummy	**0.136**	**0.131**	**0.145**	**1.802**	**1.794**
	(0.020)	(0.018)	(0.015)	(0.027)	(0.042)
Jumbo Dummy	**0.070**	0.013	0.031	**1.074**	**1.084**
	(0.018)	(0.030)	(0.017)	(0.017)	(0.026)
ARM Dummy	**0.277**	**0.216**	**0.260**	**2.840**	**2.881**
	(0.012)	(0.018)	(0.008)	(0.039)	(0.062)

Table 5 (Continued) : Robustness

	2005-2008 Sample		Full Sample		
	(1)	(2)	(3)	(4)	(5)
	Coefficients		Coefficients	Hazard Ratios	
	Benchmark	State Dummies	Year of Origination Dummies	Competing Hazards, Separate Est.	Competing Hazards, Joint Est.
LTV Ratio at Origination	**0.011**	**0.011**	**0.010**	**1.035**	**1.032**
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Ln Loan Age	**0.161**	**0.217**	**0.135**	**0.224**	**0.130**
	(0.020)	(0.026)	(0.020)	(0.004)	(0.001)
Purpose Type Dummy	**-0.154**	**-0.173**	**-0.097**	**0.602**	**0.698**
	(0.017)	(0.019)	(0.021)	(0.007)	(0.012)
Constant	**-3.09**	**-2.14**	**-3.07**	-	-
	(0.17)	(0.12)	(0.14)		
% Defaults	0.105%	0.105%	0.050%		
Log ps. likelihood	-180,901	-178,135	-308,656	-559,643	-12,033,972
Pseudo R-squared	15.0%	16.3%	17.1%		
Number of obs.	25,828,688	25,828,688	85,888,286	85,888,286	68,559,958

Notes: The dependent variable in the probit (columns 1-3) 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. LTV80 takes a value of 1 if the loan has an LTV of exactly 80%. The rate variables control for the difference between the current mortgage rate and the contract rate. 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. Columns 4 and 5 present hazard ratios from the estimated proportional hazard semiparametric models; standard errors are clustered by loan. The results in column 4 are from hazard functions for grouped data estimated separately, treating the competing hazard as censored. The results in column 5 are from the joint estimation of competing hazard functions for grouped data. Standard errors are clustered by state for the probit models. Coefficients in bold font are significant at the 5% level. % Defaults is the % of observations that are defaults.

Table 6: Recourse and the Probability of Default by Appraisal Amount (Real, 2005 $)

