Subprime Transitions: Lingering or Malingering in Default?

Dennis R. Capozza · Thomas A. Thomson

Abstract When a mortgage borrower becomes seriously delinquent (i.e., defaults), the lender initiates a time consuming and complex recovery process that may or may not result in foreclosure and eventual disposition of the real estate collateral (REO). This research studies this transition process for a unique sample of subprime mortgages that were seriously delinquent on September 30, 2001. Eight months later, possible states for the delinquent loans, in order, are 1) to remain delinquent without deteriorating further, 2) foreclosure, 3) worsen, i.e., become more months delinquent, 4) bankruptcy and 5) cure. The data indicate that, relative to prime loans, when subprime loans become seriously delinquent (90 days or longer) they are about twice as likely to become REO but take about four times longer to get there. It is unusual for a subprime default to be cured suggesting considerable forbearance by subprime lenders. We explore determinants of the transition probabilities and find that the most economically important predictors of transition from default to any other state are the number of payments the borrower has made and the loan to value ratio.

Keywords Subprime · Mortgages · Defaults · Losses · Lending

Introduction

When making mortgage loans, lenders know that with few exceptions, loans that default will not be profitable. For this reason, mortgage default is one of the most studied topics in mortgage lending. Most studies address the determinants of

D. R. Capozza (✉)
University of Michigan, Ann Arbor, MI 48109, USA
e-mail: capozza@umich.edu

T. A. Thomson
University of Texas, San Antonio, TX 78249-0637, USA
e-mail: tthomson@utsa.edu

default so that lenders can make better decisions regarding which applications to approve. In such studies, default is usually taken to mean the completion of the foreclosure process and sale of the collateral. However, the actual recovery process is quite complicated with many steps between the time a borrower stops making payments and an eventual foreclosure and sale. The transition of loans from a delinquent status to a cure or foreclosure is less well understood.

In this research we study the transition of subprime mortgage loans. Subprime lending has expanded in recent years and is an important social and financial innovation because it enables borrowers with blemished credit record to access credit, purchase homes and otherwise function in less constrained ways than was earlier the case. There is much accumulating evidence that subprime loans behave differently from prime loans. For example (Capozza & Thomson, 2005) subprime mortgage loans default earlier than prime loans and the losses are larger than for prime loans. This evidence is inconsistent with the standard option-pricing models of default and suggests that other factors may be operable.

Models of mortgage pricing commonly build the analysis on two stochastic drivers - interest rates and collateral prices. In these models it is "optimal" to default or "exercise" the put option when the put is sufficiently "in-the-money," i.e., when the collateral value is well below the balance on the mortgage (Capozza, Kazarian & Thomson, 1998; Kau & Kim, 1994). However, subprime borrowers are more likely to be constrained by low discretionary income (income minus necessary expenses) and by net worth (assets minus liabilities). For these constrained borrowers, skipping a payment is one way to meet short-term liquidity needs. As a result, mortgage pricing for subprime borrowers includes a third "solvency" option (in addition to the default put and prepayment call) that borrowers can exercise when short term financing is desired. The long and costly foreclosure process makes this option viable for all borrowers. Some lenders have codified this option and written mortgage contracts that permit skipped payments (Phillips & VanderHoff, 2004).

There are a number of stylized facts that can help us understand subprime loans.

- Certain lenders specialize in lending to subprime borrowers.[1]
- Subprime borrowers frequently miss payments, i.e., default often.[2]
- Subprime lenders are aware of the erratic payment behavior and charge premium interest rates to subprime borrowers.
- Subprime borrowers are less likely to have surplus income or assets to reinstate and cure[3] a default.

These characteristics of subprime loans relative to prime loans make forbearance and extension a rational decision for subprime lenders. In their 2004 Annual

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[1] HUD maintains lists of subprime lenders that can be downloaded from its website, http://www.hud.gov.

[2] Loan delinquency rates for subprime loans are available from the Mortgage Bankers Association. The serious delinquency rate for subprime loans tends to be almost 6 times that of conventional loans.

[3] "Cure" includes loans that prepay in full following a default.

Report (New Century Mortgage, 2005) the nations second largest subprime lender elaborates:

> Accounts that are referred to our Foreclosure Department are simultaneously referred to our Loss Mitigation Department. Various loss mitigation opportunities are explored with the borrower including the possibility of forbearance agreements, listing the property for sale, deeds in lieu of foreclosure and full reinstatements of the loan. Loss mitigation strategies are designed to minimize the loss to both the borrower and investor and are structured where possible to insure that the loan performs in a manner that supports the avoidance of foreclosure sale, while at the same time minimizing fees and costs.

Because subprime loans carry a premium interest rate, every payment that a subprime borrower makes contributes more to net revenue than those of prime borrowers. Second, when subprime mortgage loans are foreclosed, the losses imposed on investors are greater than for prime loans, *ceteris paribus* (see Capozza & Thomson, 2005). With more potential net revenue from waiting and less from foreclosing, the balance shifts towards forbearance.

