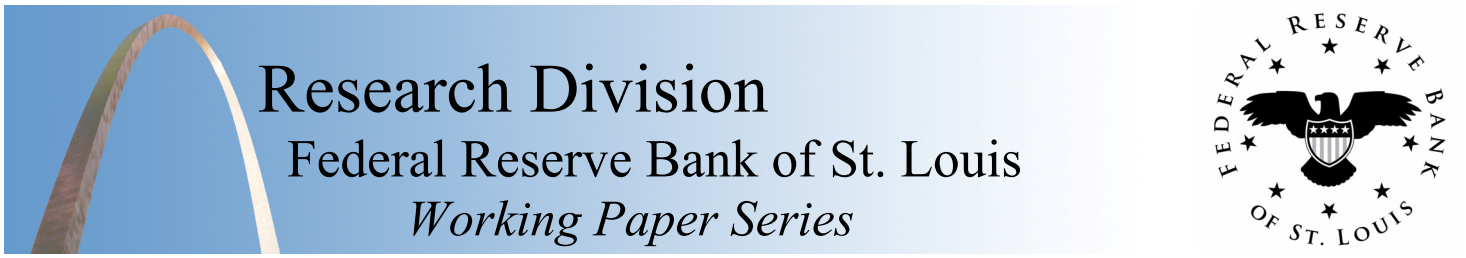

The Duration of Foreclosures in the Subprime Mortgage Market: A Competing Risks Model with Mixing

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Abstract:

This paper examines what happens to mortgages in the subprime mortgage market once foreclosure proceeding are initiated. A multinominial logit model that allows for the interdependence of the possible outcomes or risks (cure, partial cure, paid off, and real estate owned) through the correlation of associated unobserved heterogeneities is estimated. The results show that the duration of foreclosures is impacted by many factors including contemporaneous housing market conditions, the prior performance of the loan (prior delinquency), and the state-level legal environment.

JEL Classifications: D12,G12, G21, C25

Keywords: Mortgages, Subprime, Foreclosure

*The views expressed in this research are those of the individual author and do not necessarily reflect the official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve System, or the Board of Governors.

The Duration of Foreclosures: A Competing Risks Model with Mixing

Introduction

Although a borrower is technically in default when a single payment is missed or late, lenders usually wait a substantial period of time, typically more than 90 days, before attempting to take possession of the property. Lenders can take possession of property through foreclosure proceedings or through less adversarial approaches, such as deeds-in lieu of foreclosure, or the loan can be terminated through borrower repayment. For the vast majority of loans, the taking of property is not profitable for the lender. As a result, lenders make substantial efforts to delay or even forgo foreclosure and find alternative and less costly outcomes. These alternative outcomes are especially enticing to lenders in the subprime market, where losses on foreclosures tend to be higher (Capozza and Thomson, 2005) and the time spent being in delinquency tends to be longer (Capozza and Thomson, 2006). In addition, since subprime loans have relatively high interest rates, any ongoing payments made by a borrower, even if sporadic, may be able to generate more income for the lender than eviction of the owner and lender ownership of the property.

However, a substantial fraction of subprime loans do enter foreclosure proceedings. For example, the Mortgage Bankers Association of America reports that over 9 percent of outstanding subprime loans were in foreclosure at some point during the 2000-2001 time period. In contrast, over the same time period, prime loans were in foreclosure well under 1 percent of the time. It is the time period when loans are in foreclosure that this paper focuses on. In particular the paper asks the question what happens to subprime loans once foreclosure has been initiated by the lender -- in particular, what is the

probability that a loan in foreclosure today will eventually be in a state of cure (an active loans that is current or delinquent), prepaid, or lender property ownership. In general, of those loans that terminate, almost 60 percent end up with the collateral property owned by the lender and 40 percent are paid off. Approximately 13 percent do not terminate and are either cured or partially (active, but delinquent) cured. The empirical approach uses a competing-risk discrete-mass-point mixed multinomial logit model specification. The results indicate that the probability of terminating or curing and the type of termination or cure is sensitive to many factors including the amount of equity in the home, the extent of delinquency before entering foreclosure, and the state-level legal environment.

This analysis provides a contribution to the literature in a number of ways. First, the length of foreclosure is examined in detail in the subprime market. Second, the type of exit is identified in a detailed loan-level dataset of monthly observations of loans in foreclosure. Third, the use of multinomial logit in the literature is advanced by allowing for the interdependence of the potential exits (hazards or risks) from foreclosure through the correlation of associated unobserved heterogeneities.

Motivation and Literature

One of the most widely studied topics in the mortgage finance literature is the termination of loans through borrower default. Typically default is treated as the time period when the foreclosure process is finished and the property has been sold.[1] However, lenders attempt to recover any losses in a multiphase process once the borrower has stopped making payments. In particular, there is evidence that subprime loans tend to linger in

[1] Note that typically the lender "buys" the property and it becomes owned by the lender or "real estate owned". Then the lender sells the property in an attempt to recoup as much of the losses as possible.

delinquency for long periods before curing or terminating the loan. Capozza and Thomson (2006) find that subprime loans that are 90 days or more delinquent take four times longer to become Real Estate Owned (REO), but are much less likely to cure. In addition, Danis and Pennington-Cross (2005) find that subprime loans that linger in delinquency are much more likely to be prepaid than to enter foreclosure proceedings. They interpret this type of prepayment as "distressed" prepayment because of the large payment that would be necessary to bring the status of the loan back to current (cured). Not surprisingly, given their extended period of serious delinquency, subprime loans tend to inflict larger losses than prime loans (Capozza and Thomson, 2005).

Other studies have focused on the outcome of loans that are 90 days delinquent. For example, Ambrose and Capone (1998) follow more than 30,000 Federal Housing Authority (FHA)-insured loans until final resolution (reinstatement, property sale, assignment to the Department of Housing and Urban Development, and foreclosure). Loans are separated depending on the amount of equity in the home. Negative equity defaulters are viewed as "ruthless" because the value of the home is smaller that the value of the outstanding mortgage. As a result, it may make financial sense to default. Defaulters with positive equity are viewed as likely being "trigger event" defaulters. Trigger events are typically thought of as unexpected events that make it difficult for a household to continue making timely payments to service their current debt obligations. This includes job loss, a significant change in health status, and changes in family structure (divorce, in particular). If a household has used subprime lending, it is very unlikely that the household will have substantial resources to soften the impact of any

trigger events. In fact, historically, the most popular product in subprime is the cash-out refinance, which is typically used to pay off other outstanding debt. Therefore, in subprime, loans that are in default are likely dominated by trigger event defaults not ruthless defaults.