	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	**1.97**	**0.99**	**1.22**	**2.18**	**2.27**	**2.25**	**2.24**	**1.71**
	(0.19)	(0.34)	(0.36)	(0.20)	(0.23)	(0.20)	(0.22)	(0.33)
Default Option Squared	**-2.22**	**-1.79**	**-1.14**	**-2.45**	**-2.55**	**-2.86**	**-2.49**	**-2.22**
	(0.21)	(0.61)	(0.44)	(0.25)	(0.25)	(0.27)	(0.29)	(0.40)
Default Option * Recourse	**-1.52**	0.18	-0.61	**-1.76**	**-2.28**	**-2.81**	**-1.67**	1.26
	(0.35)	(0.36)	(0.39)	(0.30)	(0.36)	(0.44)	(0.82)	(1.16)
Default Option Sq. * Recourse	**1.57**	-0.20	0.31	**1.95**	**2.44**	**3.66**	1.22	**-5.30**
	(0.43)	(0.76)	(0.48)	(0.34)	(0.44)	(0.60)	(1.23)	(2.65)
LTV80	**0.13**	**0.05**	**0.08**	**0.13**	**0.19**	**0.21**	**0.20**	0.06
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)
LTV80 * Default Option	**0.57**	**2.64**	**0.86**	0.75	0.29	**-0.56**	**-1.02**	-0.04
	(0.19)	(0.92)	(0.39)	(0.45)	(0.21)	(0.12)	(0.21)	(0.23)
LTV80 * Default Option Sq.	**-1.40**	**-16.11**	**-2.44**	-1.59	**-1.14**	**0.39**	0.85	-0.14
	(0.30)	(5.08)	(0.66)	(0.97)	(0.32)	(0.20)	(0.28)	(0.33)
Rate 1	**-0.350**	**-0.200**	**-0.274**	**-0.325**	**-0.354**	**-0.547**	**-0.353**	**-0.203**
	(0.025)	(0.098)	(0.049)	(0.036)	(0.046)	(0.069)	(0.080)	(0.066)
Rate 2	**-0.306**	**-0.182**	**-0.227**	**-0.314**	**-0.325**	**-0.487**	**-0.371**	**-0.282**
	(0.033)	(0.031)	(0.023)	(0.037)	(0.048)	(0.043)	(0.090)	(0.052)
Rate 4	**0.327**	**0.233**	**0.259**	**0.321**	**0.387**	**0.399**	**0.515**	**0.471**
	(0.011)	(0.016)	(0.014)	(0.018)	(0.024)	(0.014)	(0.056)	(0.030)
Rate 5	**0.451**	**0.364**	**0.372**	**0.468**	**0.519**	**0.604**	**0.696**	**0.699**
	(0.015)	(0.025)	(0.021)	(0.019)	(0.025)	(0.031)	(0.068)	(0.050)
Divorce Rate	0.023	0.017	-0.015	0.025	**0.067**	**0.104**	**0.061**	0.019
	(0.014)	(0.024)	(0.018)	(0.016)	(0.021)	(0.025)	(0.027)	(0.032)
Lagged Unemp Rate	0.007	**0.046**	0.017	-0.012	-0.024	-0.026	-0.040	-0.022
	(0.020)	(0.021)	(0.020)	(0.018)	(0.016)	(0.020)	(0.025)	(0.024)
Fico Score at Origination	**-0.264**	**-0.206**	**-0.279**	**-0.291**	**-0.291**	**-0.292**	**-0.266**	**-0.280**
	(0.015)	(0.020)	(0.013)	(0.012)	(0.018)	(0.026)	(0.021)	(0.026)
Interest Only Dummy	**0.187**	0.010	**0.146**	**0.206**	**0.202**	**0.231**	**0.209**	**0.175**
	(0.022)	(0.035)	(0.023)	(0.018)	(0.011)	(0.017)	(0.029)	(0.051)
ARM Dummy	**0.313**	**0.291**	**0.325**	**0.344**	**0.330**	**0.206**	**0.195**	**0.102**
	(0.014)	(0.014)	(0.015)	(0.018)	(0.019)	(0.016)	(0.033)	(0.041)
LTV Ratio at Origination	**0.009**	**0.006**	**0.009**	**0.009**	**0.013**	**0.015**	**0.012**	**0.013**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)
Ln Loan Age	**0.078**	**0.039**	**0.080**	**0.096**	**0.106**	**0.101**	**0.069**	**0.076**
	(0.005)	(0.005)	(0.005)	(0.009)	(0.014)	(0.019)	(0.019)	(0.020)
Purpose Type Dummy	**-0.097**	**-0.050**	**-0.084**	**-0.108**	**-0.154**	**-0.145**	**-0.086**	-0.043
	(0.020)	(0.016)	(0.016)	(0.022)	(0.031)	(0.023)	(0.023)	(0.027)
% Defaults	0.050%	0.115%	0.048%	0.039%	0.046%	0.050%	0.034%	0.027%
Log ps. likelihood	-311,161	-55,730	-96,082	-57,104	-63,350	-26,487	-5,866	-4,121
Pseudo R-sq	16.46%	11.52%	14.62%	17.72%	20.45%	20.36%	18.29%	14.55%
Number of obs.	85,888,286	7,076,266	26,973,983	20,004,481	19,840,252	7,675,467	2,370,213	1,947,624

Notes: The dependent variable in the probit is a binary variable that equals 1 if the loan defaults in that month, 0 otherwise. The benchmark specification is specification (2) from table 3. Default Option is the probability that the borrower has negative home equity. LTV80 takes a value of 1 if the loan has an LTV of exactly 80%, 0 otherwise. The rate variables control for the difference between the current mortgage rate and the contract rate.The results for Fico Score at Origination show the effect of a 100 point increase. 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 (clustered by state) in parentheses. All regressions include a constant.