Since subprime borrowers often have blemished credit records and their poor past payment history is known to the lender in advance from credit bureau histories and scores used in their underwriting process, it should come as no surprise when subprime borrowers become delinquent. Subprime lenders must have procedures in place for managing their weak credits. Given the high delinquency rates reported for subprime mortgage pools, relative to the number of foreclosures, forbearance and extension rather than immediate foreclosure are common reactions to missed payments.

Therefore, we can hypothesize that loans will transition less quickly to foreclosure and REO when one more payment is more valuable to the lender because the interest rate premium is higher. At the same time we conjecture that foreclosure will be delayed when measures of borrower credit worthiness, such as bureau scores, payment to income ratios, time on the job, etc. are weaker.

To explore these issues we track loans that are considered to be in default at two dates eight months apart. At the first observation date the loans are at least 90 days delinquent. We observe their status a second time 8 months later. The possible outcomes at the second date are: 1) Default — to remain delinquent without deteriorating further (and possibly improving), 2) REO or foreclosure, 3) Worsen, i.e., become more months delinquent,[4] 4) Bankruptcy and 5) Cure. The REO and Cure states show transition away from the delinquent states. The financial consequences of each of these outcomes are quite different for the lender. Therefore, understanding how and when loans transition among these states is an important managerial issue.

A number of earlier studies have studied conventional or FHA losses and transitions, including Ambrose and Capone (1996, 1998), Ambrose, Buttimer and Capone (1997), Philips and Vanderhoff (2002, 2004), Danis and Pennington-Cross (2005) and Capozza and Thomson (2005). These earlier studies provide reference points or benchmarks for our subprime results.

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[4] Worsen means the loan has made fewer than 8 payments over the intervening 8 months.

Ambrose and Capone (1996) investigated whether there are differences by race in the resolution of loans that enter default. Race is not a variable in our analysis but minorities are likely to be overrepresented in our subprime sample. Ambrose et al., (1997) extend standard mortgage option pricing models to include the period between default and foreclosure. They argue that a borrower who defaults can receive a significant time of free rent, which may encourage borrowers to choose default. In this study we emphasize dual incentives since the lender will tolerate delinquency from subprime borrowers when the net interest premium is high.

Ambrose and Capone (1998) track the ultimate resolution of a sample of more than 30,000 FHA loans that were at least 3 months delinquent. The resolutions are reinstatement, property sale, assignment to HUD and foreclosure. Models that separate the loans by their expected equity position at default are statistically different, and they attribute these differences to "ruthless" versus trigger event defaulters. Since our sample is subprime, trigger event defaults should predominate.

Capozza and Thomson (2005) evaluate the sources of loss that lenders incur from defaulted loans. They document that subprime borrowers default earlier but nevertheless impose larger losses on lenders than prime borrowers. The results herein help explain the surprising findings in the earlier study. Since subprime loans remain in default much longer than prime loans, it may be that, although the initial default is earlier, the final transition to REO is later. This delayed realization can account for the higher losses.

Relative to this literature, our analysis provides novel results in four ways. First, we focus on subprime loans, which have been shown in other research to behave differently from prime loans. Second, we use a shorter window and do not wait for a final resolution of the default. This allows us to track the transitions in more detail. Third, since we have a very rich dataset that includes information on the borrower at origination, we are able to probe deeper into the factors that affect transitions. Finally we are able to include bankruptcy as one of the transition states and investigate the role of bankruptcy in the default process.

To preview the conclusions, we find that most loans remain in their defaulted state during the eight-month observation period. Arguably, this is not a surprising finding. Since the loans are subprime, the borrowers have either had past problems with credit management or lack a credit history and are inexperienced in credit management. As hypothesized above, subprime lenders do delay foreclosure proceedings for weaker credits and delay still more if the interest rate premium is higher.

We find that bankrupt loans rarely find their way to cure. Thus, transition to bankruptcy[5] is a poor outcome. Loans that transition from delinquent into bankruptcy are loans that will take a longer period to reach their ultimate resolution. The ultimate resolution for most loans is REO, but the time to get there can be quite extended.

In the next section we describe the data. The third section discusses our methodology. The results appear in the fourth section, followed by our conclusions.

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[5] Some loans enter bankrupt status without ever being delinquent, or with less than a 90-day delinquency. These loans are much more likely to be cured than the loans we address in this study — those that are both at least 90 days delinquent, and in bankruptcy proceedings.

The Data

Our data consists of about 6000 subprime mortgage loans originated by a national subprime lender. This loan sample was 90 or more days delinquent on September 30, 2001. We also observe the status of each loan eight months later. In addition to knowing the loan status at the two dates, the data include the borrower and loan characteristics that were used to underwrite the loan. We also have data describing the borrower's number of payments and length of delinquency at the first date. We follow Capozza, Kazarian, and Thomson (1998) and augment this loan level data with variables that evaluate the legal and economic environment at the time of default.

   The origination data include information on the loan, the borrower and the collateral.