If foreclosure is an event that both borrowers and lenders would prefer to avoid, then conditions that make alternatives less costly, and hence more attractive, should be associated with lower REO rates and more lender forbearance. Various studies have found that contemporaneous economic conditions such as interest rates and house price appreciation can have substantial impacts on the disposition of a seriously delinquent loan {(Ambrose and Capone (1998); Ambrose, Buttimer, and Capone (1997); Phillips and Vanderhoff (2002 and 2004); Capozza Thomson (2005 and 2006); Lambrecht, Perraudin, and Satchell (2003), Phillips and Rosenblatt (1997)}. For example, if there is positive equity in a home, then the borrower can sell the house, pay off the debt, and avoid foreclosure. While the borrower may prefer to be a homeowner and not move, it may be less costly to move and sell the home than to be evicted. If interest rates have declined, it may also be possible for the borrower to refinance the loan and have more manageable monthly payments.[2]

Data

The data consist of 5,000 loans that were originated over the calendar years 2001-2005. The time period of each loan's life under examination is the first month that the loan is reported as being in foreclosure until the loan terminates or December 2005, whichever is

[2] Another tool that could be used to reduce debt servicing requirements is to refinance into a loan with a longer repayment period or an adjustable rate loan.

first: 82 percent of the loans are observed to exit foreclosure over the observed time period. Of the exited loans, just approximately 16 percent fully or partially cured, 50 percent terminated and became REO by the lender, and 34 percent terminated and were paid off before entering REO. The paid off loans could cover all or only part of total obligation outstanding; however, in these cases the lender has fully terminated the loan and has taken the loss on any short (sale price<outstanding balance) sales or short prepayments. Since losses associated with owning property (REO) are reported to be over 50 percent of the outstanding debt obligation (Capozza and Thomson, 2005), lenders may have strong incentives for avoiding real estate ownership and may be willing to accept short sales and prepayments as lower-cost substitutes. In fact, there is strong evidence that defaulted property depreciation is idiosyncratic and only partially driven by market-wide appreciation rates (Capozza and Thomson, 2005; Pennington-Cross, 2006).

The data, leased from LoanPerformance, are loans from their Asset Backed Securities data base. These are loans that are securitized in the private label market that have been identified and marketed in the secondary market as subprime loans. Fixed-rate 15- and 30-year owner-occupied for-purchase and refinance loans are included in the sample to help remove as much unobserved heterogeneity as possible from the sample and isolate the impact of contemporaneous economic conditions, legal conditions, and prior loan performance. The average loan size at origination is just over $112,000 with a 15 percent down payment. The average FICO (consumer credit score) score was 614 and the average interest rate was over 9.3 percent and is approximately 3 percentage points above the prevailing 30-year (6.5 percent) and 15-year (6.0 percent) interest rates. Therefore,

these loans are being charged a substantial premium by the mortgage market and the borrowers would likely have a difficult time securing prime rate credit because of relatively low credit scores. However, there are a few loans that have high credit scores included in the data set. These are likely still "subprime" for other reasons such as low or no documentation or other information not included in the data set about the property or borrower. Often these loans are be labeled "nonprime" or Atl-A loans.

Table 1 provides summary statistics and descriptions of the estimation data set. Each of the 5,000 loans is repeatedly observed in each month from the beginning of foreclosure until right censoring, termination through lender property ownership, or termination through the loan being paid off. Therefore, the average fraction of loans in each type of exit will be much lower than the cumulative numbers. For example, the average rate of loan terminations per month through REO is 4 percent; the rate for loans being paid off is only 3 percent per month.

Various factors could impact whether a loan cures or terminates. For example, consider the time or months spent in foreclosure (*age*). As a loan spends more time in foreclosure the lender is incurring many expenses, including legal expenses and missed interest payments. In addition, the borrower has little incentive to maintain property because they likely will no longer the own the home. Consistent with this scenario Harding, Miceli and Sirmans (2000) find evidence that borrowers with loan to value (ltv) ratios of 100 percent spend less on maintenance than other homeowners. In addition, it just takes time

to process foreclosures. Therefore, we should expect few exits early in the process and a higher probability of terminating the loan as *age* increases.

The amount of equity is also likely to affect whether and in what manner the loan moves out of foreclosure. To measure equity the current loan-to-value ratio (*cltv*) is calculated using the unpaid balance of the loan in each month and the update house price using the Office of Federal Housing Enterprise Oversight (OFHEO) metropolitan area repeat sales price index. In general, the more equity in the home the less costly it should be for the lender if the loan does become REO. However, the borrower may also have the opportunity to sell the house and pay off the loans in order to avoid being evicted. Since the borrower has the ability to move first by selling, this may be the primary type of termination when there is equity in the home. However, this will largely be an empirical question.

Other measures of economic and borrower conditions may impact the exits as well. For example, the prior behavior of the borrower may provide an indication about borrower behavior during foreclosure as well as how the lender may treat the foreclosure process. To measure prior behavior the Fair Isaacs *fico* score at origination of the loan and the fraction of observed loan months that the loan was delinquent prior to foreclosure (*delinq*) are included. Prior extensive delinquency likely indicates that the lender or servicer has provided considerable forbearance in the past. If this pattern continues, then these loans may spend more time in foreclosure and be less likely to terminate through REO or being paid off. Because these loans are in foreclosure, borrowers with better

credit scores are, in the process, damaging their credit history. As a result, credit will be even more costly in the future and the household will likely lose their home. While this story is compelling it is an empirical question whether these circumstances lead to prolonged stays in foreclosure or toward any of the particular method of loan termination or curing.