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

	All	Fannie Mae (FNMA)		Freddie Mac (FHMLC)		Private Securitized	Private Portfolio
		All	Appraisal >$200,000	All	Appraisal >$200,000		
Default Option	**1.97**	**1.65**	**2.14**	**1.99**	**2.16**	**2.10**	**1.90**
	(0.19)	(0.25)	(0.23)	(0.27)	(0.21)	(0.18)	(0.18)
Default Option Squared	**-2.22**	**-1.59**	**-2.36**	**-2.38**	**-2.56**	**-2.56**	**-1.71**
	(0.21)	(0.33)	(0.27)	(0.31)	(0.31)	(0.21)	(0.17)
Default Option * Recourse	**-1.52**	-0.10	-0.82	-0.16	0.07	**-2.08**	**-1.15**
	(0.35)	(0.34)	(0.46)	(0.37)	(0.33)	(0.41)	(0.31)
Default Option Sq. * Recourse	**1.57**	-0.26	1.00	-0.33	-0.85	**2.29**	**1.07**
	(0.43)	(0.50)	(0.58)	(0.50)	(0.87)	(0.51)	(0.37)
LTV80	**0.13**	**0.05**	**0.06**	**0.07**	**0.10**	**0.15**	**0.17**
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)
LTV80 * Default Option	**0.57**	**0.71**	**0.59**	**0.85**	**0.79**	0.27	**0.39**
	(0.19)	(0.29)	(0.17)	(0.18)	(0.20)	(0.23)	(0.19)
LTV80 * Default Option Sq.	**-1.40**	**-1.67**	**-1.29**	**-1.83**	**-1.59**	**-0.97**	**-1.19**
	(0.30)	(0.27)	(0.25)	(0.47)	(0.49)	(0.38)	(0.37)
Rate 1	**-0.350**	**-0.121**	**-0.122**	**-0.165**	**-0.237**	**-0.448**	**-0.270**
	(0.025)	(0.038)	(0.050)	(0.073)	(0.110)	(0.031)	(0.059)
Rate 2	**-0.306**	**-0.166**	**-0.157**	**-0.144**	**-0.153**	**-0.414**	**-0.308**
	(0.033)	(0.019)	(0.021)	(0.023)	(0.035)	(0.033)	(0.041)
Rate 4	**0.327**	**0.259**	**0.296**	**0.244**	**0.285**	**0.285**	**0.397**
	(0.011)	(0.018)	(0.021)	(0.018)	(0.039)	(0.012)	(0.015)
Rate 5	**0.451**	**0.423**	**0.487**	**0.481**	**0.560**	**0.353**	**0.632**
	(0.015)	(0.023)	(0.042)	(0.029)	(0.058)	(0.011)	(0.027)
Divorce Rate	0.023	0.004	0.002	0.010	0.024	0.030	0.026
	(0.014)	(0.023)	(0.016)	(0.018)	(0.015)	(0.017)	(0.019)
Lagged Unemp Rate	0.007	0.025	0.011	0.022	0.002	0.004	0.014
	(0.020)	(0.025)	(0.025)	(0.020)	(0.020)	(0.018)	(0.023)
Fico Score at Origination	**-0.264**	**-0.307**	**-0.327**	**-0.273**	**-0.284**	**-0.232**	**-0.182**
	(0.015)	(0.014)	(0.011)	(0.016)	(0.018)	(0.015)	(0.028)
Interest Only Dummy	**0.187**	**0.205**	**0.278**	**0.307**	**0.332**	**0.130**	**0.231**
	(0.022)	(0.048)	(0.046)	(0.053)	(0.059)	(0.023)	(0.030)
Jumbo Dummy	0.027	-0.127	-0.089	-0.155	-0.118	**-0.047**	-0.004
	(0.017)	(0.073)	(0.078)	(0.060)	(0.064)	(0.020)	(0.022)
ARM Dummy	**0.310**	**0.147**	**0.167**	**0.080**	**0.094**	**0.280**	**0.261**
	(0.012)	(0.014)	(0.017)	(0.028)	(0.042)	(0.010)	(0.021)
LTV Ratio at Origination	**0.010**	**0.011**	**0.012**	**0.010**	**0.010**	**0.009**	**0.008**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln Loan Age	**0.077**	**0.088**	**0.095**	**0.124**	**0.125**	**0.075**	**0.125**
	(0.005)	(0.007)	(0.011)	(0.009)	(0.012)	(0.008)	(0.007)
Purpose Type Dummy	**-0.099**	0.017	0.003	**0.063**	0.037	**-0.163**	**-0.082**
	(0.021)	(0.013)	(0.022)	(0.013)	(0.035)	(0.017)	(0.014)
% Defaults	0.050%	0.0190%	0.0113%	0.0142%	0.0096%	0.165%	0.0585%
Number of obs.	85,888,286	37,577,506	21,452,670	22,688,658	12,897,217	17,196,843	7,460,381