Loan

- Loan purpose — cash out refinancing or purchase. The excluded category is rate and term refinances.
- Fixed interest rate — indicator that loan has a fixed rate through the entire term of the loan. The excluded loans are the various ARM's offered including "hybrids" that have a fixed rate for a small fraction of the loan term that then become ARM's.
- Standard documentation — indicator that the loan was fully documented.
- Loan to value — the ratio of the loan principal to the collateral value at origination (alternately, this equals $1-\%$ down payment).
- Interest rate premium — spread between the initial note rate and the rate on prime mortgages during the origination month. This variable measures the credit worthiness of the borrower as assessed by the lender.
- Prepayment penalty — loan has a prepayment penalty that is in effect on the first observation date.[6]

Borrower

- Credit Score — the borrower's credit score (available for 73% of the loans). An indicator variable was used when the credit score was missing and set to the mean. Loans with a missing credit score arise primarily among loans originated before the lender collected credit scores. Thus the missing credit score indicator is related to the period of origination.[7]

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[6] While at loan origination one knows whether the loan carries a prepayment penalty, the prepayment penalty depends on the age of the loan. Loans that have a prepayment penalty, in this database, typically are in force for 2 to 5 years, so whether a prepayment penalty is in effect depends on length of time a penalty may be in effect, and the age of the loan when the default is observed. Epperson, Kau, Keenan, and Muller (1985) show that one reason to default on a loan may be to remove the prepayment penalty effect when one would otherwise choose to refinance the loan.

[7] In the results that follow, as a robustness check, we also estimated regressions in which we removed the loans with missing scores. There is little effect on the results.

- Payment to Income — ratio of the monthly note payment to monthly income.
- Time on job — years employed in current position at the time of origination.
- Time at property — years of residence at the current address.

Collateral

- Single family home — indicator that the collateral is a single family home, as opposed to a unit with 2, 3, or 4 distinct living quarters.
- Owner occupied — indicator that the collateral is owner occupied.

Status

Variables that describe the current status of the loan include:

- Months delinquent — number of months the loan is delinquent at the first observation date.
- Payments made — number of payments that have been recorded at the first observation date.

Environment

Variables that describe the legal and economic environment are:

- Economic growth — we measure economic growth as the real change in house prices in the given state over the past year.
- Interest rate decline — the decrease in prime mortgage interest rates[8] between the date the loan was originated and the date of the first default observation.
- Slow foreclosure — states where the initial foreclosure process takes more than six months[9] (cf. Clauretie & Sirmans, 2003, page 209).

Descriptive statistics for these variables are presented in Table 1. While some researchers, typically those who do not know if a loan was made by a subprime lender, use loan characteristics to classify a loan as subprime, (see for example Pennington-Cross, 2003), our data is directly from a subprime lender. The data reveal that these loans have the characteristics of subprime loans such as the high proportion of loans that are cash out refinances (61%), the large number of loans that carry a variable interest rate (72%), the number of loans with alternate documentation (37%), the number of loans with a prepayment penalty (60%),

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[8] Because this variable measures the decline in interest rate, its value increases as interest rates fall, and it takes the value 0 if interest rates are stable or increase. It would seem reasonable to also investigate the effect of an interest rate increase as it makes the loan more valuable to the borrower. For the data period available, interest rates were tending to decline, so there was not enough data with increased interest rates for statistical analysis.

[9] We originally stratified the data into fast (1–3 months), medium (4–6 months), and slow (greater than 6 months). There was no statistical difference between the first two groups, showing that the state foreclosure effect is captured by addressing the slow states.

Table 1 Descriptive statistics of the covariates ($N = 6181$)

	Mean	Standard deviation	Minimum	Maximum
Loan				
Cash out refinance indicator	0.61	0.49	0.0	1.0
Purchase indicator	0.23	0.42	0.0	1.0
Fixed interest rate indicator	0.28	0.45	0.0	1.0
Standard documentation	0.63	0.48	0.0	1.0
Loan to value (1-down payment %)	75	10	17	99
Interest rate premium (%)	3.35	1.42	−2.3	8.5
Prepayment penalty indicator	0.60	0.49	0.0	1.0
Collateral				
Single family home indicator	0.82	0.39	0.0	1.0
Owner occupied indicator	0.91	0.28	0.0	1.0
Borrower				
Payment to income	0.22	0.09	0.0	0.6
Borrower time on job (years)	6.75	7.41	0.0	50.0
Borrower time at property (years)	6.28	8.62	0.0	60.0
Credit score	550	44	386	797
No credit score	0.27	0.44	0.0	1.0
Status				
Months delinquent	7.63	4.92	3.0	55.0
Payments made	18.01	17.53	0.0	79
Environmental				
Economic growth (%)	0.05	0.02	0.0	0.1
Interest rate decline (%)	−0.63	0.56	−2.1	0.0
Slow foreclosure indicator (>6 mo)	0.29	0.45	0.0	1.0

and the interest rate premium compared to prime mortgages (an average of 335 basis points). Credit scores, which are available for 73% of the loans, also indicate these loans are subprime. The average score of about 550 puts the average loan at about the 10 percentile of credit scores. Some of the loans in this sample exhibit the higher credit scores or higher downpayments that are typically associated with prime loans. These loans may still be "subprime" (also sometimes labeled "nonprime" or "Alt-A") for other reasons such as low documentation. We know that the borrower chose to borrow from a subprime lender, and include them in the subprime category. While these data are from a single lender, we believe the data are representative of the industry since the delinquency and prepayment profiles are similar to those reported by Loan Performance (2004).