Conditions in the housing and labor markets could also impact the outcome of a foreclosure. To proxy for labor market conditions, the state-level contemporaneous unemployment rate is included (*unemp*). In general, it may be more difficult for households to cure outstanding debts when labor market conditions are poor. Therefore, locations with higher unemployment rates are expected to be associated with lower probabilities of curing or partial curing. The extent that it is "in the money" to refinance is also included to proxy for interest impacts (*refi*). The present discounted value of the current mortgage is compared with the present discounted value of a market rate mortgage assuming that the term of the loan is not adjusted.[3] The savings are reported as a fraction, so that 0.10 indicates that there is a 10% savings by refinancing before considering transaction costs. If interest rates have dropped making it substantially "in the money" to refinance, it has become relatively more costly to proceed with the foreclosure from the lenders perspective. In addition, if there is a fixed cost associated with some types of termination, loan size may also impact termination type.

[3] The Freddie Mac Primary Mortgage Market Survey (PMMS) is used to proxy for prevailing interest rates on mortgages. Since these are subprime loans with risk premiums, the risk premium of the loan at origination is used to adjust up the PMMS rate to create a comparable market rate.

Prior research has found that state foreclosure laws can affect the volume and pricing of mortgage lending (Pence, 2003; Ambrose and Sanders, 2005). The legal conditions under which the foreclosure proceeds are likely to have strong impacts on the length or duration of the foreclosure spell. For example, states that require that foreclosures be processed through the state court system (*jud*) are likely to extend the stay in foreclosure and retard any exit. States that provide the statutory right of redemption (*srr*) are also likely to be associated with longer stays in foreclosure, because lenders typically wait until the end of the redemption period before attempting to take the property.

A Competing-Risk Mixed Multinomial Logit Model

While this paper differs from the prior literature because it focuses on what happens to loans that are in the foreclosure process as opposed to loans that are 90 days delinquent, the empirical techniques used are very similar because there are multiple potential outcomes that need to be considered. The prior literature has largely used the multinomial logit model specification. This approach is extended by allowing for unobserved heterogeneity and the correlation of the associated unobserved heterogeneities. In the logit context these types of models are typically referred to as mixed logit models, or in our case, because of the multiple potential outcomes, multinomial mixed logit.

Logit models, both binomial and multinomial, have been widely used in reduced-form empirical models of mortgage termination. For instance, just in the study of 90-day-delinquent loans, recent examples include Ambrose and Capone (1998), Phillips and Vanderhoff (2004), Capozza and Thomson (2005 and 2006), and Phillips and Rosenblatt

(1997). In each month the loan can be in only one state or outcome (delinquent, REO, prepaid, etc), so that by definition the multinomial logit model is a competing risks model.[4]

Assume that there are J, j=0,…,J-1, outcomes available and the vector of variables that explain the decision made for loan i is x_i. The probability (π) of observing a particular loan outcome is given by

$$\pi_{ij} = \frac{e^{\beta_j' x_i}}{\sum_{k=0}^{J-1} e^{\beta_k' x_i}}. \tag{1}$$

The parameters, β_0, are normalized to zero for identification purposes. The other β parameters are chosen to maximize the log-likelihood function

$$\ln L = \sum_i \sum_{j=0}^{J-1} d_{ij} \ln \pi_{ij} \tag{2}$$

where d_{ij} is a dummy variable equal to 1 if j is the outcome on loan i.

A drawback to the multinomial logit model is an undesirable property known as Independence from Irrelevant Alternatives (IIA). For any two alternatives m and n, the ratio of the logit probabilities can be expressed as

$$\frac{\pi_{ij}(Y_i = m)}{\pi(Y_i = n)} = \frac{e^{\beta_m' x_i} \Big/ \sum_k e^{\beta_k' x_i}}{e^{\beta_n' x_i} \Big/ \sum_k e^{\beta_k' x_i}} = e^{\beta_m' x_i - \beta_n' x_i}. \tag{3}$$

[4] A risk in this context reflects the types of exit (termination or cure) from foreclosure that compete to be the observed outcome in each month.

This odds ratio for alternatives *m* and *n* do not depend upon any other alternatives.[5] An alternative modeling strategy that partly solves this problem is to use nested logit models. Loan outcomes are partitioned into a tree structure. Each upper-level group is called a "branch," while each lower-level group of outcomes within a branch is called a "nest". The IIA property holds within nests but not between nests.

The approach used in this paper is to take advantage of the unobserved heterogeneity and allow these heterogeneities to correlate. It is not possible to obtain loan-specific parameters to measure the impact of unobserved or random forces impacting the outcome. However, it is possible to capture the differences across loans by assuming that the heterogeneity follows some distribution (McFadden, 1978; Wen and Koppelman, 2001; Train, 2003). The assumed distribution (common assumptions include normal, lognormal, triangular, and uniform) is estimated with the use of an additional parameter or parameters. However, if the a priori assumption about the shape of the distribution differs from the actual and unobserved underlying distribution, inferior solutions can be found (Heckman and Singer, 1984). The approach used in this paper is to not assume a specific distribution and instead create groups of loans that have higher or lower likelihoods of terminating the loan or becoming cured. The technique cannot directly observe which group or mass point each loan belongs to and instead estimates a discrete probability distribution so that each group has a unique influence on the

[5] A well-known example illustrates a problem with this assumption. A traveler has a choice of going to work by car or by a blue bus. Let the choice probabilities be equal, implying the ratio of probabilities equals 1. Now introduce a choice of a red bus that the traveler considers equivalent to a blue bus. We would expect the probability of going to work by car to remain the same at 0.5, while the probabilities of going to work by bus would be split evenly between blue and red buses at 0.25. If this were true, then the ratio of probabilities between car and blue bus, formerly at 1, would now be equal to 2 (0.5 divided by 0.25). The multinomial logit model does not allow this possibility. Recall that there are equal probabilities of taking a blue bus and a red bus. The only profile of probabilities that fit these two constraints puts equal probability of 0.33 on each choice. The multinomial logit would therefore overestimate the probability of taking a blue or a red bus and would underestimate the probability of taking a car.

conditional monthly probability estimate. Each group of loans is identified by a mass point, representing a distinct mass of loans. The technique is estimated using maximum likelihood to obtain estimates of the size of each mass point and the idiosyncratic shift in the probability estimates.[6] The outcomes are assumed to be independent of each other, when conditioning on observed and unobserved heterogeneities. However, each of the risks can be interdependent when conditioned only on observed heterogeneity. The interdependence of the risks conditioned on all observed characteristics is created through the correlation of unobserved heterogeneities associated with each risk.