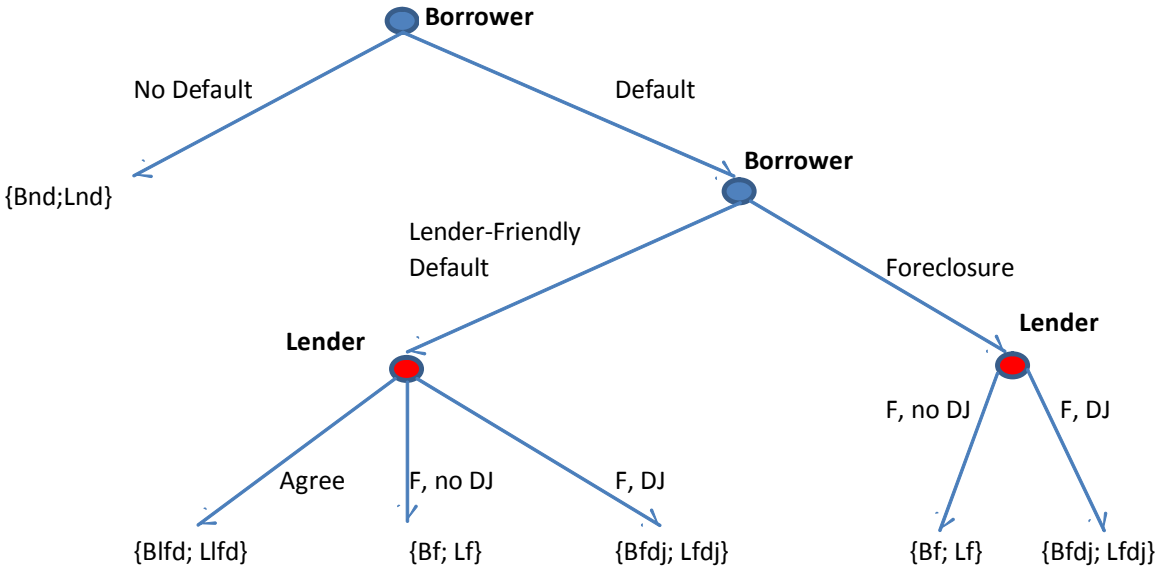
Notes: Dependent variable in the probit is a binary variable that equals 1 if the loan defaults in that month, 0 otherwise. The benchmark specification is specification (2) from table 3. Default Option is the prob. that the borrower has negative home equity. LTV80=1 if the loan has an LTV of exactly 80%, 0 otherwise. Rate variables control for the difference between the current mortgage rate and the contract rate. The results for Fico Score show the effect of a 100 point increase. Purpose Type Dummy = 1 if the loan is not a purchase mortgage, 0 otherwise. % Defaults is the % of observations that are defaults. Std. errors (clustered by state) in parentheses. All regressions include a constant.

Table 8: Recourse and the Type of Default

	(1)	(2)	(3)	(4)	(5)
Recourse	**-0.527**	**-0.554**	**-0.526**	**-0.523**	**-0.484**
	(0.164)	(0.158)	(0.137)	(0.138)	(0.155)
Default Option	-	**-0.679**	**-0.694**	**-0.667**	**-0.718**
		0.133	(0.139)	(0.142)	(0.117)
Default Option * Recourse	-	-0.523	-0.497	-0.514	-0.485
		(0.525)	(0.457)	(0.461)	(0.458)
Fico Score at Origination	-0.008	0.005	0.003	0.020	-0.003
	(0.028)	(0.032)	(0.035)	(0.042)	(0.034)
LTV Ratio at Origination	**0.003**	**0.008**	**0.008**	**0.007**	**0.009**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Foreclosure Timing Dummy	-	-	0.097	0.097	0.090
			(0.288)	(0.289)	(0.287)
Investor Type 1	-	-	-	-0.053	-
				(0.052)	
Appraisal Amount	-	-	-	-	0.030
					(0.019)
Appraisal Amount * Recourse	-	-	-	-	-0.017
					(0.040)
Constant	**1.26**	**0.85**	**0.79**	**0.77**	**0.75**
	(0.30)	(0.30)	(0.38)	(0.38)	(0.36)
% Foreclosures	86.2%	86.2%	86.2%	86.4%	86.2%
Log ps. likelihood	-16913.797	-16,777	-16,761	-16,556	-16,756
Pseudo R-squared	2.80%	3.58%	3.68%	3.78%	3.71%
Number of obs.	43,353	43,353	43,353	43,252	43,353

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. Foreclosure timing dummy is a dummy variable that takes a value of 1 if the uncontested foreclosure time is less than six months. 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. The number of observations in column 4 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. Coefficients in bold font are significant at the 5% level.

Figure 1: Model Description



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 nonagricultural 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. 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 6- or 12-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 timeframe 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 a 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 3 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 one 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. This provision applies to residential property with four or fewer units on up to 40 contiguous acres if at least one unit is owner-occupied. 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 timeframe 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 6 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 of 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 out 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)). We drop mortgages for home improvement, debt consolidation, education, medical, or other. The analysis is limited to first mortgages (Variable MORT_TYPE takes values 1 = First mortgage, or 4 = First mortgage, grade "B" or "C"). We restrict the sample to single-family residences, townhouse, or condos (PROP_TYPE=1 or C).

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 payoff out of foreclosure, by payoff out of bankruptcy or serious delinquency, or by liquidation to termination. We do not count terminations by voluntary payoff or by a loan transfer from a servicer 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 TERMINATION_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.

Default Type.—If a loan goes from being in foreclosure to being an REO loan, we treat it 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 zero 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_INT_RATE. (Variable ARM_INT_RATE contains the 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 Nonfarm 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, http://www.fhfb.gov/Default.aspx?Page=8&Top=4.

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 values and use the 2007 value for 2008.

Loan Level Characteristics.—

- ln loan age in months from the closing date to the contemporaneous month
- LTV at origination
- an indicator variable if the loan is interest only at origination (IO_FLAG)
- an indicator variable if the loan is 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)