Methodology

The data allow us to observe a transition outcome over the 8-month period between data observation points. The outcome is the result of an interaction of choices of the lender and the borrower. If the borrower did not choose to stop making regular payments on the loan, the 90-day delinquency would not occur. In the period since we first observe the default, the borrower could pay the amount in arrears, possibly through selling the property, and thus cure the delinquency. Alternatively, the borrower could make regular payments and not worsen the

situation. The borrower also may decide to declare bankruptcy. The lender decides whether to institute foreclosure proceedings, but would not typically do so if payments were being made on a somewhat regular basis. One may view this process as the borrower making choices regarding future payments with the lender responding to the borrower choice when it decides to pursue foreclosure.

We can stratify the loans at the second observation date into 5 states: 1) REO, 2) Bankruptcy, 3) Cure, 4) Worsen (but remain in default status), and 5) remain in Default while making regular payments. We model these categorical outcomes using a multinomial logistic approach where the left out category is to remain in the current status while making regular payments. The probability of transition for each loan, P_i, to each of the 5 outcome classes, O_j, is thus modeled:

$$P_i\left(O_j = 1\right) = \frac{e^{\beta_j X_i}}{1 + \sum\limits_{j=1}^{j=4} e^{\beta_j X_i}} \qquad \text{for } j = 1, 2, 3, 4$$

and to ensure that the sum of the probabilities is 1,

$$P_i(O_5 = 1) = \frac{1}{1 + \sum\limits_{j=1}^{j=4} e^{\beta_j X_i}} \qquad \text{for } j = 5$$

Where:

x_i is a column vector of the covariate measures described above for loan i
β_j are row vectors of coefficients for each outcome.

Results

We first report the overall transition outcomes, which are summarized in Table 2. The outcomes from the 4243 defaulted loans that were not in bankruptcy are that 2499 (59%) of the loans remained in the default status, while 244 (6%) cured, 475 (11%) went into bankruptcy and 1025 (24%) went to REO. Given that eight months

Table 2 Transition matrix

| | Status on September 30, 2001 | | | |
| | Default | | Bankruptcy | |
Status 8 mo. later	Number	Percent	Number	Percent
Default continues	1607	38	342	18
Default worsens	892	21	N/A	
REO	1025	24	236	12
Bankruptcy	475	11	732	38
BK worsens	N/A		597	31
Cured	244	6	31	2
Total	4243	100	1938	100

have transpired between the two observation dates, this result shows that it is common for subprime loans to remain in a default status for an extended period. Of the 2499 that remained in default, 892 saw their condition worsen (i.e., less than eight additional payments made) over the 8-month period showing that 38% of the loans remained in default without observing their condition deteriorating.

For the 1938 loans that were in bankruptcy at the first date, 1329 (69%) remained in bankruptcy at the second date, while 31 (2%) cured, 342 (18%) transitioned to Default, but not in bankruptcy, and 236 (12%) transitioned into REO. Of the 1329 loans that remained in Bankruptcy, almost half, 597 became further behind in their payments. This shows that loans that are in Bankruptcy tend to remain so for an extended period and that few ever progress to Cure. While few loans in bankruptcy cured, the 38% that did not worsen suggest that many borrowers that are in Bankruptcy are trying to prevent transition to REO.

Bankruptcy seems to be a holding state before transitioning to Default (but no longer in bankruptcy), or in most cases to REO. If one interprets the preceding table as a transition probability matrix that remains stable over time and aggregates the Worsen subclass with its main class, (that is, to include loans that worsen but remain in default with those that remain in default, and include the Worsen but remain in bankruptcy with the bankruptcy), one can project the rate at which loans reach the two potential absorbing states of Cure or REO. For example, starting from time zero on September 30, 2001, there are 2841 (= 2499 + 342) loans which are in default at time 1 eight months later. Of these 24% (or 682 loans) are assumed to transition to REO at time 2. Of the 1804(= 475 + 732 + 597) loans which are in Bankruptcy at time 1, 12% or 216 loans are projected to be REO at time 2. The total number of loans in REO at time 2 are the 1261(= 1025 + 236) from time 1, plus the newly arrived 898(= 682 + 216) loans for a total of 2159. Other loans transition to Cure in an
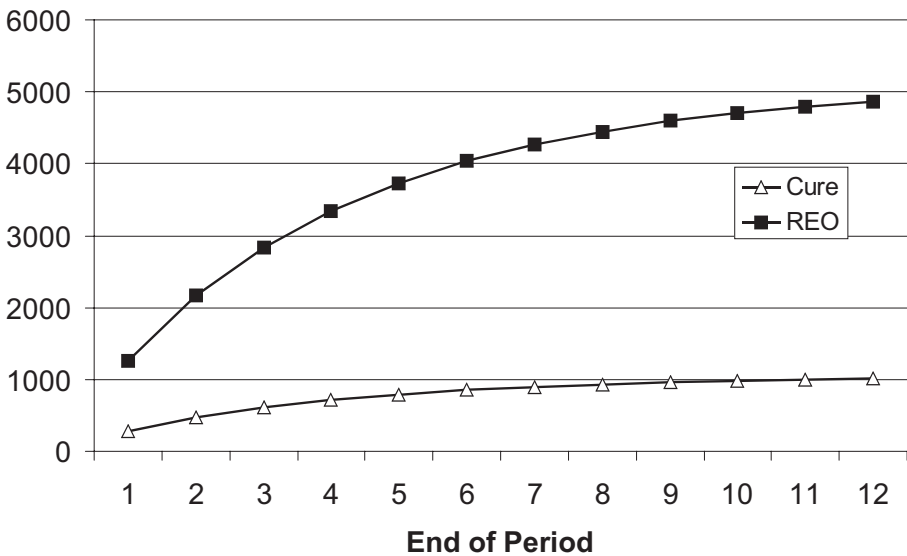

Fig. 1 Projected transition of loans to REO or cure over time. This figure is based on the constant transitions probabilities in Table 2

analogous fashion. The remainder either stay in the state they began, or transition to the other transitory state (Default transitioning to Bankruptcy, or Bankruptcy transitioning to Default). Figure 1 graphs the transition profiles to the absorbing states that are implied by these transition rates. Overall, 21% of the delinquent loans will cure (1076) while the remaining 79% (5105) will ultimately reach REO. For the given transition rates, it will take about six and one half years for 90% of the transitions to the final states to occur and confirms that subprime loans linger in a delinquent state for extended periods of time. This is not surprising given the number of loans that remain in Default or Bankruptcy without a worsening of their condition in the 8-month observation window. This large number of loans that while in delinquency show no worsening is in contrast to the framework of Ambrose et al. (1997), in which delinquency is a simple way to garner free rent. However, one could argue that making occasional payments is a way to extract even more free rent by convincing the lender to continue forbearance. The large fraction of loans, which while delinquent are making regular payments, suggests that both the borrower's and the lender's goal is to keep the borrower in the house despite any past difficulty keeping the payments current.

This overall transition for subprime loans stands in contrast to results reported in the literature for conventional or FHA loans. Phillips and VanderHoff (2002), using conventional loans, show an overall transition to REO for fixed-rate loans of 30% and for adjustable rate loans 51%. Phillips and VanderHoff (2004), however, show that for conventional loans, cure rates can be much lower than average under certain policy simulations. For FHA loans, Ambrose and Capone (1996) show an overall transition to foreclosure of 38%, and Ambrose and Capone (1998) show an overall transition to foreclosure of 32%. Furthermore, Ambrose and Capone report a much shorter period in default than our results. They show an average time in default of about 7.5 months. The results plotted in Figure 1 indicate that only 50% of the loans will transition from Default after 28 months! These subprime loans are much more likely to transition to REO after delinquency than conventional or FHA mortgages, but only after they remain in their delinquent state much longer than FHA loans. Therefore, our subprime sample is about twice as likely to transition to REO but takes about four times longer to get there.

Transition from the Defaulted Status

To probe deeper, we relate the transitions to the origination data, the status variables and the environmental variables described above. This allows us to determine to what degree the information known by the lender at the time of origination affects loan transitions relative to the information that has evolved since the loan was originated.

Table 3 presents multinomial logistic regression results for loans that are in Default status, but not in bankruptcy at the first date. Table 4 is identical to Table 3 except that the regressors have been standardized[10] to make the

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[10] We standardized the continuous variables by subtracting the mean and dividing through by the standard deviation so each of the standardized variables has a mean of zero and a standard deviation of 1. Indicator variables are not modified.

Table 3 Multinomial logistic regression estimates of transition from default to indicated state ($N = 4243$)

Covariate	Default to REO		Default to bankrupt		Default to worsen		Default to cure	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Intercept	**-2.34**	0.00	-1.27	0.21	-1.69	0.04	2.44	0.06
Cash out refinancing	-0.01	0.96	-0.23	0.13	-0.04	0.74	-0.01	0.95
Purchase	-0.26	0.10	-0.11	0.55	-0.24	0.13	0.09	0.71
Fixed interest rate	**0.23**	0.03	0.16	0.24	0.19	0.08	0.29	0.10
Standard documentation	**0.32**	0.00	**0.35**	0.00	0.10	0.33	**0.40**	0.01
Loan to value	**0.06**	<.0001	**0.03**	<.0001	**0.03**	<.0001	**0.02**	0.01
Interest rate premium	**-0.09**	0.02	-0.08	0.08	-0.06	0.12	**-0.14**	0.02
Prepayment penalty	-0.14	0.20	-0.17	0.22	**-0.27**	0.01	0.06	0.75
Single family home	-0.11	0.38	-0.20	0.17	-0.17	0.16	-0.11	0.56
Owner occupied	-0.14	0.41	**0.90**	0.00	-0.18	0.30	0.09	0.75
Payment to income	**-3.28**	<.0001	**-2.22**	0.00	**-2.36**	<.0001	**-5.73**	<.0001
Borrower time on job (years)	-0.01	0.33	0.00	0.74	0.00	0.56	0.02	0.11
Borrower time at property (years)	0.00	0.62	0.01	0.06	-0.01	0.47	**0.02**	0.03
Credit score	0.00	0.08	0.00	0.50	**0.00**	0.00	0.00	0.05
No credit score	**0.43**	0.00	**0.52**	0.00	0.19	0.22	-0.19	0.48
Months delinquent	**0.06**	<.0001	0.01	0.47	**0.05**	<.0001	**-0.28**	<.0001
Payments made	**-0.08**	<.0001	**-0.08**	<.0001	**-0.08**	<.0001	**-0.06**	<.0001
Economic growth	**-19.07**	<.0001	**-12.85**	<.0001	**-9.72**	<.0001	**-6.80**	0.03
Interest rate decline	**-0.39**	0.00	-0.07	0.63	**-0.33**	0.00	-0.32	0.08
Slow foreclosure (>6 mo)	-0.10	0.32	-0.22	0.08	**0.55**	<.0001	**0.31**	0.05

Bold indicates significance at the 5% level or better. The left out category is Default continuing without additional missed payments in the eight month observation period.

Table 4 Multinomial logistic regression estimates of transition from default to indicated state ($N = 4243$) with standardized regressors

Covariate	Default to:			
	REO	Bankruptcy	Worsen	Cure
Intercept	**−0.5**	−1.9	−0.4	−2.9
Cash out refinancing	0.0	−0.2	0.0	0.0
Purchase	−0.3	−0.1	−0.2	0.1
Fixed interest rate	**0.2**	0.2	0.2	0.3
Standard documentation	**0.3**	**0.4**	0.1	**0.4**
zLoan to value	**0.6**	**0.3**	**0.3**	**0.2**
zInterest rate premium	**−0.1**	−0.1	−0.1	**−0.2**
Prepayment penalty	−0.1	−0.2	**−0.3**	0.1
Single family home	−0.1	−0.2	−0.2	−0.1
Owner occupied	−0.1	**0.9**	−0.2	0.1
zPayment to income	**−0.3**	**−0.2**	**−0.2**	**−0.5**
zTime on job	0.0	0.0	0.0	0.1
zTime at Property	0.0	0.1	0.0	**0.2**
zCredit score	0.1	0.0	**0.1**	−0.1
No credit score	**0.4**	**0.5**	0.2	−0.2
zMonths delinquent	**0.3**	0.1	**0.2**	**−1.4**
zPayments made	**−1.4**	**−1.3**	**−1.4**	**−1.0**
zEconomic growth	**−0.5**	**−0.3**	**−0.2**	**−0.2**
zInterest rate decline	**−0.2**	0.0	**−0.2**	**−0.2**
Slow foreclosure (>6 mo)	−0.1	−0.2	**0.5**	**0.3**

The prefix "z" indicates that the variable has been standardized. **Bold** indicates significance at the 5% level or better. The excluded category is Default continuing without worsening.

interpretation of the results easier. Table 5 provides standardized results for the overall transition from Default to any other state.

The first two columns in Table 3 present results for transitioning from Default to REO, followed by two columns of results for transitioning from Default to Bankruptcy, which is followed by results for remaining in default with the loan condition worsening. The final two columns are for transitioning from Default to Cure. The first of each pair of columns presents the regression coefficient while the following column presents the *p*-value for that coefficient.

General considerations

First, we observe that the signs on the transition coefficients to REO, Bankruptcy and Worsen are quite similar. Loans that are more likely to enter foreclosure are also more likely to enter Bankruptcy or Worsen.

Consistent with our earlier hypothesis, loans with high interest rate premia are less likely to be taken into foreclosure (REO) and more likely to remain in default (Table 5). Lenders have a greater incentive to forebear when the loan interest rate premium is favorable. At the same time, the lender is more likely to foreclose on loans with fixed interest rates, standard documentation and high loan-to-value ratios, which are more likely to have been made to the higher quality borrowers.

Table 5 Logistic regression estimates of transition from default to any other state ($N = 4243$) with standardized regressors

Covariate	From default to all other states
Intercept	0.5
Cash out refinancing	−0.1
Purchase	−0.2
Fixed interest rate	**0.2**
Standard documentation	**0.3**
zLoan to value	**0.4**
zInterest rate premium	**−0.1**
Prepayment penalty	−0.2
Single family home	−0.2
Owner occupied	0.0
zPayment to income	**−0.3**
zTime on job	0.0
zTime at property	0.0
zCredit score	0.1
No credit score	**0.3**
zMonths delinquent	**0.2**
zPayments made	**−1.4**
zEconomic growth	**−0.3**
zInterest rate decline	**−0.2**
Slow foreclosure (>6 mo)	0.2

The prefix "z" indicates that the variable has been standardized. **Bold** indicates significance at the 5% level or better. The left out category is Default continuing without worsening.

Loan

Loan purpose, such as cash-out refinance or purchase, does not affect default transitions. Prepayment penalties and borrower stability (time on job and time at property) are not significant determinants.

Collateral

Whether the home is a single-family dwelling does not effect default transitions. There is also little effect from owner occupied indicator variable. Owner occupied homes are more likely to transition to Bankruptcy, but no effect on transition to other states is apparent.

Status

The longer the delinquency period, the more likely the loan is to transition to REO, the more likely it is to Worsen and the less likely to transition to Cure. The magnitude of the coefficient is much higher for transition to Cure, suggesting that loans with shorter delinquency periods are more likely to cure. Those with longer periods are somewhat more likely to transition to REO and much less likely to cure. We evaluate loans in a very different framework from Danis and Pennington-Cross (2005); but, this result appears to be inconsistent with their finding that loans which spend a long time in delinquency are more likely to prepay (one of the actions classified in this paper as Cure). Their data uses all delinquencies rather than just severe delinquencies; and its possible that some of the difference is due to data differences in addition to the very different views of loan transitions.

Table 6 Multinomial logistic regression estimates of transition from bankrupt to indicated state ($N=1938$)

Covariate	Bankruptcy to REO		Bankruptcy to default		Bankruptcy to worsen		Bankruptcy to cure	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Intercept	**-3.47**	0.02	-0.11	0.93	**2.55**	0.02	-3.89	0.27
Cash out refinance	-0.16	0.45	0.16	0.43	0.16	0.33	0.51	0.37
Purchase	0.06	0.81	0.16	0.52	0.24	0.24	0.22	0.75
Fixed interest rate	0.10	0.60	-0.17	0.30	0.18	0.19	-0.76	0.12
Standard documentation	0.11	0.54	-0.21	0.17	-0.12	0.36	-0.31	0.44
Loan to value	0.02	0.07	0.01	0.31	0.00	0.64	-0.03	0.19
Interest rate premium	-0.05	0.47	0.00	0.99	-0.10	0.05	0.09	0.54
Prepayment penalty	0.20	0.33	-0.05	0.79	-0.03	.85	0.18	0.71
Single family home	0.09	0.67	0.01	0.96	-0.04	0.79	0.03	0.96
Owner occupied	-0.63	0.13	**-1.27**	<.0001	**-0.84**	0.00	0.18	0.87
Payment to income	**2.45**	0.01	0.92	0.29	0.60	0.41	2.63	0.24
Borrower time on job (years)	**-0.02**	0.04	-0.01	0.25	-0.01	0.10	-0.03	0.31
Borrower time at property (years)	0.01	0.52	**-0.02**	0.04	0.01	0.48	-0.01	0.73
Credit score	0.00	0.22	0.00	0.14	0.00	0.39	0.01	0.15
No credit score	-0.21	0.47	0.16	0.47	0.33	0.08	0.30	0.61
Months delinquent	**0.09**	<.0001	0.01	0.46	-0.01	0.64	**-0.18**	0.01
Payments made	**-0.06**	<.0001	**-0.07**	<.0001	-0.06	<.0001	-0.03	0.10
Economic growth	-1.71	0.63	**-10.18**	0.00	-3.62	0.18	2.01	0.79
Interest rate decline	-0.08	0.68	-0.17	0.32	**-0.29**	0.03	-0.17	0.70
Slow foreclosure (>6 mo)	-0.15	0.48	**0.38**	0.03	**0.38**	0.01	-0.85	0.26

Bold indicates significance at the 5% level or better.

Table 7 Multinomial logistic regression estimates of transition from bankrupt to indicated state ($N=1938$) with standardized regressors

Covariate	From bankruptcy to:			
	REO	Default	Worsen	Cure
Intercept	−0.9	0.3	0.4	**−3.5**
Cash out refinancing	−0.2	0.2	0.2	0.5
Purchase	0.1	0.2	0.2	0.2
Fixed interest rate	0.1	−0.2	0.2	−0.8
Standard documentation	0.1	−0.2	−0.1	−0.3
zLoan to value	0.2	0.1	0.0	−0.3
zInterest rate premium	−0.1	0.0	**−0.1**	0.1
Prepayment penalty	0.2	0.0	0.0	0.2
Single family home	0.1	0.0	0.0	0.0
Owner occupied	−0.6	**−1.3**	**−0.8**	0.2
zPayment to income	**0.2**	0.1	0.1	0.2
zTime on job	**−0.2**	−0.1	−0.1	−0.2
zTime at Property	0.1	−0.2	0.0	−0.1
zCredit score	0.1	0.1	−0.1	0.3
No credit score	−0.2	0.2	0.3	0.3
zMonths delinquent	**0.4**	0.1	0.0	**−0.9**
zPayments made	**−1.0**	**−1.1**	**−1.0**	−0.5
zEconomic growth	0.0	**−0.2**	−0.1	0.0
zInterest rate decline	0.0	−0.1	−0.1	−0.1
Slow foreclosure (>6 mo)	−0.2	**0.4**	**0.4**	−0.8

Bold indicates significance at the 5% level or better. The prefix "z" indicates that the variable has been standardized.

As the number of payments that have been made on the loan increases, there is a lower transition to all other states. The coefficients are not statistically different from each other showing that the more payments that have been made, the more likely the loan will remain in the default status without worsening. This result indicates that for many loans, once they fall behind, they stay behind, and don't easily transition to another state.

Environment

Another interesting result is the importance of the local and national economic environment in lender decision-making. When economic growth is high or interest rates have declined, lenders are less likely to foreclose on loans in default. A growing economy implies the loan will tend to remain in its defaulted state. In a weak economy, there will be increased transition to REO, Bankruptcy, and Worsen. If interest rates have declined, there is a lower transition probability to REO and lower transition to Worsen. Finally, in states where the foreclosure process is slow (initial action takes more than 6 months), there is a greater tendency to transition to Worsen or to Cure, with no statistical effect on transition to REO or Bankruptcy.

Transition from the Bankrupt State

We now examine the loans that were in bankruptcy and at least 3-months delinquent on the first observation date. Tables 6, 7 and 8 present the regression

Covariate	Coefficient
Intercept	**1.2**
Cash out refinancing	0.1
Purchase	0.2
Fixed interest rate	0.0
Standard documentation	−0.1
zLoan to value	0.1
zInterest rate premium	−0.1
Prepayment penalty	0.0
Single family home	0.0
Owner occupied	**−0.9**
zPayment to income	0.1
zTime on job	**−0.1**
zTime at property	0.0
zCredit score	0.0
No credit score	0.2
zMonths delinquent	0.1
zPayments made	**−1.0**
zEconomic growth	−0.1
zInterest rate decline	−0.1
Slow foreclosure (>6 mo)	0.3

Table 8 Logistic regression estimates of transition from bankrupt to any other state ($N = 1938$) with standardized regressors

Bold indicates significance at the 5% level or better. The prefix "z" indicates that the variable has been standardized.

results. As with Tables 3, 4 and 5, the first table provides the raw coefficients; the second uses standardized variables; and the third table displays the results for the transition from bankruptcy to any other state.

Loan

Only a few covariates are statistically significant for transitioning to the Bankruptcy state. Of the covariates that relate to the loan itself, only one statistically significant coefficient is observed. As the interest rate premium increases, there is a lower probability that the loan will worsen (while remaining to the Bankruptcy state).

Collateral

The only statistically significant coefficient among the collateral variables is for owner occupied homes, which are less likely to transition from Bankruptcy status to Default status and less likely to Worsen.

Borrower

Three borrower characteristics show some effect on transition from Bankruptcy. In particular, the higher the payment to income ratio, the more likely the loan will

transition to REO status. As the length of the borrower's time on job increases, the less likely is a transition to REO. The longer the borrower's time at property, the less likely a loan will transition from Bankruptcy to Default.

Status

The greater the number of months the loan is delinquent, the more likely it is to transition from Bankruptcy to REO, and the less likely it is to transition from Bankruptcy to Cure. The more payments a loan has made to date, the less likely the loan will transition from Bankruptcy to REO, Default or Worsen while remaining in Bankruptcy. There is no statistical effect on transition to Cure.

Environment

When economic growth has been high, loans are less likely to transition from Bankruptcy to Default. When interest rates have fallen, there is a decreasing likelihood that the loan status will worsen. In slow foreclosure states, loans are more likely to transition to Default, and more likely to worsen.

The relative lack of significance of the covariates for transition from bankruptcy is consistent with the hypothesis that a transition out of the bankrupt state is determined mainly by arbitrary court proceedings rather than economic variables.

Conclusion

In this research we have explored a unique data set from a subprime lender on loans that are in default. The data allow us to follow the loans eight months later and observe their transition to other states. In particular, when a loan enters default status (90 or more days delinquent), there are two possible resolutions in our database: It either will cure, or it will be foreclosed and become real estate owned (REO). We document that the transition to the final outcome can be quite slow, with the loan remaining in a defaulted status for an extended period. Part of the time, while the loan is in this extended delinquent state, the borrower may be in bankruptcy procedures, which generally delays the transition to REO status, but rarely results in transition to Cure. For loans that entered the 90-day delinquent status, the transition probabilities suggest that 79% will become REO and only 21% cure. This REO rate is about twice that reported in the literature for prime loans.

Overall, lenders are more likely to forbear on delinquent borrowers when there is evidence that the default is due to solvency rather than optimal exercise of the put option. Specifically lenders are more likely to wait when the borrower has made more payments, when the payment to income ratio is high and when economic conditions have been favorable (Table 5). Lenders also respond to the economic incentive and forbear when the interest rate premium is high.

Loans with fixed interest rates and standard documentation, arguably the less "subprime" loans, are more likely to transition to REO. Those with standard

documentation are also more likely to transition to Cure. That is, with more reliable information, decisions by both lenders and borrowers appear to be accelerated.

Finally, while our data allow us to explore default transitions in some detail, there are many limitations to the data and many issues that we are unable to address with the data. We anticipate that future research on transitions will help resolve these open issues.

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