$$\ln L = \sum_{i} \sum_{j=0}^{J-1} d_{ij} \ln \prod_{ij} , \tag{4}$$

$$\prod_{ij} = \sum_{m=1}^{M} p_m \pi_{ijm} , \tag{5}$$

$$\pi_{ijm} = \frac{e^{\beta_j' x_i + \upsilon_{jm}}}{\sum_{k=0}^{J-1} e^{\beta_k' x_i + \upsilon_{km}}} . \tag{6}$$

υ_{jm} are the location parameters that reflect the idiosycratic risk for risk j for the mth unobserved heterogeneous group; p_m is the mass-point parameter representing the proportion of loans in the mth group; again, the parameters, β_0, are normalized to zero for identification purposes and the other β parameters are chosen to maximize the log-likelihood function along with υ_{jm} and p_m. Following Dong and Koppelman (2003) and Yu (2006) to ensure that the proportions lie within [0,1] and sum to 1, a logistic transformation is used on mass-point estimates.

$$p_m = \left(e^{q_m} / \sum e^{q_m} \right), \tag{7}$$

where $-\infty < q_m < \infty$ and q_1 is normalized to 0.

[6] The likelihood function is maximized in SAS using Proc NLP, and the code is available on request from the author.

Results

Table 2 provides the multinomial logit results with and without mixing. In general, both sets of reported results are similar in that coefficients for the exogenous variables are of similar size and direction. However, for some variables coefficient estimates can differ. For example, the impact of the local unemployment rate is lower on the results that do not include unobserved heterogeneity controls. For example, the coefficient is insignificant for curing without mixing but is significant and larger when mixing is allowed. In addition, there are just as many instances when coefficient estimates become smaller in magnitude or become insignificant in the mixing specification. Prior duration analysis on other topics has also found that parameter estimates may be biased when unobserved heterogeneity is not controlled for (for example, Deng, Quigley, and Van Order, 2000).

The mixing parameter estimates are provided at the bottom of table 2. The mass-point estimate of 1.8245 undergoes a logistic transformation and indicates that approximately 86 percent of the loans are in group 1 and 14 percent are in group 2. Group 1 includes loans with a relatively low probability of curing and a high probability of partial curing or being paid off. The estimates can be viewed as shifts up or down to the baseline function (to be discussed below). Using location parameters paid off outcome or termination, if there is only one group, the location parameter is -2.84; but when two groups of loans are allowed through the mixing function, the parameters are 0.59 and -5.06 for groups 1 and 2, respectively. This indicates a large increase (decrease) in the probability of group 1 (group 2) terminating by being paid off. For the risk of terminating foreclosure through REO, there was no evidence of heterogeneity (REO_2) was insignificant at the 10 percent

level). Therefore, the reported parameters include only one type REO loan termination. This is why the parameter estimates for the REO risk type are very stable for the model specifications, both with and without mixing.

Explanatory Variables

The impact of the loan aging while in foreclosure can be thought of as the baseline probability of leaving foreclosure. The variable *age* is positive and significant for all risks, indicating that the conditional monthly probability of leaving foreclosure increases in each month for each potential risk. Holding all other variables at their means, figure 1 provides a plot of the cumulative probability of loan termination as the loan spends additional time, measured in months, in foreclosure. The cumulative termination probability increases at a decreasing rate for both types of termination (REO and paid off). After 2.5 to 3 years, almost no additioonal loans terminate through REO, while a few more terminate by being paid off. This nonlinear relationship is further shown in figure 2, where the conditional (conditioned on being alive at the beginning of the month) monthly probability baseline reveals the relatively high (low) probability for REO termination when the loan has been in foreclosure for a short (long) time period. By the end of 3 years, over 80 percent of the loans have terminated. The remainder of the active loans are predominately cured (partially or completely).[7] Therefore, while the probability of a loan curing may be important from a competing framework perspective, almost all loans that enter foreclosure are terminated. As a result, the remaining discussion will focus on the termination outcomes.

[7] The conditional monthly probability of curing or partially curing is over 89 percent in the 37th month.

Figures 3 through 8 plot the estimated conditional monthly probability of a loan terminating for each explanatory variable over the full range of observed values while holding all other variables constant. For example, figure 3 indicates that the probability of a loan terminating through REO is low (less than 1 percent) when there is a lot of equity in the home and much higher when there is negative equity in the home (over 8 percent). In contrast, loans are more likely to terminate by being paid off when there is a lot of equity (up to 6 percent) and less likely to terminate by being paid off when there is low or negative equity (less than 2 percent). These results indicate that, although lenders would ideally like to own property that has positive equity because it will have a lower loss rate, lenders are most likely to own property when there is little or no equity to cover the expenses of selling and maintaining property.

The results (figure 4 and table 2) indicate that borrowers who had higher credit scores at origination are more likely to terminate the loan. While there may be many potential explanations, this result may indicate that borrowers with poor scores have different reasons for being seriously delinquent than those with better scores. For example, borrowers with low scores may have seasonal or unsteady income sources that could eventually lead to the initiation of foreclosure proceedings but not termination of the loan.

Higher area unemployment rates (figure 5) are associated with lower probabilities of loan termination, leading to a longer duration in the foreclosure state. If a household does experience a reduction or stop in earnings, lenders may be patient in the hopes that the

borrower will find gainful employment and start repaying the loan. In fact, the probability of the loan terminating decreases from just over 8 percent to approximately 5 percent for unemployment rates ranging from 1.5 to 10 percent.

The delinquency of a loan before it enters foreclosure may also provide information on how the lender/servicer will proceed with foreclosures. The results indicate that loans that have been delinquent over longer periods are more likely to terminate through REO than through paying off the loan (figure 7). In fact, loans that were not delinquent for very long are approximately four times more likely to terminate through paying of the mortgage, while loans that have been delinquent almost their whole lives are almost four times more likely to terminate through REO. In addition, the probability of the loan being cured is very sensitive to the history of delinquency. For example, loans with short delinquency spells are very likely to become cured (probability of being in the cured state is over 50 percent per month), while loans that have been delinquent for long spells have an almost negligible probability of being cured (under 1 percent).

In terms of interest rates, the results indicate that when interest rates have dropped the probability of the loan being paid off decreases, while the probability of the loan becoming REO is unaffected (figure 7). In addition, loans are more likely to be partially cured in "down" interest rate environments. Larger loans, as measured by the amount outstanding balances, are less likely to terminate through being paid off while smaller loans are more likely to terminate through REO (figure 8).

The impact of foreclosure laws on duration of foreclosure spells can be quite dramatic. For example, a loan in a power-of-sale state has a 53 percent higher probability of being terminated through REO than the average identical loan in a judicial foreclosure state. In addition, the probability of terminating through paying off is also 28 percent higher. In fact, all types of ways to stop the foreclosure, including curing and partial curing, are much more likely in power-of-sale states. In contrast, states that allow a statutory right of redemption had almost no observable impact on the duration of foreclosure spells.

Conclusion

This research examines a unique data set of subprime loans that are in foreclosure. The data allows the monthly observation of the loan until the loan terminates. Loans can exit foreclosure through curing, partially (delinquent) curing, becoming real estate owned (REO) property, or paying off the outstanding balance on the loan (paid off). For loans that are in foreclosure for a relatively short time period, less than a year, the primary way to terminate the loan is through REO; but, as the time in foreclosure lengthens, paying off the loan becomes the dominate method of termination. In the data approximately 40 percent of the loans were terminated through REO whereas 27 percent were terminated through paying off the loan. In contrast, 13 percent of the loans were successfully cured or partially cured.

While many factors can impact the timing and type of loan termination out of foreclosure, a state's legal environment has a very strong impact. In particular, relative to states that require a judicial foreclosure, power-of-sale states are associated with large increases in the conditional monthly probability of curing (30 to 65 percent higher) and

terminating (28 to 45 percent higher) loans. In addition, the amount of equity in the home, local unemployment rates, prior delinquency, and prevailing interest rates impact the duration of foreclosure proceedings and the type of loan termination. For example, loans with a little or negative equity tend to terminate through REO, while loans with substantial equity tend to terminate by paying off the loan.

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Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.	Description
foreclose	0.62	0.48	0	1	loan in foreclosure proceedings
cure	0.15	0.36	0	1	loan current
partial cure	0.16	0.37	0	1	loan delinquent
REO	0.04	0.19	0	1	Property is real estate owned by the lender
paid off	0.03	0.16	0	1	loan paid off
age	10.07	8.79	1	52	months in foreclosure
cltv	72.15	13.91	10.19	108.96	current loan to value ratio calculated using actual balance and the updated house price using state level OFHEO HPI
fico	603.84	58.67	417	818	Fair Isaac credit score at loan origination
unemp	5.41	1.37	2.1	26.2	state unemployment rate in the current month collected from the Bureau of Labor Statistics
delinq	0.49	0.24	0.02	1	share of observed months loan was delinquent prior to when foreclosure was initiated
refi	0.08	0.07	-0.19	0.89	fraction "in the money" to refinance due to market wide interest rate changes
upb	10.67	9.03	1.20	145.58	outstanding or unpaid balance ($10,000's) on the loan in each month
jud	0.55	0.50	0	1	judicial foreclosure state=1, and power of sale state=0 (Pence, 2003)
srr	0.12	0.33	0	1	statutory right of redemption state=1, and non-redemption state=0 (Pence, 2003)
loans	5,000				number of loans
observations	53,924				number of loan-months

Table 2: Multinomial Logit Results

		Without Mixing		With Mixing	
Risk	Variable	Coeff.	Std Err	Coeff.	Std Err
cure	age	0.1508**	0.0022	0.1651**	0.0026
	ltvc	-0.0179**	0.0011	-0.0182**	0.0012
	FICO	-0.0038**	0.0003	-0.0038**	0.0003
	unemp	0.0148	0.0101	0.0265**	0.0107
	delinq	-7.6200**	0.0975	-8.3110**	0.1167
	refi	-0.9498**	0.2206	-1.1439**	0.2306
	upb	0.0057**	0.0018	0.0064**	0.0018
	jud	-0.7043**	0.0318	-0.6488**	0.0340
	srr	-0.0331	0.0476	-0.0232	0.0500
partial cure	age	0.0829**	0.0018	0.0906**	0.0029
	ltvc	-0.0059**	0.0010	-0.0076**	0.0014
	FICO	-0.0056**	0.0003	-0.0066**	0.0004
	unemp	-0.0341**	0.0097	-0.0522**	0.0126
	delinq	0.0382	0.0690	0.6333**	0.1182
	refi	0.1380	0.1948	0.1709	0.2522
	upb	-0.0020	0.0015	-0.0013	0.0021
	jud	-1.4575**	0.0288	-1.9194**	0.0858
	srr	0.0975**	0.0379	0.1205**	0.0491
REO	age	0.0203**	0.0039	0.0208**	0.0039
	ltvc	0.0246**	0.0021	0.0249**	0.0021
	FICO	0.0008*	0.0004	0.0008*	0.0004
	unemp	-0.0687**	0.0192	-0.0683**	0.0192
	delinq	-0.1527	0.1210	-0.1414	0.1226
	refi	-0.0266	0.3524	-0.0289	0.3522
	upb	-0.0153**	0.0032	-0.0155**	0.0032
	jud	-1.0888**	0.0503	-1.0963**	0.0505
	srr	0.0045	0.0661	0.0034	0.0662
paid off	age	0.0706**	0.0041	0.0735**	0.0056
	ltvc	-0.0201**	0.0020	-0.0234**	0.0030
	FICO	0.0017**	0.0005	-0.0004	0.0008
	unemp	-0.0575**	0.0211	-0.0945**	0.0264
	delinq	-2.6305**	0.1564	-1.1865**	0.2391
	refi	-2.2496**	0.4091	-2.3367**	0.5354
	upb	0.0139**	0.0023	0.0180**	0.0052
	jud	-0.7143**	0.0597	-1.6382**	0.1727
	srr	0.0401	0.0837	0.1018	0.1125
mass point	$mass_1$			1.8245**	0.0991
location	$cure_1$	-1.7399**	0.0279	-4.2005**	0.4950
	$cure_2$			-1.7844**	0.0301
	partial $cure_1$	-0.7441**	0.0200	1.8730**	0.2046
	partial $cure_2$			-1.2842**	0.0773
	REO_1	-2.3051**	0.0365	-2.3012**	0.0366
	paid off_1	-2.8371**	0.0458	0.5867*	0.2865
	paid off_2			-5.0635**	1.1941

All continuous variables are mean deleted for estimation. The second group for the *REO* location parameter was insignificant and therefore not included in the final specification. A logistic transformation is used for the reported mass point and location coefficients. ** indicates significant at 1percent and ** at 10 percent.

Figure 1:

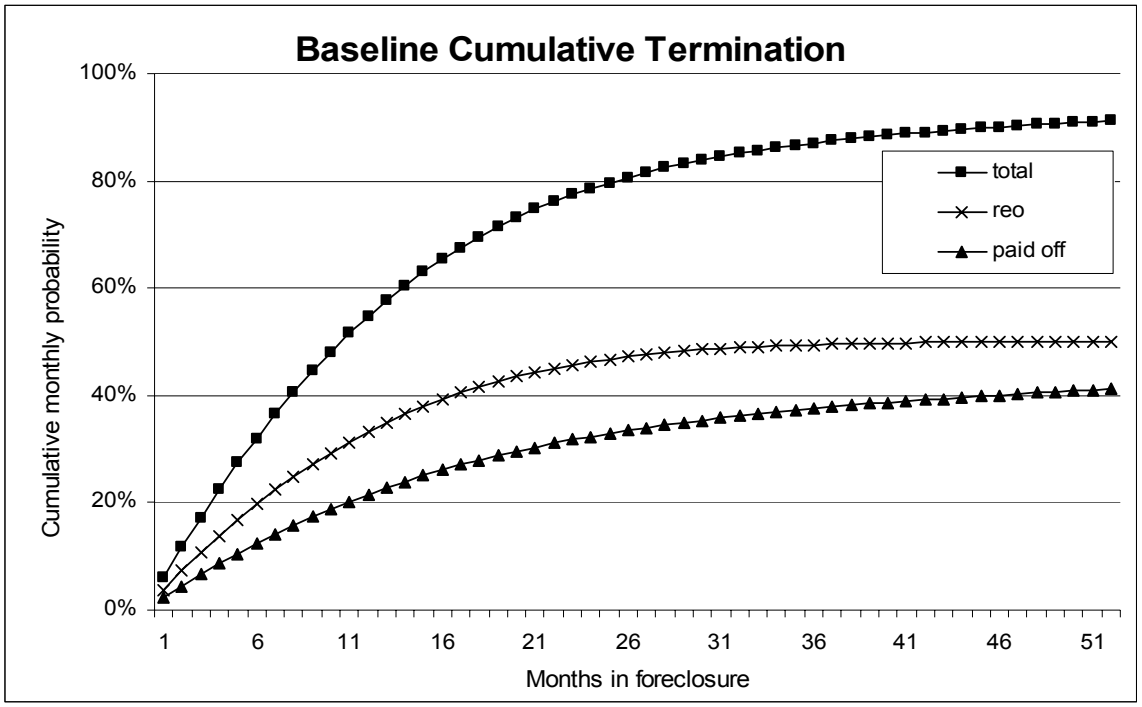

Figure 2:

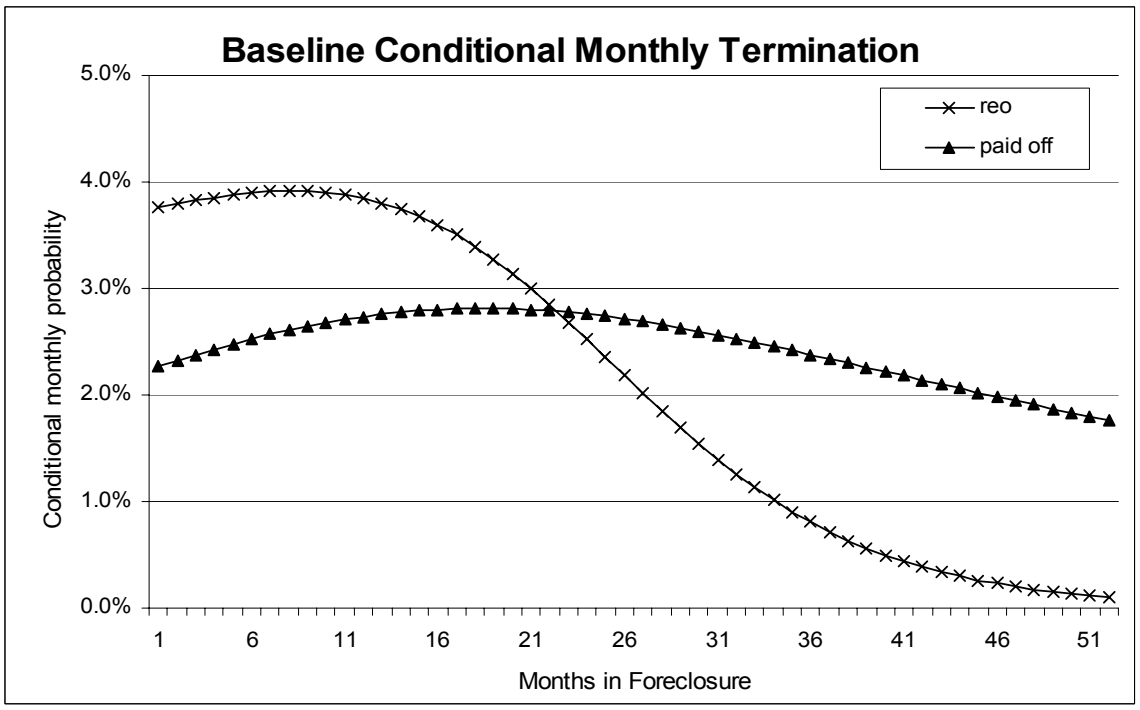

Figure 3:

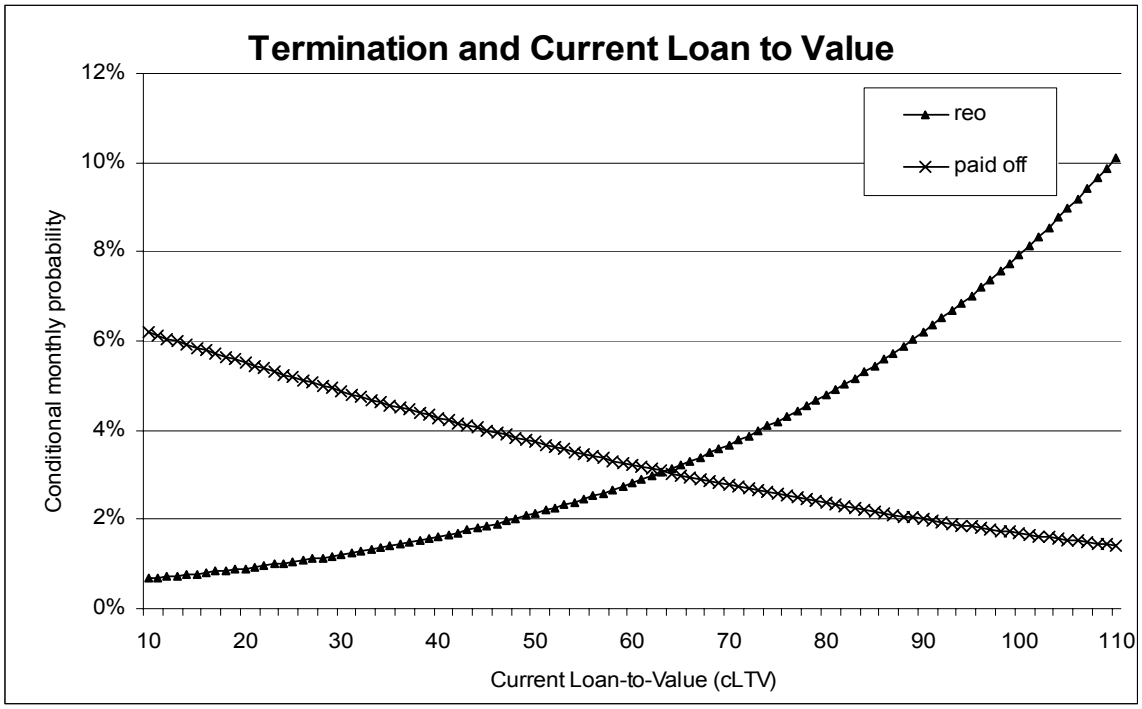

Figure 4:

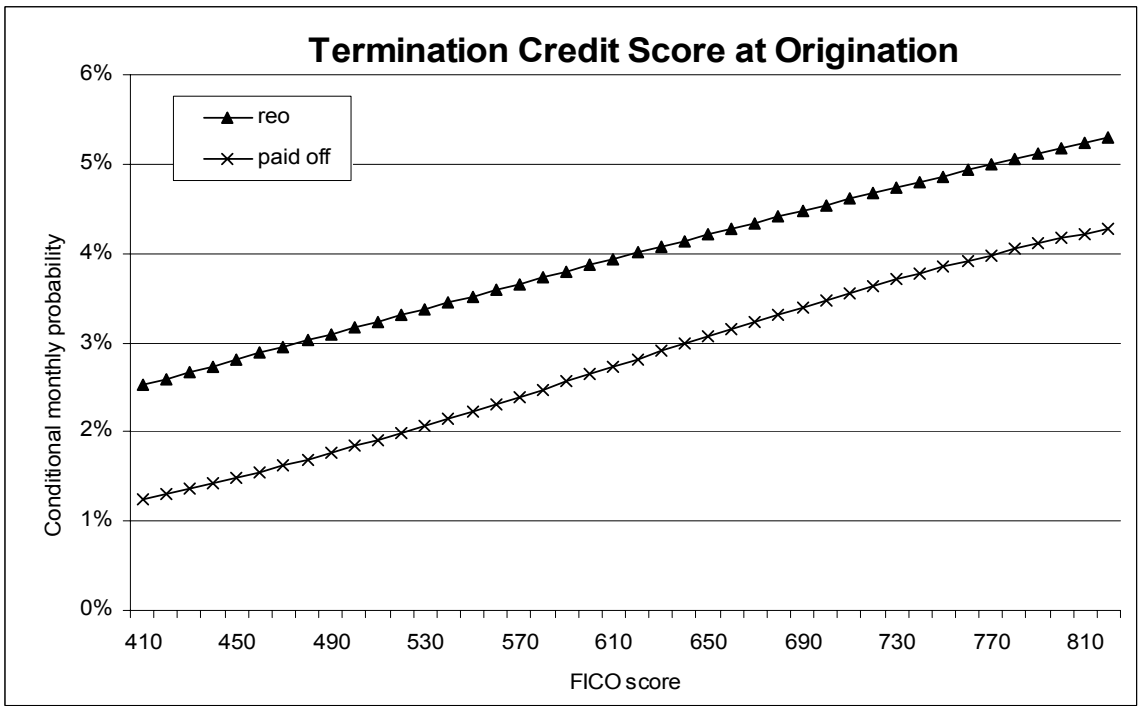

Figure 5:

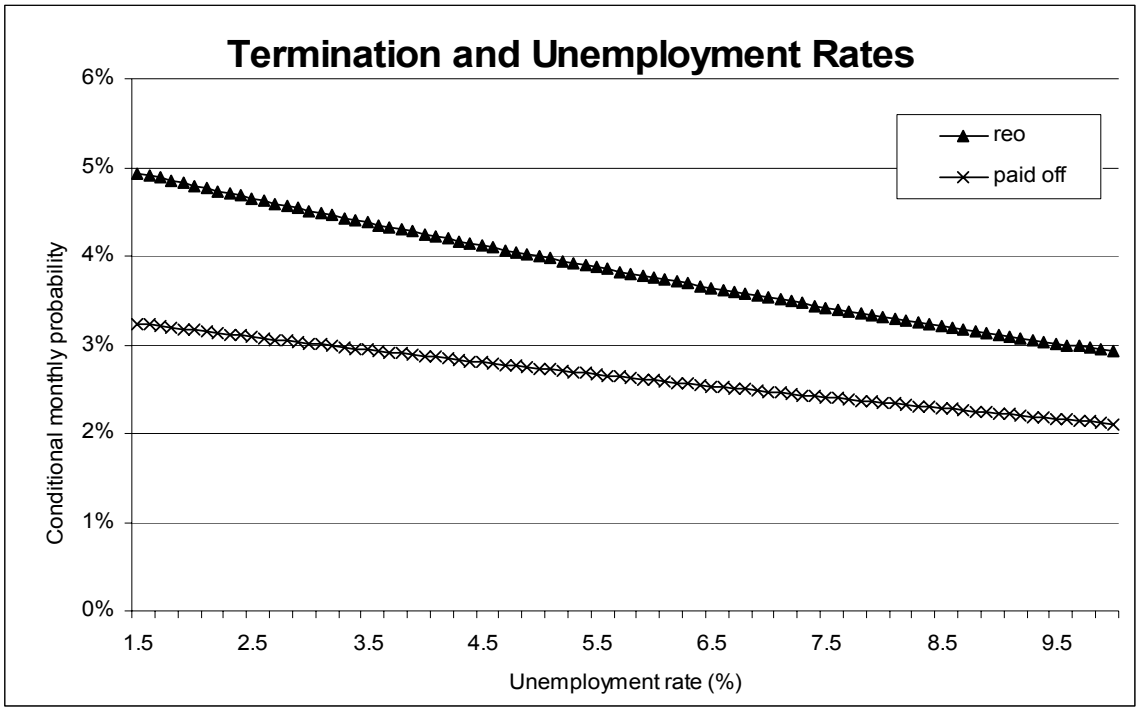

Figure 6:

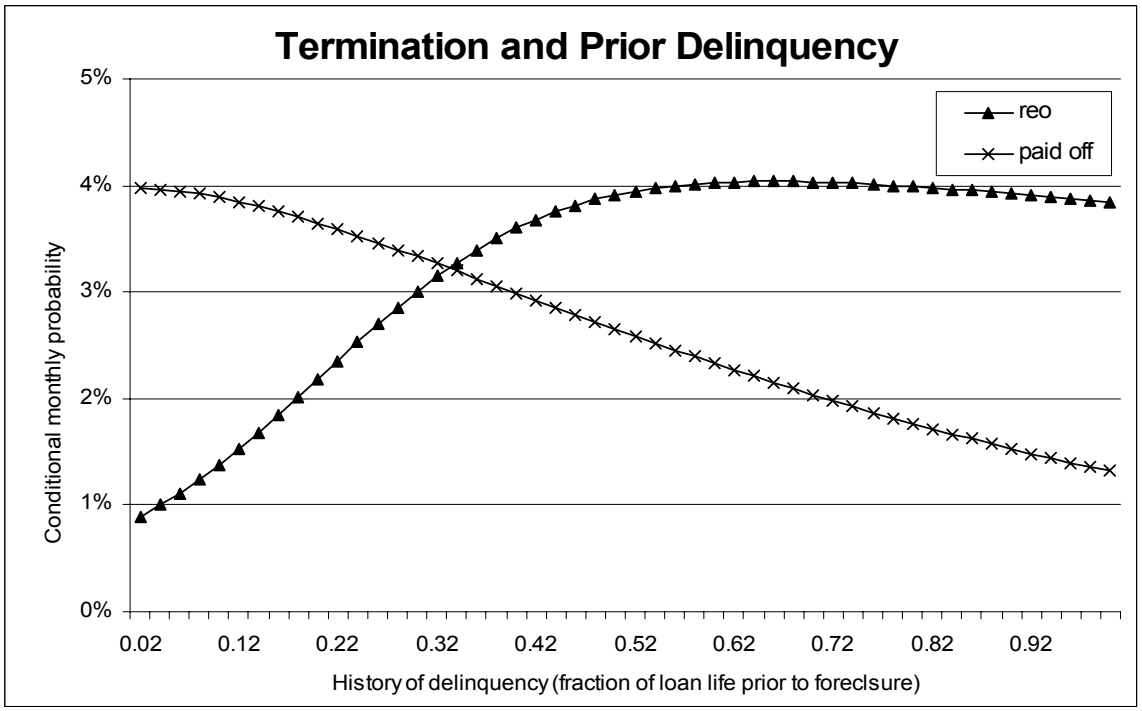

Figure 7:

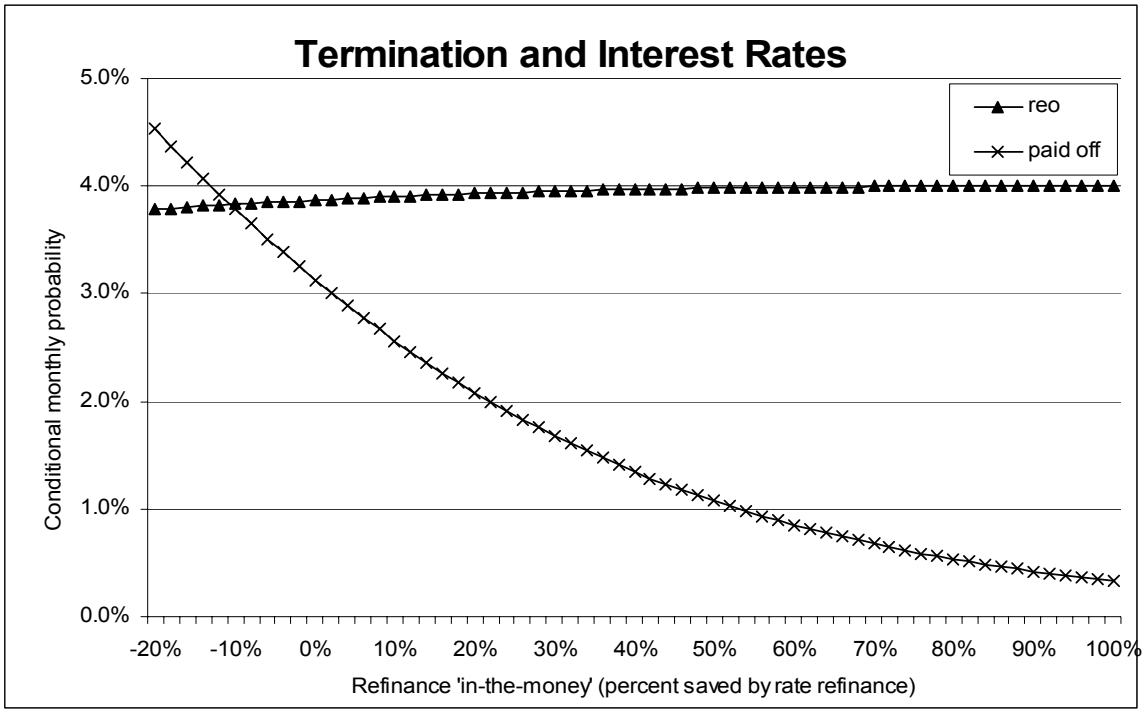

Figure 8: